INSIGHTS IN PUBLIC MENTAL HEALTH: 2021

EDITED BY: Wulf Rössler
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INSIGHTS IN PUBLIC MENTAL HEALTH: 2021

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EDITORIAL
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Editorial: Insights in Public Mental Health: 2021

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Editorial on the Research Topic

Insights in Public Mental Health: 2021

We are now entering the third decade of the twenty-first century, and, especially in the last years, the achievements made by scientists have been exceptional, leading to major advancements in the fast-growing field of Public Mental Health.

Mental health must be considered a dynamic state, whereby individual psychosocial development is influenced by multiple layers of intersecting social and environmental factors. Good mental health enables individuals to work, to learn, to engage with other people and to participate in society. Conversely, mental disorders cause significant suffering for individuals, their families and society as a whole. Mental disorders arise early in life's course and may last for long periods of time. Persons suffering from mental disorders, have a significantly reduced life expectancy. Public mental health aims to improve the mental health of the population by providing information about levels of mental disorders across populations and also by preventing mental disorders and promoting mental health. Public Mental Health also takes responsibility for the provision of mental health services. As such Public Mental Health aims to publish major insights into the promotion of mental health, the prevention of mental disorders, as well as the provision of care.

This Research Topic "Insights in Public Mental Health: 2021" is focused on new insights, novel developments, current challenges, latest discoveries, recent advances and future perspectives in the field of Public Mental Health. The goal of this Research Topic is to shed light on the progress made in the past decade in the Public Mental Health field and on its future challenges to provide a thorough overview of the status of the art of the Public Mental Health field. This article collection will inspire, inform and provide direction and guidance to researchers in the field.

In recent years, psychiatric genetic research has gained a lot of public attention, but in fact the majority of mental problems arise from social and physical environmental influences. Mental health is a dynamic state, where the development of an individual is influenced by multiple layers of intersecting social and environmental factors. To facilitate our current understanding of Public Mental Health, Kousoulis and Goldie are proposing a new visualization for the traditional socio-ecological model approach.

Psychiatric epidemiology is a cornerstone of Public Mental Health. Nonetheless data about the frequency and distribution of mental disorder are rare. In China, some studies were conducted to assess the prevalence of mental disorders at the national level and in some metropolitan cities. However, the prevalence of mental disorders in Chinese underdeveloped provinces has not been reported internationally in recent decades (Sun et al.). Rates assessed In this study were comparably low and warrant further confirmation.

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Differences in rates of mental disorders between women and men have been known for a long time. For most internalizing disorders (e.g., major depression and eating disorders), women are more frequently affected, whereas for externalizing disorders (e.g., substance abuse) more men are affected. This systematic review takes a closer look at similarities and differences of mental health in women and men from three large German epidemiological cohorts (Otten et al.).

The association between social capital and depression is a frequent Research Topic in developed countries, often with inconclusive results. Furthermore, for both social capital and depression, there are gender differences established in the literature. This study from Brazil investigates gender differences in the association of social capital with the incidence and maintenance of depressive episodes (Souto et al.). The results highlight the importance of the dimension "social support" in both genders in its association with mental health.

Research on the association between food insecurity and bullying victimization is limited. Using a representative global sample, this study aimed to investigate the association between food insecurity and bullying victimization in adolescents and whether the association varied between country income levels, sexes, and age groups (Liang et al.). Bullying victimization is prevalent among global adolescents with food insecurity being a significant correlate.

To monitor population mental health, the identification of relevant indicators is pivotal. This scoping review provides a comprehensive overview of current indicators representing the various fields of public mental health core topics (Peitz et al.). It was conducted as a first step to build up a Mental Health Surveillance for Germany.

The majority of people who die by suicide have never seen a mental health professional or been diagnosed with a mental illness. To date, this majority group has largely been ignored, with most existing research focusing on predictors of suicide such as past suicide attempts. Identifying the characteristics of people who die by suicide without receiving services, often with a fatal first attempt, is crucial to reduce suicide rates through guiding improvements to service pathways and "just in time" interventions. In this systematic review the current state of the art is reported (Tang et al.).

Public interest for mental health services mostly focus on industrialized or first world countries, less so on developing countries. This narrative synthesis and perspective piece encompasses an overview of mental health care competencies, best practices and capacity building needed to fast track patient responsive services in Kenya and gives us an idea what is needed to improve mental health care in an African country (Kumar et al.).

During the last decade "air pollution" was found to be related to mental health problems. Two studies deal with this issue. One study examines the heterogeneous impact and mediating mechanisms of air pollution on mental health based on data of 51 countries from 2010 to 2017 The findings show that there is heterogeneous impact of air pollution on different types of mental health. Specifically, air pollution has a significant positive impact on depression (Hu et al.). Researchers from Taiwan investigated this question in depth, analyzing sample of older adults was recruited from a nationally representative multiple-wave study, the Taiwan Longitudinal Study on Aging. They confirmed that exposure to traffic-associated air pollutants could increase depression risks among older adults (Wang et al.).

What does social support sound like? Passive audio data collection on mobile phones (e.g., episodic recording of the auditory environment without requiring any active input from the phone user) enables new opportunities to understand the social environment (Poudyal et al.). Passively capturing audio obviously has the potential to improve understanding of the social environment. This is a good example how creative research in public mental health can be.

Another neglected aspect of our social environment is art and cultural participation. Many different forms of art and cultural participation, for example, visiting museums and galleries, have received increasing attention as an important new focus for public health. The purpose of this study was to explore the effects of art and cultural participation of museums and galleries on life satisfaction intervened and controlled by physical and mental health and interpersonal relationships and individual's background (Lee et al.). It seems that art and cultural participation had direct effects on life satisfaction and indirect effects through the development of interpersonal relationships.

Job-related distress has been in the focus of public mental health research for decades, best known under the name "burnout." Job-related distress has a well-documented health-damaging and life-threatening character. In this article, Schonfeld and Bianchi review recent developments in research on job-related distress and examine ongoing changes in how job-related distress is conceptualized and assessed. They argue, that the construct of burnout have proved to be problematic and propose to address job-related distress within the long-established framework of depression research.

Job-related distress is not equally distributed across all occupational groups. Employees in the healthcare sector, for example, are particularly exposed to such stress. The COVID-19 pandemic has had an additional impact on the mental health and wellbeing of health workers on the frontlines of the pandemic. The purpose of this article is to provide an evidence-based overview of the adverse mental health impacts on healthcare workers during times of crisis and other challenging working conditions and to highlight the importance of prioritizing and protecting the mental health and wellbeing of the healthcare workforce, particularly in the context of the COVID-19 pandemic (Søvold et al.).

One pivotal component of health care is humanized care because the professional work of nursing seeks to provide quality services to patients who are suffering and fear illness. The main objective of this work was to find scientific evidence on humanized care from the perspectives of nurses and hospitalized patients in a exploratory systematic review (Meneses-La-Riva et al.).

Life transitions are often periods of increased risks for mental health problems. One of these risk period is the transition from home, school or college into university. Although pressure to perform academically whilst fulfilling the stereotypical student

life is keenly felt during the transition period, many students conceal their struggles from family and friends (Worsley et al.).

As the majority of mental disorders have an onset before the age of 18, it is a point of major interest, what causes adolescents' emotional distress. Results from this qualitative study show that distinct categories for perceived cause of emotional distress exist (e.g., perceived lack of control or unfair treatment) among adolescents considered to be "at risk" of developing mental health difficulties (O'Neill et al.).

COVID-19 physical distancing measures had a detrimental effect on adolescents' mental health. Adolescents worldwide alleviated the negative experiences of social distancing by spending more time on digital devices. The key message of this systematic review is that not all uses of digital media had negative consequences on adolescents' mental health during the pandemic. Their results suggested that social media use was helpful in mitigating the feeling of loneliness during COVID-19, but only when a one-to-one or one-to-few communication, rather than a general social media use, was promoted (Marciano et al.).

The global incidence of premenstrual syndrome and premenstrual dysphoric disorder is increasing, with increasing suicide reports. However, the bibliometric analysis of global research on these disorders is rare. This bibliometric analysis aimed to evaluate the global scientific output of research on PMS and PMDD and to explore their research hotspots and frontiers from 1945 to 2018 (Gao et al.). Keyword and reference analysis indicated that the menstrual cycle, depression and ovarian hormones were the research hotspots, whereas prevalence, systematic review, anxiety and depression and young women were the research frontiers.

The sport community has paid increased attention to the mental health of elite athletes. While sports participation can bring lots of benefits to elite athletes, they usually need to cope with demands, e.g., career dissatisfaction, performance, expectation, and sport injuries, which can pose potential threats to their mental health. The aim of this cross-sectional study was to examine the prevalence of Generalized Anxiety Disorder (GAD) and its risk and protective factors in elite collegiate athletes (Li et al.). The overall prevalence of GAD symptoms was 22%. Athletes with a history of sport injury, a high risk of ADHD, and a high level of fear of failure had a significant and positive association with GAD, while high levels of mental toughness and satisfaction in sport were significantly and negatively related to GAD.

Non-pharmacological interventions for mental health problems are always of Interest for public mental health practice. As such, the World Health Organization (WHO) has encouraged the inclusion, recognition, and use of Integrative and Complementary Health Practices in national health systems. This evidence map presents a summary of studies that addressed the effects of meditation on various clinical and health conditions (Schlechta Portella et al.). Several meditation techniques were evaluated in different contexts. Most of the studies reported positive effects and a beneficial potential of the practice of meditation.

Another non-pharmacological treatment offered as psychological support is bibliotherapy, which can be described as the process of reading, reflecting, and discussing literature to further a cognitive shift. The COVID-19 pandemic demands a response to prevent a collapse of mental health services. Thus, this study aimed to review articles on the effectiveness of bibliotherapy on different mental health problems (Monroy-Fraustro et al.). This mixed-methods systematic review showed, that through bibliotherapy patients developed new coping capacities. Additionally, values such as autonomy and justice were closely linked with positive results in bibliotherapy.

Another focus of public mental health research is the link between nutrition and mental health, as recent studies suggested that nutritional supplementation may be beneficial in improving mental disorders. This systematic review meta-analysis examined the effectiveness of polyphenol supplementation, which may have anti-inflammatory and antioxidant properties in improving depression, anxiety and quality of life (Lin et al.). The results suggest that polyphenol supplementation is effective in improving depression.

Last not least there is one overarching topic in the field of public mental health: the stigma of mental disorders. This study investigated factors affecting gender-specific stigmatization in the context of drug addiction (Sattler et al.). Their results showed higher stigma if the person used "harder" drugs, displayed aggressive behavior, or had a less controllable drug urge. Knowledge about addiction or prior drug use increased some forms of stigma, but reduced others.

Studies presented here only represent a small sample of the large number of published studies in Public Mental Health 2021 in the section Public Mental Health of Frontiers Public Health, Frontiers Psychiatry and Frontiers Sociology. Many others would have been worth mentioning here as well. Public Mental health has a vibrant research community and submissions in 2022 show a further increasing interest in the field. It is to be hoped that the many interesting scientific results will also be reflected in mental health care worldwide.

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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ORIGINAL RESEARCH
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Art and Cultural Participation and Life Satisfaction in Adults: The Role of Physical Health, Mental Health, and Interpersonal Relationships

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Many different forms of art and cultural participation, for example, visiting museums and galleries, have received increasing attention as an important new focus for public health. While a growing body of evidence suggests that art and cultural participation enhance human health and well-being in the West, the research is just in the infancy in the East. The purpose of this study was to explore the effects of art and cultural participation of museums and galleries on life satisfaction intervened and controlled by physical and mental health and interpersonal relationships and individual's background. This study adopted large-sample data from the seventh period of the Taiwan Social Change Survey. The sample population comprised 2,034 adult participants, involving 1,042 males and 992 females. The average age of the respondents was 47.67 ± 17.48 years. The results showed that individuals aged 30–64 years with an average monthly income between NT$20,000–NT$40,000 had a higher frequency of art and cultural participation of museums and galleries. Women under 29 years reported better life satisfaction. Individuals with a higher frequency of art and cultural participation of museums and galleries affected life satisfaction not only directly but also indirectly through interpersonal relationships, particularly among women and the elderly. Individuals who visited museums and galleries more frequently had greater life satisfaction and higher frequency of interpersonal contact. This was particularly evident in older females. Art and cultural participation of museums and galleries directly affected individual's life satisfaction and indirectly affected it via interpersonal relationships after controlling for gender, age, and monthly income. These findings indicate that visiting museums and galleries can enhance the frequency of interpersonal interactions and life satisfaction.

Keywords: art and cultural participation, life satisfaction, interpersonal relationship, mental health, physical health, museums and art galleries

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INTRODUCTION

Art and cultural events are leisure activities that improve quality of life (1, 2). They offer physical, mental, social, educational, and aesthetic benefits, in addition to relaxation, resulting in improved life satisfaction (3, 4). In the Cultural White Paper issued by the Cultural Construction Committee of the Executive Yuan in Taiwan, it is stated that "culture is the foundation of the country, and the

track of an individual's life depends on the accumulation of his or her behavioral and ideological growth." The ultimate goal of cultural development is to enrich an individual's life satisfaction and quality of life, both of which are closely related to a country's development (5). Culture is the lifeline of a nation, and cultural growth is the driving force behind social progress (6). For these reasons, to enrich people's spiritual life and to promote the flourishing of culture, it is important to look at the topic of art and cultural participation from various perspectives.

Art and cultural participation such as visiting museums and art galleries has received increasing attention by many scholars (7–10). Especially, previous studies have verified that the participation can enhance human health and well-being (11, 12). To participate in museums and art galleries activities can increase the benefit of physical functioning for patients in hospital and care home (13–18). Chatterjee and Noble (19) point out that to engaging with museums and art galleries can lead to reduced anxiety and raised positive emotions, decreased social isolation, increased communications among families, and positive social experience (7). Visiting museums and art galleries is widely accepted as an essential index of art and cultural participation to provide the references of health and well-being for populations and local communities when analyzed and valued in a multidimensional, multi-attribute, and multi-value socioeconomic environment (20). Although there are robust studies regarding the efficacy of art and cultural participation in the West, the study in the East is still limited.

Studies have used objective and explicit indicators such as gender, ethnicity, educational qualification, socioeconomic status, and other background variables to explain life satisfaction (21–24). However, much research is inconsistent or contradictory owing to differences in the sample populations and control variables (25–27). Furthermore, the absence of intermediary variables between the applicable variables confuses the causal relationships between background variables with art, cultural participation, and life satisfaction (25). In recent years, researchers have explored how art and cultural participation promotes life satisfaction using multivariate statistical methods involving critical intermediate variables to analyze causal mechanisms (28–30). To clearly understand the relationship between art and cultural participation and life satisfaction, the following intermediating variables have been explored: sense of achievement (26), physical and mental health (31–34), interpersonal attachment and self-efficacy (30), and interpersonal relationships (22, 24, 27).

Physical and mental health factors are important variables affecting an individual's life satisfaction. Good physical health not only increases participation in various activities but also improves life satisfaction (33, 35). Moreover, good mental health improves attitudes and allows people to fulfill their desires, which in turn promotes life satisfaction. Notably, the quality of interpersonal relationships is another variable that influences life satisfaction: good interpersonal relationships and attachments and engaging in the community are key factors for improving life satisfaction (24, 25, 31). For these reasons, studies should explore the relationships between variables by addressing the factors that affect life satisfaction from the viewpoint of physical and mental health and interpersonal relationships.

Although previous studies supported that art and cultural participation was associated with individual's health and life satisfaction (26, 29, 30, 36), the factors of physical and mental health and interpersonal relationships and individual background had not been included as mediator and control variables, which are important in improving our understanding of the impact of art and cultural participation on individuals' life satisfaction. The purpose of this study was to investigate the influences of art and cultural participation of museums and galleries on life satisfaction intervened and controlled by physical and mental health and interpersonal relationships and background. Specifically, based on the large sample data from the basic survey database of social change in Taiwan and after controlling background variables, we expanded the survey samples and regions to explore the relationship between variables and conducted further research on the consideration of relevant units by using various statistical methods. Moreover, government agencies and nongovernmental organizations can take our findings as solid evidence to develop effective strategies to promote art and cultural participation in individuals to increase life satisfaction.

BACKGROUND CONCEPTION

Art and Cultural Participation

Art and cultural activities entail leisure and happiness and have cognitive, emotional, spiritual, and educational functions that can help humans satisfy their need for knowledge (37). Beauty and self-realization can further enhance the public's appreciation of art, culture, and beauty (24). Culture and art experienced during adulthood are manifested through food habits, clothing, housing, education, and music. These societal elements constantly evolve with the pulse of life and are subsequently infused with new connotations (6). Along with social changes, art and culture present various facets of adulthood. All events with cultural significance can be defined as cultural activities. According to this definition, everything can be viewed as art or cultural activity. In a narrower sense, engagement with music, dance, art, drama, literature, on-site creative technology, or other domains of art and culture, recognized by competent authorities, can be considered art and cultural participation (37). Such pursuits satisfy human's thirst for knowledge, aesthetics, and self-realization. They can also improve one's ability to appreciate art, culture, and aesthetics. Additionally, participation refers to a person's involvement in an action or an event (38), characterized by physical and mental investment and interpersonal interaction behavior (11). In the current paper, because of the nature of the data collected through the Taiwan Social Change Survey, we focus on one specific aspect of art and cultural participation: visiting museums and galleries.

Evaluation of Life Satisfaction

In academia, happiness, mental health, quality of life, and life satisfaction are the main indicators of individual living conditions (39, 40). Subjective well-being and life satisfaction

are important determining factors (41). Happiness, mental well-being, quality of life, and life satisfaction have similar meanings; typically, they signify a positive mental state. These words are even used synonymously (42). Life satisfaction plays an important role in defining and evaluating the quality of life (43). Satisfaction is judged by comparing one's current situation with their ideal situation, the standards of which are set by individuals themselves rather than by others. Life satisfaction is defined as an individual's cognizance and evaluation of his own life and a comprehensive or specific evaluation of contributing factors (42). In short, life satisfaction is an individual's subjective cognizance and evaluation of his personal life situation based on appropriate standards.

Life satisfaction reflects an individual's conscious experience of inner pleasure and encourages the individual to actively pursue his or her goals (44). Individuals with specific goals are more capable of improving their life satisfaction because they can organize and integrate their resources to move toward their goals (45). Life satisfaction drives an individual to actively pursue a meaningful life. Many methods have been developed for assessing life satisfaction. For example, the Satisfaction With Life Scale (SWLS) utilizes the perspective of perceived self-life state (41). Comprehensive Quality of Life (ComQol) is evaluated through the perspective of material well-being, health, intimacy, safety, community, and emotional well-being (46). There remain several measurements, including the desire to improve life (47), personal satisfaction with the past and the future, self-assessment of personal life, the comparison of personal desire and actual achievement (48), the discussion of the quality of life and other mental and physical health indicators (49), the aspects of work and family fields, and personality traits (50). As mentioned above, research on life satisfaction should evaluate the impact of physiological, psychological, and social benefits on individual lifestyles.

Art and Cultural Participation and Life Satisfaction

Art and cultural participation not only is an essential component of public leisure participation behavior but also effectively promotes individual life satisfaction (2). Studies have reported a positive correlation between leisure participation and life satisfaction (34). In particular, increased participation in art and cultural activities is related to increased life satisfaction (26). Hence, studying art and cultural participation can improve our understanding of life satisfaction.

Leisure participation provides physical, mental, and social benefits and in turn promotes life satisfaction (51, 52). Art and cultural events are considered leisure activities. The physiological and psychological experiences, satisfaction, and interpersonal relationship involved in the process of participation promote physiological, psychological, and social benefits (2, 53).

Physical and mental benefits and interpersonal relationships are related to life satisfaction. First, physical health has a positive effect on perceived life satisfaction. Compared with static leisure, participation in dynamic leisure activities can have additional benefits on life satisfaction as it improves physical health (7, 33, 35). Therefore, there is a strong association between individual physical health and life satisfaction. Secondly, while experiencing happiness, individuals feel satisfied and happy with their personal life. The more individuals engage in positive behavior, the less likely they are to experience negative emotions (41). Individuals can psychologically benefit from leisure participation, which are associated with numerous empirical outcomes (3). Moreover, leisure participation has a positive correlation with psychological well-being and shares a causal relationship with mental health and life satisfaction (54–56). Therefore, through leisure participation, individuals can achieve happiness, good mental health, and life satisfaction with positive benefits. Finally, social networks created through leisure participation are important for promoting life satisfaction. Many researchers believe that leisure participation at the social level can effectively improve individual happiness, relaxation, health, psychological state, happiness, and life satisfaction. Having good social relationships can promote interpersonal relations and consequently improve life satisfaction (2, 52, 53). Support from social networks and interpersonal relationships improves well-being (57, 58). Interpersonal variables may be a crucial factor affecting life satisfaction mediated by the similarities between well-being and life satisfaction. In short, interpersonal relationships are positively associated with life satisfaction.

METHODS

In this study, background variables such as gender, age, and average monthly income were controlled for. Physical and mental health and interpersonal relationships were used as intermediary variables to explore the influence of art and cultural participation on life satisfaction.

Participants

We obtained data from the first comprehensive questionnaire of the seventh period of the Taiwan Social Change Survey (QTSCS) in 2015 (59). The sample population comprised 2,034 participants in Taiwan from various counties and cities, all older than 18 years. The study population included 1,042 males (51.2%) and 992 females (48.8%). The basic survey of social change in Taiwan is a long-term research project involving a sampling survey sponsored by the Humanities Department of the Ministry of Science and Technology. This research uses data collected since 1984 from a public database that has been extensively used for academic research. By the end of 2017, more than 1,900 studies have been conducted using data collected from this database (60).

Measurements

Background

1. Gender: In the regression analysis, males were assigned a value of 1 and females 0.
2. Age: Year of birth.
3. Income: The monthly income of participants was recorded. The options were no income, <NT$10,000, <NT$20,000, and NT$30,000 or more, scored as 1, 2, or 3. Higher scores denoted higher average monthly incomes.

Art and Cultural Participation

The participants were asked about the number of times they had visited art and history museums and art galleries in the previous year. Points from 1 to 6 corresponded to no visit, once, twice, three times, four times, and more than five times, respectively.

Physical Health

Participants were asked if they experienced headaches, palpitations (rapid heartbeats), and worries about possible heart disease, tightness in the chest, extreme discomfort, shivering, or numbness (59). Points from 4 to 1 corresponded to never, sometimes, more than usual, and frequently, respectively. A higher score represents better physical health.

Mental Health

The participants were asked whether they felt burdened, lost, hopeless, nervous, or incapable of relaxing (59). Points from 4 to 1 corresponded to never, sometimes, more than usual, and frequently, respectively.

Interpersonal Relationship

The participants were asked how often they had visited their relatives and friends. Answers were recorded as never, very few times, once in 2 or 3 months, one to three times a month, once a week, and twice a week or more (59). The participants were evaluated with respect to the number of individuals that they communicated with within a single day, from morning to night. The answers were 0–4, 5–9, 10–19, 20–49, 50–99, and more than 100, and the responses were assigned 1, 2, 3, 4, 5, and 6 points, respectively.

Life Satisfaction

The participants were asked if they were satisfied with their current quality of life and their relationships with their friends (59). Scores from 4 to 1 corresponded to very satisfied, fairly satisfied, not satisfied, and very dissatisfied, respectively. Furthermore, participants were asked if they were happy with their current life, and scores from 4 to 1 corresponded to very happy, fairly happy, not very happy, and very unhappy, respectively.

Data Analysis

Descriptive statistics, including the number of participants, means, standard deviation, and percentage values, were used to analyze the sample distribution. The survey data were subjected to exploratory factor analysis to identify the dimensions of QTSCS. Through the background variables, we analyzed the variance in art and cultural participation, physical and mental health, interpersonal relationships, and life satisfaction. If the variances were found to be significant, study comparisons were performed using the Scheffé method. The background variables were controlled for multiple regression analyses to investigate the effects of the following variables on life satisfaction: participation in art and cultural events; physical and mental health; and interpersonal relationships.

RESULTS

Demographics

The sample population comprised 2,034 respondents, including 1,042 (51.20%) males and 992 (48.80%) females. The average age of the respondents was 47.67 ± 17.48 years. The average monthly income of 309 (20.16%), 273 (17.81%), 178 (11.61%), and 167 (10.89%) respondents were <NT$20,000–NT$30,000, NT$30,000–NT$40,000, NT$10,000–NT$20,000, and NT$40,000–NT$50,000, respectively. The remaining respondents comprised 10% of the population.

Factor Analysis

The objective of factor analysis was to explore the grouping between the 11 questionnaires. The study was to utilize factors with a latent root or eigenvalue > 1 (61). Items with factor loading of 0.4 or higher were considered acceptable variables to measure constructs (62). This approach produced four factors for the data, and this is supported by a scree test (61). Based on an assessment of the factor loading scores, the following four dimensions were proposed: (1) Physical health (eigenvalue = 2.44, explained variance = 17.39%), (2) mental health (eigenvalue = 2.35, explained variance = 16.79%), (3) life satisfaction (eigenvalue = 1.77, explained variance = 12.62%), (4) interpersonal relationship (eigenvalue = 1.41, explained variance = 10.06%). The four with eigenvalues that exceeded 1 were extracted, and it was found that these explained 56.86% of the overall variance in the data (**Table 1**). (63) suggested that over 50% of the overall variance was reasonable for a data set of this kind. Therefore, four factors of physical health, mental health, and interpersonal relationship were identified as the main factors.

Factors Influencing Life Satisfaction

The regression analysis of life satisfaction (1), background variable, revealed that female gender ($\beta = -0.10$, $p = 0.00 < 0.05$) and monthly income ($\beta = 0.09$, $p = 0.00 < 0.05$) had significantly positive effects on life satisfaction (**Table 1**). Similarly, regression analysis of life satisfaction (2), background variable, revealed that female gender ($\beta = -0.09$, $p = 0.00 < 0.05$), age ($\beta = 0.07$, $p = 0.13 < 0.05$), and art and cultural participation ($\beta = 0.07$, $p = 0.01 < 0.05$) had significantly positive effects on life satisfaction. Regression analysis of life satisfaction (3), background, physical health, mental health, and interpersonal relationship variables indicated that female gender ($\beta = -0.11$, $p = 0.00 < 0.05$), age ($\beta = 0.10$, $p = 0.00 < 0.05$), art and cultural participation ($\beta = 0.05$, $p = 0.05 < 0.05$), physical health ($\beta = 0.06$, $p = 0.02 < 0.05$), mental health ($\beta = 0.07$, $p = 0.01 < 0.05$), and interpersonal relationships ($\beta = 0.16$, $p = 0.00 < 0.05$) had significantly positive effects on life satisfaction. However, monthly income ($\beta = 0.05$, $p = 0.10 > 0.05$) was not a significant factor in life satisfaction, with an overall variance of 5.6% (**Table 2**). Additionally, the regression analysis suggests that a higher frequency of participation in art and cultural participation was positively associated with physical and mental health, interpersonal relationships, and life satisfaction, which was particularly evident in older women.

TABLE 1 | Exploratory factor analysis of QTSCS.

Dimensions of QTSCS*	Physical health	Mental health	Interpersonal relationship	Life satisfaction
Feel headache or tight head?	0.64			
Feel palpitation or palpitation, worry about possible heart disease?	0.77			
Feel tight chest, very uncomfortable?	0.80			
Feel your hands and feet shaking or numb?	0.65			
Feel that many things are a burden to you?		0.66		
Feel lost confidence yourself?		0.84		
Feel hopeless in life?		0.78		
Feel nervous and can't relax?		0.72		
Do you and your relatives get together frequently?			0.66	
Do you and your friends often get together?			0.70	
How many people do you contact from morning to night in a day?			0.64	
Are you satisfied with your current quality of life?				0.74
Are you satisfied with your relationship with your friends?				0.75
Do you feel happy at present?				0.72
Eigenvalue	2.44	2.35	1.41	1.77
% of variance explained (Total = 56.86%)	17.39%	16.79%	10.06%	12.62%

**Questionnaire of the seventh period of the Taiwan Social Change Survey.*

TABLE 2 | Regression analysis of physical health, mental health, interpersonal relationship, and life satisfaction.

Variables	PH* (1) β	PH* (2) β	MH* (1) β	MH* (2) β	IR* (1) β	IR* (2) β	LS* (1) β	LS* (2) β	LS* (3) β
Male (female as reference)	−0.09**	−0.09**	−0.02	−0.02	0.04	−0.05	−0.10**	−0.09**	−0.11**
Age	0.02	−0.02	0.11**	11*	−0.22**	−0.21**	0.06	0.07**	0.10**
Monthly income	−0.06**	−0.07**	−0.08**	−0.08**	0.16**	−0.13**	0.09**	0.07**	0.05
Art and cultural participation		0.03		−0.01		0.14**		0.07**	0.05**
PH									0.06**
MH									0.07**
IR									0.16**
R square	0.014	0.012	0.022	0.23	0.093	0.111	0.015	0.020	0.056
Adj. R square	0.014	0.012	0.021	0.20	0.091	0.108	0.013	0.017	0.051

**PH, physical health; MH, mental health; IR, interpersonal relationship; LS, life satisfaction.*
***$p < 0.05$.*

Criterion Variables of Physical and Mental Health and Interpersonal Relationships

In the regression analysis, background variables were controlled to determine whether participation in art and cultural participation influenced life satisfaction through intermediary variables, such as physical health, mental health, and interpersonal relationships. These were considered criteria to determine whether the individual's background variables influenced life satisfaction through intermediary variables (**Table 2**).

Regression analysis of physical health (1), background variable, indicated that female gender ($\beta = -0.09$, $p = 0.00 < 0.05$) and monthly income ($\beta = -0.06$, $p = 0.02 < 0.05$) had significantly positive effects on physical health. Regression analysis of physical health (2), background variable, revealed that female gender ($\beta = -0.09$, $p = 0.00 < 0.05$) and monthly income ($\beta = -0.07$, $p = 0.01 < 0.05$) had significantly positive effects on physical health. However, art and cultural participation ($\beta = 0.03$, $p = 0.28 > 0.05$) was not significantly correlated with physical health, with an overall explained variance of 1.2%. This result suggests that art and cultural participation is not correlated with physical health.

Regression analysis of physical health (1), background variable, revealed that age ($\beta = 0.11$, $p = 0.00 < 0.05$) and monthly income ($\beta = -0.08$, $p = 0.00 < 0.05$) had significantly positive effects on physical health. The regression analysis of physical health (2), background variable, indicated that age ($\beta = 0.11$, $p = 0.00 < 0.05$) and monthly income ($\beta = -0.08$, $p = 0.00 < 0.05$) had significantly positive effects on physical health. However, female gender ($\beta = -0.02$, $p = 0.92 > 0.05$) and art and cultural participation ($\beta = -0.01$, $p = 0.83 > 0.05$) were not significantly associated with mental health, and the overall

explained variance was 2.0%. These results suggest that art and cultural participation was not correlated with physical health.

Regression analysis of physical health (1), background variable, indicated that age ($\beta = -0.22$, $p = 0.00 < 0.05$) and monthly income ($\beta = 0.16$, $p = 0.00 < 0.05$) had a significantly positive effect on interpersonal relationships. Regression analysis of physical health (2), background variable, indicated that age ($\beta = -0.21$, $p = 0.00 < 0.05$), monthly income ($\beta = 0.13$, $p = 0.00 < 0.05$), and art and cultural participation ($\beta = 0.140$, $p = 0.00 < 0.05$) had a significantly beneficial effect on interpersonal relationships. However, female gender ($\beta = -0.02$, $p = 0.10 > 0.05$) was not significantly associated with interpersonal relationships, and the overall explained variance was 11.0%. These results demonstrated that art and cultural participation was not correlated with physical health.

A Path Analysis of Life Satisfaction

Figure 1 shows that arts and cultural participation had a positively direct effect ($\beta = 0.5$, $p = 0.05 < 0.05$) on life satisfaction and an indirect effect through the development of interpersonal relationships ($\beta = 0.02$, $p = 0.00 < 0.05$). Physical health ($\beta = 0.06$, $p = 0.02 < 0.05$) and mental health ($\beta = 0.07$, $p = 0.01 < 0.05$) only affected life satisfaction by controlling the background variables, gender, age, and monthly income. Art and cultural participation did not significantly influence physical health ($\beta = 0.03$, $p = 0.28 > 0.05$) or mental health ($\beta = -0.01$, $p = 0.83 > 0.05$).

DISCUSSION

After controlling for background variables (gender, age, and monthly income), individual art and cultural participation had direct effects on life satisfaction and indirect effects through the development of interpersonal relationships. Individuals aged 30–64 years with average monthly income of NT$20,000–NT$40,000 had more participation in art and cultural activities. Women under 29 years reported improved life satisfaction. A higher frequency of art and cultural participation not only directly affected life satisfaction but also indirectly affected satisfaction via the development of interpersonal relationships during these activities, particularly in women and the elderly. Moreover, good physical health and mental health were beneficial in developing positive personal attitudes toward life. Women's life satisfaction was higher than that of men, consistent with findings of previous studies. This could be attributed to women's traditional aesthetic training in Taiwan's social environment. Women establish their self-identity and improve their life satisfaction by cultivating their artistic taste (64). This finding is also consistent with the theory of cultural and financial capital (53). It is believed that older women spend more capital in art and cultural activities, in turn improving their life satisfaction.

Art and cultural participation enhances interpersonal relationships and mutual understanding. In this study, art and cultural activities had a positive impact on interpersonal relationships, which is consistent with findings of studies that suggested that art and cultural participation increases opportunities for interpersonal communication and relationships (Chatterjee and Noble, 2013) (21, 51). The weak state of interpersonal relationships in modern society demonstrates the value of art and cultural participation. Notably, individuals with increased art and cultural participation reported greater levels of life satisfaction, which was consistent with findings of previous studies (2). Specific cultural resources, such as art and cultural performances, cultural publishing, film and television, music, and cultural exchanges and consumption, improved individual life satisfaction. Some studies have also indicated that the frequency of individual's art and cultural

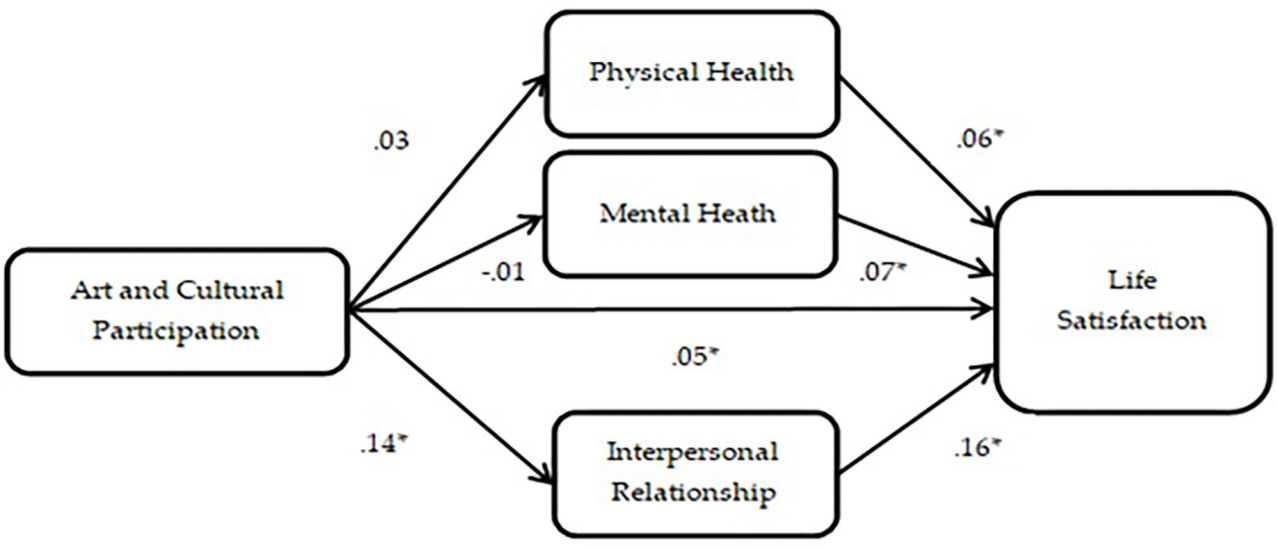


FIGURE 1 | Path analysis of art and cultural participation on life satisfaction.

participation had a positive relationship with his or her life satisfaction (65). Art and cultural participation has been proposed to relax the body and mind, improve self-development, enhance life enjoyment and social integration, and promote health (66), all of which positively affects individual satisfaction with conditions of life. A recent study suggested that individuals with good taste in art and culture, self-worth, and self-dignity demonstrate multifaceted life satisfaction (26). These studies contribute to the existing research and establish that art and cultural participation can promote social interactions (67). In particular, individual participation in art and culture can promote good interpersonal relationships and life satisfaction.

The results suggest that physical health and mental health are determining factors that can contribute to life satisfaction, findings consistent with those of previous literature. A psychologically healthy individual is more capable of experiencing happiness, making it easier for him or her to achieve a positive evaluation of life, happiness, and satisfaction with life (29, 55, 56). Art and cultural activities have cognitive, emotional, spiritual, and educational functions that help humans meet their demands for knowledge, beauty, and self-realization. Encouraging individuals to appreciate art, culture, and aesthetics improves life satisfaction.

Interpersonal relationships have positive impacts on life satisfaction. In fact, studies have suggested that, if individuals get along with each other, their willingness to create social networks increases and in turn promotes their life satisfaction (2). Moreover, the quality of interpersonal interactions, interpersonal attachment, sense of community, and interpersonal relationships are factors that affect an individual's life satisfaction (25, 28). Taken together, these findings suggest that individuals with good interpersonal communication opportunities and interactions promote interpersonal relationships and enhance their life satisfaction.

CONCLUSION AND SUGGESTIONS

We found that increased participation in art and cultural participation affects an individual's life satisfaction not only directly but also indirectly via interpersonal relationships, and this was particularly evident for women and the elderly. Effective use of leisure time can offer personal, physical, and psychological benefits and can improve interpersonal relationships, in turn promoting life satisfaction (30, 53). We suggest that government agencies should evaluate measures to increase art and cultural events to promote life satisfaction in individuals. For example, providing more opportunities for teaching art and cultural events in school education would be an effective means of accomplishing this objective. Public and private organizations should provide information on art and cultural events through media platforms, encouraging individuals to participate in these events.

On the face of it, it appears plausible that art and cultural participation should have a significant impact on individual's quality of life or any other indicator of physical health and well-being (Chatterjee and Noble, 2013); however, this study did not find the relationship between them. There may also be the problem of reverse causality—people who are healthy and have good psychological well-being may be more likely to engage with cultural opportunities. In future research, we can explore the reverse causal relationship between art and culture participations and health from many aspects. People who are healthy and happy would tend to participate in art and cultural activities more.

After controlling for the variables of gender, age, and average monthly income, we found that high levels of participation in art and cultural activities and strong interpersonal relationships promote life satisfaction. Many other important variables can be considered to examine how art and cultural participation influences life satisfaction. For example, personality characteristics such as perception-seeking and experience-seeking can determine an individual's satisfaction with activities. Moreover, marital status and ethnic backgrounds affect participation in art and cultural activities in different ways. For example, married individuals and those with children have restrictions and obligations, limiting the types of activities they choose to participate in Qiu and Chen (68). Studies have shown that social support systems are important for personal, physical, and mental health, and they affect life satisfaction (69, 70). Future studies can include the variables of marriage and ethnic backgrounds, personality characteristics, and social support systems to fully understand the determining factors of life satisfaction.

This study used information from an existing database (QTSCS) for analysis. Although it employs a large sample size, with high efficiency, wide age range, and good representativeness, the analysis and interpretation of variables have limitations caused by the content planning of the questionnaire. For example, the questions concerning physical health variables are biased toward physiological cognition and less toward behavioral aspects, the latter of which warrants further investigation. Further research on the effect of physical and mental health and interpersonal relationships on life satisfaction is warranted. Placing questions into an appropriate category can clarify the relationships among these research variables.

DATA AVAILABILITY STATEMENT

Publicly available datasets were analyzed in this study. This data can be found here: https://srda.sinica.edu.tw/datasearch_detail.php?id=1057.

AUTHOR CONTRIBUTIONS

H-CH and L-CL contributed to the conceptualization, methodology, and data analysis. L-CL, C-WL, and H-CH contributed to writing the original draft preparation. C-WL and H-CH contributed to writing, review, and editing. All authors contributed to the article and approved the submitted version.

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Similarities and Differences of Mental Health in Women and Men: A Systematic Review of Findings in Three Large German Cohorts

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In Germany, large, population-based cohort studies have been implemented in order to identify risk and protective factors for maintaining health across the life span. The purpose of this systematic review is to analyse findings from three large ongoing cohorts and to identify sex-specific prevalence rates, risk and protective factors for mental health. Published studies from the Cooperative Health Research in the Region Augsburg (KORA), the Study of Health in Pomerania (SHIP) and the Gutenberg Health Study (GHS)), representing the southern, north-eastern and middle parts of Germany, were identified through searches of the databases PubMed and Web of Science. A total of 52 articles was identified from the start of each cohort until June 2019. Articles reporting prevalence rates of mental health [$N = 22$], explanatory factors for mental health [$N = 25$], or both [$N = 5$] were identified. Consistent across cohorts, higher prevalence rates of internalizing disorders were found for women and more externalizing disorders for men. Risk and protective factors for mental health included social factors, lifestyle, physical health, body mass index (BMI), diabetes, genetic and biological factors. In all areas, differences and similarities were found between women and men. The most evident were the sex-specific risk profiles for depression with mostly external risk factors for men and internal risk factors for women. Gender was not assessed directly, therefore we examined whether socioeconomic and family-related factors reflecting gender roles or institutionalized gender could be used as a proxy for gender. Overall, this systematic review shows differences and similarities in prevalence rates and determinants

of mental health indicators between women and men. They underline the importance of focussing on sex specific approaches in mental health research and in the development of prevention measures. Current research on mental health still lacks focus on gender aspects. Therefore, an increased focus on sex and gender in mental health research is of great importance.

Keywords: systematic review, mental health, sex, gender, regional differences, Germany

INTRODUCTION

Mental disorders have become major public health concerns affecting quality of life, work productivity and life expectancy (1) of a large proportion of the general population. Representative German studies have shown that approximately one in three women and one in four or five men had a diagnosis of a mental disorder in the previous 12 months (2). For most internalizing disorders (e.g., major depression and eating disorders), women are more frequently affected (3, 4), whereas for externalizing disorders (e.g., substance abuse) men are more frequently affected.

Mental health differences between women and men have been attributed to sex and gender differences. Rooted in genetics, anatomy, and physiology (5), sex represents a biological construct. In contrast, gender comprises psychosocial variables that differentiate women and men (6) elucidating societal conditions and offering explanatory models. Gender can be differentiated according to (1) gender roles: behavioral norms attributed to women and men in a given society; (2) gender identity: how people see themselves on the dimensions of femininity-masculinity; (3) gender relations: how individuals interact with or are treated by others based on ascribed or experienced gender; and 4) institutionalized gender: distribution of power between women and men in institutions in society which shapes social norms and justifies different expectations and opportunities for women and men (5). Sex differences in mental health can be explained by sex hormones (7, 8) and dysregulations in the hypothalamic-pituitary-adrenal (HPA) axis (7, 9), especially for stress-related psychiatric disorders. Gender differences in mental health can be explained by e.g., gender-based violence (10), low self-esteem (7) and belonging to a gender minority (11). The interplay between sex and gender is an important factor in mental health. Sex and gender interact in the development of diseases (12, 13) [e.g., depressive disorders (14)] and coping strategies (15). The association between biological sex and mental health in Europe is moderated by socioeconomic and family-related factors (16), which explain about 20% of the differences in mental health between women and men. Such factors are for example employment (16, 17), education, housekeeping or looking after children and income (16, 18). The inverse association between socioeconomic position and morbidity and mortality has been termed social gradient of health (19). While multiple inequalities between women and men (e.g., gender pay gap, lower pension due to maternity leaves and part-time employment) are known, interactions between sex and socioeconomic position, which may put women at a disadvantage have been understudied (19).

Sex and gender differences vary across countries and regions (20). In a study including 48 countries, males have consistently reported higher self-esteem than females, but the strength of this effect differed between countries (21). Furthermore, sex, gender, and cultural differences for self-reported emotional intensity (arousal) were found between the Chinese and German culture (22). However, in a study on the universality of emotions across 37 countries, no differences were found between women and men (23); in all countries men reported more powerful emotions (e.g., anger), whereas women tended to report powerless emotions (e.g., fear or sadness). A study focussing on similarities and differences in three psychological domains (cognitive domain, social and personality and well-being) combined numerous meta-analyses and identified only small differences between women and men (24). These differences remained consistent across countries. Regional differences regarding material living standards and employment conditions may also affect women and men differently (20). In examining mental health, it is therefore important to consider differences between countries and regions.

In Germany, large population-based cohort studies have been implemented in order to identify risk and protective factors for health in the general population. Major ongoing cohorts have been established between 1983 and 2007. These include the Cooperative Health Research in the Region Augsburg (KORA) [formerly Monitoring of Trends and Determinants of Cardiovascular Disease (MONICA)], the Study of Health in Pomerania (SHIP) and the Gutenberg Health Study (GHS), representing different German regions, respectively, the southern, north-eastern and middle part of Germany. KORA focusses on the fields of epidemiology, health economics, and health care research (25), SHIP contains a broad range of health and quality of life indicators (26) and GHS focusses on uncovering risk factors for several conditions, such as cardiovascular and mental diseases (27). The three cohort studies followed representative samples of participants stratified by sex and age, which were drawn in comparable ways from their respective regions (28) (GHS: $N = 15\ 010$ respondents, 35–74 years; KORA: $N = 18\ 079$ respondents, 25–74 years; SHIP: $N = 12\ 324$ respondents, 20–79 years). The three German regions differ regarding socioeconomic and economic parameters: Unemployment rates are highest, discretionary incomes, and life expectancy lowest in Greifswald (SHIP). As the eastern and western states of Germany have evolved in different political and economical systems following the 2nd World War,

these regions show pronounced differences regarding full-time employment rates among mothers resulting in different gender pay gaps (28).

These three cohorts also include mental health variables and are therefore particularly suitable to derive knowledge on sex, mental health and their relationships to physical health. The GESA consortium (GEnder Sensitive Analyses of mental health trajectories and implications for prevention) has recently been established to enable future conjoint analyses (28). The purpose of this systematic review is to analyse published findings from the three cohorts and to identify sex-specific prevalence rates of mental disorders and to identify risk and protective factors and regional effects.

METHODS

Published studies were identified through searches of the databases PubMed and Web of Science. We included studies from initiation of each cohort until June 2019. KORA started in 1996 (25) following its precursor MONICA which had started in 1984, SHIP started in 1996 (26) and GHS started in 2007 (27). Keyword, title, authors and abstract information were used. The search terms were "*KORA*," "*Cooperative Health Research in the Augsburg Region*," "*SHIP*," "*Study of Health in Pomerania*," "*GHS*" or "*Gutenberg Health Study*" combined with "*mental health*," "*sex,*" or "*gender*." English and German publications were considered. Unpublished papers, abstracts, dissertations and book chapters were not included. The search took place from April until June 2019.

To decide whether an article fulfilled the criteria, the first rough selection was made by inspecting the title and abstract of the article. To identify relevant studies, the following inclusion criteria were used:

1) studies using KORA, SHIP or GHS data;
2) cross-sectional and longitudinal/prospective studies addressing mental health;
3) studies containing sex, respectively gender.

Furthermore, it was required that the articles either (1) contained descriptive statistics on mental health variables including statistical tests that probed for differences between women and men, or (2) tested factors related to mental health with separate analyses for women and men, respectively analyses with an interaction term for sex. We only selected papers that included mental health as a dependent variable. This first group of articles was used to describe prevalence rates of mental health for women and men. The second group of articles was analyzed to describe explanatory factors for mental health between women and men. Of the selected articles the literature list was meticulously examined and further relevant articles were selected. Articles including analyses with mental health as dependent variable, but only including sex as a control factor, were not taken into account. Articles containing descriptive statistics for mental health aspects, but without differences between women and men (statistically tested) were excluded. Lastly, we excluded methodological papers. The selection procedure is displayed in detail in **Figure 1**.

Mental health is a broad concept. In this article, we were guided by the definition of WHO including mental, physical and social well-being, not just the absence of mental disorders (29). Similarly, Galderisi et al. (30) interpreted mental health as a dynamic state of well-being changing through lifetime and depending on life events. Therefore, not only mental disorders, but also mental health aspects such as well-being, somatic symptoms, loneliness and resilience were taken into account in this review.

RESULTS

Our search strategy has identified 52 articles reporting GHS, KORA or SHIP data on mental health and sex differences. We found articles reporting prevalence rates of mental health [$N = 22$], explanatory factors for mental health [$N = 25$] and articles reporting both [$N = 5$].

Articles assessing gender differences based on gender identity and gender relations were not found, but some articles included variables indicating gender aspects related to gender roles and institutionalized gender. Previous research indicated gender differences in power, responsibilities and in dimensions of the self (4), contributing e.g., to lower income of women, more responsibilities in childcare and more domestic work. In another previous study a gender index based on secondary data specified taking care of children, being unemployed, working few hours and lower education as indicators for feminine gender roles (31). Such socioeconomic and family-related factors were included as possible gender factors.

Prevalence of Mental Health Complaints

The articles reported a broad range of prevalence rates of mental health indicators for women and men. The articles are consistent in their findings, but most prevalence rates were only reported in one or two of the three cohorts, based on specific diagnostic instruments. The results are listed in **Table 1**.

In general, women reported more mental health problems than men (38, 39). Regardless of the measurement scale, depression or depressive symptoms were reported more often by women than by men (32, 36, 41, 42, 46, 58). This also applied to new onset of depression (55) and additionally to specific subgroups, e.g., elderly (49). Major depressive disorders were more frequently present among women compared to men (36, 56). However, when the depression and exhaustion subscale was used, no difference between women and men in reporting depressed mood was found (54). Depression combined with obesity was more often seen in women (52). Depending on operationalization, depression or depressed mood in women ranged from 8.7% (GHS) to 36.8% (SHIP) and in men from 5.8% (GHS) to 37.7% (KORA). Suicidal ideation was more often present in women (9.2% GHS) compared to men (6.0% GHS) (35). However, the risk of committing suicide was higher for men (0.5% KORA) than for women (0.3% KORA) (48). Lastly, anxiety was more often present among women (55.8% SHIP) compared to men (38.9% SHIP) (32), this also applied to elderly women (10.6% KORA) and men (4.8% KORA) (49).

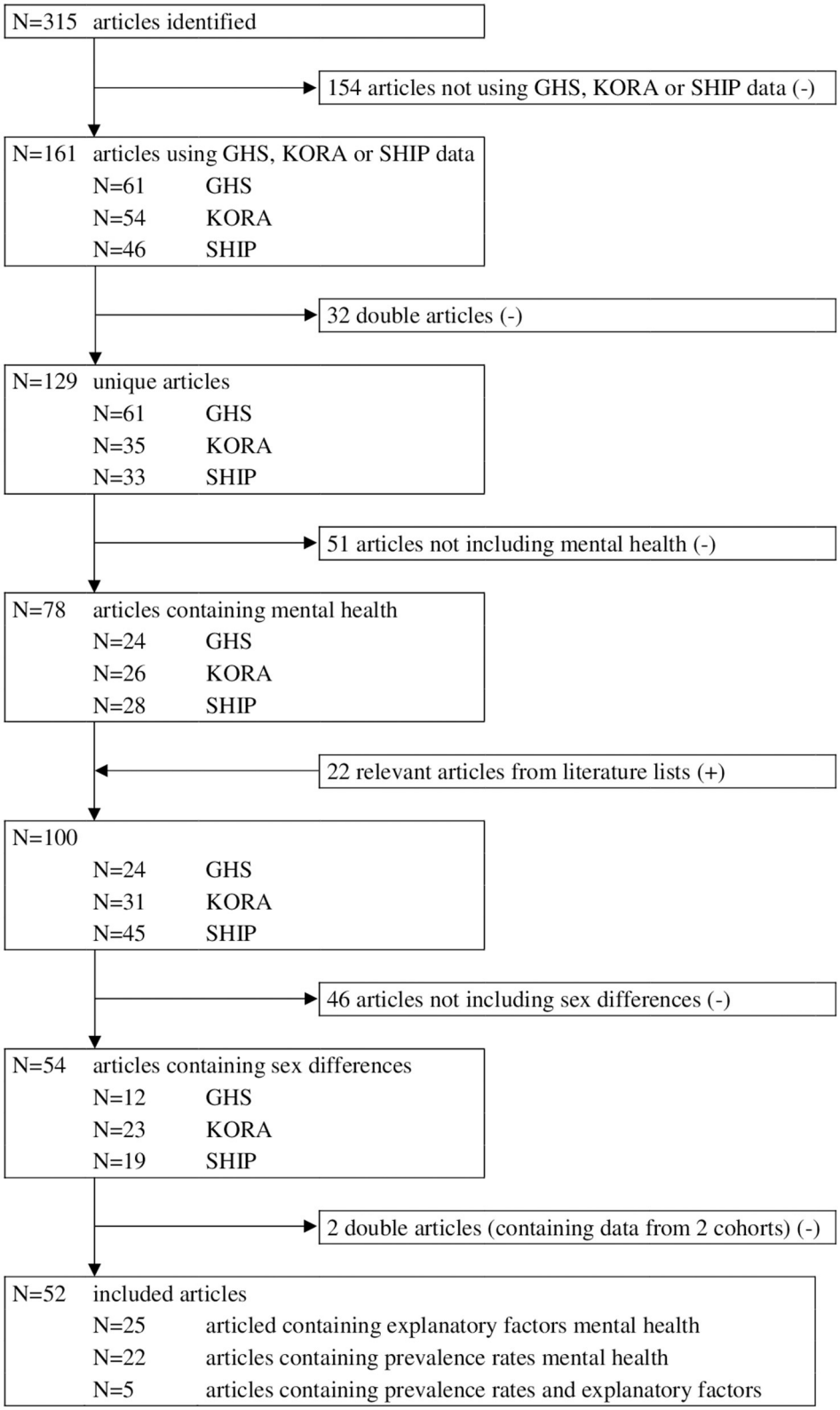


FIGURE 1 | Overview of identified, screened and included articles.

TABLE 1 | Results prevalence rates mental health for women and men.

References	Study	*N*	Mental health construct	Measurement scale, cut-off value (range)	Total	Women[1]	Men[1]	*p*-value[2]
Grabe et al. (32)	SHIP	3,300	Depression	CID-S[6]: two items, ≥1 (0–2)	4,310	807 (36.8%)	507 (23.9%)	***p* < 0.05**
			Anxiety	CID-S[6]: five items, ≥1 (0–5)	4,310	1,223 (55.8%)	823 (38.9%)	***p* < 0.05**
			Somatization	CID-S[6]: one item, ≥1 (0–1)	4,310	384 (17.5%)	308 (14.5%)	***p* < 0.05**
Grabe et al. (33)	SHIP	3,045	Traumatic event	PTSD module of SCID[7], ≥1[7a]	3,045	830 (52.8%)	833 (56.5%)	***p* < 0.05**
			PTSD[3]	PTSD module of SCID[7], ≥6 (0–17)[7b]	1,663	43 (5.2%)	24 (2.9%)	***p* < 0.05**
Spitzer et al. (34)	SHIP	3,171	PTSD[3]	PTSD module of SCID[7], ≥1 (0–17)[7c]	3,171	42 (2.5%)	20 (1.3%)	***p* ≤ 0.007**
Michal et al. (35)	GHS	4,912	Suicidal ideation	Item PHQ-9[8], ≥1 (0–3)	4,912	223 (9.2%)	151 (6%)	***p* < 0.001**
Appel et al. (36)	SHIP	2,157	Depressive symptoms	BDI-II[9], continues (0–63)	2,157	7.0 ± 7.9%	5.7 ± 6.3	***p* < 0.001**
			MDD[4]	M-CIDI[10]	2,157	253 (22.3%)	117 (11.5%)	***p* < 0.001**
Michal et al. (37)	GHS	4,900	Depersonalization	CDS-2[11], ≥3 (0–6)	4,900	20 (0.8%)	21 (0.8%)	$p = 0.96$
Spitzer et al. (38)	SHIP	1,772	Mental health problems	CID-S[6], ≥1 (0–12)	1,772	372 (40.9%)	261 (30.2%)	***p* ≤ 0.001**
Wiltink et al. (39)	GHS	5,000	Mental distress[5]	PHQ-9[8], ≥10 (0–27); PHQ panic module[12], ≥2 (0–4); Mini-Spin[13], ≥6 (0–12); GAD[14]-2, ≥3 (0–6)	4,753	453 (19.4%)	304 (12.6%)	***p* ≤ 0.001**
Beutel et al. (40)	GHS	4,928	Type D personality	DS14[15], ≥10 (0–28)	4,928	561 (23.1%)	534 (21.3%)	$p = 0.13$
Grabe et al. (41)	SHIP	2,035	Depressive symptoms	BDI-II[9], continues outcome (0–63)	2,035	7.0 ± 7.9	5.7 ± 6.5	***p* < 0.001**
Grabe et al. (42)	SHIP	1,974	Depressive symptoms	BDI-II[9], continues outcome (0–63)	1,974	7.0 ± 7.8	5.6 ± 6.2	***p* < 0.001**
Häfner et al. (43)	KORA	1,369	Sleep disturbances, no depressed mood	USI[16], ≥3 (1–6); DEEX[17], ≥12 women; ≥10 men (0–24)	1,369	157 (22.1%)	95 (14.4%)	***p* < 0.01**
Perna et al. (44)	KORA	3,347	Resilience	RS-11[18], upper third	3,347	536 (30.5%)	501 (31.5%)	$p = 0.173$
Ladwig et al. (45)	KORA	3,000	Full PTSD[3]	PDS and IES[19]	3,000	32 (2.1%)	19 (1.3%)	***p* < 0.001**
Michal et al. (46)	GHS	4,937	Depression	PHQ-9[8], ≥10 (0–27)	4,937	212 (8.7%)	145 (5.8%)	***p* < 0.001**
Michal et al. (47)	GHS	9,751	Severe sleep problems	Item PHQ-9[8], ≥2 (0–3)	9,751	548 (11.4%)	354 (7.2%)	***p* < 0.001**
Schneider et al. (48)	KORA	12,888	Commiting suicide	Death certificates	12,898	18 (0.3%)	30 (0.5%)	***p* = 0.001**
Zebhauser et al. (49)	KORA	1,022	Mild/moderate depression	Geriatric Depression Scale-15[20], ≥4 (0–15)	1,058	87 (17.2%)	60 (10.9%)	***p* = 0.011**
			Anxiety	GAD-7[14], ≥10 (0–21)	1,005	53 (10.6%)	24 (4.8%)	***p* = 0.005**
			Low life satisfaction	Item Satisfaction With Life Scale[21], ≤4 (0–10)	1,022	32 (6.3%)	24 (4.7%)	$p = 0.24$
			Low resilience	RS-11[18], lowest two thirds	993	356 (71.8%)	333 (67%)	***p* = 0.10**
Zebhauser et al. (50)	KORA	346	Living alone and loneliness	Item living alone (dichotom); UCLA- Loneliness-Scale-12[22], ≥21 (0–36)	346	76 (29.6%)	29 (32.6%)	$p = 0.59$
Beutel et al. (51)	GHS	14,661	Severe loneliness	Item frequency alone, =4 (0–4)	14,413	165 (2.3%)	83 (1.2%)	***p* < 0.001**
Goltz et al. (52)	SHIP	3,926	Depression and obesity	PHQ-9[8], ≥10 (0–27); WHR[23], > 0.85 females; > 1.0 males	3,926	77 (3.8%)	25 (1.3%)	***p* < 0.010**
Rose et al. (53)	GHS	7,930	Fatigue	PBS[24], ≥50 (0–100)	7,948	1,266 (35.8%)	918 (20.9%)	***p* < 0.001**
Atasoy et al. (54)	KORA	9,340	Depressed mood	DEEX[17], ≥12 women; ≥10 men (0–24)	9,340	1,702 (37.6%)	1,814 (37.7%)	$p = 0.96$
Beutel et al. (55)	GHS	12,061	New onset of depression	PHQ-9[8], ≥10 (0–27)	10,036	232 (5%)	205 (3.8%)	***p* = 0.003**
König et al. (56)	SHIP	2,265	Lifetime MDD[4]	M-CIDI[10]	2,265	267 (22.5%)	119 (11%)	***p* < 0.001**

(Continued)

TABLE 1 | Continued

References	Study	*N*	Mental health construct	Measurement scale, cut-off value (range)	Total	Women[1]	Men[1]	*p*-value[2]
Beutel et al. (57)	GHS	7,974	Somatic symptom load	PHQ-12[25], ≥4 (0–24)	7,974	1,121 (28.8%)	1,073 (16.1%)	***p* < 0.001**
Schlax et al. (58)	GHS	12,484	Depressive symptoms	PHQ-2[8], ≥2 (0–6)	12,484	1,598 (26.4%)	1,281 (19.9%)	***p* < 0.001**

[1]*Number and percentage or mean and standard deviation.*
[2]*Bold printed values significant.*
[3]*Post-traumatic stress disorder.*
[4]*Major depressive disorder.*
[5]*Depression, panic, social anxiety or generalized anxiety.*
[6]*Composite International Diagnostic Screener (CID-S): 12 yes/no questions addressing different diagnostic domains.*
[7]*PTSD module of the Structured Clinical Interview for DSM-IV (SCID) measures experience of traumatic event and PTSD symptoms, including criterion A2 (experiencing high distress during/after event), criterion B (five re-experiencing symptoms), criterion C (seven avoidance symptoms), and criterion D (five arousal symptoms).*
[7a]*Experiencing more than one traumatic event varying from combat or war zone experience to rape or abuse and illness.*
[7b]*Experiencing one re-experience (0–5), three avoidance (0–7) and two hyperarousal (0–5) symptoms.*
[7c]*Experiencing one re-experience (0–5) [no avoidance (0–7) or hyperarousal (0–5)] symptoms.*
[8]*Patient Health Questionnaire 2 or 9 (PHQ-2 or PHQ-9) screens, diagnoses, monitors and measures severity of depression with two or nine items (4-point-Likert rating scale, 0–3).*
[9]*Beck Depression Inventory-II (BDI-II) measures presence and severity of depressive symptoms with 21 items (4-point-Likert rating scale, 0–3).*
[10]*Munich-Composite International Diagnostic Interview (M-CIDI) assesses psychiatric disorders over the lifespan according to DSM-IV criteria.*
[11]*Brief Cambridge Depersonalization Scale (CDS-2) measures frequency and duration of depersonalization symptoms with two items (4-point-Likert rating scale, 0–3).*
[12]*Brief PHQ Panic Module screens panic disorders with four dichotomous items.*
[13]*Mini-Social Phobia Inventory (Mini-Spin) detects social anxiety with three items (5-point-Likert rating scale, 0–4).*
[14]*Generalized Anxiety Disorder 2 or 7 (GAD-2 or GAD-7) screens for anxiety disorders with 2 or 7 items (4-point-Likert rating scale, 0–3).*
[15]*Type D scale (DS14) comprises two reliable subscales with seven items each for negative affectivity and social inhibition (5-point-Likert rating scale, 0–4).*
[16]*Adapted version of Uppsala Sleep Inventory (USI) measures initiating and maintaining sleep with two items (3-point-Likert rating scale, 1–3).*
[17]*DEpression and EXhaustion subscale (DEEX scale) measures presence and severity of depression and anxiety with eight items (4-point-Likert rating scale, 0–3). Sex-specific cut-off points were applied (≥12 for women, and ≥10 for men).*
[18]*Resilience scale 11 (RS-11) with 11 items (7-point-Likert scale, 1–7); highest one third indicates resilience, lowest two thirds indicates low resilience (thirds based on data).*
[19]*Post-traumatic Diagnostic Scale (PDS) and impact of event scale (IES) indicate, respectively experience of a traumatic event (criteria A, 11 events) and symptoms of PTSD (criteria B, C, and D; re-experiencing, avoidance and arousal). Exposure to one traumatic event and 1 re-experience, one avoidance and 1 hyperarousal symptom indicate full PTSD.*
[20]*Geriatric Depression Scale-15 measures depression among elderly with 15 dichotomous items.*
[21]*Satisfaction With Life Scale: one item measuring satisfaction with life on a 0–10 rating scale.*
[22]*UCLA loneliness scale-12 measures loneliness with 12 items with a 4-point-Likert rating scale (0–3).*
[23]*Waist-to-hip ratio (WHR) is calculated by dividing the waist circumference through the hip circumference and therefore can adapt divergent values.*
[24]*Personal Burnout Scale (PBS) measures physical and mental exhaustion with six items with a 5-point-Likert rating scale (1–5). Data were transformed to a metric scale (1 = 0; 2 = 25; 3 = 50; 4 = 75; 5 = 100).*
[25]*Patient Health Questionnaire 12 (PHQ-12) contains the somatic symptom module of the Patient Health Questionnaire-15 (PHQ-15): 12 items with a three-point-Likert rating scale (0–2).*

Women reported more somatic complaints compared to men (32, 57). This varied from 17.5% (SHIP) to 28.8% (GHS) for women and from 14.5% (SHIP) to 16.1% (GHS) for men. Sleeping problems (47) and fatigue (53) were more often reported by women. In addition, the combination of sleep disturbances and depressed mood was more frequent among women (43). Men reported more traumatic life events than women (33), whereas women developed more often (lifetime) post-traumatic stress disorder (PTSD) after experiencing such an event (33, 34, 45). In women, PTSD ranged from 2.1% (KORA) to 5.2% (SHIP). In men, PTSD ranged from 1.3% (KORA and SHIP) to 2.9% (SHIP). Loneliness was also more frequently prevalent in women than in men (51). For women in the age groups 35–44 years and 55–64 years, living alone was strongly associated with loneliness (51). For elderly who lived alone, no difference was found for loneliness between women and men (50). Other indicators of mental health, such as presence of Type D disorder (40) and depersonalization-derealization (37) did also not differ between women and men. For elderly, no difference between women and men was found regarding resilience (44, 49) and life satisfaction (49).

Factors Associated With Mental Health

A broad range of factors was associated with mental health. We categorized the results in five categories: (1) social and gender-related factors, (2) lifestyle, (3) interplay of physical and mental health, (4) body mass index (BMI) and diabetes and (5) genetic and biological factors. An overview of the results can be found in **Table 2**. The main findings are described below.

Social and Gender-Related Factors

The three cohorts have been drawn as local representative samples of the general population, stratified for sex, age, and urban-rural residence. In all cohorts, women had a lower income than men. Furthermore, men were more often married or living with a partner, whereas more elderly women were living alone. In addition, life expectancy differed between the regions; life expectancy was highest in the middle of Germany and lowest in the northeast of Germany. The demographic and socioeconomic differences between the cohorts influenced associations with mental health.

Social support and social isolation were often associated with mental health. Lack of social support was a strong predictor for

TABLE 2 | Explanatory factors mental health for women and men from the three cohorts.

References	Design[a]	*N*	Wave[b]	Main results[e]
Grabe et al. (59)	CS	976	SHIP-0 (non-random)	◦ Low social support associated with high mental and physical distress (f). ◦ Chronic diseases associated with high mental and physical distress (f, m). ◦ *S/s*-genotype and *s/l*-genotype on serotonin transporter gene (*5-HT*) and unemployment related to higher mental and physical distress compared to l/l genotype (f). ◦ *S/s*-genotype and *s/l*-genotype on the *5-HT* and chronic diseases related to higher mental and physical distress compared to *l/l* genotype (f).
von Lengerke et al. (60)	CS	947	KORA-Survey-2000	◦ No differences between f and m in associations between different weight groups and mental health-related quality of life (HRQL).
Grabe et al. (61)	CS	1,059	SHIP-0 (subjects aged $\geq$ 60)	◦ More years in school, respectively 12 (f) or 10 (f, m) related to better mental status for older people. ◦ For older people, higher income, respectively in the 3rd quintile (m) or in the 4th and 5th quintile (f, m) related to better mental status. ◦ Five or more children associated with worse mental status (older f, m). ◦ A smaller number of teeth negatively associated with mental status (older f).
Lucht et al. (62)	CS	406	SHIP-I	◦ Oxytocin receptor gene (*OXTR*) *rs53576 A/A* associated with less positive affect (m).
Wiczinski et al. (63)	CS	2,732	KORA F3	◦ Normal weight more often present in younger and higher educated people (f, m). ◦ Not living with partner related to a higher Body Mass Index (BMI) (m). ◦ Statutory health insurance associated with a higher BMI (f). ◦ Higher BMI (direction obese) associated with lower physical HRQL (f, m). ◦ Interaction between social support and BMI on physical HRQL (m). ◦ No association between BMI and mental HRQL (f, m).
Grabe et al. (64)	CS	1,638	SHIP-LEGEND[c]	◦ No interaction effect of emotional neglect and Corticotropin-releasing hormone receptor (*CRHR1*) gene on depression (f, m). ◦ No interaction effect of abuse and *CRHR1* gene on depression (f, m). ◦ For male interaction effect of physical neglect and *CRHR1* gene on depression.
Ladwig et al. (65)	CS	3,079	KORA F3	◦ Low net income, physical inactivity, high level of somatic complaints and pulmonary disease symptoms associated with suicidal ideation (SID) (f, m). ◦ Unemployment, living alone, cigarette smoking, medium level of somatic complaints, myocardial infarction associated with SID (m).
Ladwig et al. (66)	CS	11,895	MONICA S1 MONICA S2 MONICA S3	◦ High cholesterol, obesity, hypertension, low alcohol consumption and diabetes mellitus related to excessive symptom reporting (ESR) (f, m). ◦ No partner (f), lower educational level and higher unemployment (f, m) associated with ESR. ◦ Diseases (metabolic syndrome, circulatory diseases, bronchial diseases, cancer and other diseases) related to ESR (f, m). ◦ Regular sleep disturbances, not a good health perception and psychological symptoms related to ESR (f, m).
Grabe et al. (67)	CS	4,308	SHIP-0	◦ Confirmation of findings of the original paper of Grabe et al. (59) with an updated sample.
Häfner et al. (68)	CS	1,547	MONICA S1 MONICA S2 MONICA S3	◦ Depression associated with social isolation (f), physical inactivity (m) and lower BMI (m). ◦ Inflammatory marker high-sensitivity C-reactive protein (*hs-CRP*) not associated with depression or social isolation. ◦ *Hs-CRP* levels higher for people with depression and social isolation (m). ◦ Inflammatory marker interleukin-6 (IL-6) associated with social isolation (m). ◦ IL-6 levels higher for people with depression and social isolation (m).
Häfner et al. (69)	CS	1,229	MONICA S1 MONICA S2 MONICA S3	◦ Higher C-reactive protein (*CRP*) levels associated with social isolation and (no) depression (m). ◦ Higher leptin levels associated with social isolation/integration and depression (m). ◦ Smoking (m) and no partner (f) associated with social isolation (regardless of having depression). ◦ No partner (m) and higher age (f) associated with social isolation without depression. ◦ Sleeping disorder, high somatic complaints and negative self-perceived health associated with depression (regardless social isolation or integration) (f, m). ◦ Physically inactivity related to social isolation (regardless of having depression) (f, m) and to social integration and having depression (m).
Schunk et al. (70)	CS	9,579	KORA S4 SHIP-0	◦ Type 2 diabetes related to lower score on mental HRQL (f). ◦ No differences in associations between no Type 2 diabetes and mental HRQL (f, m).
Grabe et al. (41)	CS	2,035	SHIP-LEGEND[c]	◦ A three way interaction between (1) *brain-derived neurotrophic factor (BDNF) Met allele*, (2) *biallelic/triallelic 5-HTTLPR ss-allele* and (3) non/mild childhood abuse influenced depression (f).
Häfner et al. (43)	CS	1,369	MONICA S1 MONICA S2 MONICA S3	◦ No associations between leptin levels and depressed mood or sleep disturbances (f, m). ◦ Associations between leptin levels and an interaction between depressed mood and sleep disturbances (f). ◦ Higher leptin levels related to depressed mood and sleep disturbances in normal weight people (f). ◦ For people with obesity and elevated leptin levels no associations between higher leptin levels and depressed mood and sleep disturbances (f).

(Continued)

TABLE 2 | Continued

References	Design[a]	*N*	Wave[b]	Main results[e]
Lukaschek et al. (71)	CS	3,080	KORA S4	◦ Combat or war zone (f, m), non-sexual assaults by known assailants (f, m), experience of interpersonal conflict (m), sexual assaults by known assailant (m) and life threatening diseases (f) important factors for development of full Post-Traumatic Stress Disorder (PTSD). ◦ For men experience of interpersonal conflict (f, m), life threatening illness (f, m), having a serious accident (m) and sexual or non-sexual assaults by known assailants (f) important factors for development of partial PTSD.
Schomerus et al. (72)	CS	395	SHIP-0 SHIP-I SHIP-LEGEND[c]	◦ No differences between f and m in the association between childhood abuse, personality traits and resilience and help-seeking for depression.
Wiltink et al. (73)	CS	5,000	GHS BL	◦ Obesity measure waist-to-hip ratio (WHR) positively related with depression and somatic-affective symptoms (m). ◦ Obesity measures BMI and waist-to-height ratio (WHtR) negatively related to cognitive-affective symptoms (f). ◦ Obesity measure waist circumference (WC) negatively associated with cognitive-affective symptoms (m).
Emeny et al. (74)	CS	985	KORA-AGE[d]	◦ Higher levels of insulin-like growth factor binding protein-3 (IGFBP-3) associated with higher well-being (elderly f). ◦ Higher insulin-like-growth factor 1 (IGF-I) levels associated with more depression (elderly f). ◦ No relation between IGFBP-3 and depression (elderly f, m). ◦ Active elderly f with the highest IGF-I and IGFBP-3 levels higher well-being than inactive elderly f with similar IGF-I levels and IGFBP-3 levels.
Hunger et al. (75)	CS & LS	1,046	KORA S4 KORA F4	◦ People of 55 years and older with prediabetes at baseline and diabetes at follow-up scored lower on mental HRQL than people with persistent prediabetes (m). ◦ People of 55 years and older with normal glucose tolerance (NGT) at baseline and prediabetes at follow-up scored lower on mental HRQL than people with NGT at follow-up (f).
Klug et al. (76)	CS	969	KORA-AGE[d]	◦ For elderly people higher attachment (m) and lower loneliness (f, m) scores related to not having late life depression.
Laxy et al. (77)	LS	3,080	KORA S4 KORA F4	◦ Heavy weight gain associated with impairments in physical health (f, obese m) and improvements in mental health (f).
Sievers et al. (78)	CS & LS	4,079 (CS) 3,141 (LS)	SHIP-0 SHIP-I	◦ Low IGF-I levels (f) and high IGF-I levels (m) predict incidence of depressive disorders.
Zebhauser et al. (49)	CS	1,022	KORA-AGE[d]	◦ People older than 85 years experience more loneliness than people between 64 and 84 years (f, m). ◦ Elderly women (>85) experience more loneliness than elderly men. ◦ For older people associations between a small social network and loneliness (f, m). ◦ Older age related physical limitations mostly not associated with loneliness (f, m). ◦ Inactivity related to loneliness (elderly f). ◦ Depression and anxiety associated with loneliness (elderly f, m). ◦ More life satisfaction and stronger resilience associated with not being lonely (elderly f, m).
Baumeister et al. (79)	LS	4,228 (SHIP-0) 4,251 (SHIP-T)	SHIP-0 SHIP-Trend	◦ Relative increase of depressive symptoms between 1997–2001 and 2008–2012 stronger for men than for women. ◦ Strongest change of depressive symptoms between 1997–2001 and 2008–2012 in age group 50–64 years (f, m); smallest change in age group 20–34 years (f, m). ◦ No difference in prevalence of depressive symptoms between 2008–2012 and 1997–2001 (f, m).
Johar et al. (80)	CS	733	KORA-AGE[d]	◦ Lower morning to evening cortisol ratio associated with cognitive impairment (elderly m). ◦ Late evening cortisol measures and cortisol awakening response (CAR) not associated with cognitive impairment (elderly f, m).
Schunk et al. (81)	CS	846	KORA S4 SHIP-0	◦ Using oral diabetic medication, insulin diabetic medication or oral and insulin diabetic medication associated with lower mental HRQL (f).
Lukaschek et al. (82)	CS	3602	KORA-AGE[d]	◦ For elderly low income, anxiety, depression, sleeping problems, physical inactivity and multi-morbidity associated with low subjective well-being (f, m). ◦ Living alone associated with low subjective well-being (elderly f).
Rabel et al. (83)	CS & LS	3,080	KORA S4 KORA F4 KORA FF4	◦ Women with a higher BMI later in life less physical HRQL than men. ◦ Women with no or low physical activity later in life less mental HRQL than men.
Beutel et al. (55)	LS	12,061	GHS BL GHS FU 2	◦ Cancer, loneliness, social phobia and generalized anxiety risk factors for new onset of depression (f). ◦ Smoking and life events risk factors for new onset of depression (m). ◦ Social support associated with less new onset of depression (f, m).

(Continued)

TABLE 2 | Continued

References	Design[a]	*N*	Wave[b]	Main results[e]
Beutel et al. (57)	CS	7,974	GHS FU 2	○ Lack of social support, adverse life events, depression, generalized anxiety, panic and social phobia strongest predictors for somatic symptoms (f, m). ○ Loneliness predictor for somatic symptoms (f).

[a] *CS, cross-sectional study; LS, longitudinal study.*
[b] *SHIP-0 = 1997–2001, SHIP-I = 2002–2006, SHIP-LEGEND = 2007–2010, SHIP-Trend = 2008–2012, KORA S4 (1999–2001), KORA F3 = 2004–2005, KORA F4 (2006–2008), KORA FF4 (2013–2014), MONICA S1 = 1984–1985, MONICA S2 = 1989–1990, MONICA S3 = 1994–1995, GHS BL = 2007–2012, GHS FU 1 = 2009–2014, GHS FU 2 = 2012–2017.*
[c] *SHIP-LEGEND is an add on study, based on the SHIP-0 cohort.*
[d] *KORA-AGE includes MONICAS1, MONICAS2, MONICAS3 and KORA S4. Participants aged 65 years or older at the end of 2008 were selected.*
[e] *f, female; m, male.*

somatic symptoms for both women and men (57). For older women and men, a smaller social network was associated with loneliness (49). For women, low social support was associated with higher mental and physical distress (59) and women without a partner reported more excessively somatic symptoms (66) and were more often socially isolated (69). The presence of social support turned out to be a protective factor against new onset of depression for both women and men (55). For men, not having a partner was associated with social isolation (69) and living alone was linked to suicidal ideation (65). Additionally, elderly women living alone reported lower subjective well-being (82). Depressed women were more likely to be socially isolated (68), and older women were also more often socially isolated, regardless of suffering from a depression (69). For women as well as men, adverse life events were strong predictors for somatic symptoms (57). For men, negative life events were a risk factor for new onset of depression (55) and associated with the development of PTSD (55). Experience of combat or war zone and non-sexual assaults by known assailants were risk factors for developing full PTSD (71) for women and men. For help seeking when suffering from depression, no differences were found between women and men (72).

With regard to gender-related factors, findings for women and men were similar. Social economic status predicted somatic symptoms for women and men (57). Low income had a negative effect on well-being (82) and was associated with suicidal ideation (65). Having five or more children was associated with a worse mental health status (61) and low educational level and unemployment were related to excessive symptom reporting (66). A difference was found in the association between unemployment and suicidal ideation, which was only present for men (65). No effects were found for social economic status on new onset of depression (55), educational level on well-being (82) and unemployment on somatic symptoms (57). Furthermore, no association between net income and status as homemaker were found (65). In general, educational attainment, income and employment did not have an effect on the increase of depressive symptoms over the last years (79).

Lifestyle

Smoking and physical inactivity are known factors to negatively influence physical and mental health. Smoking was a risk factor for new onset of depression, but only in men (55). Besides, smoking was associated with suicidal ideation (65) and with social isolation (69) for men. For physical activity, effects for women and men were found. For both women and men being physically inactive was related to social isolation and for men also to social integration and suffering from depression (69). Another study confirmed that depressed men were more likely to be physically inactive than women (68). For both women and men associations between physical inactivity and suicidal ideation were found (65). Women who were moderately active had a lower mental health-related quality of life (HRQL) score than men who were moderately active (83). For older women physical inactivity was associated with loneliness (49), whereas the association between physical inactivity and low subjective well-being was found for both elderly women and elderly men (82). Low alcohol consumption was associated with excessive symptom reporting for both women and men (66).

Interplay of Physical and Mental Health

The interplay between physical and mental health has been examined in many studies included in the current review. For both women and men chronic diseases were associated with worse mental and physical well-being (59). For women the experience of a life threatening disease was associated with the development of full and partial PTSD, for men it was only associated with partial PTSD (71). For women cancer, social phobia, generalized anxiety and loneliness were risk factors for new onset of depression (55). Sleeping disorder, somatic complaints and negative self-perceived health were associated with depression for women as well as for men (69). For elderly women and men absence of loneliness was a protective factor for depression later in life (76), for elderly men, stronger attachment was an additional a protective factor. Depression, generalized anxiety, panic and social phobia predicted somatic symptoms for women and men (57), for women somatic symptoms were also predicted by loneliness. Increased reporting of somatic symptoms was predicted by diseases in general (metabolic syndrome, circulatory diseases, bronchial diseases, cancer and other diseases) for both women and men (66) and associated with sleep disturbances, worse health perception and presence of psychological symptoms. High levels of somatic complains and pulmonary disease symptoms were associated with suicidal ideation for women and men (65), for men medium level of somatic complaints, myocardial infarction and stroke were additionally associated with suicidal ideation. For women as well

as for men, depressive symptoms were associated with suicidal ideation (65).

Body Mass Index (BMI) and Diabetes

Obesity and diabetes are significant health threats in an aging population. When comparing women and men in the association between BMI and HRQL (physical and mental), women with a higher BMI reported lower physical HRQL later in life than men with a higher BMI (83). Another study found an association between high BMI and less physical HRQL for both women and men (63), but in men with strong social support, this association vanished. No association was found between BMI and mental HRQL for either women or men (63) and no differences were found between women and men (60, 83). Women with type 2 diabetes scored lower on mental HRQL compared to men with Type 2 diabetes (70), regardless of type of diabetic medication (81). Changes in the diabetes trajectory also influenced mental HRQL. Men of 55 years and older with prediabetes at baseline and diabetes at follow-up scored lower on mental HRQL than men with persistent prediabetes (75). Women with normal glucose tolerance at baseline and prediabetes at follow-up scored lower on mental HRQL compared to women who still had normal glucose tolerance at follow-up (75). For women and overweight men weight gain was associated with impaired physical health (77). For women, weight gain was associated with improvements in mental health (77). Men with lower BMI more often suffered from a depression (68) and lower BMI was associated with social isolation (69). In addition, diabetes mellitus and obesity were related to excessive somatic symptom reporting (66). Furthermore, using different indicators for obesity [e.g., waist-to-hip ratio (WHR) or BMI] led to different findings (73).

Genetic and Biological Factors

Genetic and biological factors may affect mental health status and the development of mental health disorders. For mental and physical distress, the *s/s*-genotype and the *s/l*-genotype on the serotonin transporter gene in combination with unemployment or chronic diseases was related to higher mental and physical distress for women (59, 67). Elderly women reported better well-being when higher levels of insulin-like growth factor binding protein-3 (IGFBP-3) were present. A discrepancy between women and men was found for insulin-like-growth factor 1 (IGF-I). For women, low IGF-I levels predicted the incidence of depressive disorders 5-years later, whereas for men high levels of IGF-I predicted future depression (78). In another study an association between IGF-I levels and current depression was found for elderly women, but contrary to the previous results; higher IGF-I levels were associated with more depression (74). Furthermore, for women lower cholesterol levels were associated with suffering from depression (69). Higher cholesterol levels were associated with increased symptom reporting of somatic symptoms and with hypertension for women and men (66). For men higher C-reactive protein (CRP) levels were associated with social isolation and the presence of depression (69). The inflammatory marker high-sensitivity C-reactive protein (hs-CRP) was not associated directly with either depression or social isolation, but for men with a depressed mood hs-CRP levels were higher compared to men without depressed mood and without being socially isolated (68). No associations between leptin levels and depressed mood or sleep disturbances were found for either women or men (43). However, in normal weight women, leptin levels were higher for women suffering from both depressed mood and sleep disturbances. Associations between cortisol levels and cognitive functioning depend on time of day measurement of cortisol levels (80). Associations between cortisol levels and loneliness were found in married elderly men, but not in married elderly women (84). A study focussing on the oxytocin receptor gene rs53576 A/A found an association between oxytocin receptor gene and less positive affect (strong excitement/emotion) for men (62). A three way interaction between *brain-derived neurotrophic factor: Met allele*, *biallelic 5-HTTLPR: ss-allele* and no/mild childhood abuse was found to influence depression for women (41). For men an interaction effect of physical neglect with Corticotropin-releasing hormone receptor 1 gene on depression was found (64).

DISCUSSION

In this systematic review, we compared prevalences and determinants of mental health indicators from three large, ongoing German cohorts. The benefits of combining three different cohorts are multiple. First, the cohorts represent the general population in three regions, namely KORA in the south, SHIP in the northeast and GHS in the middle of Germany. In these three regions, the composition of populations differs with respect to socioeconomic and regional characteristics. Therefore, the articles complement each other and the conclusions based on concurrent evidence are stronger. Secondly, the stratified random sample selection in all cohorts provides representative groups for the general adult population in the respective areas of Germany. The proportions of women and men in the cohorts are equal and broad ranges of age are covered. Repeated follow-ups provide the opportunity to study participants longitudinally and determine life-span developments. A third advantage of are the overlapping psychological, medical and laboratory assessments. Lastly, the overall number of participants from the three cohorts together is more than 40 000 (28).

Mental health plays a major role in the concurrent German cohort studies and sex differences are increasingly taken into account in analyses. This is underlined by the differences of prevalence rates of mental distress between women and men. In all cohorts, women reported worse mental health than men (38, 39, 85). Particularly, depression, depressed mood or symptoms were more often present in women (32, 36, 41, 42, 46, 52, 54, 56, 58). Additionally, as reported in one or two of the three cohorts, new onset of depression (55), anxiety (32), traumatic events and PTSD (33, 34, 45), suicidal ideation (35), sleeping problems and fatigue (47, 53), somatic complaints (32, 57) and loneliness (51) were more often reported by women, whereas the risk of committing suicide was stronger in men (48). A recent paper using SHIP data confirmed that women were more often affected by depressive, anxiety, obsessive-compulsive disorder, PTSD, somatoform and eating disorders (12-month and lifetime),

whereas men indicated substance use more often (86). These results indicate similarities between cohorts and thus regions in sex-specific prevalence rates of mental health. Furthermore, these findings are consistent with current literature on prevalence rates of mental health in several countries. A meta-analysis on depression including 90 studies from 30 countries reported consistently higher prevalence rates of depression in women compared to men (87). In a review on social anxiety disorder including 14 studies from different countries, women were more often suffering from anxiety and reported elevated severity compared to men (88). A systematic review on suicidal behavior and suicide in Europe and America reported that men commit suicide more frequently, whereas women have more attempts and suicidal behavior (89). Furthermore women reported more often lifetime PTSD (90), somatoform diseases (91) fatigue (92, 93) and loneliness (94, 95). The higher prevalence of loneliness is especially present in older women and consistent across several European countries (96).

With regard to risk and protective factors for mental health, differences and similarities were found between women and men. For women loneliness, social isolation and low social support were risk factors for depression or mental distress (55, 59, 68, 69, 76). This finding was consistent in the three cohorts Further, for women, cancer, social phobia, generalized anxiety (55), sleeping disorders and negative self-perceived health (69) were associated with (new onset of) depression. For men myocardial infarction and stroke were associated with suicidal ideation (65). As men experience cardiovascular events at younger age (97), their consequences may lead to a high burden in daily life which can contribute to an increase of suicidal ideation. Additionally, for men, physical inactivity was associated with depression (68, 69) and smoking with new onset of depression (55), suicidal ideation (65) and social isolation (69). With regard to biological factors, for women, lower cholesterol levels were associated with depression (69) and higher leptin levels with depressed mood (43). For men, higher interleukin-6 levels and higher hs-CRP levels were associated with depression and social isolation (68), higher leptin levels predicted depression and social isolation (69). For other mental health outcomes, no differences were found between women and men. Chronic and life threatening diseases were associated with more mental and physical distress for women as well as for men in all three cohorts (59, 66, 67). Further, for both women and men associations were found between somatic complaints and depression (69) and suicidal ideation (65), life threatening disease and partial PTSD (71) and pulmonary disease and suicidal ideation (65). Additionally, depression, generalized anxiety, panic and social phobia were predictors of somatic symptoms for both sexes (57). Lastly, no differences between sexes were found in the association of BMI with mental HRQL (60, 63, 83).

Not all mental health aspects and possible risk and protective factors were examined in all cohorts, this makes it more complicated to draw conclusions about regional similarities and differences. The most consistent and detailed findings were found for depression. In all cohorts depression, depressed mood or symptoms of depression were more often present in women compared to men (32, 36, 41, 42, 46, 52, 54, 56, 58). This gender gap is known to become manifest already in early adolescence and declines in early adulthood, remaining stable afterwards (98). When controlling for demographic and socioeconomic background this gender gap persisted (99). However, many studies question whether men actually experience less depression or if depression among men just remains frequently undetected. In a study on men's attitude regarding depression, normative expectations regarding masculinity equated suffering from depression to a weakness (100). Conforming to such traditional masculine norms is problematic for help-seeking for depression (101). This may also contribute to the higher suicide rate in men. Men are less likely to seek treatment for depression and when they seek treatment, they are less likely to be diagnosed with major depressive disorder (97). This is in part due to different symptoms of depression in women and men. When examining depressed patients, men reported more anger attacks compared to women and scored higher on irritability and overreaction (102). When testing the Gotland Scale for Male Depression (103), irritability appeared to be the best indicator of male depression (104). Studies have also strong associations between alcohol abuse, depression and suicidal behavior interacting with biological factors in men (105) and alcohol consumption as a coping strategy for depression in men (106). Thus, depression in men is often masked by atypical symptoms, such as externalizing depression symptoms. For men, external risk factors for depression were also found in this review [e.g., smoking (55) and physical inactivity (44)], whereas the risk profile for women contained more internal factors [e.g., loneliness (55) and social isolation (68)].

Since gender was not measured directly in the studies reviewed, socioeconomic and family-related factors were examined as gender-related factors. In general, women were more often housewives (41), in maternity leave (41), or unemployed (59) compared to men. On average, men had a higher income and education (41) compared to women. Differences between women and men with regard to gender indicators and mental health were found for unemployment and suicidal ideation (65, 69). For men unemployment was positively associated with suicidal ideation. Other associations between gender indicators and mental health were found for both women and men. Income was negatively associated with suicidal ideation (65), positively with mental health status (61) and for elderly positively with subjective well-being (82). Education was negatively associated with excessive symptom reporting (66) and positively with mental health status (61). Lower social economic status predicted somatic symptoms (57) and having five or more children was associated with a worse mental health status (61). Lastly, unemployment was positively associated with excessive symptom reporting (66). Unfortunately, none of the articles examined a moderation or mediation effect of gender-related factors in the relation between sex and mental health. Therefore, it is not possible to determine the contributions of sex and gender. In general interactions between sex and socioeconomic position are understudied (19). A study in Brazil testing mediating effects of socioeconomic factors in the association between sex and mental health revealed that personal income and schooling at the age of 30 mediates the

association between sex and depression, anxiety and common mental disorders (107), but not family income or maternal schooling. Testing socioeconomic and family-related factors in associations between sex and mental health in longitudinal studies could contribute notably to the understanding of gender aspects in mental health.

Only very recently, the binary assessment of sex has been supplemented by the third category, diverse sex. Therefore, this paper does not discuss gender diversity, although it is known that the mental health of the German LHBTI community (lesbian, gay, bisexual, transgender and intersex individuals) should be further examined (11). Mental health of the LHBTI community has been expected to differ from the overall population [e.g., depression and suicidal behavior (108, 109)] due to the heteronormative orientation of society (110, 111)". Increasing social acceptance could lead to more possibilities to express one's gender identity and sexual orientation which could improve the health status of sexual minorities (11). A further limitation in this study is that mental health was measured by self-report questionnaires. Since the measurements tools used are reliable and valid, it will still be a good indication of reality. Different questionnaires were used to assess the same mental health construct. In order to overcome this last limitation, the GESA project, integrating data from these three cohorts to examine mental health, harmonizes data (28). Studying interactions between socioeconomic and vocational factors with sex (e.g., full employment of women in SHIP vs. the role of housewife in KORA and GHS) will help to identify differential impact of socioeconomic inequality.

Overall, this systematic review shows the differences and similarities in prevalence rates and determinants of mental health indicators between women and men, from genetic and biological factors to indicators of the social environment. While our picture is far from complete, gender gaps regarding income, education, or living in a relationship underline the need to differentiate mental health outcomes according to sex-related determinants of mental health. Differing risk and protective factors for mental health require a sex sensitive prevention approach. However, this review shows that current research on mental health still lacks a clear focus on gender roles and identities, which have recently been included in the Gutenberg Health Study. Future research should therefore illuminate sex differences and broader sex and gender diversity (112). Therefore, an increased focus on sex and gender in mental health research is of great importance.

AUTHOR CONTRIBUTIONS

This review was written as part of the GESA Project. All authors contributed to the development and refinement of the GESA consort. MB, EB, HB, HG, JK, K-HL, GS, and PW were grant holders. The idea for this paper came from DO and MB. DO performed the literature search, selection of paper and drafted, together with MB, the first version of the review, which was substantially revised by GS, AT, and EB. Improvements of HB, JK, K-HL, PW, and HG lead to the current version of this review.

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Risk and Protective Factors of Generalized Anxiety Disorder of Elite Collegiate Athletes: A Cross-Sectional Study

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The aim of this study was to examine the prevalence of Generalized Anxiety Disorder (GAD) and its risk and protective factors in elite collegiate athletes. A cross-sectional survey was conducted during the 2019 in-season. A sample of elite collegiate athletes (n = 285) from China completed a self-report form assessing GAD and potential predictors including age, gender, sport type, sport achievement, sport injury, attention deficit hyperactivity disorder (ADHD), fear of failure, mental toughness, and satisfaction in sport. The overall prevalence of GAD symptoms was 22%. The results of zero-order correlation showed that age, gender, sport type, and sport achievement were not significantly related to GAD. However, athletes with a history of sport injury, a high risk of ADHD, and a high level of fear of failure had a significant and positive association with GAD (r = 0.14–0.54). Meanwhile, high levels of mental toughness and satisfaction in sport were significantly and negatively related to GAD (r = −0.22 to −0.24). The results of multiple regression analysis indicated that sport injury, ADHD, and fear of failure were significant risk factors of GAD (β = 0.10–0.40). These findings suggest the necessity to understand the GAD symptoms in elite collegiate athletes. Further research is needed to better understand and support the mental health of this target group.

Keywords: sport, mental disorder, predictor, university, observational study

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INTRODUCTION

The sport community has paid increased attention to the mental health of elite athletes (1). Elite athletes refer to those who compete at the collegiate, Olympic, or professional levels (2). While sports participation can bring lots of benefits to elite athletes, they usually need to cope with both sport-specific and non-sport-specific demands (e.g., education, performance expectation, and sport injuries), which can pose potential threats to their mental health (3, 4). According to a recent meta-analysis (5), the prevalence of mental disorders and symptoms in elite athletes ranged from 19% for alcohol misuse to 34% for anxiety/depression.

Anxiety disorders refer to a group of disorders manifesting as excessive fear, tension, and worry (6). These disorders include different subtypes, such as agoraphobia, Generalized Anxiety Disorder (GAD), and social anxiety disorder. Anxiety disorders have been found to deteriorate sport performance (7), suggesting the need to understand their risk and protective factors.

Several factors may result in the development of anxiety disorders in elite athletes. For example, female and younger athletes tended to have a higher level of GAD than male and older athletes (8). Other potential risk factors for anxiety disorders in elite athletes include career dissatisfaction, sport injury, and adverse life events (2, 9, 10). However, little is known about other predicting factors of anxiety disorders, such as sport type, sport achievement, attention deficit hyperactivity disorder (ADHD), mental toughness (the ability to deal with adversity), and fear of failure (a tendency to avoid associated shame after one fails). For example, sport type, ADHD, and fear of failure have been identified as predictors of mental health problems other than anxiety disorders, such as burnout, depressive symptoms, and obsessive compulsive disorder (8, 11–13). Furthermore, only a few of these outlined factors have been examined within the same study. Thus, it is unclear which factor plays a more significant role in predicting anxiety disorders than the other.

The aim of this research was to examine the prevalence of GAD and its associated risk and protective factors (i.e., gender, age, sport type, sport achievement, sport injury, ADHD, mental toughness, fear of failure, and satisfaction in sport) in elite collegiate athletes. According to the above literature review, it was hypothesized that female, younger age (8), individual sport (11), ADHD (14), sport injury (2), and fear of failure (15) would be risk factors of GAD. In contrast, sport achievement (16), mental toughness (17), and satisfaction in sport (2) would be protective factors.

MATERIALS AND METHODS

Design

A cross-sectional survey design was used in the present study. Ethics approval for the study was obtained from the Human Research Ethics Committee of China University of Geosciences (Wuhan) on 19 September 2019.

Setting and Participants

Participants must meet the following inclusion criteria: (a) currently an active collegiate athlete, (b) based in a public university in China, (c) within the age range of 16–30 years, and (d) a grade 2 or above athlete (i.e., generally compete at provincial level or above). Athletes are classified into six levels based on their sport achievement under the Chinese sport system: international master sportsman, national master sportsman, grade 1, grade 2, grade 3, and no grade. Head coaches from four public universities located in Hubei and Zhejiang provinces were approached to invite eligible athletes to participate in this anonymous survey between September and December 2019 (i.e., in-season). A total of 337 athletes were invited, and 289 of them completed the paper-and-pencil-based survey (86%). Four athletes were excluded as they were grade 3 or non-grade athletes. Thus, the data of the remaining 285 athletes were used for analysis.

Measures

The outcome of the present research was GAD. Risk and protective factors included demographic variables (i.e., age, gender, sport type, and sport achievement), sport injury, ADHD, fear of failure, mental toughness, and satisfaction in sport.

GAD

The validated Chinese version of the GAD-7 scale was used to measure GAD symptoms (18). The 7-item scale was developed based on the criteria stated in the fifth version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5). A 4-point scale (0 = not at all, 3 = nearly every day) was used for rating the items (e.g., "Over the last 2 weeks, how often have you been bothered by feeling nervous, anxious, or on edge"). A total score $\geq$10 out of 21 was used as a diagnostic cutoff for GAD (18). The scale had excellent internal reliability with the current sample ($\alpha = 0.93$).

Demographic Questions

Demographic items were used to measure age, gender (male, female), sport type (individual sport, team sport), and sport achievement (international master sportsman, national master sportsman, grade 1, grade 2, grade 3, no grade).

Sport Injury

An item "Did you experience a sports-related injury last month" was employed to measure sport injury (0 = no, 1 = yes) (4). A sport injury refers to those injuries resulting in athletes to stop, limit, or modify sport training or competitions for at least 1 day (19).

ADHD

The validated Chinese version of the Adult ADHD Self-Report Scale was employed to assess ADHD symptoms (20). A sample item is "How often do you have problems remembering appointments or obligations." Participants rated the 6-item scale on a 5-point scale (0 = never, 4 = very often). A total score was calculated, with a higher total score indicates a greater risk of being diagnosed with ADHD. The internal reliability of the scale was supported in the present study ($\alpha = 0.83$).

Fear of Failure

The validated Chinese version of the Performance Failure Appraisal Inventory—Short Form was used to assess fear of failure in sport (21). Participants used a 5-point scale (1 = do not believe at all, 5 = believe 100% of the time) to provide responses to the five scale items (e.g., "When I am failing, I worry about what others think about me"). A higher mean scale score suggests a higher level of fear of failure. The scale had good internal reliability in the current study ($\alpha = 0.81$).

Mental Toughness

The validated Chinese version of the Mental Toughness Inventory was used to measure mental toughness (22). The scale consists of eight items (e.g., "I consistently overcome adversity").

Participants provided responses on the scale using a 7-point scale (1 = false, 100% of the time, 7 = true, 100% of the time). A higher mean scale score indicates a greater mental toughness level. The scale showed good internal reliability with the present sample ($\alpha = 0.89$).

Satisfaction in Sport

The validated Chinese version of the Satisfaction in Training and Competition was employed to measure satisfaction in sport (23). The scale has six items (e.g., "I am satisfied with my training and competition"). Participants answered the items using a 7-point scale (1 = strongly disagree, 7 = strongly agree). Higher scale scores represent greater levels of satisfaction in sport. The scale demonstrated good internal reliability with the current sample ($\alpha = 0.84$).

Statistical Analysis

Five item-level missing values were replaced with item means. Descriptive statistics were used to describe features of the study variables. The prevalence of GAD was calculated as the number of participants with GAD symptoms divided by the total number of respondents. Zero-order correlations were computed to determine the associations between predicting factors and GAD levels (total score). Factors that showed a significant association with GAD levels were used in subsequent multiple regression analyses. Assuming a medium and practically meaningful effect ($f^2 = 0.15$, $\alpha = 0.05$, power = 0.95, number of predictors = 8), a minimum sample size of 160 was needed for multiple regression analysis using G*Power 3 (24). Univariate/multivariate logistic regression analyses were not employed as there was inadequate statistical power for conducting these analyses with the current sample size. A statistical significance level was set at $p < 0.05$. All the analyses were conducted with IBM SPSS Statistics 25 (IBM, Armonk, NY, USA).

RESULTS

Participant Characteristics and Descriptive Statistics

Table 1 represents the participant characteristics. The participants had a mean age of 20.30 years (SD = 1.51). Most of the participants were male ($n = 206$, 72%) and involved in an individual sport ($n = 206$, 72%). About half of the participants were grade 2 athletes ($n = 132$, 46%). Over one-third of the participants sustained a sport injury over the last month ($n = 98$, 34%). The participants reported below average levels of ADHD and GAD as well as moderate to high levels of mental toughness, fear of failure, and satisfaction in sport (see **Table 1**). Nearly one quarter (22%; 95% CI: 17, 27) of the participants met the diagnostic cutoff of GAD.

TABLE 1 | Respondents' characteristics.

Variable	M (SD)/*n* (%)
Age (year)	20.30 (1.51)
Gender	
Male	206 (72%)
Female	79 (28%)
Sport type	
Team	79 (28%)
Individual	206 (72%)
Sport achievement	
National master sportsman	44 (15%)
Grade 1	109 (38%)
Grade 2	132 (46%)
Sport injury	
No	187 (66%)
Yes	98 (34%)
GAD	
No	223 (78%)
Yes	62 (22%)
ADHD (0–24)[a]	9.62 (4.74)
Fear of failure (1–5)[a]	2.66 (0.84)
Mental toughness (1–7)[a]	5.83 (0.78)
Satisfaction in sport (1–7)[a]	4.80 (1.11)
GAD (0–21)[a]	6.21 (5.20)

GAD, generalized anxiety disorder; ADHD, attention deficit hyperactivity disorder.
[a]*Possible range.*

Zero-Order Correlations

The results of zero-order correlations indicated statistically significant associations between GAD and five variables, including sport injury, ADHD, fear of failure, mental toughness, and satisfaction in sport ($r = -0.24$–0.54, ps < 0.05; see **Table 2**). The magnitudes of these associations ranged from small to large (25). However, there were insignificant and trivial associations between GAD and other predicting variables, including age, gender, sport type, and sport achievement ($r = -0.07$–0.06, $p = 0.26$–0.74).

Risk and Protective Factors

Table 3 presents the results of multiple regression analysis. A history of injury, a high risk of ADHD, and a high level of fear of failure were significant risk factors for GAD ($\beta = 0.10$–0.40, partial coefficient = 0.12–0.42, ps < 0.05). These effects were small to moderate (25). However, higher levels of mental toughness ($\beta = -0.09$, partial coefficient = −0.10, $p = 0.08$) and satisfaction in sport ($\beta = -0.03$, partial coefficient = −0.03, $p = 0.64$) were insignificant and trivial protective factors for GAD. Overall, all the predicting factors explained 39% of the total variance in GAD, and the effect size was deemed large (25).

DISCUSSION

In responding to the call to study the mental health of elite athletes (1, 2), the present research examined the prevalence of GAD symptoms and its associated risk and protective factors in elite collegiate athletes. The prevalence of GAD symptoms was 22% in our sample, which is higher than the prevalence rates measured in general populations (5%), elite national athletes (7%), and elite rugby league players (15%) based on the same measure and cutoff (26–28). The observed differences may be

TABLE 2 | Zero-order correlations among study variables.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Age	–								
2. Gender	−0.06	–							
3. Sport type	0.08	0.26**	–						
4. Sport achievement	−0.10	−0.18**	−0.29**	–					
5. Sport injury	0.03	−0.04	−0.15*	−0.04	–				
6. ADHD	0.01	−0.09	−0.14*	0.04	0.11	–			
7. Fear of failure	−0.04	−0.12*	−0.14*	0.02	0.004	0.40**	–		
8. Mental toughness	−0.12*	−0.11	−0.05	0.09	0.02	−0.13*	−0.23**	–	
9. Satisfaction in sport	0.01	0.08	0.15*	−0.03	−0.04	−0.20**	−0.30**	0.41**	–
10. GAD	−0.02	0.03	−0.07	0.06	0.14*	0.54**	0.48**	−0.22**	−0.24**

ADHD, attention deficit hyperactivity disorder; GAD, generalized anxiety disorder. Gender (0 = male, 1 = female). Sport type (0 = team sport, 1 = individual sport). Sport achievement (0 = national sportsman, 1 = grade 1, 2 = grade 2). Sport injury (0 = no, 1 = yes).

**p < 0.05 (2-tailed).*

***p < 0.01 (2-tailed).*

TABLE 3 | Risk and protective factors of generalized anxiety disorders.

Factor	Correlations				*t*	*p*
	B	**β**	**95% CI of β**	**Partial**		
(Constant)	0.91				0.40	0.69
Sport injury	1.05	0.10	(0.002, 0.19)	0.12	2.04	0.04
ADHD	0.44	0.40	(0.29, 0.50)	0.42	4.44	0.00
Fear of failure	1.81	0.29	(0.17, 0.41)	0.31	6.46	0.00
Mental toughness	−0.60	−0.09	(−0.21, 0.03)	−0.10	−1.73	0.08
Satisfaction in sport	−0.12	−0.03	(−0.14, 0.07)	−0.03	−1.00	0.64

B = unstandardized coefficient. β = standardized coefficient. Partial = standardized partial coefficient. CI, confidence interval; ADHD, attention deficit hyperactivity disorder. Sport injury (0 = no, 1 = yes).

attributed to varying participant demographics across these studies. The finding suggests that regular screening for GAD symptoms in elite collegiate athletes should be used.

Although early research showed that female and younger athletes were inclined to have a higher anxiety level than male and older athletes (2, 29), age and gender did not significantly predict GAD in the present research. The discrepancy may be explained by the small age range in the present sample consisting of only young athletes (17–25 years) and different psychosocial factors associated with gender (30). Despite females are more vulnerable to stress-related psychopathology than males, other psychosocial factors (e.g., gender equity and marriage status) that may contribute to the development of anxiety disorders were not measured here (31).

We did not find sport type and sport achievement as significant predictors of GAD. The finding provides the initial evidence about the predictability of these two factors on GAD symptoms. Early research also showed that there was no group difference in general anxiety symptoms (non-GAD) between individual and team sport athletes (32). Of note, individual sport and low sport achievement were, however, identified as risk factors of psychological distress and depressive symptoms in elite athletes (11, 16). Thus, these two risk factors may still need to be considered for mental health enhancement in elite athletes.

In line with early research, a history of sport injury was identified as a risk factor of GAD (28, 29). A large proportion of our participant sustained a sport injury over the past month (34%), and some of them seemed not to respond to the injury in a healthy way. Sport injuries could trigger problematic responses, such as alteration of appetite and sleep disturbance, which subsequently result in the increase of anxiety levels (33). Another identified risk factor in the present research was ADHD. Indeed, non-athletic groups with ADHD were found to have a high risk of developing anxiety disorders (14). Although some symptoms of ADHD, such as impulsivity, are believed to be associated with better sport performance (e.g., a shorter reaction time is associated with impulsivity), they can cause academic difficulties and other dysfunctions (34).

One significant strength of the current research was to include several psychological predictors of GAD (fear of failure, satisfaction in sport, and mental toughness). The participants with a higher level of fear of failure were more likely to have a greater level of GAD. The finding is parallel to the study finding in that fear of failure was perceived as a risk factor of

mental disorders in elite athletes (12). The sport environments are competitive in nature (e.g., peer comparison) and are usually associated with threat appraisal, which can lead to negative psychological outcomes, such as anxiety and depression (15, 35).

Given careers dissatisfaction has been found to predict anxiety (2, 36, 37), it was reasonable to expect that satisfaction in sport would be a protective factor of GAD. In agreement with the hypothesis, our finding showed that satisfaction in sport had a significant bivariate association with GAD. Mental toughness was another significant bivariate correlate of GAD in the present research. Mental toughness may represent a positive indicator of mental health (38), and early research showed that higher levels of mental toughness were associated with lower levels of psychological distress and depression (17). These findings add to the existing literature in that mental toughness could be a protective factor for several mental disorders in athletes. However, it is worthy to note that satisfaction in sport and mental toughness were no longer significant predictors of GAD after controlling for other factors. Meanwhile, the other three risk factors including sport injury, ADHD, and fear of failure remained as significant predictors of GAD. Thus, priority may be given to monitor and intervene these three risk factors.

Limitations and Future Directions

A few limitations inherent within the present study should be acknowledged. Firstly, despite the high response rate, the participants of the present study were elite collegiate athletes from four public universities in China. Consequently, the generalizability of our study findings is limited. Sample representative of sub-elite athletes and athletes in other contexts and countries should be investigated to see whether the present findings can be replicated in future research. Secondly, as a cross-sectional survey design was employed in this study, the causal relationships between the study variables should be inferred with caution. It is suggested that future research should use a prospective longitudinal or trial design to further examine their relationships. A large sample size would be needed if the diagnosis of GAD is used as the dependent variable (i.e., to ensure adequate statistical power for conducting logistic regression analyses). Thirdly, self-reported measures were exclusively employed in the present study so that participants' responses may be biased (e.g., recalling difficulty and social desirability). Thus, objective measures or observational tools may be used in the future. Furthermore, in addition to using the GAD-7 as a screening tool, clinical diagnosis should be followed to determine the presence/absence of GAD symptoms. Finally, although several predictors of GAD were initially identified in the present research, future research may examine other potential predicting factors, such as social context factors and personality traits (3).

Conclusions

The present research examined the predictors of GAD in a sample of elite collegiate athletes. About 2 in 10 athletes showed signs of GAD, suggesting the necessity to understand the GAD symptoms in elite collegiate athletes. A history of injury, a high risk of having ADHD symptoms, and a high level of fear of failure were risk factors of GAD. While these identified risk factors of GAD might be used for improving GAD symptoms of elite collegiate athletes, further research is needed to better understand and support the mental health for this target group.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Human Research Ethics Committee of China University of Geosciences (Wuhan). Written informed consent to participate in this study was provided by the participants, and if necessary their legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

CL, RF, and GL conceived the overall study design. CL and GL analyzed the data. All the authors were involved in the manuscript preparation and approved the final version for submission.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Bibliotherapy as a Non-pharmaceutical Intervention to Enhance Mental Health in Response to the COVID-19 Pandemic: A Mixed-Methods Systematic Review and Bioethical Meta-Analysis

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Background: A non-pharmaceutical treatment offered as psychological support is bibliotherapy, which can be described as the process of reading, reflecting, and discussing literature to further a cognitive shift. The coronavirus disease 2019 (COVID-19) pandemic demands a response to prevent a peak in the prevalence of mental health problems and to avoid the collapse of mental health services, which are scarce and inaccessible due to the pandemic. Thus, this study aimed to review articles on the effectiveness of bibliotherapy on different mental health problems.

Methods: A systematic review was conducted to examine relevant studies that assess the effectiveness of bibliotherapy in different clinical settings as a treatment capable of enhancing a sense of purpose and its surrounding values. To achieve this, a systematic review, including a bioethical meta-analysis, was performed. A variant of the PICO (Participants, Intervention, Comparison, and Outcome) model was used for the search strategy, and the systematic review was conducted in three databases: PubMed, Bireme, and OVID. Inclusion criteria were relevant studies that included the keywords, excluding documents with irrelevant topics, studies on subjects 15 years or younger, and in languages besides Spanish or English. Starting with 707 studies, after three rounds of different quality criteria, 13 articles were selected for analysis, including a hermeneutic analysis, which was followed by a fourth and final recovery round assessing bibliotherapy articles concerning healthcare workers.

Results: Our findings showed that through bibliotherapy, patients developed several capacities, including the re-signification of their own activities through a new outlook of their moral horizon. There are no research road maps serving as guides to conduct research on the use of bibliotherapy to enhance mental health. Additionally, values such

as autonomy and justice were closely linked with positive results in bibliotherapy. This implies that bibliotherapy has the potential to have a positive impact in different settings.

Conclusions: Our contribution is to offer a road map that presents state-of-the-art bibliotherapy research, which will assist institutions and healthcare professionals to plan clinical and specific interventions with positive outcomes.

Keywords: bibliotherapy, litherapy, mental health, coronavirus disease 2019, pandemic, values, bioethics, systematic review

INTRODUCTION

Amid the coronavirus disease 2019 (COVID-19) pandemic, a pressing problem faced by different health ministries is the mental health of the population, this includes both those who have been social distancing and staying indoors for long periods at a time and those considered essential workers who have continued laboring despite the considerable risk—among them are healthcare workers (HCWs). This has exposed the population to a variety of psychological diseases such as sleep disorders, depression, anxiety, and burnout. These disorders affect a broad spectrum of individuals from different backgrounds and across ages (1–3). If not addressed, the prevalence and financial burden of mental health disorders in communities affected by COVID-19 will grow exponentially. Furthermore, both the healthcare and socioeconomic systems will collapse if a significant improvement is not made in the diagnostic approach, prevention, and non-pharmacological treatment of psychological disorders.

Mental health problems can be addressed through a plethora of available treatments, such as psychosocial therapies or cognitive behavioral therapy (CBT), which are provided by trained psychologists (4). However, regardless of the availability of different treatments, few people with mental health problems have sought help during the COVID-19 pandemic (5). This setting, along with the need for social distancing, poses a challenge when considering available treatments for improving mental health.

One of the available non-pharmacological treatments in psychological literature is bibliotherapy (6). This is defined as reading as a guide to therapeutic change; bibliotherapy has been studied by mental health scientists in recent years as a tool, different from traditional interventions, that improves the readers' lives (7, 8). Though several definitions have been created to conceptualize *bibliotherapy*, they all focus on three essential elements: reading material for inside- or outside-session use, a therapeutic and achievable goal, and personal improvement.

Bibliotherapy is better understood as the process of reading, reflecting upon, and discussing literature (personal narratives and stories). This discussion of curated literature promotes cognitive shifts within the reader (9). It is crucial to note that bibliotherapy differs from self-help strategies as the reflection and discussions of literature take place in a structured setting (10). The reading material is also subjected to scrutiny and has a specific purpose or problem that it addresses.

The use of books in a systematic clinical setting offers the possibility of improving mental health at a low cost. In addition, it represents an alternative for those who are hesitant to receive treatment for mental health problems (11). For essential workers, including healthcare professionals, it is essential to be treated and to get help. Not only do mental health problems lead to moral distress, but they can be associated with loss of values when treating patients, which in turn reduces the quality of care.

Bibliotherapy has shown positive results for various mental disorders in different trials, which justify the rational and empirical evaluation of this approach. However, in the existing literature, it remains to be studied whether bibliotherapy can enhance values that contribute to obtaining a sense of purpose. Therefore, the main objective of the present work is to review the principal studies that assess the effectiveness of bibliotherapy as a treatment to enhance a sense of purpose and values in those with different mental health problems. Based on these results, healthcare professionals and institutions can plan clinical and specific interventions that are well-tested, assessed, and valued and show clinical effectiveness in improving mental health and the work environment. As a result, different mental health issues, such as anxiety, depression, sleep disorders, and burnout, can be addressed through bibliotherapy.

METHODS

A diagnostic screening was performed on five databases: PubMed, Bireme, OVID, Philosopher's Index, and JSTOR, searching for the most recent articles on the use of bibliotherapy as a non-pharmacological intervention to help mental patients and HCWs. Subsequently, a systematic review was conducted up to February 2018 to obtain original articles about available literature-based non-pharmacological treatments (bibliotherapy). This search was complemented with a screening up to 2020, incorporating the COVID-19 pandemic. The search strategy was based on the PICO (Participants, Intervention, Comparison, and Outcome) approach coupled with the PRISMA (Preferred Reporting Items for Systemic Reviews and Meta-Analyses) checklist (12). However, the comparison variable was removed due to the research being focused only on bibliotherapy as an intervention. The PIO (Participants, Intervention, and Outcome) strategy, which includes participants or problems, the intervention or exposure, and outcomes, was used to systematically search all databases. This type of modified search derived from the PICO model has also been used in other systematic reviews (13–15).

Search Strategy/Literature Search

The search strategy was carried out on five computerized databases: PubMed, Bireme, Philosopher's Index, JSTOR, and OVID. The first database used was PubMed, produced by the National Library of Medicine (a public body that depends on the National Institutes of Health of the United States), which, according to Cochrane (16), contains approximately 16 million references to journal articles from the year 1950 onward, as well as 5,200 indexed journals. This makes PubMed/Medline the most widely used database in the health sciences field globally. Subsequently, a search was carried out in the Virtual Health Library (VHL) database, produced by Bireme (Latin American and Caribbean Center for Information in Health Sciences), which is a specialized center of the Pan-American Health Organization (PAHO). There is a considerable importance to this database because it contains (indexed) the most relevant scientific literature journals from Latin America and the Caribbean. We performed the search as well in Philosopher's Index, which is a premier database designed to find publications of interest in the field of philosophy. The axiological analysis is the great interest for philosophers worldwide. Following is JSTOR that is a cross-functional database.

Finally, a search was carried out in OVID, the world's most trusted medical research platform, which has been a vital part of healthcare for over 20 years. OVID's flagship platform is the leading choice, globally, among clinicians, researchers, educators, and students in the medical, scientific, and academic fields.

Mesh terms were used to review this phenomenon. The following keywords were used for Participants: "healthcare personnel," "healthcare professional," "healthcare manpower," "physician," "doctor," "nurse," "social worker"; Intervention: "bibliotherapy"; and Outcome: "liberty," "empowerment," "tolerance," "justice," "benevolence," "equity," "respect," "charity," "beauty," "autonomy," "purity," "ethical values," "axiology," "personal identity," and "dignity." The Boolean operator "AND" was used to link PIO variables, while the operator "OR" was used to combine keywords from the same variables. This search strategy was used to obtain relevant articles from each database, as shown in **Figure 1**. All references were stored in Mendeley Desktop. Due to the scarce results on health workers, a redirection to the general population was done using the screened papers that were already in our curated database.

Eligibility Criteria

In the first round, articles were selected from every electronic database and were screened for relevance based on their title and abstract. Works with a double reference, on participants 15 years old or younger, irrelevant topic, related to letters or books, and not written in English or Spanish were excluded. Before the second round, three authors performed an iterative review to confirm the actual relevance of each paper.

In the second round of selection, the full text of the articles was considered. A quality criterion, as seen in **Supplementary Table 1**, was used to assess the methodological value of each reference. The articles were read and classified according to the following criteria: (a) clear investigation objectives, (b) inclusion of a research question according to the objectives, (c) adequate and solid methodology, (d) terminology definition, and (e) results according to the objectives. Each criterion was worth 20%, with a maximum quality score of 100%.

In the third round, 13 articles met the optimal quality criteria (higher than 80%). Each article was analyzed and codified using Atlas. ti software to highlight the backgrounds of the bibliotherapy interventions, methodological elements, and results. All articles were codified to develop a deeper qualitative analysis based on the different codes, their relations, co-occurrences, and their networks. The bioethical meta-analysis searched for networks that could link bibliotherapy as an intervention to enhance social, ethical, and professional values.

Finally, a fourth round was executed as a recovery round to retrieve any articles directly linked to the intervention of bibliotherapy for HCWs.

RESULTS

Relevance Assessment of the State of the Art of Bibliotherapy

The first round yielded 707 initial articles, after which 25 articles were retrieved in the second round of selection; lastly, 13 articles met the quality criteria and were retained for further analysis (**Figure 1**, **Supplementary Figure 1**).

Studies that had clear research questions and objectives, definitions of the measured concept, valid measuring instruments, detailed description of the methods, information of the targeted population, characteristics of the participants, addressed missing values, and used appropriate statistical analysis were considered. The results are shown in **Table 1**.

These 13 studies were analyzed in depth to highlight the strengths of each work. The following considerations were added to the analysis: if it was treatment or prevention, targeted disorder, duration of intervention, sessions per week, instrument used, and main results (**Table 2**).

One of the main findings showed that all studies addressed a treatment perspective rather than a prevention perspective. Three of these studies did not specify the length of the intervention, and two out of these 13 studies did not mention the kind of literature they used (17, 18).

Considering the main results of these studies, three of them found no differences between the bibliotherapy group and control group (17, 19, 20). However, results from four other studies indicated that bibliotherapy may facilitate self-concept and an internal locus of control (20–23).

Another study showed that with bibliotherapy, though there was a significant change, it did not result in a better intervention than traditional treatment (19). Another study pointed out that bibliotherapy was better than being on the waiting list (24). Finally, the remaining three studies found that bibliotherapy was a potential self-help resource (10, 24, 25).

Of the 13 studies included, two used bibliotherapy as an additional treatment (19, 23), while the remaining 11 studies tested bibliotherapy as the main treatment. One paper described pretreatment evaluation (17), while 12 studies evaluated pretreatment and posttreatment. None of the studies

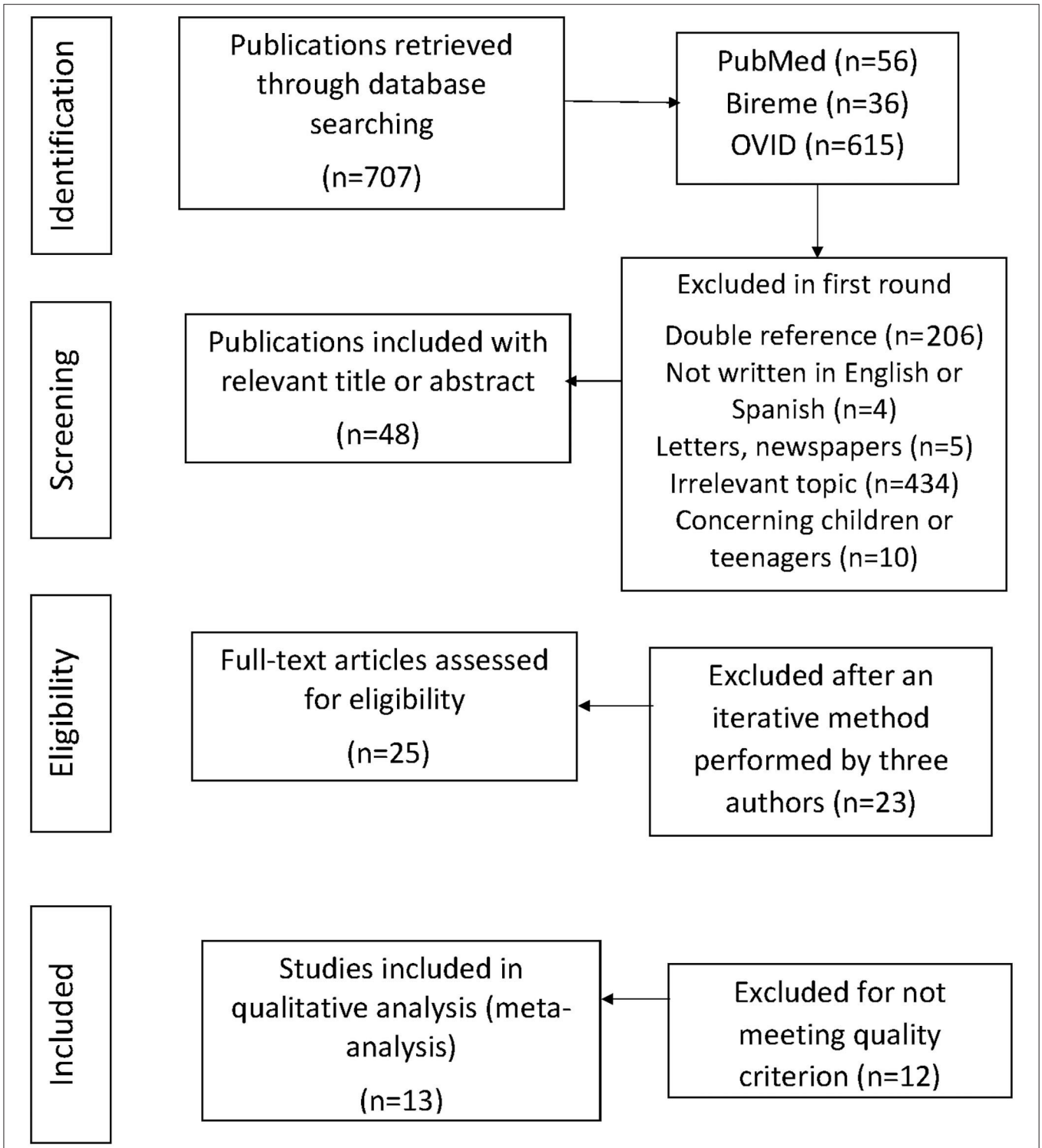


FIGURE 1 | Flowchart. It shows the selection process used to retrieve the final 13 articles. In the first selection round, 707 articles were obtained from three computerized databases (PubMed, Bireme, and OVID). Works with double references, irrelevant topic, or not written in English or Spanish were excluded during the second round of screening, leaving 25 articles. The third round of selection included a quality criterion in which the full text was read. Finally, 13 studies with over 80% were selected for a hermeneutic analysis.

TABLE 1 | Quality criteria for the second round of selection.

First author, year of publication	Setting	Sample size	Sample characteristics	Design study	Study quality
Bilich (2008)	Psychotherapy	84 participants	Ages between 18 and 60 scored between 10 and 29 on BDI	Control vs. Experimental 1 vs. experimental 2	87.5%
Bokey (2002)	Literary works analysis	–	–	–	–
Buwalda (2009)	Pilot study	40 participants	Mean age 43, with hypochondriacal complaints.	Treatment condition vs. waiting list condition	100%
Chien (2016)	Clinical trial	116 caregivers	Chinese people, mean age 50 years, two thirds were females	Only experimental group	100%
Cohen (1992)	Literature for woman analysis	–	–	–	–
Cohen (1993)	Books analysis	–	–	–	–
Cohen (1994)	Interview	8 persons	Participants between 26 and 54 years	Participants interviewed or 90 min	50%
Evans (1999)	Clinical trial	34 patients	Aged between 16 and 50 with deliberated self-harm episode	Experimental vs. treatment as usual	100%
Harrison (2001)	Literature analysis	–	–	–	–
Hodgins (2007)	Booklets delivery mail setting	169 participants	Over 17 years and meet criteria for pathological gambling	Experimental vs. experimental	87.5%
Joling (2011)	Psychological intervention	119 elderly eligible people	Elderly people aged 75 years and older	Usual treatment plus cognitive behavioral bibliotherapy intervention vs. treatment as usual	100%
Kaldo (2012)	Psychotherapy	89 persons	Participants mainly Caucasian, well educated, mean age 49.1	Control vs. experimental	87.5%
Kohutek (1983)	Correlational setting	42 people	Incarcerated males, average age 34	Experimental groups only	87.5%
Lanza (1991)	Literature review	–	–	–	–
Macdonald (2013)	Bibliotherapy *via* local services	157 participants	Exclusion criteria: under 16, without reasonable English literacy, diagnosed with mental illness	Experimental group	87.5%
McAllister (2014)	Memoirs works analysis	–	–	–	–
McArdle (2001)	Theoretical analysis	–	–	–	–
McKenna (2010)	Interviews	11 volunteers	Mean age 41 years, age range 27–64 years 5 men, 6 women	Interviews	62.5%
Naylor (2010)	Medicine center	38 persons	From 22 to 83 years old. Predominantly female and Caucasian.	Treatment as usual vs. experimental	50%
Porter (2008)	Mailed surveys	21 persons	Not specified	Mixed-methods design	50%
Reeves (2005)	Clinical trial	19 patients	18 years old, experiencing mild to moderate stress/anxiety	Only experimental group	50%
Reeves (2010)	Control trial	43 clients	Age limit 18 upward and primary presenting problem	Treatment group vs. control group	100%
Van Lankveld (1999)	Couple's therapy	246 couples	Older than 16 with heterosexual relationship and a sexual disorder	Voluntary response sample and waiting list group	87.5%
Volpe (2015)	Hospitalized patients	41 patients	Patients had a diagnosis of schizophrenia, schizoaffective and bipolar disorder	Control group vs. experimental group	100%
Wright (2000)	Participants who completed a previous study	45 patients	Patients with panic attacks	Wait list group control vs. experimental	87.5%

BDI, Beck Depression Inventory-Revised.

TABLE 2 | Description of the articles in the third round of selection.

First author, year of publication	Sample	Design study	Treatment or prevention	Disorder	Duration	Sessions per week	Books and booklets used	Test	Results	Impact of intervention
Bilich (2008)	84 participants	Control vs. Experimental 1 vs. experimental 2	T	Depression	20 weeks	30 min telephone contacts	The Good Mood Project (2003)	BDI II DASS 21 K 10	Bibliotherapy as a potential self-help resource	
Buwalda (2009)	40 participants	Treatment condition vs waiting list condition	T	Hypochondriasis	Not specified	Not specified	Doctor, I hope it's nothing serious?	The Groningen illness attitude scale Spielberg state trait anxiety questionnaire Beck Depression Inventory	Bibliotherapy is an efficient aid in reducing hypochondriacal complaints	
Chien (2016)	116 caregivers	Only experimental group	T	Family caregivers	22 months	20-week modules, 1 h per session	Clinician-supported problem-solving bibliotherapy	Family burden interview schedule Experience of caregiving inventory	Bibliotherapy produces moderate long-term benefits to caregivers and first episode psychosis patients	
Evans (1999)	34 patients	Experimental vs. treatment as usual	T	Deliberate recurrent self-harm	6 months	Not specified	Manual assisted cognitive behavior therapy	Social Functioning Questionnaire Parasuicide History Interview	Feasibility of MACT as a therapeutic procedure for deliberate self-harm	
Hodgins (2007)	169 participants	Experimental vs. experimental	T	Pathological gambling	6, 24, 52 weeks	Not specified	Series of relapse prevention booklets	Gambling severity GASS CES-D	Extended relapse prevention bibliotherapy to problem gamblers does not improve outcome	
Joling (2011)	119 elderly eligible people	Usual treatment plus cognitive behavioral bibliotherapy intervention vs. treatment as usual	T	Subthreshold Depression	12 weeks	1 per week	Coping with depression self-help manual	CES-D	Significant change statistically and clinically relevant but not better than TAU	Bibliotherapy is only effective if patients are motivated and acknowledge their depression
Kaldo (2012)	89 persons	Control vs. experimental	T	Insomnia	6 weeks	Telephone intervention 15 min	Not specified	Insomnia Severity Index		
Kohutek (1983)	42 participants	Experimental groups only	T	Incarcerated male inmates	4 weeks	Not specified	Three settings of readings: personal growth packet, rational-growth packet, and general readings packets.	Levenson Locus of Control	Bibliotherapy may facilitate self-concept and internal locus of control as well as usual treatment. No differences between treatments	
Macdonald (2013)	157 participants	Experimental group	T	Mild mental health that does not require referral to psychological or psychiatric services	Not specified	Not specified	"Read yourself well" scheme	Clinical outcomes in routine evaluation questionnaire General health questionnaire	Positive use of self-help written materials in the management of minor mental health problems	

(Continued)

TABLE 2 | Continued

First author, year of publication	Sample	Design study	Treatment or prevention	Disorder	Duration	Sessions per week	Books and booklets used	Test	Results	Impact of intervention
Reeves (2010)	43 clients	Treatment group vs. control group	T	Mild to moderate stress and anxiety	5 months	30–40 min per session	Assisted therapy	The hospital anxiety and depression scale The clinical outcomes in routine evaluation score Satisfaction questionnaire Compliance questionnaire	Assisted self-help package produces clinically significant improvements above of those in waiting list	
Van Lankveld (1999)	246 couples	Voluntary response sample and waiting list group	T	Sexual dysfunctions	Not mentioned	Not mentioned	Not specified	CIDI GRISS SCL90 IBCS MMQ IPSO	No differences between bibliotherapy group and control group	
Volpe (2015)	41 patients	Control group vs. experimental group	T	Functional psychosis	6 months	90 min	Serious literature materials	Brief Psychiatric rating scale The Personal Health Questionnaire Depression Scale Mini-Mental State Examination	Statistical significant improvement of cognitive and psychosocial functioning	
Wright (2000)	45 patients	Wait list group control vs. experimental	T	Panic Attacks	6 months	Not specified	"Coping with panic" Manual	Panic Attacks Symptoms and Cognitions Questionnaires, Avoidance Questionnaire, Coping Strategies (CS) and Confidence in CS Questionnaires, Beck Depressive Inventory	Significant reductions of frequency of panic attacks, panic cognitions, anticipatory anxiety, avoidance and depression.	

BDI II, Beck Depression Inventory-Second Edition; CES-D, Center for Epidemiological Studies - Depression Scale; CIDI, Composite International Diagnostic Interview; DASS, Depression, Anxiety and Stress Scale - 21; GASS, Gambling Abstinence Self-efficacy Scale; GRISS, Golombok Rust Inventory of Sexual Satisfaction; IBCS, Intimate Bodily Contact Scales; IPSO, Interactional Problem Solving Questionnaire; K10, Kessler Psychological Distress Scale; MMQ, Maudsley Marital Questionnaire; SCL90, Symptom Checklist-90.

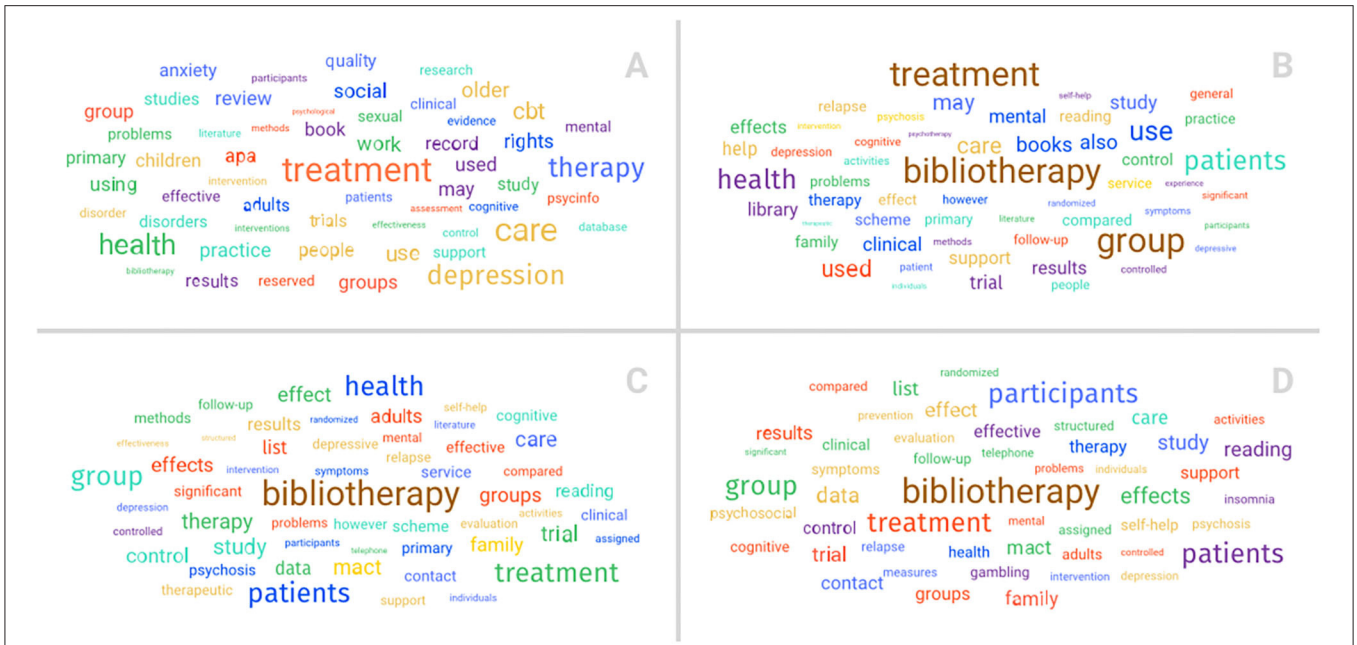


FIGURE 2 | Keyword frequency. Analysis of database stored in Mendeley regarding the words in the title, keywords, and abstract. **(A)** Four hundred eighty-eight articles were retrieved in the first round, **(B)** 35 in the second, **(C)** 25 in the third, and **(D)** 13 in the fourth. Results showed a coincidence in the most frequent words.

showed any adverse effects of using bibliotherapy as a treatment; however, two studies described the effect as not adverse, although this finding was not significant (19, 26).

Regarding improvement, out of the 13 studies, six did not specify the percentage of patients who improved (11, 20–22, 24, 27). Bilich et al. (10) describes that 31% of the total sample showed clinically significant changes (10), Hodgings et al. (26) reported a 23% improvement, and Kaldo et al. (18) reported that 68% of the progress was made in the bibliotherapy group (26). Furthermore, Macdonald et al. (25) mentioned a 100% advance in participants receiving bibliotherapy, and Wright et al. (23) specified an 89% recovery of the participants in the experimental manipulation condition.

The three studies found in the recovery round, which assessed articles directly linked with bibliotherapy in HCWs, showed the impact that different literary works can have. While two studies focused on the nursing population, Amar (28) examined the impact of personal stories on nursing students' education and Harrison (29) studied the use of imaginative literature in scholarly inquiry, Andersonet al. (30) assessed the importance of empathy in both physicians and patients through the use of graphic stories. Taken together, all three articles highlight the positive impact of bibliotherapy for healthcare personnel.

Semantic Networks as an Initial Compass

The database stored in Mendeley was analyzed for the frequency of the terms used in the title, keywords, and abstract of each work according to the search parameters specified in the Methods section. The results of the first search yielded 488 articles (without double references) (**Figure 2A**), and five studies were discarded because no abstract was found. Based on this volume of articles, the word count was modified to consider only terms with 75 coincidences, meaning those with a significant frequency (**Figure 2**).

The five most common terms in the literature records were treatment (560), care (386), health (378), depression (316), and interventions (271). At this point in the research, bibliotherapy did not appear as a frequent word, since there were only 126 coincidences, placing it at the 38th position. As bibliotherapy was the key concept of the present study, another round was conducted to obtain relevant studies for the analysis.

In the second round, which yielded 35 documents, three were discarded due to the lack of an abstract. The most frequent terms in those articles were bibliotherapy (62), treatment (40), group (35), patients (31), and health (28), where the terms treatment and health coincided with the previous selection (**Figure 2B**).

In the crossed iteration of the second round, 25 articles were retrieved, where two were again discarded because they did not have an abstract. The same list of terms, as in the previous round, was found; nevertheless, based on the significantly reduced volume of articles, the coincidences were not limited. The most frequent words in these documents were bibliotherapy (40), treatment (30), group (24), health (22), and patients (22) (**Figure 2C**).

These new results showed a coincidence in the most frequent words except in the order of health and patients, since these terms were inverted in the present third round. It is worth noting that bibliotherapy was the most frequent word in the 25 articles that point out the proper delimitation of each selection round.

In the third round of selection, 13 final articles were retrieved. One of them did not have an abstract. The same list of terms as in the previous search was found, and there was no restriction on the

TABLE 3 | Values considered in the last round of review.

References	Fidelity	Autonomy	Liberty	Equality	Respect	Tolerance	Interest	Love	Service attitude	Charity	Purity
Bilich et al. (10)		X	X				X				
Buwalda and Bouman (27)	X	X	X								
Chien et al. (11)	X	X	X		X	X		X	X	X	
Evans et al. (21)		X	X					X			
Hodgins et al. (26)		X	X		X		X	X			X
Joling et al. (11)		X	X		X		X				
Kaldo et al. (18)		X	X								
Kohutek (20)		X	X								
Macdonald et al. (25)		X									
Reeves (24)		X								X	
van Lankveld et al. (17)	X	X		X	X		X	X			
Volpe et al. (22)		X	X				X				
Wright et al. (23)				X	X						

number of elements in the word count. The most frequent words were bibliotherapy (23), group (23), treatment (21), patients (17), and participants (15) (**Figure 2D**).

There was a coincidence in four out of the five terms compared to the previous round of selection. This change shows that the articles had a strong methodological component in the implementation of bibliotherapy, which is consistent with the present systematic review.

In the last round, we also researched the complete text of the 13 articles; the most frequent words were group (427), treatment (402), bibliotherapy (295), participants (288), study (258), depression (244), health (191), mental (160), patients (160), and clinical (156).

Findings From Bibliotherapy and Values

Hereafter, a table was created to show values that were considered in each paper (**Supplementary Tables 1**, **2**). The different values that a study impacted are shown, with a cognitive shift on the part of the participants or considered relevant, on how they view their own life, their treatment, or everyday activities. By doing this, it was found that all articles spoke about gaining autonomy from bibliotherapy, 10 works addressed liberty as a central value in the intervention, and five articles regarded being proactive toward treatment. No articles that highlighted honesty, veracity, justice, or beauty were found (as shown in **Table 3**). To specify what is understood for each value, examples of quotes can be seen in **Table 4**.

To develop the hermeneutic analysis, each paper was read in depth and codified using Atlas. ti software to create networks of terms. One example is shown in the next image (**Figure 3**), where values such as liberty, autonomy, and justice are closely linked and associated with positive results in bibliotherapy.

In the third round of selection, the analysis showed that autonomy, justice, and freedom were the values most frequently discussed in these papers. Autonomy was a value closely linked with positive results in the case of bibliotherapy because this is one of the ways to promote a self-help treatment that could promote empowerment and allow for the control of an increasing number of situations in patients' lives, enable them to solve their own problems, and acquire the skills necessary to do it (19). These studies showed improvements related to self-concept

TABLE 4 | Instances of values.

Value	Example
Fidelity	The participants valued the book substantially, by rating it and its separate chapters as highly useful (27).
Autonomy	Our study demonstrated that structured group reading activities may exert some positive influence on clinical symptomatology and cognitive and psychosocial functioning in patients with psychosis (22)
Liberty	The main prison population may be less defensive about the topic in that they have more freedom and, therefore, can benefit more from the principles of rational growth (20)
Equality	Our findings strongly support the theoretical notions of the existence of distinct types of sexual difficulty, associated with different personal and relational characteristics (17).
Respect	Individual empowerment, which is one of the aims of bibliotherapy, contributes to the development of problem-solving skills and increases self-esteem and self-efficacy (19).
Tolerance	The CSPSB also experienced a greater reduction in negative appraisals of caregiving and more positive experiences of family relationships/communication with their FEP relative than the UOFS group (11).
Interest	The findings are also supported by several researchers who emphasize the importance of individuals who are engaged in "self-help" treatment having telephone contact with mental health workers, particularly in rural settings (10).
Love	The results nonetheless suggested that the intervention might be effective in reducing the number and frequency of self-harm episodes, with simultaneous reduction in depressive symptoms (21).
Service attitude	The 5-month CSPSB demonstrated very positive effects on family caregiving at 12-month follow-up (22).
Charity	Contact with the clinician was repeatedly identified as being valued and is consistent with the previous studies (24).
Purity	These participants appeared "ready to change" and were motivated enough to initiate some self-change as a result of being involved in a research study. The extended contact (i.e., follow-up interviews) have also contributed to the maintenance of their motivation (26).

CSPSB, Clinician-Supported Problem-Solving Bibliotherapy; FEP, First-Episode Psychosis; UOFS, Usual Outpatient Family Support.

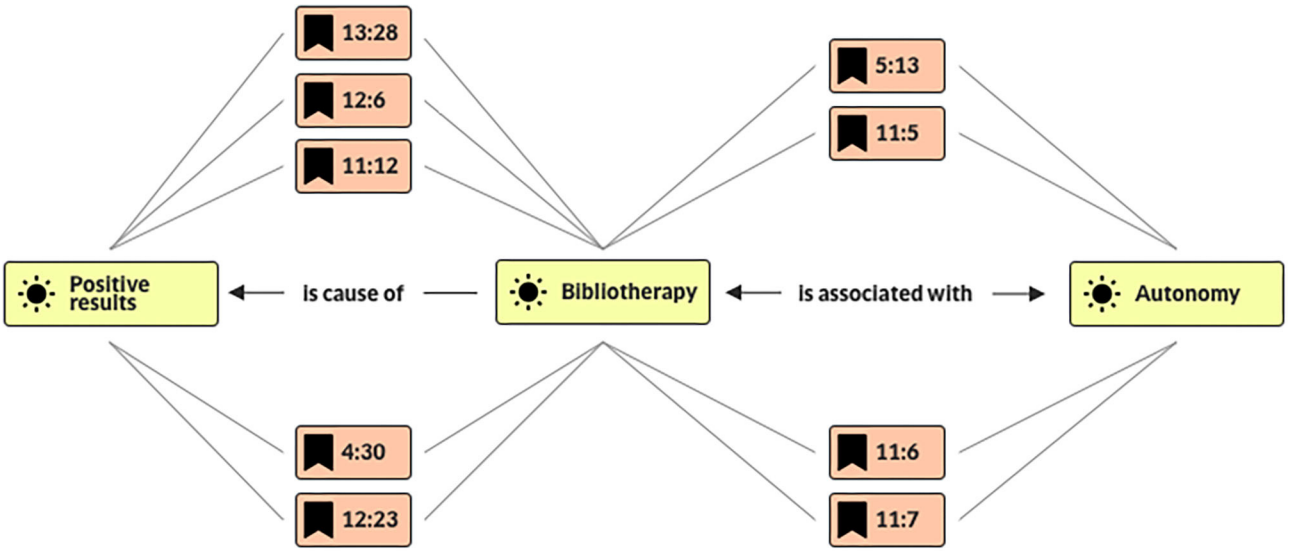


FIGURE 3 | Values linked to bibliotherapy. Network of values performed in Atlas. ti. It illustrates how values such as autonomy, liberty, and justice are associated with positive results regarding bibliotherapy treatment. The figure depicts how autonomy is a crucial value found in all 13 texts of the final round as well as a network between values. The identification numbers refer to each of the 13 texts and the line in that text.

and locus of control, which also reflect improvements in the autonomy of a patient. However, bibliotherapy was also found to promote autonomy in the participation of a patient in their own treatment by being proactive when given access and benefiting from the information about their illness or condition and lowering the caregiver's burden by improving compliance and reducing anxiety episodes (27). Values such as autonomy and proactiveness also showed an impact on values, such as liberty, due to the enhanced self-efficacy and self-concept, an improvement in life possibilities, options open to patients with fewer symptoms, and better control of their day-to-day lives.

Meanwhile, justice may also be considered a value linked to bibliotherapy in the view of these works because it allows for a great deal of access to this form of intervention. Wright et al. (23) states that bibliotherapy is accessible to individuals who may be geographically or otherwise isolated; it is also a valuable form of treatment for those with limited economic resources and helps caregiving institutions to pay attention to larger groups with limited personnel. Bibliotherapy also allows for a more private way to address these health issues, without having to deal with negative perceptions or the reticence of those not willing to share their concerns with others.

These considerations may also be applied to a specific population, that is, HCWs who, due to the COVID-19 pandemic, have been under significant stress and their mental health has been threatened due to the conditions they face, moral burdens, and workload. In the literature reporting the specific case of mental health among HCWs, we found that all the previous stress factors signaled to widespread anxiety- and depression-related disorders (31–33). There was no report on bibliotherapy used to help HCWs; however, it stands as a viable option due to the logistic difficulties of offering standard treatments amid the pandemic.

A Hermeneutic Analysis on How Bibliotherapy Works

The analysis of these texts stemmed from phenomenological and hermeneutic approaches. The latter's, insofar as it concerns a naive reading, results are shown in **Table 5**.

Phenomenologically, each paper was read in accordance with real, sensible experiences described. Thus, the reading focused on real-life scenarios behind research subjects. Compared with a wait-list control group, individuals receiving relapse prevention (RP) exhibited significant reductions in the frequency of panic attacks, panic cognitions, anticipatory anxiety, avoidance, and depression. In addition, individuals in the RP group were more likely to attain a "clinically significant change" in status on both panic-free status and level of avoidance more frequently than individuals in the control group (23). For example, in an article focusing on panic attacks, subjects are written in as individuals, far beyond being mere topics of interest due to panic attacks.

Although the table may reflect the subjects as mere numbers or components in the study, for the purposes of the bioethical and value-based medicine research that is behind this, the subjects are taken as single phenomena, independent of numbers or statistics. The real element of value then is the final discussion and conclusions that each paper arrived at and how they reflected on the effectiveness and ineffectiveness—that bibliotherapy may have as treatment or how it could aid in treatment. Research on bibliotherapy yields benefits when teaching people about the value of literature and how it may impact their daily lives and their day-to-day practices. As was seen in the 13 articles reviewed

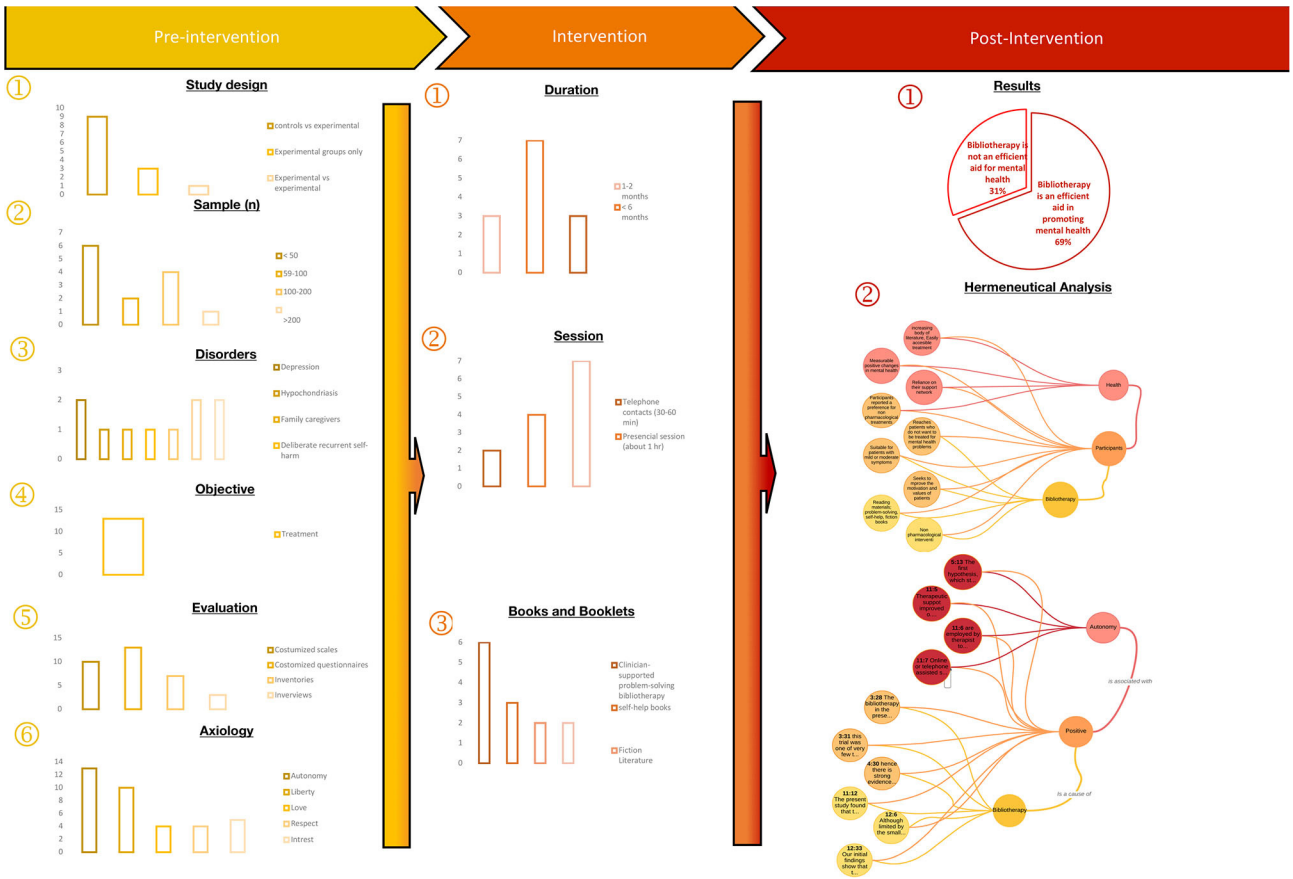


FIGURE 4 | A road map to the systematic review. On the road map, we can appreciate the following: (1) That most of the studies on the last round of analysis were comparative experimental studies (9) that used a control group. (2) The studies most often had sample sizes smaller than 50 participants (6), but larger studies with less than 200 participants were also frequent. (3, 4) These studies tried to measure the efficacy of bibliotherapy mostly on patients with depression, anxiety disorders, and functional psychosis. (5) A variety of standardized tests, scales, and questionnaires were used along with interviews to measure the degree of change achieved through treatment. (6) Autonomy and liberty were the values most often related with positive results in these studies. (7) Bibliotherapy was offered in-person and through telephone sessions, although many of the studies did not pay enough attention to this aspect of the study. (8) A wide array of literature options was offered for these treatments, most frequently the clinician-supported problem-solving literature was used. (9) Nine out of the 13 studies reported positive results of bibliotherapy, which was considered a cost-efficient therapy suitable for mild to moderate disorders.

for this study, bibliotherapy's results and effects vary across the board; however, the general consensus seems to be positive.

A Road Map and Compass to Bibliotherapy as a Non-pharmaceutical Intervention

The results of prior studies illustrate some of the best practices that should be implemented in offering bibliotherapy (**Figure 4**). Several studies were designed to compare control and experimental groups, with relatively small groups (most of them with fewer than 50 participants). Most of the studies' length was between 3 and 6 months, and these were often the ones that had positive results. The aim of the studies was to treat disorders such as depression, stress, and anxiety, as well as functional psychosis, among others; it is an option that can be considered as far reaching for a large population, including HCWs, that has mental health problems during the COVID-19 pandemic (**Figure 4**).

It is important to note that there are still several features of bibliotherapy that need further research. For example, most of the studies found were not specific about the type of sessions in which the therapy was offered; the recurring types of sessions were in-person and through telephonic contact. The last of these options, as well as online contact, is especially important if we wish to offer mental healthcare during times in which health services may be needed to be reserved for those who are critically ill. Another feature of bibliotherapy, which needs further research, is the materials, books, and booklets used in this type of therapy. Out of 13 studies, six used problem-specific books to offer therapy; however, the structure of such materials is not clear and cannot easily be reproduced. Moreover, one should consider those who cannot easily access hospitals; thus, studies on the wider fiction literature that may help are needed.

DISCUSSION

The articles present themselves as sturdily scientific; however, their motivations are to aid patients who suffer from problems

TABLE 5 | Hermeneutic analysis.

Source	Methods analysis	Results	Discussion
Characteristics of couples applying for bibliotherapy *via* different recruitment strategies: A multivariate comparison Jacques J. D. M van Lankveld, 2008	They took 140 couples who responded to a call, and 106 couples who attended a clinic. The couples were interviewed separately	The distribution of sexual dysfunction varies between men and women. Diagnoses of varied disorders in men and women.	The objective was to know the sexual dysfunctions of couples who actively sought bibliotherapy. No multivariate differences were found between the two groups: Media Group and Sexology Group.
Involving Clients in Treatment Methods: A Neglected Interaction in the Therapeutic Relationship Viktor Kaldo, 2015	89 participants were taken who fulfilled the criterion of insomnia, predominantly educated white women.	The result was that carrying out a treatment with the therapist's help significantly increases the benefits of such treatment.	Therapeutic support is more effective with the involvement of the patient, so it is concluded that the relationship and methods depend on said interaction.
Effectiveness of Bibliotherapy Self-Help for Depression with Varying Levels of Telephone Helpline Support Linda L. Bilich, 2008	The effectiveness of telephone support was examined in 84 subjects with mild to moderate depression.	Clinically significant improvements in two of the control groups.	Participation was not spontaneous as the participants were contacted *via* advertisements. The results are supported by researchers who emphasize the importance of self-help when contacting by phone.
Does Providing Extended Relapse Prevention Bibliotherapy to Problem Gamblers Improve Outcome? David C. Hodgins, 2006	169 who had recently quit gambling were recruited *via* public ads and were followed for 6–12 months.	The results suggest that providing bibliotherapy to gamblers does not improve the result	Almost all participants reported having read the booklet provided by the researchers and in turn reported having used the procedures.
How Effective Is Bibliotherapy for Very Old Adults With Subthreshold Depression? A Randomized Controlled Trial Karlijn J. Joling, 2010	170 participants in retirement homes who were offered a self-help pamphlet adapted to the needs of the elderly population.	86% of participants completed the pamphlet, but no significant changes were found.	Bibliotherapy alone is not able to relieve the symptoms of depression in older populations
Bibliotherapy within a correctional setting Kenneth J. Kohutek, 1983	54 volunteers from the general and segregated sectors of a maximum security prison	There were no significant changes in the treatment but in the self-consciousness of the prisoners.	Bibliotherapy can have effects on the self-control and self-knowledge of the prisoners but has no distinction or greater effect than the therapeutic intervention.
Reading Group Rehabilitation for Patients with Psychosis: A Randomized Controlled Study Umberto Volpe, 2015	41 patients with psychosis were assigned to groups and evaluated at the beginning and end of the 6 months	Cognitive and psychosocial performance was improved after 6 months	The programs are an easy therapeutic implementation and are well regarded by patients.
A Bibliotherapy Approach to Relapse Prevention in Individuals with Panic Attacks Joseph Wright, PhD, 2000	participants who completed phase 2 of Febraro, Clum, Roodman, and Wright (1999) study. The materials were delivered by mail, without intervention or direct contact. Telephone calls were used to improve participation.	A mixed decrease but with a positive trend in the results for the improvement of participants' panic attacks.	Generally positive result, general report of fewer panic attacks
An evaluation of a collaborative bibliotherapy scheme delivered *via* a library service J. Mcdonald, 2012	157 participants of whom 114 gave their complete data. questionnaires and evaluations were offered.	Significant posttreatment improvement in men and women and in all groups.	The results support the theory that library-based bibliotherapy can be effective in treating mental disorders.
Manual-assisted cognitive-behavior therapy (MACT): a randomized controlled trial of a brief intervention with bibliotherapy in the treatment of recurrent deliberate self-harm K. Evans, 1999	34 patients between 16 and 50 years old who have suffered a parasuicidal attack in the last 12 months randomly assigned	32 patients are followed, of whom 10 carried out a suicidal act. The rates of depression and suicidal acts decreased.	This pilot study can be carried out effectively in cognitive behavioral therapy.
A Randomized Controlled Trial of Clinician-Supported Problem-Solving Bibliotherapy for Family Caregivers of People with First-Episode Psychosis Wai Tong Chien, 2016	116 caregivers assigned randomly and evaluated in periods of 1, 6, and 12 months.	Positive effects reflected in posttreatment evaluations at 12 months	The burden of care on the study subjects was alleviated and in turn family relationships improved
A controlled study of assisted bibliotherapy: an assisted self-help treatment for mild to moderate stress and anxiety Gary Winship 2010	a treatment group was compared with a controlled group, randomly assigned	The final results were carried out in only 43 participants due to the departure or decline of others. Significant improvements	Bibliotherapy is thought of as a more economical therapy alternative
Cognitive–Behavioral Bibliotherapy for Hypochondriasis: A Pilot Study Femke M. Buwalda, 2009	Participants were given a book with cognitive–behavioral activities	The results were positive, given the active participation.	Bibliotherapy can be an effective aid in the treatment of mental disorders.

such as mental disorders, addiction, and imprisonment. The most valuable piece of information for the purposes of this study is the reports of the individual studies' subjects, as more patients reported feeling an improvement with the kind of bibliotherapy provided by the conductors of the investigations. Although none of the 13 articles directly discussed bibliotherapy in treating service workers, doctors, medical personnel, or even workers who suffer from burnout, some of the articles may be pointing in this direction, aiding us in our own implementation of bibliotherapy as an alternative intervention in mental healthcare. Studies that address topics such as anxiety, depression, caregivers, and stress-related issues may have a direct impact on the way we understand the approach to be taken for our own subjects.

This study specifically addresses the issue of values—or lack thereof—and their possible furtherance through literature while simultaneously encompassing the axiological works of several philosophers that shed light on this topic. The selection of literary works has been carefully curated to each reflect a distinct value, which will thereafter be applied in clinical practice through value-based medicine, which reflects and grapples with these absences in evidence-based medicine. One of the main objectives is to take the correct approach when trying to understand and, in a way, treat our subjects with the implementation of literature as a manner of therapy.

The methodological approach was based on these previous studies on the effectiveness of bibliotherapy. It is considered that, given the literature's effectiveness as a reflection medium, it could impact the attendees in their everyday practice (10). The most common therapeutic intervention used for bibliotherapy is CBT. CBT helps clients identify their distorted and depressogenic thinking and learn more realistic ways to frame their experiences by reading and conducting exercises that are completed at home, with minimal or no supervision from a therapist (10).

The results showed autonomy and justice linked with positive results in bibliotherapy often because this type of therapy could promote empowerment, decision-making, and problem-solving. Enhancement of clinical autonomy was also often reported where patients were prone to participate in their own treatment, reducing the caregiver's burden by improving compliance and reducing anxiety episodes. Though the role that reflection plays in reviewing the experience of others and how it strengthens self-control and decision-making is not clear, its effects are noticeable.

Bibliotherapy is a complementary resource to the clinical treatment of a disease. It is a strategy that helps patients, through literature, to cope with their situation by identifying with the experiences lived by the characters, and from reading, to develop their own tools to make better decisions about their health and exercise control over their lives and their illness. It is well-known that literature, as a reflection of human existence, leads those involved to reflect on themselves and their environment, and that, in addition to its esthetic character, it possesses the richness of confronting individuals with their emotions, values, feelings, and conflicts. It is also a way of helping individuals express, live, and solve these. It is an intrinsic character of literature to serve as therapy, catharsis, and cure for any conflict that disrupts our existence, and that is why human beings have always resorted to it (and, of course, also to the arts) in some way as the best medicine for life.

The process involves three phases: identification, catharsis, and insight (34). First, the reader creates a bond with the character with whom they identify most; then, this character encounters a conflict and resolves it; and finally, the reader, having experienced the conflict of the character through the text, reflects on personal circumstances and internalizes some behaviors represented in the book that will serve as tools to resolve their own conflicts. Nussbaum (35) for the same reason points out that "the novel's capacity to explore the length and breadth of a life, but the combination of this exploratory power with the presence of a character who will count as a high case of the human response to value, that creates the telling argument."

The key to moral behavior not only implies theoretical understanding, but it must be connected with practice, unleashing a clear consciousness in the reader in such a way that unpacks their moral objectives, values, and hierarchy of values, creating moral abilities involved in reading and interpreting it (35, 36). Hence, patients can re-signify their own matters, being able to think about their lives and conflicts from a broader moral horizon.

In this study, we explored the heterogeneity of the outcome of bibliotherapy and its value network relationship. The results implied that the patient uses and develops several capacities in an indispensable way such as emotion, creativity, values, moral horizon, and imaginative capacity. This means that, as readers, we assume the challenge of unpacking our imperfections (such as physical, ethical, and axiological). Nussbaum (35) expresses it this way, "We notice the way we are inclined to miss things, to pass over things, to leave out certain interpretative possibilities while pursuing others." In brief, to teach us "how we should live." However, as Pellegrino [(37), p. 16] states: "She or he can enmesh us in the variegated particulars of an imagined life, but that cannot replace the hard work of normative ethics. In the end, the reader must choose whether to accept, reject, or modify his or her own way of life in light of the experience gained by the evocations of affect and thought in a work of fiction."

Patients with psychosis improved in their clinical symptomatology and cognitive and psychosocial functioning after having attended a reading group program compared to patients who did not attend such structured activities. Patients who attended the group also reported that reading activity had a positive impact on group cooperation dynamics and that it was perceived as highly pleasant, useful, and interesting (22). Although not to be taken as a single means to treat a patient, it is an aid to other kinds of therapy such as CBT.

The scientific literature reports demonstrate certain benefits from bibliotherapy, maybe not surpassing those of other psychological treatments, but since one of the advantages of the treatment is that it can be widely available, bibliotherapy can and should be considered when developing public policies to help take care of the mental health of those affected by the COVID-19 pandemic, and for physicians, nurses, and other healthcare professionals to cope with the saturation of healthcare services during the COVID-19 pandemic. There is still plentiful details of the treatment and the phenomenon to discover and

be systematically assessed to expand the benefits for health personnel and prevent diseases such as sleep disorders, anxiety, depression, and burnout, which greatly decrease the quality of life of communities and healthcare professionals. However, some thought must be given to the mechanisms of implementation of such therapies, where the most common instruments of bibliotherapy are books, which are currently difficult to share. In this sense, electronic books and materials would probably be a better option for implementation.

CONCLUSION

After this systematic review, we respond to our main research question, building up the road map, and many conclusions regarding bibliotherapy can be drawn. First, when the methodology of a bibliotherapy treatment is conducted cautiously, positive effects can be seen, regardless of the diseases. It can be noted that bibliotherapy treatments promote values as supplementary profit. One of the main positive aspects of bibliotherapy is that it is a low-cost alternative that can reach those unable to access treatment during the COVID-19 pandemic; it is an integrative and multidisciplinary treatment that links psychology, medicine, humanities, and literature. Hence, this means that bibliotherapy could potentially be applied to a larger population and healthcare personnel and, when implemented in a structured way, could have a positive impact on enhancing mental health amid the COVID-19 pandemic.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

MA-B, NA-B, PS, and AH-B conceived and designed the experiments. DM-F, IM-C, MA-B, AH-B, PS, and NA-B performed the systematic research and/or bioethical meta-analysis, and analyzed the data. DM-F, IM-C, MMA-B, SR, AH-B, PS, MA-M, and NA-B wrote the paper and contributed to helpful discussions. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2021.629872/full#supplementary-material

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Bridging the Gap: Exploring the Unique Transition From Home, School or College Into University

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Although previous research has shown that psychological distress increases on entering university, little is known about first-year student perspectives on the stressors in university environments, and what measures might better support student mental health and well-being during the transition period. The present research seeks to bridge this gap by exploring the unique transition period from home, school or college into university in order to identify aspects of the university experience (teaching, curriculum, support services, accommodation) that could be adapted to better support student mental health and well-being. Eight focus groups were conducted across two higher education institutions in North West England. Focus group data were thematically analyzed. Four overarching themes were identified: "*Tackling multiple challenges*"; "*The preparatory role of schools and colleges*"; "*University staff and services: Feeling supported/unsupported*"; and "*Friendships*." Although pressure to perform academically whilst fulfilling the stereotypical student life is keenly felt during the transition period, many students conceal their struggles from family and friends. Living beyond their familiar support structures often leaves students in need of compassionate humans to turn to for support or advice, especially as many keep their struggles hidden. Large-group teaching settings stifle social connection and leave students feeling lonely. Loneliness was also experienced within accommodation environments. Providing increased opportunities for connection within living and learning environments would enable young people to build and strengthen relationships with fellow students and staff. As supportive environments foster a sense of belonging and community, universities should ensure that students feel supported by staff and peers whilst they acclimatize to multiple new challenges.

Keywords: first-year student experience, transition period, loneliness, sense of belonging, friendships and relationships, well-being

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INTRODUCTION

While starting university is exciting and liberating (1), the transition period can be stressful, especially for those who are relocating (2). In Britain, over 80 per cent of full-time students leave their family home to attend university (3). The transition to university coincides with a critical developmental period during which young people leave their family home whilst their brain is undergoing accelerated growth and shows heightened sensitivity to stress (4). There are a number of unique stressors associated with moving from home into shared accommodation such as

living with strangers, developing independence, and managing domestic commitments (5). Many students are also required to work part-time alongside their studies to support themselves, and this often exacerbates stress (6). Indeed, psychological distress increases on entering university (7, 8). Many students who drop out of university do so during the first few weeks of term (9), with well-being concerns being the most commonly cited reason (10). On the other hand, positive transition experiences enable students to cultivate a sense of belonging, which can enhance feelings of well-being and lead to increased academic success (1, 9).

Student preparation is one factor that determines whether an individual experiences the transition as positive or negative. Indeed, the opportunity to cultivate social and navigational capital enables young people to settle quickly into their new environment (11). For example, students who completed a pre-entry programme reported higher academic self-efficacy and satisfaction than traditional route students within the first few weeks of their academic study (11).

Students entering higher education (HE) become responsible for their own learning and achievement (12, 13). This increased responsibility and the need to manage time across multiple demands can lead to increased levels of stress and anxiety (14). As students' expectations diverge from the reality of their first-year at university, their ability to adapt to their new learning environment can be hampered (15, 16). While students are expected to become independent learners during the transition period, many are unaware that this is a key requirement for success and report not possessing the necessary skills for effective independent study (16, 17). Feeling unprepared for independent learning is cited as a cause of withdrawal from studies (18).

Crabtree, Roberts and Tyler (19) interviewed college tutors and university lecturers to explore the similarities and differences in learning environments, with a particular focus on teaching styles. Whilst the primary emphasis for college tutors was on student success and achievement, university teachers placed more emphasis on motivating students to develop an interest or enthusiasm for their subject and expected students to take personal responsibility for their learning (19). According to a recent report, college teachers express concerns about the transition to independent learning (2). More specifically, as students are often "spoon-fed" information to help them achieve high grades in schools and colleges, teachers perceive self-directed learning in HE as a marked change from earlier education (2). College teachers also express concerns regarding levels of support in HE institutions, fearing that students may "slip off the radar" if they are struggling academically as university staff often have less capacity to spot signs of distress (2). Compared to school or college, university students receive less support and often experience difficulties in getting to know their academic tutors due to large-group teaching settings (20).

In line with this, students also experience difficulties in getting to know their course peers (20). Although course peers were found to be an important source of support, students' living arrangements were found to be central to the process of making compatible friends (21). Wilcox et al. found that friends in halls provide direct emotional support, equivalent to family relationships. This is especially important considering that, for many students, this is likely to be the first time they have lived away from home. However, as building meaningful relationships with others takes time, students often feel lonely during the transition period (5). According to a recent report, forming new friendships at university can be stressful, and many young people experience pressure to establish and fit in with a new group of friends (22). Indeed, a gap exists between applicants' expectations of a busy and fulfilling social life at university, and the reality that making friends cannot be guaranteed, especially with those you live with (23). Jopling and Valtorta (24) found that students were spending on average 4.2 h per day alone in their room, and over a third of those who reported spending longer than 4 h alone also reported not having friends to spend time with. Many students expect to interact more regularly with others at university more than school, and often students are disappointed when this does not happen (22). According to Neves and Hillman (25), a quarter of students who rated their university experience as worse than expected claimed that this was due to limited interaction with other students.

As the transition from home to halls engenders significant changes in young people's social networks and the primary support system often shifts away from family and high-school friends (26, 27), it is important to ensure that universities provide supportive environments (28). Although the quest to develop supportive networks is an integral part of the first-year student experience, developing new support networks may be particularly important for those who live in halls of residence as they are physically and emotionally separated from family and high-school friends. The current research aims to provide a rich insight into the resident student experience of the unique transition period through qualitative means with a particular focus on the transition to independent living. By exploring factors that facilitate or hinder a successful transition, we aimed to identify aspects of the university experience (teaching, curriculum, support services, accommodation) that could be adapted to better support students during the transitional phase.

METHODS

Ethical Approval

Ethical approval was received from the University's Health and Life Sciences Research Ethics Committee (5762). The participants provided their written consent to participate in this study.

Participants

A total of eight focus groups were conducted across two higher education institutions in North West England including a Russell group and a post 92 institution, namely the University of Liverpool (UoL) and Liverpool John Moores University (LJMU). Students studying at UoL reside in university-owned accommodation (UOA) whereas students studying at LJMU reside in privately owned accommodation (POA). Participants were recruited to participate in the study via bulk emails and flyers. In total, 38 first year students participated in the research,

and were remunerated for their time. Thirty-three females and five males were engaged in the eight focus groups with group size ranging from four to five. The majority of participants were between 18 and 19 years old. In the context of some Research Ethics Committee concerns regarding assurance of confidentiality of those involved in these focus groups where matters to do with well-being were discussed, the authors chose not to gather detailed demographic information that could identify students.

Focus Groups

Focus groups followed a semi-structured set of questions. Within focus groups, most students answered each question although some contributed less to the overall discussion. Examples of topics covered included adapting to university life; expectations about what it would be like; challenges during the transition; and factors that helped or hindered the process. The focus group interview schedule can be found in **Supplementary File 1**.

Each focus group was conducted by the first author. Data collection was carried out during November and December 2019, which corresponded to semester 1 of the first year at university. Focus groups were conducted in students' halls of residence so the environment was familiar to participants. This ensured that there was an appropriate member of staff (e.g., a residential adviser) to draw on if required. Each focus group lasted 1 h and each discussion was recorded using a Dictaphone. Data were anonymised at the point of transcription. All transcription was undertaken by the first author to allow maximum data immersion.

Analysis

Focus group data were analyzed using thematic analysis by the first author who was trained in qualitative methods. Thematic analysis is a flexible qualitative method that aims to identify, analyse, and report recurrent themes in data. The five steps for conducting thematic analysis as outlined by Braun and Clarke (29) were followed. Initial and repeated viewing of the transcripts was undertaken, considering both contextual and reflective notes. Although there were some pre-determined areas the researcher wanted to explore, line by line coding derived from a largely inductive approach ensured that data were not overlooked. Although line by line coding was undertaken by the first author, research meetings were held throughout the coding process to examine emerging impressions of the data. The initial themes captured by coding were refined during discussions with another member of the research team to produce the final themes and subthemes reported below.

RESULTS

Four overarching themes were identified from the data: "*Tackling multiple challenges*"; "*The preparatory role of schools and colleges*"; "*University staff: Feeling supported/unsupported*"; and "*Friendships.*" A number of subthemes were identified in relation to each overarching theme (see **Table 1**).

TABLE 1 | Overarching themes and subthemes.

Themes	*Subthemes*
Tackling multiple challenges	*Complex life transition*
	Anticipation versus reality
	From a class of 30 to a cohort of 300: From spoon feeding to holding your own
	From home to halls
	Financial pressures
The preparatory role of schools and colleges	
University staff: Feeling supported/unsupported	*Academic staff*
	Accommodation staff
	Support services staff
Friendships	*Forming friendships in a lecture hall: An impossible task?*
	Friendships in flats

Theme 1: Tackling Multiple Challenges

Complex Life Transition

Although young people found starting university exciting and liberating, certain aspects, such as living away from home, were found to be stressful:

> "*Exciting and like liberating. You were more independent from your family so I suppose it made me feel free in a way. I think over time you sort of feel stressed because some of us are from a different country, like I'm from Ireland, so it's hard not seeing your family for a few months*" (POA FG3 p1).
> "*I found it exciting but also being from Northern Ireland and being away from home it's hard. I wanted to be more independent and free which is why I chose to go overseas and not stay back home because it is more liberating to able to be yourself and make your own choices*" (POA FG3 p4).

For the majority of students, this was the first time they had lived away from home, and sharing a living space with unfamiliar people was difficult:

> "*Up until university I had never been away from my family for more than three days*" (POA FG1 p5).
> "*It was a bit hard at first because I'm used to walking around like seeing your family in the house and you walk and you are just seeing people who you've only just met*" (UOA FG4 p1).

As starting university involves several periods of transition, many young people struggled to navigate multiple new environments:

> "*We are all dealing with a lot of stuff at once you've got your accommodation, you've got your course starting, meeting friends etc. I think a lot of people are well fragile might not be the right word but they are kind of in that stage were they might be struggling a little bit*" (UOA FG3 p5).
> "*It is difficult though because there are so many factors. It's not just is this the right course for me, it's is this the right city? Is this the right accommodation? Is this the right time for me to progress my educational career? There is a lot you have to consider*" (POA FG4 p3).

Thus, for many of the resident students involved moving away from home was challenging because of the need to adjust quickly to multiple new educational, social and physical environments.

Anticipation vs. Reality

Students' expectations often diverge from the reality of their first few months at university, and this can leave them feeling disappointed:

> "*You have these expectations about what it's going to be like and then it's different, like social stuff. I get on with all my flatmates but it's just different to how everyone said it would be or you have this massive expectation of university being this life changing experience and sometimes you get here and it's just university*" (POA FG3 2).
> "*Before you go to uni, people make it out as though it's going to be the most amazing experience and everyday is going to be amazing, everybody is going to be so friendly but you just have to be more realistic with yourself and accept that it's just life and it's not amazing all of the time*" (UOA FG2 p4).

More specifically, many students were expecting to experience the "best years" of their life at university:

> "*I do think there is almost like a pressure that uni is going to the best years of your life, you'll love it and I didn't love it straight away*" (POA FG4 P4).
> "*In the first few weeks I found it really tough because I was like why am I not having the bestest time in the world when I've been told I should be*" (UOA FG1 p2).

It is also common for students to expect to form lifelong friendships, believing that cultivating these friendships will be an easy process:

> "*It's very much like you are going to find your 'friends for life' with your flat and things like that and when it's not like that it's a bit disappointing*" (UOA FG4 p1).
> "*Everyone says you will be fine making friends at uni but it's actually hard*" (UOA FG1 p1).

Students described their expectations of university as a positive "life changing experience" and being fun-filled with new friends. However, this was not the reality for most. Thus, the mismatch between the idealized image of the university experience and the lived reality was commonly heard.

A Class of 30 to a Cohort of 300: From Spoon-Feeding to Holding Your Own

As students in HE become responsible for their own learning, many found this to be a marked change from earlier education. In particular, young people are often "spoon-fed" information in order to achieve at school or college whereas studying at university requires greater autonomy:

> *"I think with school and the way it is structured, you are spoon-fed everything from GCSEs then to A-levels and it's all part of a natural progression. Then you come to uni and it's like not only are you in a new city, you've also got new people in a new environment and then a new teaching style and it is a whole new structure of education"* (UOA FG1 p2).
> "*I think it's completely different to A-levels because I've been told that I've got two essays to do and we've literally just been given our questions and they have just said do this essay and at A-level they just gave us more structure and guidance. Then you just get thrown into lectures and you're taking your own notes and if you miss one it's your own responsibility. You are more responsible for your own learning*" (UOA FG1 p1).

Compared to earlier education where young people are taught in small groups of around 20–30, students in HE are often taught in large group settings:

> "*It's a very different kind of learning in terms of uni itself so it's not as one on one because there are almost 300 of us. There is no direct help you've got to put the effort in yourself*" (POA FG2 p2).
> "*I wasn't expecting the lectures to have 550 people in a lecture trying to learn everything and know everything by yourself because I did a btec and everything was pretty much just given to me. That's what they don't tell you that at university how much you've got to do yourself*" (UOA FG3 p3).

Young people perceived school as a familiar environment where they received personalized support from their teachers. In contrast, students found that there was less personalized support on offer at university, and often felt as though they had become just "another face in the crowd" (UOA FG2 p4):

> "*I feel education-wise, study-wise, coming from school to uni is whole change. In school, you are in one classroom with 30–40 people so the teacher knows each and every student. If any student has some problem they can just approach the teacher but in uni it is a lecture room filled with 150–200 people*" (UOA FG3 p4).
> "*You lose your identity a bit in university. I think everyone does just because of the sheer number of people. You become just another person rather than having that whole life around you like you would have done when you were at school*" (UOA FG3 p5).

Some students struggled with their work and/or workload, especially those who were undertaking placements alongside their academic studies:

> "*He told me a few problems he couldn't do and the course was a little difficult. He's actually smart but he felt left out. It was more his anxiety of being less than other people*" (UOA FG3 p4).
> "*My course is a lot different to what I thought it would be. It's a lot harder and I can't handle the work which I wasn't expecting because at college I'd always do it. I do a 60-hour week in the ambulance and then my lecturers put something up about the nervous system that they want you to learn by yourself. I think a lot of it is that you have to learn by yourself and when you don't know what you're learning it's quite hard to do that*" (POA F2 p4).
> "*We don't have to go to lectures as we just get sent them but even so they give us more hours of lectures than you could even fit into those days so it isn't like being in 9–5*" (UOA FG2 p5).

In summary, following the marked change from earlier education, students expressed genuine concern regarding their ability to carry out educational tasks such as completing work,

acquiring knowledge from online lecture content, and keeping up with the standards of academic excellence set by other students.

From Home to Halls

There are a number of unique challenges associated with moving from home into shared accommodation such as developing independence and managing domestic commitments. Many young people referred to a reliance on parents:

> "*I'm only 18 and you are just thrown from a pit of being at home with your parents 24/7 sorting everything out to being by yourself, to doing everything by yourself and it is stressful trying to adapt to that situation*" (POA FG3 p4).
> "*When you were at home you never thought you would have so much responsibility because when you are at home you get fed three times a day, your mum does your washing, literally everything, you come home and she's changed your bed*" (POA FG4 p2).

Further illustrating the dynamic of interpersonal dependence, certain aspects of independent living, such as cooking and cleaning, were highlighted as challenging:

> "*I'm used to coming home to a plate of food to thinking have I got the meat? Did I take it out of the freezer? Everyday I forget to take the meat out of the freezer and I end up going to the takeaway*" (POA FG4 p1).
> "*The amount of times I've literally just been sat in my room and I've just forgotten to make my own tea and then it's got to 9 o'clock and I'm like oh I should have done that*" (POA FG1 p4).

Some students acknowledged that their diet had worsened upon starting university, and this had an impact on their physical and mental health:

> *"I don't buy fruit for myself. I'm used to my mum buying it and telling me to eat it and then I realized I'm tired all the time and my diet is absolutely awful"* (UOA FG4 p2).
> "*At one time I didn't want to speak to anyone. I didn't want to go out. I just wanted to be alone in the room. I had to force myself to go and socialize which was really hard for me but it was all down to what I was putting in my body*" (POA FG3 p4).

As parental figures often take control of the household duties and chores, some students found it difficult to share a space in a co-operative way:

> "*I have really bad OCD and they don't understand that if you leave pots on the side it's going to be used and if you leave it dirty it really stresses me out*" (POA FG4 p1).
> "*If you've got that thing were you want the dishes to be washed straight away and another person doesn't, it then becomes that's annoying me. If I try to deal with it and say look can you please wash it, and they don't like it, it then starts an argument*" (UOA FG3 p3).

Living in student accommodation alongside strangers often leaves young people feeling lonely and homesick, especially if they feel they do not fit the mold:

> "*I got homesick because you are away from your family and you are basically living with people you've never met in your life so it's quite odd*" (POA FG1 p2).
> "*I got here and I was like I just want to be at home because I was just so lonely. I don't really go out and I thought there would be more to do if you didn't go out*" (POA FG4 p3).

This subtheme illustrated the adjustment associated with moving from home to halls that resident students go through. For the majority of students, this will be the first time they have lived away from home, and they have to start managing many aspects of life independently. Feeling lonely and homesick is a common experience.

Financial Pressures

Many students struggled financially. Budgeting was often cited as a cause of worry:

> "*There is also the finance stress of it as well. That's a massive thing and budgeting because it's like I want this thing but I realistically shouldn't do that*" (POA FG2 P2).
> "*I think budgeting as well. Say I have 50 pounds per week to spend on everything so it's knowing how much of that money to spend on food for the week and how much to spend say if I went on a night out. I find that quite hard*" (POA FG1 p2).

Financial concerns were heightened for those undertaking placements alongside academic studies:

> "*I'm doing nursing and it's full-time so I can't get a job so then I'm having to ask my mum for money for trains to get to placements and it's just very stressful. It causes a lot of stress really*" (POA FG1 p2).
> "*I think for us with nursing we have to pay £4 for the train ticket. £4 a day when you are on placement four times a week, that takes up quite a lot of your £50 budget and you've got to remember that every month you have your phone bill which is £20*" (POA FG1 p4).

Accommodation costs take an increasingly large portion of young people's student loans. In fact, some students highlighted that accommodation costs were either equivalent to, or greater than, their student loan:

> *"My loan didn't cover my accommodation. My parents last month had to pay an extra 600 pounds toward the accommodation and have to give me money weekly"* (POA FG1 p2).
> "*I think I've managed to do my finances well because my cost of rent and the amount I get from student loan is basically like the same so I can disregard them both*" (POA FG1 p5).

As a consequence, many students worked part-time alongside their studies to support their living situation; however, this often exacerbated stress:

> "*If you can't afford things like you've got to balance if you can afford food or going out and which is the better option. I've got two jobs as well as uni because I've got to pay for my life basically so it's like added pressure*" (UOA FG2 p1).
> "*I have found trying to juggle my money hard so I have had to work a little bit as well just to make sure I've got enough money but then*

when you are working you are not concentrating on your degree as well so I have found it hard to balance them both" (POA FG3 p3).

Pulling this together, it seems that many students felt that they lacked budgeting skills. Financial pressures led to students working alongside their studies, which was perceived to exacerbate stress. Parents need to provide financial support added to the sense of pressure with many students taking part-time jobs as well as relying on parental support.

Theme 2: The Preparatory Role of Schools/Colleges

As many students struggled to acclimatize to their new living environment, it was felt that schools and colleges could prepare students for independent living by embedding preparatory life skills workshops into curricula:

"*Sometimes I think it's not the actual uni that's stressful, it's more the living and budgeting and living with other people and you are not really told about any of that. Maybe teach us more about budgeting and life skills*" (POA FG2 p3).
"*We had no support on money or even like cooking meals. Even though it's like the little things, it is what makes your experience living in halls so much different*" (POA FG1 p4).

Although schools and colleges help young people with the application process, young people would appreciate assistance in preparing them for self-directed learning and the independence that ensues:

"*My college did really help with the academic side so 'you need to do this to go to uni'. UCAS forms they helped us so much and applying and looking but then it's the actual transition from going from college 9-4 to being in uni and being totally independent with your studies and your life in general*" (POA FG1 p4).

One way by which school or college teachers could prepare young people for higher education is by treating them as adults and giving them additional responsibilities:

"*I think they could treat you more like an adult in school because I think they continue to treat you like a child*" (UOA FG3 p3).
"*One of the things with sixth form is that the teachers say oh we are going to treat you like adults now and then they don't*" (UOA FG2 p5).

Taken together, as schools and colleges focus only on the application process, students felt ill-prepared for living at university. The data suggest that students would welcome the opportunity to attend workshops in FE settings focusing on cooking, finances, budgeting, and independent learning and living to ensure that they are adequately prepared for the transition to university.

Theme 3: University Staff and Services: Feeling Supported/Unsupported

The Role of Academic Staff

Some students felt supported by their lecturers in their new learning environment:

"*I do fashion communication so my course is really small so my lecturers know me really well which is a good thing. I can email my lecturer and be like 'oh I'm having a meltdown' and he would be like 'right don't panic, come and see me at this time'. He knows who I am. That's the thing I really like*" (POA FG4 p3).
"*At uni they do treat you like an adult but they treat you like an adult who is fragile and who needs to be taken care of which is exactly what I am*" (UOA FG2 p5).

However, other students did not feel adequately supported, and were often left feeling as though they were "another face in the crowd":

"*I did expect to have some more support from my lecturers. I think it's quite easy to just slip through the net with it and have no idea what's going on when everyone else does. It is quite hard to ask for help especially when you're in front of so many people*" (POA FG2 p2).
"*I thought we would get more support from the uni than we do because I feel like we get no support at all not with my health and stuff but the work as everything is online and the teachers make you feel like you're being an inconvenience if you email them so they do these online discussion boards but I don't like them. I really don't*" (POA FG2 p3).
"*We got told our academic advisers and things like that and I had in the back of my mind I've got this academic adviser if I am super stressed it's fine but then nothing has happened with them and I haven't seen them and I couldn't remember who they were. I was expecting a meeting*" (UOA FG4 p3).

To summarize this section, students undertaking courses that have a small cohort size feel able to approach their lecturers and regard them a source of assistance when they are experiencing difficulties. By contrast, those who are part of a larger cohort of students do not perceive the support to be adequate, and identified problems around lack of approachability and availability.

The Role of Accommodation Staff

Within shared accommodation, young people value staff who are friendly and approachable, and they feel valued when operational teams organize events:

"*I think it's good that you come in and there's always going to be someone on reception and they're so nice and they are so friendly. There are a couple of young people so it's quite good as you can go and say something that you might not want to say it to someone that's like your parents age*" (POA FG4 p3).
"*Staff-wise everyone is lovely and friendly and they want to be there to support you and do little things like the Halloween party they did for us. It makes you feel as though they do really care about you. You are not just a flat number, you are a person because they are doing it for you*" (POA FG3 p4).

In university-owned accommodation, residential advisers (RA) live alongside students in order to offer support. There were, however, inconsistencies, as some students felt supported by their RA whereas others did not:

> "*I've got [name of RA] and she's so nice. I think it was yesterday or this morning, she came in and just said how are you all getting on kind of thing. She literally just came in for a 10 minute chat like is everything ok? How are you getting on? So I do feel supported by the RA*" (UOA FG2 p5).
> "*I've only seen the residential adviser [once]. Are they just there to stop fires or are they there for support?. He hasn't dropped in to say I'm still here if anybody wants to talk to me. I don't even know what room he is in so if I did need to find him I would be lost*" (UOA FG4 p2).

In light of this, it would be beneficial for all RAs to be proactive in getting to know the students living on their floor in order to enable them to feel comfortable approaching their RA in a crisis:

> "*Even if they just drop by every two weeks for 5 minutes, that would be more than what we've had*" (UOA FG4 p2).
> "*People can present themselves in a certain way and then go back to their room and be depressed, anxious and they don't want to put on the front as being the depressed person in the flat so they hide it very much because they want to look and fit in with everyone else and not be the person who causes problems by not feeling 100% so I feel like definitely having services share with accommodation is definitely be beneficial and just having little prompts to make sure people are ok can make the world of difference for people*" (UOA FG4 p1).

Taken together, operational teams and residential advisers appear to be a source of support for resident students. Many students discussed the importance of having friendly and caring staff who they feel able to approach and confide in.

Support Services

Mental health and well-being support services are widely advertised across university campuses, and students found this to be beneficial:

> "*I think from what I've seen the university has been really on top of mental health issues. There is a lot of information out there and they do things on Instagram and Facebook and it is really pushed so honestly from my perspective the university does do a lot from a mental health perspective, especially for new students*" (UOA FG4 p5).
> "*When you are walking through uni there are posters everywhere and billboards even, and the big cardboard stands. Everyone makes sure that not only is there support, it's in your face here is the support so people walking past, you don't have to walk up to someone. The information is put up there for you to see which is quite good*" (POA FG3 p1).

On World Mental Health Day, UoL support services had a stall in university square to advertise their mental health support offer, and students valued this informal approach:

> "*There was the World Mental Health Day and there was a stand and the free coffee was an incentive to go over and talk to people. You could just go up and talk to people so I think doing things like that where it's not an organized event so someone might be having a really bad day and seeing that stand walking past, saw there was free coffee and just walked up. Just something that is really casual because someone would feel more open to talk*" (UOA FG4 p3).

Students discussed the importance of casual support offers, and would welcome the opportunity to have "mental health check-ups":

> "*You have check ups for physical health, why can't you have check up for mental health?*" (UOA FG4 p1).
> "*You see so many people saying we need to talk about mental health and people get scared of it so it almost has the opposite effect so if it was just casual it would be normal*" (UOA FG4 p2).

Some students suggested ways in which university support services could be improved. At present, there is an over-reliance on students to communicate causes of stress. However, young people are often reticent and prefer to keep their struggles hidden:

> "*They have mental health and disability drop-ins sessions but it is very much up to the individual to put the effort in to go and attend those when there's not as much online support than there is the face to face support*" (UOA FG3 p1).
> "*I know you can still use ChildLine up until 19, but if there was something that was university-focused that would be quite beneficial. So if you were in your room isolating yourself, that would be very beneficial in my opinion because you wouldn't have to leave your room. You don't have to fear speaking to anyone and what you might need to release, in terms of what has built up inside you could really benefit from typing it, writing it*" (UOA FG4 p4).

Last, some students face the challenge of discontinuity of support on arriving on campus as the transition between home and university disrupts the established therapeutic relationship with their clinician. Due to high demand for psychological therapies, it is common for students to join a waiting list at university. Thus, it would be beneficial for universities to support vulnerable young people whilst they await therapy:

> "*I know you instantly get referred for support off the university but sometimes just more of a extra bit of help to say you've been having therapy back home up until you move to university and then you suddenly have that striped away from you like more of a transition into a different sort of help rather than just going into not having any help and having to wait a significant amount of time if you are used to a certain way of being seen by someone*" (UOA FG4 p1).
> "*My mum was very weary because we know how hard it is to get a therapist or anything across the country at like your age and waiting lists are ridiculous so we were very much like you don't want to have that in the back of your mind that you're on a waiting list at uni. You almost just end up being an object on the waiting lists like you don't really feel like you are a priority and I think that would have stressed me out more if I tried to start it here*" (UOA FG4 p3).

Data falling under this subtheme illustrated that some students expected poor care from the outset because of long waiting lists.

Others articulated the importance of having an online support service staffed by people who are familiar with university-specific issues.

Theme 4: Friendships

Forming Friendships in a Lecture Hall: An Impossible Task?

Some students felt integrated within their school or department, and a sense of belonging was often derived through feeling connected with others on their course:

> "*I do feel like I belong as a Liverpool physio[therapy] student because I've found people I get on with and we are together all the time*" (UOA FG2 p5).
> "*I feel part of the Classics department. I think we are very close as a department*" (UOA FG2 p2).

Attending a course induction week or reception was highlighted as an important way to form friendships with course peers:

> "*We had the reception at Garston museum because we are doing Classics. We met there and we found some other people there so that's how we found friends really and everyone in Classics are nerds so we all have the same interests*" (UOA FG2 p2).
> "*The people I met on my course in the induction week, I'm still friends with them now and I feel without that I would have had a different experience*" (UOA FG4 p4).

Forming friendships with course peers is important as peers provide a source of emotional and practical support:

> "*There are 70 of us and you go out in the ambulances and you can see anything so you use everyone as a support mechanism*" (POA FG2 p2).
> "*Support system. We do the same course so if one of us needs help we can help the other person even if it is just proof reading something for someone that is helpful*" (POA FG2 p4).

Some people experienced difficulties forming friends with their course peers, and many cited large-group teaching settings as a barrier:

> "*I also think it's quite hard to find friends on your course because when you are in lectures you can't really speak to anyone and then in seminars not really either. I do Psychology and there are 300 people there so I literally can't speak to anyone*" (UOA FG2 p1).
> "*I haven't made that many friends on my course, especially in the lectures, everyone sits in a different place each time so you never really see someone for long enough to start making friends*" (POA FG2 p3).

In fact, large-group teaching settings stifle social connection and leave students feeling isolated:

> "*You still kind of feel by yourself even though you are in a lecture hall with 300 other people. You still feel like just by yourself because you don't know anyone. You don't have anyone to talk to*" (POA FG1 p4).

Students acknowledged that small teaching groups, such as seminars and tutorials, are useful in aiding the process of friendship development as these settings facilitate student-student interactions:

> "*It's more in your tutorials that you can actually speak to someone because it's a smaller group. Even then it's like you are just speaking to someone for an hour and then you'll go your separate ways until next week*" (POA FG2 p3).
> "*With our course we don't have seminars we only have lectures literally just lectures so seminars where you go into a group and talk and stuff we don't have any of that side so we literally just sit there, have someone talking at us and then go. We don't have any group seminars where you sit there talking to other people*" (POA FG1 p2).

In summary this subtheme illustrated that the course structure can facilitate or impede the pursuit of supportive friendships. Students desire more opportunities for connection using small group teaching and learning methods as simply being on campus attending lectures does not appear to be enough to reduce feelings of loneliness.

Friendships in Flats: Throwing People Together

Feeling integrated within shared accommodation is also important during the transition period. Some young people gelled with their flatmates easily, and this had a positive impact on their experience:

> "*In this accommodation, I have gelled with a lot of people to the point of hobbies and interests*" (POA FG3 p4).
> "*I didn't find it as hard as I thought it was going to be but I think that's because the people I met in my very first week, my flatmates, are really lovely*" (UOA FG4 p4).

Flatmates are able to provide a source of emotional and instrumental support, which is particularly important as young people's familiar support network becomes remote when they move to university:

> "*I remember one night I was properly upset here and all I wanted was my mum and it was just hard because a phone call is not the same as seeing in person but yet again if you do have good flatmates it helps to be honest so you can talk to them*" (POA FG3 p4).
> "*I've found it really hard being away from my family. I think it depends on who your flatmates are as well because I found it a lot easier to talk to my flatmates as opposed to if I didn't get on with them so that's made it easier*" (POA FG3 3).

As some students' support needs are adequately met by their flatmates, over time this source of support begins to replace their reliance on their familial support system. However, others struggled to form interpersonal bonds with their flatmates due to different preferred means and methods of socializing or lack of shared interests:

> "*I don't get on with my flatmates that well. We don't have similar interests or hobbies*" (UOA FG2 p3).
> "*Everyone in mine is quite antisocial and quiet. I do feel quite lonely*

at times because they are not the people to come out and socialize with you" (POA FG3 p4).

Despite experiencing loneliness and/or perceiving their direct social support as inadequate within their accommodation environment, some students concealed their struggles:

"*I think it can be quite isolating as well because you move away from your friends and family and then if you're not really making friends, you feel quite lonely and I think you start to panic and then you might not necessarily want to tell your parents you're feeling like that because you don't want them to worry and you don't want to stress them out and then you just end up feeling lonely by yourself*" (POA FG2 p1).

Young people would welcome the opportunity to foster friendships with fellow students living in their accommodation:

"*As much as we are adults it would be nicer to have more support in getting to know people and stuff like making it feel more of a community because I do feel as though we have just been left to our own devices*" (POA FG1 p4).
"*Even if it was a case of your floor in your block, having like an opportunity to arrange events because then you will have more contacts on your floor and that's not necessarily (name of accommodation) wide but it will still create a sense of community if you are making more friends in your Block because then if you are having difficulties with your flatmates then you still have someone to reach out to who is relatively close to you*" (UOA FG4 p1).

Students highlighted the importance of living with similar others who are able to provide the social support that is so crucial during the transition period. Fellow residents share a mutual understanding and can provide immediate emotional support. Nevertheless, as some students struggled to form interpersonal bonds with their flatmates, loneliness was keenly felt by some.

DISCUSSION

The present study provides rich detail of the early first year student experience from the perspectives of those living in halls of residence. Consistent with previous research [e.g., (21)], our findings demonstrate that resident students require support whilst navigating their new academic environment, and as they acclimatize to their new living environment without their pre-existing support networks of family and friends. Although pressure to perform academically whilst fulfilling the stereotypical student life is keenly felt during the transition period, many students conceal their struggles from family and friends.

In line with previous work [e.g., (5)], there are a number of unique challenges associated with the transition. One major challenge young people encounter is developing independence. Before moving to university, young people often have one or two elders advising them on every aspect of life. Young people also display a similar pattern of reliance on teachers for help. Living outside of these familiar support structures often leaves students in need of compassionate humans to turn to for support or advice, especially as many conceal their struggles. Consistent with previous research [e.g., (20)], some students found it difficult to make friends with their course peers. Large-group teaching settings stifle social connection and leave students feeling lonely. In line with previous research [e.g., (21, 24)], loneliness was also experienced within accommodation, with some students reporting dissatisfaction with the levels of support offered within halls. As these findings illustrate the importance of the human element during the transition period, universities should ensure that first-year students feel supported by staff and peers in residential and learning environments as they acclimatize to multiple new challenges.

Recommendations for Schools and Colleges

As the transition from school or college into university is a period of significant change, greater communication between schools, colleges, and universities would be beneficial. The data presented here suggests that a joined-up approach between schools, colleges, and universities is vital in order to achieve continuity of support. For example, perhaps HE institutions should receive more information from schools or colleges on their students' needs and any generic difficulties they have encountered. This would enable universities to appropriately support young people on arrival, and may prevent a young person from repeating details on any previous negative experiences.

As many students highlighted that schools and colleges focused only on the application process, preparing students for the transition into university may be beneficial. Workshops within FE settings that focus on cooking, finances, budgeting, and independent learning and living could be delivered to ensure that young people are better prepared for the transition to independence at university. Consistent with previous research [e.g., (30)], educating prospective students on budgeting and the cost of university before arrival may prove beneficial.

Recommendations for Academic Staff

During the transition period, academic advisers should be more proactive in getting to know their students to enable young people to feel comfortable approaching them if they are struggling with their academic studies. This could involve meeting with each student on a one-to-one basis to cultivate a trusting relationship, and to ensure they feel comfortable in their new learning environment. Consistent with previous research [e.g., (2)], it is important for academic advisers to offer more frequent pastoral support in a way that is mindful of the transition as students' feelings about their environment often impact their academic performance. This approach seems particularly advisable for courses with large numbers and lecture-based teaching methods.

To aid friendship development during the transition period, course induction events are critical. Similarly, as students desire more opportunities for social connection, particularly in large-group teaching settings, academic staff could embed icebreaker activities into lectures to encourage peer interactions.

As there is a need to reduce feelings of isolation in large-group teaching settings beyond the induction period, there are clear strategies, consistent with Social Identity Theory (31), around making small changes to curricula in order to increase identification with university and the course itself. For example, within large-group teaching settings, belonging-focussed learning activities could be embedded throughout curricula, and consistent with previous research [e.g., (21)], it may be beneficial for courses to implement more group-based projects to foster connections. As tutorials and seminars further support this idea, it may be beneficial for some courses to rethink the curriculum, especially those where learning opportunities are only provided in the context of large-group teaching settings.

It would be useful to address key issues that are important to people's well-being within smaller group settings such as tutorials. For example, discussing matters such as the transition into university and the process of friendship development using light-touch facilitation would open tutorial groups up to a more natural discussion. While such emotionally live group experiences are not commonplace in HE settings, enabling students to settle into a system that is less hierarchical and more focused on wisdom and experience would be beneficial. Whilst living at home, young people draw on parental wisdom, and as emerging adults, they are still developing socio-cognitive skills. As tutors have wisdom in the area that students are working toward and also in the lived experience of the HE system, both of those knowledge bases could be drawn on within tutorials. This approach would be beneficial with regard to students' academic performance, especially in disciplines that integrate group-based assessments, as sessions addressing key matters that are important to people's well-being will enable students to develop trusting and co-operative relationships with each other. These discussions help "we-ness" to emerge as groups of people connect with each other.

In addition to this, a structured peer-mentoring programme should be considered across schools within each university department. Peer mentors, who could be third- and fourth-year university students, would perform an integral pastoral duty that could be recognized and rewarded. As young people are isolated from sources of support when they move from home to university, it would be beneficial to simulate the small family-like community within their new learning environment. Parents would be simulated through the tutor system whereas older siblings could be simulated through the peer mentoring system. While challenges exist in establishing such initiatives, peer-mentoring programmes offer valuable benefits such as the promotion of well-being and acquisition of new skills for both student participants and student facilitators (32).

Recommendations for Accommodation Providers and Teams

Social Identity Theory (31) offers clear strategies that could be implemented within accommodation environments. To better manage the transition, accommodation teams could involve groups of students in the process of making decisions about the decoration of communal spaces in their accommodation. More specifically, students could be given the opportunity to make decisions about the plants, pictures, and layout of their lounge and dining areas. Consistent with previous research in care home settings (33), engaging with fellow students in this way may give young people a greater sense of psychological comfort and empowerment with a view to increasing social identification.

During the transition period, pastoral staff should be more proactive in getting to know the students living on their floor in order to enable young people to feel comfortable approaching them in the event of crisis. This could involve meeting with each student on a one-to-one basis to foster a trusting relationship, and to ensure that they feel comfortable in their accommodation environment. This would also enable pastoral staff to be in a position to notice deterioration in students' mental health. Pastoral staff could also meet their students as a group to introduce them to others who live near by.

As students often struggle when their experiences diverge from their romanticized expectations, it would be beneficial for universities to reconsider the marketing material that is disseminated to university applicants. Consistent with previous work [e.g., (34)], a more sensitive marketing message could help the transition as the belief that university years should be the "best time of your life" can exacerbate feelings of isolation experienced by many. Indeed, those who access pre-entry resources conveying a realistic picture of the university experience find it helpful in informing their decision about whether university is right for them (35). Educational institutions and accommodation providers should also revisit the potential implications of accommodation costs, as often students' loans do not cover the cost of their accommodation.

Recommendations for Support Services

It may be useful for support services to engage students using a wider variety of methods. For example, first-year students could be assigned a well-being adviser and a well-being peer group. By allowing students to develop a trusting relationship with a well-being adviser, they may be more likely to disclose important information and seek support before they reach crisis point. Well-being advisers would also be well-positioned to notice deterioration in a student's mental health.

On WMHD, students valued the opportunity to interact with well-being advisers who were familiar with the challenges they were encountering. As the benefits associated with a more informal mental health support offer were acknowledged, a number of similar events could be held during the transition period and throughout the academic year. As some young people report feeling too anxious to leave their bedrooms during the transition period, it may be beneficial to develop a transition-specific virtual help offer, which could be similar to ChildLine (https://www.childline.org.uk), where young people have the option to either call or type their concerns. Indeed, for those who are vulnerable, online or phone counseling may be beneficial, especially if they are not willing to seek face-to-face support. As students are a transient population, online resources may be

particularly relevant, and many students hold favorable attitudes toward online forms of support (36).

Further to this, as advocated by Universities UK (37), our findings illustrate that joined-up working between universities and NHS mental health services is urgently required. Young people in our sample expressed concerns about not receiving continuity of care at a time of significant change, which requires them to adjust to a new environment without the help of familiar support networks of parents, teachers, and school friends. When relocating, students are often unable to access NHS mental health services due to long waiting lists, which leaves them without support in a new environment. A fast-track approach should be adopted to ensure that young people with pre-existing mental health problems are able to access continuity in their care when moving from home to university. This could be from one NHS mental health service into another or from an NHS mental health service into university mental health services.

Limitations and Future Research

Several limitations of this work should be acknowledged. As participants in this research were predominantly female and all came from two university campuses situated in a small geographic location within a North West England city, our findings may not be generalizable to the whole student population.

The findings only reflect the views of those living in shared accommodation and therefore cannot be generalized to the whole student population (e.g., commuter students). There are likely to be differences between resident students and commuter students in terms of integration with regard to both academic studies and extracurricular activities. Taking this into consideration, future investigation that elucidates the similarities and differences between resident and commuter students would be beneficial. Future research should therefore explore differences in common mental health difficulties between students who live in shared accommodation and those who live elsewhere (e.g., commuter students), and how the development of friendships and group memberships relate to this. As the findings only reflect students' perspectives, future research could explore how lecturers, residential advisers and student support services staff perceive the challenges for new university students.

There is a need to develop interventions that reduce feelings of isolation in large-group teaching settings. As our findings clearly demonstrate that students desire more opportunities for social connection particularly in large-group lectures, designing setting-based interventions that enhance belonging by embedding learning activities that encourage social connection within course content topics would be beneficial. As many efforts to enhance social connections within universities are often *ad hoc* and unevaluated (38), future research should evaluate setting-based interventions that aim to reduce loneliness, increase engagement, and improve mental health within traditional large-group teaching settings.

Conclusion

Starting university involves several transitions such that resident students are required to tackle multiple challenges within new environments without the help of established support networks. Our findings demonstrate that academic, residential, and well-being advisers could be more proactive in supporting vulnerable young people during the transition period. In line with creating a psychologically healthy environment, providing increased opportunities for connection would enable students to build and strengthen peer relationships. With minor changes to living and learning environments, this human touch is possible, and friendly and supportive environments will foster a sense of belonging and community. Research findings like this can only have risen up the priority agenda during the current global COVID-19 pandemic. The enforced restrictions on movement, teaching and learning methods and socialization will have impacted greatly on first year students' transition to university life. When things return to normal, there will be a need to reinforce support and sense of belonging for incoming first years as well as those progressing to second and third years of undergraduate study following what has been a vastly disrupted university experience for them.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the data collected is sensitive and could compromise the confidentiality and anonymity of the participants. Requests to access the datasets should be directed to Joanne Deborah Worsley, jworsley@liverpool.ac.uk.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Health and Life Sciences Research Ethics Committee, University of Liverpool. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

JW collected and analyzed the qualitative data, wrote the draft of the manuscript, and wrote the final version of the manuscript. RC and PH read, commented on, and revised the manuscript providing important intellectual input. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2021.634285/full#supplementary-material

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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What Does Social Support Sound Like? Challenges and Opportunities for Using Passive Episodic Audio Collection to Assess the Social Environment

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Background: The social environment, comprised of social support, social burden, and quality of interactions, influences a range of health outcomes, including mental health. Passive audio data collection on mobile phones (e.g., episodic recording of the auditory environment without requiring any active input from the phone user) enables new opportunities to understand the social environment. We evaluated the use of passive audio collection on mobile phones as a window into the social environment while conducting a study of mental health among adolescent and young mothers in Nepal.

Methods: We enrolled 23 adolescent and young mothers who first participated in qualitative interviews to describe their social support and identify sounds potentially associated with that support. Then, episodic recordings were collected for 2 weeks from the mothers using an app to record 30 s of audio every 15 min from 4 A.M. to 9 P.M. Audio data were processed and classified using a pretrained model. Each classification category was accompanied by an estimated accuracy score. Manual validation of the machine-predicted speech and non-speech categories was done for accuracy.

Results: In qualitative interviews, mothers described a range of positive and negative social interactions and the sounds that accompanied these. Potential positive sounds included adult speech and laughter, infant babbling and laughter, and sounds from baby toys. Sounds characterizing negative stimuli included yelling, crying, screaming by adults and crying by infants. Sounds associated with social isolation included silence and TV or radio noises. Speech comprised 43% of all passively recorded audio clips ($n = 7{,}725$). Manual validation showed a 23% false positive rate and 62% false-negative rate for

speech, demonstrating potential underestimation of speech exposure. Other common sounds were music and vehicular noises.

Conclusions: Passively capturing audio has the potential to improve understanding of the social environment. However, a pre-trained model had the limited accuracy for identifying speech and lacked categories allowing distinction between positive and negative social interactions. To improve the contribution of passive audio collection to understanding the social environment, future work should improve the accuracy of audio categorization, code for constellations of sounds, and combine audio with other smartphone data collection such as location and activity.

Keywords: digital health, passive data, depression, mental health, adolescent, adolescent mothers

INTRODUCTION

The social environment, including social support, social burden, and quality of interactions, is important for a range of health outcomes, including mental and behavioral health. Social support has been shown to be one of the most important factors for mental health outcomes (1). For example, in the case of maternal depression, social support is one of the most important predictors of severity and duration (2). Social isolation and loss of social group membership are considered as risk factors for postpartum depression (3, 4). Additionally, changes in perceived social support influence the course of depression (5). Women who have positive and affectionate social support constantly available are significantly less likely to experience postpartum depression than those who have it available sporadically (6). Overall, postpartum support has been reported to improve infant and maternal well-being (7). The transition of adolescent and young women to motherhood is often psychologically stressful, and social support facilitates a smooth transition and the emotional well-being for mothers (8). Social support reduces morbidity and mortality, exposure to health hazards, and psychological stress (9). Ultimately, social support is an important factor in reducing the incidence of postpartum depression and other health issues, particularly among adolescent and first-time mothers.

Investigators have used different methods to assess and measure social support among mothers. For example, functional social support refers to informational, emotional, instrumental and appraisal support, and structural support encompasses both formal (i.e., from doctors, nurses, and midwives) and informal (i.e., from husbands, mothers, fathers, siblings, etc.) support (9). Other methods include interactions between family and community members, satisfaction with support received, and specific types of support, such as child care (10). Another widely used framework parses social support into three-dimensions: emotional support, instrumental support, and informational support in the context of postpartum depression (6, 11, 12).

There are many challenges that come with assessing social support. Self-report measures are the dominant approach to quantify social support, but this is often unreliable and socially biased. There is a need for more objective approaches to understand social environments, identify risk factors, and target and track social domains for change over time. In addition, social support is a multi-dimensional topic that does not have one universally agreed upon definition and thus is difficult to quantify. This creates challenges when interpreting outcomes of interventions that specifically target social support as the hypothesized mechanism of action for recovery from maternal psychological distress (10).

Passive sensing data is increasingly being used in mental health research (13, 14). It refers to the capture of users' information without their active input while they go about their daily lives (15, 16). One of the commonly used methods is smartphone-based passive sensing data. The Global Positioning System (GPS) location, physical activity and movement, and amount of time that a device or app is used, such as Web-based social activity are a few examples of passive data collection (17, 18). Another form of passive sensing is episodic audio recording that can capture brief snippets of the audio environment (19). The audio recording can be helpful in identifying speech and non-speech audio stimuli around users that can be indicators of social support and interactions. Machine learning can be used to categorize these sounds. This helps to preserve confidentiality because transcriptions or listening directly to audio is not required. The output of machine learning can be used to quantify the timing and frequency of different types of audio to understand the social environment (20). Thus, passive audio data can provide an important and unique insight into a mother's social environment through continuous data collection.

To explore the potential for passive audio collection as a window onto the social environment, we conducted a two-part study. First, we conducted qualitative interviews with adolescent and young mothers about their social experiences to identify sounds potentially associated with social support. Second, we collected audio for 2 weeks on mobile phones and used machine learning to quantify the frequency of different types of sounds. We combined the qualitative and passive audio collection findings to identify opportunities and challenges for future research on social support in the home environment.

Abbreviations: COREQ, Consolidate Criteria for Reporting Qualitative Studies; EBM, Electronic Behavior Monitoring; EMA, Ecological Momentary Assessment; GPS, Global Positioning System; HOME, Home Observation for Measurement of the Environment; IDI, In-depth Interviews; OMCI, Observation of Mother-Child Interaction; PHQ-9, Patient Health Questionnaire – 9.

METHODS

Setting

This current study was part of a broader initiative to improve mental health services in rural Nepal (21), including a special focus on use of technology to improve maternal mental health for adolescents (19). We conducted the study in Chitwan, a southern region of Nepal with a population of 579,984. Chitwan has an under 5 mortality rate of 38.6 per 1,000 and a literacy rate of 78.9% (22). Chitwan has been the center for district-wide scaling-up of community-based mental health services in Nepal as a result of which there is an established partnership with the local health systems (23). We conducted the study in seven health facilities selected on the basis of number of postnatal mothers visiting the facility and availability of mental health treatment. Data collection was undertaken between November 2018 and April 2019.

Study Population and Sampling

We screened 782 mothers at health posts during infant immunization camps. Eligibility criteria included mothers between the ages of 15–25 years with infants younger than 12 months of age to participate in the study ($n = 320$). We consented the mothers to participate in the study before they completed a depression screening tool, the Patient Health Questionnaire (PHQ-9), to assess depression symptoms. PHQ-9 is a common, well-validated tool used to measure depression symptoms severity across 9 items, with each item having 3 response options, ranging the score from 0 to 27. It has been used in prior studies in Nepal and validated in primary care settings in Chitwan. We categorized mothers into three groups: low-likelihood of depression (referred to as "not depressed"), high-likelihood of depression (referred to as "depressed"), and mixed-probability. Not-depressed were mothers with a PHQ-9 total score below 7. Depressed were mothers with a PHQ-9 cut-off of 9 or above. The mixed group was a PHQ-9 score of 7 or 8. Among Nepali adults presenting to outpatient services, a cut-off of 9 has a sensitivity of 94% and specificity of 69%, positive predictive value (PPV) of 0.33 and negative predictive value (NPV) of 0.99 (24). For non-depressed, a cut-off of less of 7 has a sensitivity of 100%, specificity of 55%, PPV of 0.26, and NPV of 1.00. This means that an adult presenting to primary care centers with a score of below 7 has an extremely low probability of having depression (i.e., low probability of being a "false negative"). We excluded mothers with PHQ-9 scores of 7 and 8 from either group because of greater risk false positives.

Once the mother was screened for depression and consented, a study team member visited her home for family consent. For participants under the age of 18 years, we asked for a written parental permission form and assent form. The study was approved by the Nepal Health Research Council (#327/2018) and George Washington University's Institutional Review Board (#051845).

Among the mothers screened, 320 were 15–25 years old, had an infant under 12 months, and had a PHQ-9 score of either <7 or ≥ 9. There were 294 categorized as non-depressed (PHQ-9 < 7) and 26 categorized as depressed (PHQ-9 ≥ 9). We serially enrolled non-depressed mothers who consented with a target sample size of 25. Because of drop-outs, 23 mothers were the final non-depressed sample. Only non-depressed adolescent and young adult mothers (PHQ-9 < 7) were included in the analyses presented in the current paper in order to provide a reference point for understanding social support. Social support for depressed and non-depressed mothers can be different. Findings from the current study on feasibility of collecting passive audio data to understand social support of non-depressed mother can inform future comparisons between depressed and non-depressed mothers' social environment.

Study Procedure and Data Collection

Qualitative Data

We conducted in-depth interviews (IDIs) and administered Day-in-life tool to qualitatively assess mother's social environment. We reached out to the mothers within 2–3 days of first contact at health posts to conduct IDIs. We also included field notes from each participant encounter in the data analysis. Field notes provided cultural and environmental description of mothers' surroundings. These also include reflection from two observation tools that were administered during the study period. Home Observation Measurement of the Environment (HOME) (25, 26) and Observation of Mother Child Interaction (OMCI) (27) were observation tools used to draw impressions of mother's surroundings and her interaction with the baby to complement the qualitative findings. HOME is a 45-item tool used to measure child's exposure to his/her environment. This tool consists of 6 substances—responsivity, acceptance, organization, learning materials, involvement, and variety, which are elicited by the combination of rater observations during home visit and direct elicitation of self-report by the parent. This tool has been used extensively in South Asia (27–29) and culturally adapted for Nepal. OMCI is an 18-item tool that documents maternal responsive behaviors (responsivity, emotional support, support for infant attention, and language stimulation). In this paper, we have explored items from these tools that are indicative of mothers' social environment and mother-child interaction.

Female research assistants used semi-structured interview guides to conduct IDIs that intended to be 30–45 min. Questions were asked to understand maternal experience for adolescent and young adult mothers, including their interaction with the child. Mothers were asked about their support system, social environment including social responsibilities. We asked about coping and help-seeking behavior, as well as negative social interactions. We included The Consolidate Criteria for Reporting Qualitative Studies (COREQ) checklist as a **Supplementary File** (30). Besides IDIs and field notes, we administered Day-in-life tool to understand an adolescent and young adult mother's typical day. We asked mothers what they did the day before and recorded the responses.

Passive Audio Data

Prior to the current study, we evaluated the acceptability and feasibility of passive data collection in low-resource settings (31). Based on this, we selected passive sensing modalities that would be feasible and contribute to improving maternal

and child mental behavioral health. This included episodic audio recording on mobile phones. For this study, we used the Samsung J2 Ace smartphone to collect passive audio data. It was an affordable phone (US $160) popular in the study setting. Low-end mobile phones in Nepal generally cost US $70-$120. The smartphone selected for the study was slightly more expensive than commonly-used devices. In the study setting, most individuals already own mobile phones or have family members who own mobile phones. Additionally, Samsung J2 Ace phone is widely available for purchase within Nepal. It was also the cheapest option that could effectively run all the features and apps required for the study.

Mothers were provided with the phone for the duration of the study. They returned the smart phone after data collection ended. To collect the audio data, we installed our custom-built Electronic Behavior Monitoring app (EBM version 2.0). The EBM app passively collected audio data for 30 s every 15 min between 4 A.M. and 9 P.M. A folder (Namaste) was created automatically once the EBM app was installed on the mobile phone. All audio data were stored in the folder "Audio" inside the Namaste folder. For episodic audio recording, the microphone in the phone recorded 30s audio clips every 15 min and saved the recordings in an m4a format. Every week, a research assistant then collected the audio data from the mother's phone and uploaded it in a secured cloud database for analysis. The audio data was then processed for sound classification by a machine learning system. In our previous studies, we had produced a video to explain these data collection processes to potential study participants (31), including information on confidentiality management, such as deleting audio files (32). In the current data collection, mothers could delete audio files before research assistants uploaded the data off of the phones. Mothers were also instructed that they could turn off the phone at any point during the day to assure confidentiality or address other data collection concerns.

Data Analysis

Qualitative Data

IDIs were conducted and transcribed in Nepali. Written Nepali transcripts were then translated into English using an established Nepali-English translation procedure and mental health glossary. A bilingual translator preserved culturally meaningful words (33). The interview transcripts were then combined with field notes and independently read by two researchers (AH, AP) to generate common themes. AH and AP then generated a preliminary codebook that was modified by AH, DL, and AP. The codebook was modified while obtaining intercoder agreement. The intercoder agreement of 0.70 was attained. Three researchers (AP, AH, and DL) then independently coded the interview transcripts in NVivo 12 (34). After coding, code summaries were written for each of the domains by two researchers (CI and AT) following a thematic approach (35, 36). Summaries were revised after discussion with several authors (AP, AT, CI, and BK). **Table 1** shows the domains, themes and related codes that we explored in this study.

Passive Audio Data

On average, about 40 raw audio files were generated each day. Files were downloaded from the device by research assistants and then uploaded to a secure server. Here the files were processed using a pre-trained machine learning model based on a Convolutional Neural Network architecture (VGGish) available as part of the AudioSet project (37). AudioSet, released in 2017 by Google, is a large-scale audio events dataset. It was constructed using millions of 10 second YouTube videos that were manually annotated. The dataset contains 632 audio event classes and is presented as a hierarchical graph of event categories (e.g., animal -> dog -> barking). The categories cover human and animal sounds, musical instruments and common environmental sounds. The files were processed by our machine learning model and the audio classification label with the highest probability score was saved as a single comma separated csv file for weekly audio clips. The .csv file had audio predictions along with time and date stamps used for analysis. These data were then cleaned to remove data of mothers who dropped out of the study and fix outliers introduced by some readings missing a valid date time value. Standard exploratory data analysis was performed on these data, including the calculation of measures of central tendency, range and missing value analysis. Plots and tables were produced on the full dataset (4 A.M. to 9 P.M.). We conducted a manual validation of 6,450 s of audio sounds. A research assistant listened to randomly selected audio clips to validate whether the machine-predicted speech and non-speech sounds were accurate.

RESULTS

Qualitative Results

We assessed mothers' social environment to identify a) individuals that are present in mother's social environment, and b) speech and non-speech sounds that reflect mothers' interactions, support, and other social domains (**Table 1**). Codes in parenthesis correspond to the qualitative reference number for the quotes provided in **Supplementary File 1**. **Table 2** consists of the demographic information of the mothers.

Based on the qualitative interviews, a typical day started at around 6 A.M. in the morning and would include either taking care of the baby, e.g., changing or breastfeeding, or household chores that included making morning tea for the family. Mid-morning usually included preparing meals for the family. Usually husbands in a nuclear family and older female family members, such as mothers-in-law, and sisters-in-law, took up infant's caretaking roles when mothers were busy with household chores. Mid-morning to noon usually included washing dishes after breakfast, washing clothes, and cleaning. In the afternoons, mothers usually rested with the baby and watched television or YouTube videos. This was also the time she interacted with female family members, neighbors, and friends; male household members were typically out of the house working or socializing during this time of day. However, female family members were present at the home throughout the day and interacted in the afternoon after household chores and around afternoon tea. Some mothers shared using their mobile phones to call distant family and friends during the afternoon. Evenings were much

TABLE 1 | Qualitative themes and related codes.

Domain	Theme	Related codes
Interaction	Adult interactions	Positive social interaction Negative social interactions
	Mother-child interaction	Positive mother-child interaction Negative mother-child interaction
Support	Emotional support	Mother's emotional support Positive emotions Negative emotions Coping/help seeking Isolation/No social interaction Trust
	Instrumental support	Support in household chores Childcare support General help Coping/help seeking
	Informational support	Informational support Coping/help seeking
Others	Recreational events	Positive social interactions Non-human interaction
	Social/religious events	Common social interactions Positive social interactions Negative social interactions
	Physical activities/exercise	Movement
	Sporting activities	Movement
	Stressful noises	Violence

TABLE 2 | Demographic characteristics of the participants.

Total participant (n = 23)	N (%) or mean range
Mother's age	**19.5 years (16–25)**
16–18	7 (30.43%)
19–21	11 (47.83%)
22–25	5 (21.74%)
Caste	
Brahman/chhetri	5 (21.74%)
Janajati	13 (56.52)
Dalit	5 (21.74%)
Religion	
Hindu	18 (78.26%)
Buddhist	3 (13.04%)
Christian	2 (8.70%)
Education	
Primary	3 (13.04%)
Secondary	17 (73.91%)
Higher secondary	3 (13.04%)
Child sex	
Female	12 (52.17%)
Male	11 (47.83%)
Child age	
1–7 months	17 (73.91%)
8–12 months	6 (26.09%)
Number of children	
First child	19 (82.60%)
Participant occupation	
Housewife	18 (78.26%)
Agriculture	3 (13.04%)
Business	1 (4.35%)
Day labor	1 (4.35%)

like mornings with mothers cooking and washing dishes until 7 or 8 P.M. A typical day would end with mothers putting the baby to sleep and spending time talking to her husband or family members. Mothers would then go to sleep with their infants, with co-sleeping being common. When it came to family members, mornings and evenings were the most social time where the family came together to eat meals.

Social Interactions

In the qualitative interviews, mothers described their social interactions throughout the day. We coded the qualitative accounts for potential sources of audio stimuli that could be associated with presence and quality of these interactions.

Adult Positive and Negative Social Interactions

Positive social interaction was strongly related to mother's increased comfort and trust of family members. Adult conversations were often on matters related to childcare (SOC_01). Besides immediate family members, mothers also interacted with their neighbors. This interaction was usually centered around the babysitting or playing with the infant (SOC_02). Although non-family members were involved periodically in these roles, mothers spent most of their time interacting with immediate family members. *Negative social interactions* such as yelling and screaming were reported in households where husbands or family members had alcohol use problems:

> *Participant [P]: Previously my husband used to drink alcohol because of that I had tension in my mind.*
>
> *Interviewer [I]: At that time, what types of thoughts used to come in your heart-mind?*
>
> *P: At that time, I didn't have anyone to share my problems. Mostly I remained alone. His father [husband] used to drink alcohol and yell at me all the time. He used to get angry with me because of that I was unhappy. And I used to think that all this was happening because of me. But now he doesn't drink alcohol. Previously he used to stay outside but nowadays he returns home.*
>
> *20-year-old mother with 3-month-old infant*

In such households, besides increased negative interactions, there were limited positive adult sounds (laughter, adult conversations), since mothers expressed limiting their conversations even when the family members were sober. Mothers were also likely to turn their mobile phones off when there were arguments at home.

Therefore, audio stimuli that can predict positive social interactions include adult conversations, gender-specific conversations, and laughter while stimuli that can predict

negative social interactions include adult yelling, screaming, and crying.

Mother-Child Positive and Negative Interactions

Most *positive mother—child interactions* mentioned were of mother playing with the infant (SOC_04). Mothers expressed joy and satisfaction when they played with their baby with toys and rattles and heard their baby laughing or babbling:

I: In your opinion, what does your baby want from you? Like love, talking with him etc.

P: He needs love. Someone to talk with him, friends etc.

I: How do you know that your baby needs all these things?

P: He starts to cry when I leave him inside the room, starts laughing and enjoying when someone remains with him and talks with him. Due to these types of behaviors, I came to know that he wants someone to talk with him.

22-year-old mother with 12-month-old infant

Besides direct interaction, mothers enjoyed taking pictures and videos of the baby. *Negative mother-child interaction* often remained unreported in recorded interviews because mothers feared they would be considered bad mothers if they said they beat or yelled at their children. These incidents were reported in observational tool assessments and field notes. Through observational tool assessments, HOME and OMCI, we also observed mother's speech (items 2–8), physical punishment (items 12, 16), and hostile speech (items 14, 15, 17, 18) as sounds present in the social environment. Similarly, OMCI also gave information on mother positive and negative speech (items 1–6, 8–11), along with positive and negative infant reaction (items 14–16), such as laughing, babbling, squealing, when with mothers.

Therefore, adult sounds like mother's speech, laughter in conjugation with child babbling or child laughter can be an indication of positive-mother child interaction. Negative mother—child interaction can include audio stimuli such as mother screaming and crying along with child crying and screaming. Non-speech sounds such as baby rattles and toys along with adult sounds and infant-related sounds can be an indication of mother-child interaction.

Support

We explored this domain as supportive or non-supportive outcomes of social interactions. Unlike interaction, we studied support beyond the mere presence or absence of certain sounds in mother's environment. In this domain, we explored constellations of sounds, or combination of sounds that predicted supportive or burdensome social environment for the mother.

Emotional Support and Burden

Family members were the primary source of emotional support, especially husbands. Mothers generally considered "talking about her feelings" or "sharing problems with her family" an important coping mechanism (SUPP_01). Integrating mothers' conversations with family members and positive sounds such as laughter and singing can predict mothers' emotional environment. Besides family, neighbors and health care professionals were other important sources of emotional support (SUPP_02). The role of neighbors and health care professionals was even more prominent when the mother had strained family relationships and less emotional support from family members. Frequent conversations of mothers with members outside of the family, infant sounds (laughing, crying, squealing) along with adult sounds of non-family members, and positive/negative adult sounds (laughter, crying) could be indications of mothers seeking support outside of the family members.

I: How did you get rid from those [mental health] problems?

P: My family members supported me and they suggested that I take care of my baby.

I: And you got rid of those problems?

P: Umm. All my relatives and family members supported and gave suggestions. They suggested that I have to love my baby; I have to breastfed my baby on time.

19-year-old mother with 5-month-old infant

I: Why do you feel comfortable asking help from your landlord aunt [neighbor]?

P: She feels very happy to play with my daughter and she always asks me [if she can take care of the baby] when I have to go somewhere. So, I feel easier to ask her for help.

17-year-old mother with 3-month-old infant

Another important prediction of mother's emotional burden can be social isolation. Isolation or no social interaction was prevalent among mothers who were generally worried about the future of their children, either because of financial difficulty or family problems. If family members were the primary source of stress, mothers were not comfortable sharing these thoughts with their family members. This emotional burden also led to mothers feeling negatively about the baby, especially when the baby did not sleep or cried a lot. A complete lack of human speech for a prolonged period of time can be an indication of social isolation (SUPP_03, SUPP_04). Presence of machine-generated speech sounds such as TV/radio without human speech for a prolonged period of time could be another important indication of isolation.

P: Because of the birth of my baby, I had different types of [negative] thoughts like how should I provide care to her and at that time I wanted to stay alone, didn't want to eat anything etc.

I: What types of activities did you do to decrease those problems?

P: I wanted to stay alone, walk, or listen to songs.

19-year-old mother with 5-month-old infant

Hence, audio stimuli that predict emotional support or burden can be positive and negative adult speech sounds (conversations, laughter, singing, crying, yelling), frequent adult speech sounds (family members, non-family members), along with complete absence of speech sounds, or presence of machine-generated speech sounds (such as TV, radio) without adult speech sounds.

Instrumental Support

Two kinds of instrumental support were important—childcare support and support in household chores. In nuclear families, husbands were strongly involved in providing instrumental

support to their wives, but older female members such as mother-in-law and sister-in-law in joint families were equally engaged (SUPP_05). To understand instrumental support better, audio data can be used to predict mother's speech sounds along with that of the family members within the house, especially around infant sounds (child crying, child laughing, babbling) indicating childcare support, or household chores sounds (washing, doing dishes, sweeping) indicating support in household chores.

I: When did you feel difficulty?

P: Some days after delivering the baby, the baby did not feel well and we had to admit this baby to the hospital. At that time, I had to face many difficulties.

I: At that time, who helped you?

P: I got support mostly from my family members. My mother-in-law cooked food, washed clothes, and the baby's father [my husband] also supported me a lot.

21-year-old mother with 5-month-old infant

Much like emotional support, instrumental support was hindered when the mother did not have good relationship with the family members. The family relationship and role of family in instrumental care were critical mostly because most mothers only trusted family members to take care of the baby in her absence. Strong family involvement was even more critical in case of young mothers who were generally inexperienced in childcare and had to learn it either experientially or through demonstration by other family members. If either of these did not happen, mothers had significant instrumental burden to take care of the baby. If the family members did not support her in household chores, she had to take care of her child on top of her regular household after childbirth. The lack of instrumental support meant mother was constantly involved in taking care of the child as well as household chores.

We can record the lack of instrumental care by assessing the amount of household chores sounds (cooking, washing, and sweeping) and infant-related sounds (breastfeeding, child bathing, oil massaging, child laughing, babbling, and crying) in a typical day, especially a comparison of these sounds alone and in combination with adult speech sounds, which might indicate presence of other adults. Another way to get a snapshot of mother's social environment is through observation tools. For instance, HOME item 20 asks about childcare support provided by one of the three regular substitutes, and HOME item 41 explores the role of the father in providing at least some form of childcare daily.

Therefore, instrumental support or burden can be understood through positive and negative speech sounds (adult conversations, adult laughter, adult yelling, and crying) in conjugation with child sounds (child babbling, child laughter, oil massaging, and child bathing), or household sounds (washing, sweeping, and cooking).

Informational Support

Given adolescent and young adult mothers' lack of experience in childcare, informational support is another important supportive outcome of social interactions. Family members were crucial in providing instrumental support both in young mothers' maternal home (father, mother, and sister) and husband's home (mother-in-law, father-in-law, and sister-in-law). Young mothers generally needed support in feeding the baby, bathing and oil massaging. Culturally in Nepal, oil massaging is a big part of infant's growth and development, and one in which mother needed the most support. Demonstration (SUPP_06) by an older female member (mother-in-law, mother, sister, sister-in-law) along with informational support (SUPP_07, SUPP_08) was significant in supporting young mothers. An important way to capture the informational support could be adult conversations within household in conjugation with infant-related sounds (child bathing, breastfeeding, oil massaging). Few mothers said they learned to take care of the baby without any external informational support from family members, friends, or health care professionals (SUPP_09).

"When I asked her about the challenges of being mother, she shared that she didn't feel any difficulty. At first, she used to feel difficult to take care of her baby i.e. bathing her baby but later on when her mother, sister and mother in-law taught her then she felt easy."

Field notes (18-year-old mother with 2-month-old baby)

P: In the hospital, sister [Nurse] told me more things [about childcare] than my family members. I got more information from her. She told me how to provide proper care to a newly born baby.

21-year-old mother with 4-month-old infant

Almost all mothers had some form of informational support, primarily from family members, but also from health care professionals and neighbors. Therefore, we can have a better understanding of mother's information support system outside of the family if we collect passive audio data that captures mother's conversations with non-family members, especially conversations with health care professionals.

Therefore, positive adult speech sounds (adult conversations, laughter) and frequent adult speech sounds (family members, non-family members) along with infant-related sounds (child bathing, breastfeeding, oil massaging) can indicate informational support.

Other Social Domains

We explored other common domains of mothers' social environment for better understanding of speech and non-speech noises that constitute these phenomena.

Recreation

Young mothers were very comfortable using mobile phones to watch YouTube videos or use social media, mostly Facebook and IMO (a messaging application popular in the study area) (OTH_01). Additionally, mothers often recorded videos on their phones or transferred and played songs/videos from their friends or family member's phones for recreation. Smartphones were important to the mothers for recreation, either to listen to songs or engage in conversations with family and friends through messaging applications (OTH_02). Mothers also used messaging app and smartphones to talk to husbands who were away for employment. Mothers also had audio alerts on their phones when they received instant messages.

I: Usually what do you use on your mobile [phone]? Which applications do you use?

P: IMO [Messaging app].

I: Oh, usually you use IMO on your mobile, and do you feel comfortable using that application on your mobile?

P: Um, I use IMO when I have time in the evening, and usually once or twice in a week when my brothers call me.

20-year-old mother with 4-month-old infant

Social or Religious Events

Social and religious events were a big part of mothers' environment. These events constituted of religious functions, characterized by bells, singing bowl, religious instruments or social functions like marriage, with musical instruments and wedding bands. In both the events, frequent and multiple adult human speech can indicate presence of many people in the surrounding.

Physical and Sporting Activities

Movement or physical activity was a big part of adolescent and young mothers' lives. Bicycling and walking around the neighborhood were pretty common when running errands. Some mothers mentioned walking recreationally, to reduce mental stress. Movement was highly restricted for the first few months after childbirth for both physical and cultural reasons. Culturally, new mothers are often asked to stay home for at least the first 6 months of childbirth to facilitate breastfeeding and reduce the risk of infections. Environmental noises suggestive of outdoor activities include vehicles, birds, domestic animals, whistles, and activity sounds (bicycling and walking sounds).

Stressful Events

Some mothers described that violence was also a part of their lives. The mothers reporting violence were most likely to attribute this to husbands. For these mothers, there was a long-term exposure to violence often starting early in the marriage, throughout pregnancy and post-childbirth. In terms of her social environment, speech (adults arguing, crying, screaming, yelling) and non-speech (objects thrashing, hitting) could provide some indication of violence and disruptive family behaviors. Frequency and amount of these exposures in mother's environment can provide stronger evidence of stressful events in her surroundings.

"I did this last follow up interview in the participant's maternal home. She went there to celebrate a festival and she felt comfortable having a conversation with me because she was away from her husband's home. At that time, she shared about her problems with her husband's family, problems that she felt difficult sharing in her husband's home. Because of this I came to know various things about her family that she tried to hide from me during my previous visits and interviews [at her husband's house]. She shared all these things openly without any hesitations. Her husband used to scold her. And he used to beat her during pregnancy. She tried to stay away from her husband when he got angry."

Field notes; 16-year-old mother with 4-month-old infant

TABLE 3 | Sounds accuracy ($n = 215$ audio clips).

	True speech	True non-speech
Speech	157 (73.0%)	58 (27.0%)
Non-speech	133 (61.9%)	82 (38.1%)

Pilot Passive Audio Data Collection

In our pilot study, we wanted to determine if we could successfully collect passive audio data from adolescent and young adult mothers and whether this data could give preliminary insights into the mothers' social environment. We successfully collected 14 days of audio data using the EBM app installed (with their knowledge) on the mobile phones provided to them. We were able to use a pre-trained machine learning model to predict sound categories (speech, vehicle, music etc.). Finally, we were able to determine the most common sounds in mothers' social environment along with the distribution of these sounds throughout the day.

A total of 319 categories of sounds were identified in 7,725 audio clips collected from 23 participants each recruited to participate for 14 days. About 42.7% ($n = 2{,}318$) of the sounds were human speech sounds, 35.4% were music sounds, and 6.3% were vehicle sounds. A manual validation of the 6,450 s of speech sounds showed 73% of the machine-predicted speech sounds were true speech sounds (**Table 3**). Of all the machine predicted non-speech sounds 62% were speech sounds.

Machine-predicted speech sounds were uniformly distributed throughout the day (**Figure 1**). We also assessed music and vehicle noises throughout the day. Music was consistently present throughout the day (range 21–29%), while vehicle noises were more prevalent in the morning (range 4–10%) than during the day (range 4–6%), or evening (range 3–6%). **Table 4** shows the 10 most commonly predicted sounds.

Finally, we also tried collecting audio stimuli that could be strong predictors of the social environment. Since we used YouTube trained machine learning, these nuanced sounds were not detected frequently, and could not therefore be used as strong predictors of social environment. **Table 5** shows the audio stimuli predicted by YouTube trained machine learning. These audio stimuli were not manually validated.

DISCUSSION

We qualitatively assessed mother's social environment and identified audio stimuli that could give us a better picture of her social environment. We then collected audio data from adolescent and young adult mothers for 14 days and used YouTube-trained machine learning to predict audio sounds. Qualitatively, we verified that mother's social environment mostly comprised of family members, and she was always surrounded by husband, mother-in-law, father-in-law, sister-in-law, and brother-in-law providing supportive roles especially during first few months of childbirth. Speech sounds for adult (laughter, adult speech) and child sounds (child laughter, babbling) were common around mother's social environment.

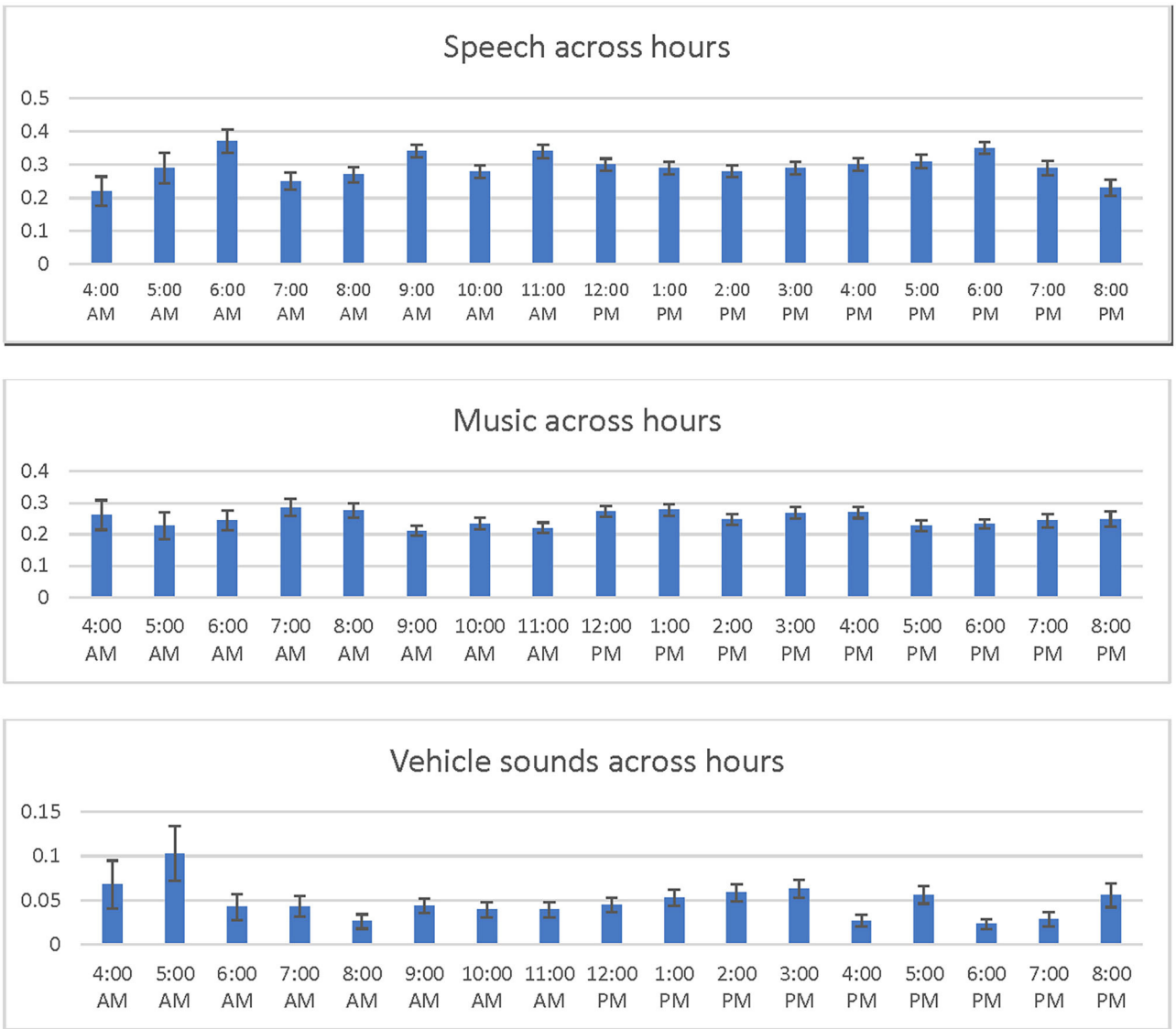


FIGURE 1 | Common sounds throughout the day. This shows the average distribution of speech, music, and vehicle sounds from 4 A.M. to 9 P.M. each day.

Most common non-speech sounds included mothers doing household chores (washing, cooking) or childcare activities (bathing, oil massaging the baby). Mothers also engaged in recreational activities (watching YouTube videos, TV, listening to radio) frequently. Through passive audio data analysis, we identified speech as the most frequently detected sound, followed by music and vehicles.

Based on our qualitative findings and passive audio collection, we propose a matrix for what types of social interactions and activities could potentially be captured through the audio environment (see **Table 6**). Speech and non-speech sounds such as laughter, adult speech, TV noises, and social functions could be predictors of positive interactions. Similarly, crying, yelling, along with sounds of beating, thrashing, or object breaking showed negative interactions. A prolonged presence of any of these positive or negative sounds for a given mother could help predict her household environment. Studies have previously captured the number of conversations and duration to successfully determine social interaction (38). Passive audio data have been used to estimate the number of conversations a person engages in, the duration of the conversation, and the time the individual speaks within the conversation along with speaking rate and variation in pitch (39, 40) to understand social isolation (41).

Based on our initial experiences, social support is a more complex concept and requires understanding beyond presence and absence of audio stimuli. We suggest an analysis of "constellations of audio sounds" around the mother to give us a better picture of her social support i.e., drawing social environment conclusions based on grouping of speech and/or non-speech sounds. This would require integration of audio clips from a given time frame that predict mother's social support.

TABLE 4 | Ten most common sound categories.

	Frequency	Percent
Speech	2,318	42.67
Music	1,920	35.34
Vehicle	340	6.26
Organ	184	3.39
Rail transport	143	2.63
Tubular bells	131	2.41
Fire	125	2.30
Bus	101	1.86
Car	89	1.64
Insect	82	1.51
Total	5,433	100

TABLE 5 | Other audio social sounds and their prediction frequency.

Other audio social sounds	Frequency	Percentage
Child speech	9	0.12
Male singing	7	0.09
Whispering	7	0.09
Whimper	4	0.05
Babbling	3	0.04
Female singing	3	0.04
Female speech	3	0.04
Child singing	2	0.03
Children playing	2	0.03
Male speech	2	0.03
Children shouting	1	0.01

For instance, "instrumental support" could be categorized when the following combination is present: (a) audio of mother laughing, (b) adult female speech of a family member, and (c) audio of washing dishes. Understanding the nature of social support would also require gender differentiation (male vs. female speech). Non-speech sounds, both positive and negative, can help determine support and burden in mother's environment. Additional tools such as daily diary elicitation, social support scale (42, 43), and sleep monitoring (44, 45) can give additional assessment of her support system.

In our matrix, we have suggested additional data collection tools that can further validate the findings from passive audio. For example, application and call logs have also been used to determine communication (46). In case of mother-child interaction, we suggest using additional observation tools such as HOME (27–29) and OMCI (47–49) which have been used in multi-cultural settings to assess mother and child's social environment, interactions and support. Finally, additional methods of passive data collection, such as Bluetooth beacons attached to child's clothing, can help determine the time mother and child spend together (19, 31).

Finally, other social noises such as social events, recreational activities, physical activities, and stressful events can be good predictors of overall social environment. We can understand the time and modes of recreation for the mothers if we capture passive audio data across sounds of YouTube videos, and messaging apps. Additionally, passive audio features such as application and call logs can also help us understand her environment. In addition to passive audio data, Global Positioning System (GPS) (50) and accelerometer (40, 46) have been successfully used in studies to determine movement and activity. Passive audio data can be critical in identifying domestic violence. Intimate partner violence (IPV) has been associated with depressive symptoms (51, 52) but remains highly underreported in Nepal (53). Passive audio data can give an invaluable insight into stressful events of mother's lives predicting domestic violence.

Additional assessment methods such as Ecological Momentary Assessment (EMA) (54) have triggers tied to hearing certain sounds which asks if a sound is accurate when heard in the environment. Such assessment methods can validate passive audio clips. Mood tracking tied to speech and non-speech sounds is another efficient method of understanding mother's mood associated with particular audio stimuli (46). Studies have also explored alternative coding approach for culturally diverse audio (55).

Additional validation tools in combination with passive audio data can provide important insight into mothers' lives especially under domains like mother-child interaction and domestic violence, which are difficult to assess, especially in low- and middle- income settings (48, 56). Studies focused on passive sensing data often use additional validation measures to ensure accuracy (13). We suggest similar approach to studying domains such as interaction and support. Passive audio data can generate evidence on the quantity of sounds, but qualitative assessments and/or multiple passive data methods can provide a more reliable picture of the social environment. Additionally, it is important to consider the measures of audio data that might be most meaningful. While domains such as interactions can be assessed by the presence or absence of human speech, domains like support might require total number and frequency of speech, time-specific contact, predictability of interactions and amount of audio stimuli observed/expected. Passive audio data when combined with appropriate qualitative and observational tools such as daily diary elicitation, ecological momentary assessment, HOME, Quality of mother-child interaction, and additional passive data collection methods like Global Positioning System (GPS) (50), Bluetooth beacons (19, 31), sleep pattern detection (45), accelerometer (40, 46), including recording call logs (46) and application usages (57), and device activity (58) can provide unique and innovative insight into mother's social environment.

LIMITATIONS

The major limitation of our current study was the accuracy of the pre-trained model. One of the major challenges to accurately collecting passive sensing data was inaccuracy of YouTube trained machine learning. The social and cultural environment

TABLE 6 | Mother's social environment and potential speech and non-speech sounds.

Domain	Theme	Speech sounds	Non-speech sounds	Additional assessment
Interaction	Positive mother-child interaction	Baby talk, child laughter, mother laughter, motherese, mother singing, lullaby	Sound of rattles, toys	Proximity beacon, *HOME, **OMCI, application use [videos and photos of baby]
	Negative mother-child interaction	Adult yelling, adult crying, child screaming, child crying	Physical violence (slapping, thrashing)	Proximity beacon, HOME, OMCI, call logs, application use [photos and videos of baby]
	Positive adult interactions	Adult laughter, adult speech	TV noises, movie theater, music, social functions noise,	Passive data collection tool in family members' phones, call logs
	Negative adult interactions	Adult yelling, adult crying	Physical violence (slapping, thrashing), objects breaking, thrashing, loud noises of objects dropping	Proximity beacon, passive data collection tool in family members' phones, call logs
Support vs. burden	Emotional support or burden	Gender-specific speech detection, Person-specific audio (voice recognition)	TV and radio noises, songs, total silence	HOME, daily diary elicitation Maternal social support scale, sleep monitoring
	Instrumental support or burden	Family members' voice recognition, voice recognition (family vs. outside), lack of human speech, mother doing household chores alone (lack of interaction in integration during household chores)	Mother household chores (e.g., washing utensils) along with positive human interaction (laughter, talking), constant household chores noises (washing clothes, washing dishes)	Proximity beacon, OMCI, HOME, daily diary elicitation, ***NIH toolbox adult social relationship scales
	Informational support	Talking	TV, radio	Application usage, browser history
Others	Recreational activities	Individual singing, humming, multiple people singing	Music, TV, YouTube (videos)	Application usage, browser history
	Social events	Adult speech, laughter	Music, instruments (organ, piano, band music)	GPS, daily diary elicitation
	Religious events	Prayers, multiple people singing (Nepali: *bhajan*)	Puja bells/vedic chanting	GPS, daily diary elicitation
	Physical activities/exercise	Adult speech, adult laughter, crowd noises	Outdoor noises, vehicular noises, foot tapping, running/walking noises, sweeping, washing, bicycling	Accelerometer, GPS
	Sporting activities	Crowd noises, cheering	Whistles, bicycling	Accelerometer, GPS
	Stressful noises	Constant loud human speech, persistent human noises for a long duration	Non-stop transportation noise, horns	Pollution indicators environment–environmental noise, Accelerometer, sleep monitoring

**Home Observation for Measurement of the Environment.*
***Observation of Mother-Child Interaction.*
****National Institutes of Health.*

of adolescent and young adult mothers are not universally consistent, so prior to the passive audio data collection, it is integral to record and train some of these culturally relevant sounds from the study setting to train the machine. Similarly, a strong prediction model to distinguish individual-specific audio stimuli such as adult vs. child speech, female vs. male speech, and sounds such as adult vs. child laughing, can predict positive/negative adult conversations along with positive and negative mother-child interaction.

Moreover, social support and social interaction cannot fully be understood without better models to identify positive and negative sounds, such as polite vs. hostile conversation, yelling or laughing sounds. These audio stimuli are culturally sensitive and must be recorded prior to the study for better prediction of the environment. It is equally integral to distinguish between machine-generated speech sounds such as TV/radio and adult speech sounds, mostly when studying social isolation, when continuous exposure to machine-generated speech sounds can have very different impact than that of adult speech sounds. Another important consideration for future studies should be more contextual information on mobile phone usage in the setting. In our study, some mothers carried phones more consistently than others. In some instances, other family members used the mobile phone along with the mother. So, we need to consider that the audio captured might be different from mother's actual experience. A thorough understanding of mother's usage patterns and social factors (such as cell phone sharing) needs to be considered when drawing meaningful conclusion.

Another limitation of our study is the sampling technique which could impact the generalizability of the findings. We used purposive sampling, therefore our findings might not be representative of the population. We had to constantly modify how we explained the study to the mothers and their families as we learned how best to clarify the technology use. This led to a mix in data capture, with low data collection at the

beginning and more toward the end of the study. We only collected audio data between 4 P.M. and 9 P.M., so we could have missed important speech and non-speech sounds outside of the study period. With the advancement of cellular networks in rural Nepal, the use of Android-based smartphones is getting more popular. We anticipate more acceptance of mhealth initiatives such as these in the future. A better understanding of average adolescent and young mother's lifestyle and cultural barriers to her use of technology will be integral in successful implementation of mobile health and passive data studies in Nepal.

CONCLUSION

Using passive audio data to capture the auditory environment of adolescent and young mothers gives a unique opportunity to improve our understanding of their social environment. Besides information on total speech and non-speech exposure, it can help assess quality and frequency of these sounds. Although current methods have limited comprehensive distinction between positive and negative social interactions, nuanced sounds like child laughter, child crying, adult laughter, or distinction between machine (TV, radio) vs. adult speech, a stronger model trained using culturally appropriate sounds can provide prediction of mother's auditory environment. We recommend a strong machine learning model combined with techniques such as coding of constellation of sounds, validation with observation, and qualitative tools for stronger indication of mother's environment Combining additional passive sensing data such as location and activity can also be integral in understanding mother's social support and interactions.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethical approval was received from the Nepal Health Research Council (#327/2018) and George Washington University Institutional Review Board (#051845). Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

AP and BK drafted the manuscript. AP and AHa conducted the qualitative data analysis. AHa supervised the qualitative data collection and analysis. AHe developed the EBM app. AHe and PB developed the StandStrong app. AHe and AP conducted the quantitative data analysis. SM supervised data collection and onsite study implementation. BK, AHe, and AHa conceptualized the study and study design. All authors revised the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2021.633606/full#supplementary-material

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Public Stigma Toward Female and Male Opium and Heroin Users. An Experimental Test of Attribution Theory and the Familiarity Hypothesis

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Drug abuse and addiction exist around the world. People addicted to drugs such as opium or heroin often encounter dehumanizing discriminatory behaviors and health-care systems that are reluctant to provide services. Experiencing discrimination often serves as a barrier to receiving help or finding a home or work. Therefore, it is important to better understand the mechanisms that lead to the stigmatization of drug addiction and who is more prone to stigmatizing behaviors. There is also a dearth of research on whether different patterns of stigma exist in men and women. Therefore, this study investigated factors affecting gender-specific stigmatization in the context of drug addiction. In our vignette study ($N_{Mensample}$ = 320 and $N_{Womensample}$ = 320) in Iran, we experimentally varied signals and signaling events regarding a person with drug addiction (i.e., $N_{Vignettes}$ = 32 per sample), based on Attribution Theory, before assessing stigmatizing cognitions (e.g., blameworthiness), affective responses (e.g., anger), and discriminatory inclinations (e.g., segregation) with the Attribution Questionnaire. We also tested assumptions from the Familiarity Hypothesis by assessing indicators of respondents' familiarity with drug addiction (e.g., knowledge about addiction). Results, for example, show higher stigma if the person used "harder" drugs, displayed aggressive behavior, or had a less controllable drug urge. Self-attributed knowledge about addiction or prior drug use increased some forms of stigma, but diminished others. These findings only partially converged between men and women. We suggest that anti-stigma initiatives should consider information about the stigmatized person, conditions of the addiction, and characteristics of stigmatizers.

Keywords: public stigma, attribution theory, substance abuse, gender, opium, heroin, familiarity hypothesis, addiction

INTRODUCTION

Drug abuse and addiction are problems around the world, leading to major health and social concerns. For example, in the United States, approximately 70,000 people died due to overdosing drugs in 2018 (1). Among them, opioid drug overdose was a leading cause of 67.8% of deaths (2). Besides the opioid crises, the United States also faces a heroin epidemic with a sharp increase in heroin use and heroin-involved overdose death, which grew almost 5-fold from 2010 to 2018 (3).

In addition to these lethal consequences of drug use, being addicted to drugs comes with the problem of stigmatization (4–8). Expressions of such stigma comprise the attribution of negative labels such as being reckless, hopeless, helpless, unreliable, dangerous, and crazy (9, 10). Such labeling is often based on the ascription that people choose to use drugs and are thus responsible for their addiction (6).

Such negative cognitions are known to evoke affective responses including fear and anger, which in turn, raise discriminatory behaviors such as dehumanization and reduced levels of help from public and health-care systems (9, 10). People that are stigmatized by others also experience self-stigmatization which is often accompanied by psychological harm, and they may be negatively affected in their uptake of health care services (6). As a consequence, stigmatization can impede the process of recovery, but also the ability to find a home, a job, or insurance (11, 12).

We thus need to better understand the factors driving stigmatization in the general population to design evidence-based programs to reduce it (11). Further research is also warranted given that, notwithstanding diverse efforts, stigmatization of people with mental illnesses such as drug addiction is a fact rather than a rudiment (13). Although growing, the research on the stigmatization of substance abuse and therein, on negative affective responses toward people with addiction, is still too rare (14). Moreover, only a few studies, thus far, have investigated stigma toward people addicted to the increasingly abused opium and heroin. Existing studies in this context often only use correlational (8) rather than experimental designs, which limits the test of causal hypothesis.

Therefore, this experimental vignette study wants to examine several candidate factors that may influence stigma of drug use based on assumptions of two influential frameworks in this context: Attribution Theory and the Familiarity Hypothesis (15–17).

Assumptions Based on Attribution Theory

Attribution Theory postulates that individuals have a tendency to attribute levels of controllability and responsibility in order to better understand and explain the causes of the behaviors and conditions (such as addiction) of others, or related events and outcomes (11, 15, 18). Thereby, individuals are receptive to or actively search for signals and signaling events which can evoke negative cognitive beliefs (such as blameworthiness and dangerousness), negative affective reactions (such as anger and fear), and discriminatory behaviors (such as coercion and segregation).

In the context of drug addiction, such signals and signaling events can include information about (a) the onset of addiction that may evoke beliefs about its controllability, in which the individual's stronger control over the onset of their addiction is assumed to increase stigma; (b) reasons for staying addicted that might be perceived as a lack of effort or ability which could increase stigma; (c) how the addiction's persistence can trigger beliefs about whether the addiction cannot be reversed, which would also increase stigma; or (d) consequences of an addiction such as negatively perceived behaviors that are, too, assumed to increase stigma (18–22).

In this study, we will examine the impact of five factors pertaining to these four partially interwoven signals and signaling events that may affect stigma toward a drug addicted person and that have been received with various levels of empirical scrutiny and support thus far (8, 13, 21). These five factors are the precipitating events of the addiction, the age of the drug-addicted person, the drug of addiction, the controllability of the addiction, and aggressive behavior.

Following the reasoning of Attribution Theory, information about the precipitating event for the onset of the addiction can evoke beliefs about the controllability of the addiction. One pathway to develop an addiction is repeated drug use, for example, due to overprescribing by physicians. This has been documented, for example, by Kolodny et al. (23). On the other hand, drug use also often starts in the company of friends who are also a frequent drug source (24, 25). The precipitating event and the development of the addiction in the first pathway might be perceived as comparatively less inside a person's control and responsibility (e.g., because physicians should oversee drug use and warn about addiction), which can reduce the accountability and stigma (4, 15, 21, 26). We therefore assume that the onset of drug use which began via asking a friend for drugs induces more stigma than if it started via a physician's prescription (see **Table 1** for a summary of the expected effects of all investigated Attribution Theory-based factors).

Moreover, the age of the addicted person can be a signal about the controllability of the onset of the addiction and the persistence of the addiction. Older people with drug addiction might be blamed more for starting to use drugs. Due to their maturity and knowledge, they should be more in control of their behavior and less easily influenced by others, thereby avoiding becoming addicted (27, 28). If an older person is addicted, individuals might also understand this as a signal of the addiction having an earlier onset; therefore, a longer duration and persistence of the addiction that a person is less able to reverse. Thus, older age should increase stigmatization.

Another factor relevant for stigma can be the drug of addiction, whereby higher levels of stigma are expected for drugs perceived as "harder" and "more addictive" (e.g., heroin), causing a more serious and persistent addiction. Users of such drugs might also be seen as irresponsible for engaging in them (29, 30). By using such drugs, they also risk more likely and more severe health consequences and may face more difficulties in quitting the addiction, or they might put others in danger when using "harder" drugs (8, 21).

TABLE 1 | Description of the experimental variation of five vignette dimensions per gender ($N_{Vignettes} = 32$) and directions of the expected effects on stigma.

Dimension	Levels	Expected effect	Examples of two contrasting vignettes
Age	. Young . Old	+	*Example for women*: **Maryam** is **25** years old. 1 year ago, **she** had jaw surgery. To make **her** mild pain go away, **she was given a prescription for a bottle of painkillers from a medical doctor**. The bottle included a 1-month supply of pills even though the injuries like this typically take a couple of days to heal. Although **Maryam's** pain went away in 4 days, **she** finished the entire bottle over the next month. After that, **she** started to replace the pills with **opium**. When **she** feels some urge to take **opium** these days, **she can easily** resist. Yesterday, someone accidentally stumbled over **her** bag in the bus. The man apologized politely and **Maryam smiled and accepted that**.
Precipitating event	. Medical doctor . Friend	+	
Drug of addiction	. Opium . Heroin	+	
Controllability	. Low . High	−	*Example for men:* **Ali** is **60** years old. 1 year ago, **he** had jaw surgery. To make **his** mild pain go away, **he asked a friend whom he knows has one left-over bottle of prescription painkillers from a prior healed illness**. The bottle included a 1-month supply of pills even though the injuries like this typically take a couple of days to heal. Although **Ali's** pain went away in 4 days, **he** finished the entire bottle over the next month. After that, he started to replace the pills with **heroin**. When **he** feels some urge to take **heroin** these days, he **cannot** resist. Yesterday, someone accidentally stumbled over **his** bag in the bus. The man apologized politely and **Ali shouted and pushed the person hard several times**.
Aggressive behavior	. No . Yes	+	

Note: Bold text indicates experimentally varying element of the vignette. In the survey, the text was not in bold.

If a person with addiction has a strong impulse to use drugs and is hardly able to resist, it can be seen as another signal affecting the stigmatization process. An inability to resist might be understood as a low control over the addiction and also as a less reversible addiction (19). Therefore, we assume that the inability to resist an urge to use drugs increases stigma.

More stigma might be also elicited if a person with addiction shows behavior that threatens or endangers others. The resulting negative consequences can lead to the perception that the addiction is more severe, irreversible, or uncontrollable (4, 7, 8, 26, 31–33). It might also confirm stereotypes that people with addiction are dangerous. Therefore, we assume that aggressive behavior increases stigma.

Assumptions Based on the Familiarity Hypotheses

Over and above the five experimentally varied Attribution Theory-based signals and signaling events, we examine personal characteristics of the respondents to explore assumptions underlying different facets of the Familiarity Hypothesis. Hereafter, tolerance and understanding toward people with drug addiction are a function of the knowledge (be it self-reported knowledge about addiction or education) or personal (e.g., own drug use) as well as vicarious experiences (e.g., having peers with drug addiction).

Such familiarity is known to shape the level of stigmatization (15, 16, 34–36). Previous studies found, for example, that familiarity with drug addiction reduced blameworthiness or feelings of fear and it evoked more tendencies to interact and help people with drug addiction (15, 37).

However, the evidence regarding these predictions is partially inconclusive (8, 15, 21, 38). In their review of research on familiarity, Corrigan and Nieweglowski (38) show that familiarity does not always reduce stigma, and that stigma can be elevated in some people in an especially familiar relationship (such as nuclear family members or healthcare providers) to persons with addiction. Two reasons for this can be the perceived higher burden and associative stigma. In most other cases, however, familiarity will likely reduce stigma.

We want to extend the literature on stigma for such relationships by examining stigma toward a person with addiction who is not in a relationship with the respondent. We expect a stigma-reducing effect of familiarity. Therefore, we plan to test different previously used indicators of familiarity with stigma, namely personal and vicarious experience, as well as self-reported knowledge about addiction using education as a proxy for such knowledge [e.g., (8, 15, 16, 21, 37, 38)].

Assumptions Concerning Gender Differences in Stigma

Evidence about the possible occurrence of different patterns of stigma toward men and women also from their own gender are still mixed or scarce. Some research shows no gender differences, while other shows more negative attitudes toward men with addiction as compared to women (4, 8, 11, 21, 39). For example, men with drug addiction are perceived as more harmful and threatening, while women are seen as needing protection and help. Still other research indicates that women might be particularly stigmatized when using certain drugs such as cocaine, which has been ascribed to possible double standards (40). One study, for example, found that women (compared to men) would be more avoided when using cannabis and stronger coerced into treatment when using methamphetamine (8). Such findings can be explained by the fact that women with addiction are seen as unable to play their traditional family roles (41–43). While men oftentimes attend treatment centers accompanied with their family and wives, women with addiction have often already lost family support (41).

Moreover, women who use drugs might even be stigmatized by peers of the same gender (44). It has been also found that some women display more gender stereotyping and negative attitudes toward other women (45), partially because of competitive attitudes. Such gender-based sexism has been also observed in other life-domains (e.g., work), namely that some women

elicit gender-typical perceptions against in-group members (i.e., women) by distancing the self from group stereotypes (46) or by feeling the need to punish and correct such outsiders. This might result in elevated levels of bullying other women (47). Similar research on men's reactions to men with drug addiction seems to be limited. However, some research indicates that in general men are also prone to be stigmatized (by both other men and women) on issues such as child care or behaving violently (48).

Because gender differences in stigmatization in the context of drug addiction are yet to be better understood (14), this study also aims to explore such differences with a sample of women and men who evaluate individuals with drug addiction of the same gender.

Study Objectives

In sum, this study has the following objectives: (1) We aim at gaining a deeper understanding of stigma formation processes, and the signals/signaling events promoting and diminishing stigmatizing cognitions, affective responses and behavioral intentions. (2) We assess the role of respondent characteristics as indicators of familiarity with drug addiction. (3) Thereby, we explore gender-specific stigmatization, i.e., how men stigmatize other men and how women stigmatize other women.

STUDY SETTING

Our study is conducted in Kerman, the largest province of Iran. Its proximity to the Afghan borders made it one of the main regions of drug trafficking and drug addiction (49). We aim to examine public stigma toward drug addiction in Iran, because this is one of the major social problems also in this country (50–52). Based on a national survey, 2.1% of Iranians between 15 to 65 years are estimated to use illicit drugs, and opium is the most frequently used drug (53).

Common reasons for women to start using opioids are to relieve pain or because their husband (who often also takes drugs) encourages or pressures them into it; the onset for men is more pleasure-related and peer-driven (54). The use of opium as a painkiller seems to be especially frequent for treating chronic diseases, which could point toward a higher acceptance as compared to heroin (55).

While using drugs was illegal for several years (with punishment including the death penalty for the possession of small amounts of drugs), this has changed gradually and in recent years drug addiction is no longer a crime; it is now considered to be a medical condition (50). People with drug addiction are offered treatment and harm reduction services (56). Due to the strict religious and cultural norms of the society and the religious government which promotes gender segregation (57), such offerings of drug treatment and related services are becoming more common in centers for either men or women (58).

However, using drugs is still highly stigmatized in Iranian society and this is seen as a barrier for seeking medical and social services for treatment (32, 56). It could be that the highly traditional and religious setting exacerbates stigma, especially for women. But evidence regarding factors influencing public stigma toward drug users in Iran is very limited. We believe that our investigation of the attribution-based mechanisms of stigmatization and the familiarity of effects can inform not only stigma research and prevention in Iran, but can also be applied around the globe because traditional gender and religious norms exist in many countries in various proportions (59, 60).

MATERIALS AND METHODS

Participants and Study Design

We conducted a paper-and-pencil survey in Kerman, Iran. We implemented a street-based convenience sample in part because web-based services covering the general population are not available. Street-based sampling has been found to very feasible in comparison to random sampling via households, especially when investigating sensitive topics (61). Based on previous studies, we stratified Kerman based on the socio-economic status (low, medium, and high) (62, 63). In each division, two interviewers (one female and one male) visited different highly populated places (e.g., parks, shopping centers, street corners) between June and July 2019. They approached every person who appeared to be above 18 years old and living in Kerman. Respondents younger than 18 or not living in Kerman were excluded. After introducing themselves and before obtaining verbal consent, they gave each participant adequate information about the study purpose (i.e., knowing how people understand drug addiction), the method of data collection, the completely voluntary nature of participation, and that no financial incentive is provided. They approached potential individuals ($N = 710$) to reach the planned sample size of $N = 320$ per gender (response rate: 90%). High response rates are not uncommon in this setting (64). They can be attributed to the shortness of the interview (∼5 min) and the vignette method sounding interesting to the approached persons. The mean age for women was 33.8 years and 36.3 years for men (see **Table 1** for all sample descriptions). This resembles the average age (of people over 18) in Kerman (women: 35.2; men: 35.0). The Research Ethics Committee at the Kerman University of Medical Sciences approved the study, including the procedure and the experiment (reference number: IR.KMU.REC.1398.104).

Instruments

Factorial Survey

We used a full factorial survey design with vignettes as this method enables experimentally and simultaneously varied descriptions of persons and situations to understand attitudes and behaviors regarding a specific topic (65, 66). This method counterbalances the weaknesses of classical experiments and traditional surveys by offering high internal validity due to an orthogonal design and a controlled setting combined with the potential for high external validity due to diversified and large samples. Vignettes (i.e., short experimentally varied descriptions of hypothetical situations) are especially useful to study stigmatization, because manipulations of the "real world" can be practically and ethically difficult (67). Moreover, they can reduce socially desired responses when sensitive topics are investigated (68, 69).

In our study, respondents were randomly assigned to one vignette (*between-subjects design*) describing a person, her/his conditions at the onset of addiction, and consequences of the

TABLE 2 | Descriptive statistics of the respondents' characteristics in the sample of women ($N = 320$) and men ($N = 320$), with EM-imputation.

	Sample of women		Sample of men	
Categorical variables	**Frequency**	**Percent**	**Frequency**	**Percent**
Educational level				
. Illiterate	10	3.1	4	1.3
. No high school diploma	36	11.3	36	11.3
. High school diploma	95	29.7	114	35.6
. University degree	179	55.9	166	51.9
Prior drug use				
. Yes	59	18.4	97	30.3
. No	261	81.6	223	69.7
Knowing people with drug addiction				
. Yes	245	76.6	238	74.4
. No	75	23.4	82	25.6
Continuous variables	**Mean (*M*)**	**Standard deviation (*SD*)**	**Mean (*M*)**	**Standard deviation (*SD*)**
Age	33.8	11.9	36.3	11.0
Self-reported knowledge about addiction	5.8	2.7	6.6	2.2

addiction. The development of the vignette was informed by previously used vignettes with similar dimensions and levels (4, 21). We adapted these existing vignettes to the study context by using typical Iranian names and varying the substances of interest. We also verified the relevance of the dimensions through discussion with colleagues ($N = 8$) in the field of addiction. In each vignette, we experimentally varied five dimensions (i.e., age, precipitating event, drug of addiction, controllability, and aggressive behavior) with two levels each, resulting in a vignette universe of $N_{Vignettes} = 32$ (**Table 2**). Due to the study design and to cultural sensitivity, the gender used in the vignette was matched with respondent gender. Thereby, each female vignette was rated by 10 women and each male vignette by 10 men.

Attribution Questionnaire (AQ)

After reading the vignette, respondents answered eight items on different cognitions), affects, and discriminatory inclinations toward people with drug addiction (**Figure 1** for item texts). The items were derived from the short Attribution Questionnaire, based on the highest factor loadings from the long scale (4, 15, 21, 70, 71). We included two negative cognitions: One captures the perception of whether the described person is seen *dangerous*, and the second cognition refers to the perception of whether the person is seen as responsible and should be *blamed* for the addiction and related consequences. Two items assess negative affects: *fear* and *anger*. Four further items measure discriminatory inclinations: *avoidance* as the intention to stay away from the person; *coercion* as the view that the person should be forced to treatment, even against her/his will; the unwillingness to provide *help* to this person; and finally, the view to *segregate* them from the community through institutionalization (also as a form of punishment). The nine-point response scale ranged from "*not at all*" [0] to "*very much*" (8). Due to the controversy around feeling "pity" toward a person with drug addiction, this item was not assessed (72).

Familiarity

Personal and vicarious experiences with, as well as knowledge about, people with addiction was assessed by asking about (a) the life-time use of the two investigated substances opium and heroin ["*no prior use*" (0) and "*any prior use*" (1)] (16); (b) knowing people who are addicted to opium and/or heroin ("*no*" (0) and "*yes*" (1) (8, 21); (c) self-reported knowledge about addiction with the item "I consider my knowledge of the brain mechanisms of addiction as…" "*very low*" (0) to "*very high*" (10) (21); and d) education (see **Table 2**).

Pretesting

In a pilot study ($N = 30$), we tested the procedure of data collection (including length) and how well-respondents understood all the questions, the vignette itself, and their reactions to the study. We did not identify any major problems and noticed that people were generally interested in the study.

Statistical Analyses

Ordered logit regression models (73) were computed to estimate the effects of the independent variables (i.e., the five vignette dimensions, four indicators of familiarity, and respondents' age). We report odds ratios (ORs), whereby ORs above one indicate that a higher category on the dependent variable is more likely than a lower category if the predictor increases by one unit (holding all other predictors constant); ORs below one indicate that a lower category is more likely; and ORs of one indicate no effect. We report *p*-values and confidence intervals for the ORs.

To account for missing data due to item non-response and to examine the stability of the results, estimates were made using an Expectation Maximization (EM) algorithm (74). This allows testing of the stability of the results and attainment of smaller standard errors of the estimates (75). The results are, however, very similar to non-imputed data **Supplementary Tables 1**–**4**.

RESULTS

Figure 1 shows the mean values and standard deviations for each attribution question for the sample of women and men. In each sample, blame and coercion were the stigma facets with the highest means; while fear (in women) and avoidance (in men) were the facets with the lowest level.

In the following, we present the results of the multivariate regression analysis (**Tables 3**, **4**). **Supplementary Table 5** offers a summary of our findings.

Findings Concerning Attribution Theory

For both women and men, an aggressive vignette character increased the level of most stigma outcomes statistically

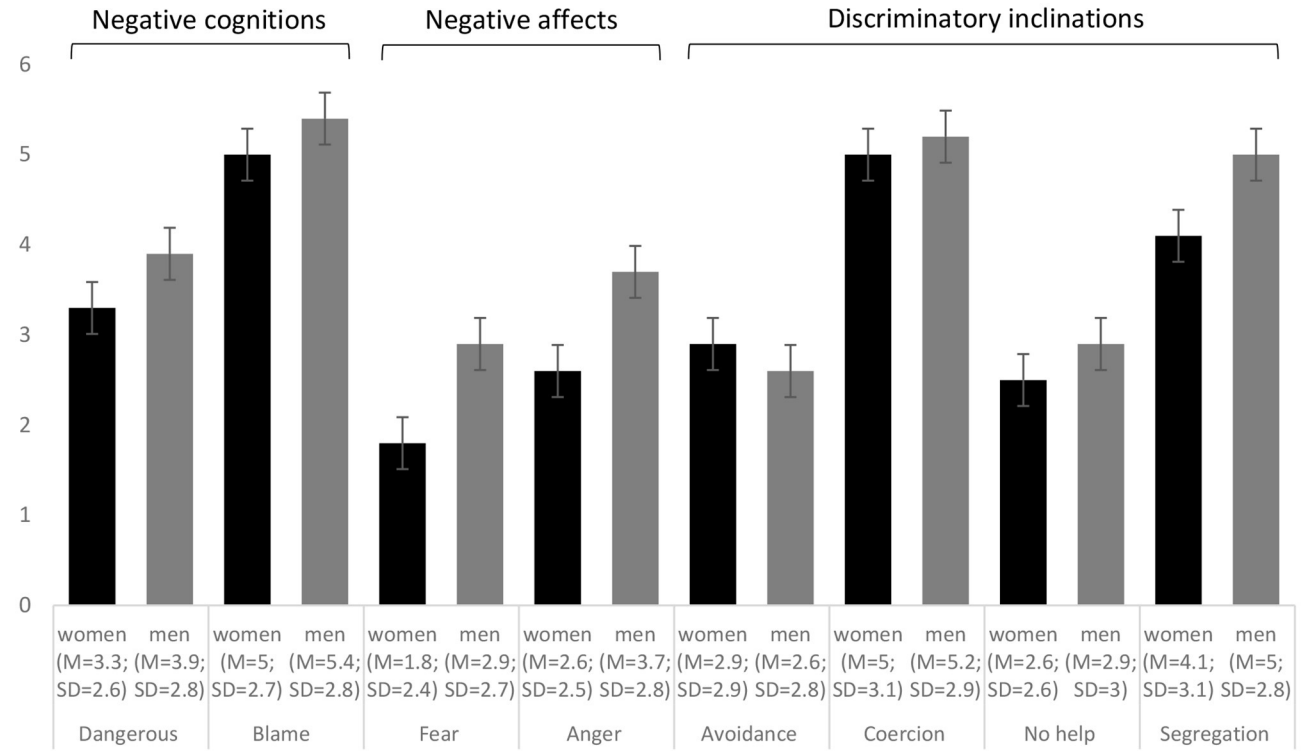


FIGURE 1 | Means (*M*) and standard deviations (*SD*, error bars) of the attribution questionnaire (AQ[†]) for the sample of women (black bars) and men (gray bars), with imputed data (*Number of imputations* = 20; *Number of observations* = 320 per sample). [†]*Dangerous:* I think she/he[‡] is dangerous. *Blame:* I would think that it was her/his[‡] own fault that she/he[‡] is in the present condition. *Fear:* I would feel scared of her/him[‡]. *Anger:* I would feel angry at her/him[‡]. *Avoidance:* I would try to stay away from her/him[‡]. *Coercion:* Her/His[‡] doctor should force him/her[‡] into treatment, even if she/he[‡] does not want to. *No help:* I would probably help her/him[‡] (reverse coded). *Segregation:* I think it would be best for her/his[‡] community if she/he[‡] were put away in a psychiatric hospital. [‡]The displayed gender aligns to the gender in the sample. Responses were assessed on a scale from "*not at all*" (0) to "*very much*" (8).

significantly, namely dangerousness (p_{Women} = <0.001; p_{Men} = <0.001), blame (only for men; p_{Men} = 0.002), fear (p_{Women} < 0.001; p_{Men} = <0.001), anger (p_{Women} = <0.001; p_{Men} = 0.009), avoidance (p_{Women} = <0.001; p_{Men} = 0.001), coercion [(p_{Men} = 0.004), and segregation (p_{Women} = 0.01; p_{Men} = 0.002, see **Tables 3**, **4**]. For example, the perceived fear increased by a factor of 3.50 or 350% for women, and 3.58 or 358% for men, respectively. If the woman in the vignette used heroin (in comparison to opium), this woman was perceived as more dangerous (p_{Women} = 0.013), caused more fear (p_{Women} = 0.033), and was deemed more in need of segregation (p_{Women} = 0.032). No effects for the type of drug were found for men. If prescription drugs had been obtained legally from a physician rather than acquired from a friend, blame (p_{Women} = 0.004) and avoidance (p_{Men} = 0.006) decreased. A higher ability to resist using reduced stigma in the form of behavioral intentions for women (segregation, p_{Women} = 0.038) and men (coercion, p_{Men} = 0.048). We only found that older people with drug addiction were blamed more than younger ones (p_{Women} = 0.009).

Findings in Relation to Familiarity Hypothesis

Respondents who used drugs during their lifetime had increased anger (p_{Women} = 0.029), segregation (p_{Women} = 0.021), avoidance (p_{Men} = <0.001), and coercion (p_{Men} = 0.002). Knowing relatives or peers who are addicted to drugs decreased the level of anger (p_{Women} = 0.014) and segregation (p_{Women} = <0.001) and increased intention to withhold help (p_{Women} = <0.001). Respondents reporting more knowledge about addiction enunciated less perceived dangerousness (p_{Women} = 0.033) and less coercion (p_{Men} = 0.009), but also more blame (p_{Men} = 0.044) and a stronger willingness to withhold help (p_{Women} = 0.001; p_{Men} = 0.038). Holding a degree lower than a high school diploma was unexpectedly associated with lower odds of segregation (p_{Women} = 0.028) and correction (p_{Men} = 0.021) in comparison to a University degree.

Additional Findings

We found that only for men an older age was negatively associated with blame (p_{Men} = 0.037), anger (p_{Men} = <0.001), and avoidance (p_{Men} = 0.008).

DISCUSSION

Research on stigma toward people with addiction is increasing. This is crucial because the high prevalence of addiction, the manifold health and social consequences, and the related stigma around addiction warrant attention. This study therefore engaged

TABLE 3 | Multivariate ordered logit regression models† on the Attribution Questionnaire (AQ) for women ($N = 320$), with EM-imputation.

Model	1	2	3	4	5	6	7	8
Stigma dimension	**Negative cognitions**		**Negative affects**		**Discriminatory inclinations**			
Stigma facet	**Dangerous**	**Blame**	**Fear**	**Anger**	**Avoidance**	**Coercion**	**No help**	**Segregation**
Vignette dimensions								
Age: old (ref. young)	1.07 [0.72, 1.58]	1.70** [1.14, 2.54]	1.14 [0.77, 1.69]	1.03 [0.69, 1.52]	1.15 [0.78, 1.72]	0.89 [0.60, 1.32]	0.98 [0.66, 1.45]	1.03 [0.69, 1.52]
Precipitating event: drug from friend (ref. from medical doctor)	1.23 [0.83, 1.83]	1.82** [1.22, 2.73]	1.21 [0.81, 1.79]	1.41 [0.96, 2.08]	0.84 [0.56, 1.25]	0.82 [0.55, 1.22]	0.89 [0.59, 1.33]	1.26 [0.85, 1.87]
Drug of addiction: heroin (ref. opium)	1.64* [1.1, 2.44]	0.94 [0.63, 1.4]	1.53* [1.04, 2.29]	1.08 [0.73, 1.59]	0.81 [0.54, 1.2]	0.92 [0.62, 1.36]	1.04 [0.69, 1.55]	1.54* [1.04, 2.29]
Controllability: high (ref. low)	0.93 [0.63, 1.37]	1.08 [0.73, 1.62]	0.89 [0.61, 1.33]	0.97 [0.65, 1.44]	1.37 [0.92, 2.04]	1.25 [0.85, 1.86]	1.07 [0.72, 1.59]	0.65* [0.44, 0.98]
Aggressive behavior: yes (ref. no)	3.73*** [2.46, 5.65]	1.45 [0.97, 2.17]	3.50*** [2.32, 5.29]	2.04*** [1.37, 3.03]	2.20*** [1.47, 3.31]	1.27 [0.85, 1.88]	0.98 [0.65, 1.46]	1.69* [1.14, 2.53]
Respondent characteristics								
Age	0.99 [0.97, 1.00]	0.98 [0.96, 1.01]	1.00 [0.98, 1.02]	1.01 [0.98, 1.03]	1.01 [0.99, 1.03]	0.98 [0.96, 1.00]	0.99 [0.98, 1.02]	0.99 [0.97, 1.01]
Educational level (ref. University degree)								
• Illiterate	0.13 [0.01, 1.19]	2.17 [0.34, 13.68]	0.31 [0.05, 1.96]	0.42 [0.06, 3.11]	0.19 [0.03, 1.18]	0.50 [0.06, 3.70]	0.99 [0.15, 6.41]	1.16 [0.18, 7.24]
• No high school diploma	0.61 [0.31, 1.19]	0.88 [0.44, 1.79]	0.72 [0.37, 1.41]	0.70 [0.36, 1.39]	1.12 [0.55, 2.27]	0.92 [0.47, 1.80]	1.16 [0.57, 2.37]	0.47* [0.24, 0.92]
• High school diploma	0.67 [0.42, 1.07]	0.96 [0.59, 1.53]	0.73 [0.46, 1.16]	1.08 [0.68, 1.71]	0.97 [0.61, 1.54]	1.01 [0.63, 1.61]	1.21 [0.76, 1.92]	0.79 [0.49, 1.28]
Self-reported knowledge about addiction	0.90* [0.82, 0.99]	1.03 [0.94, 1.14]	0.98 [0.88, 1.08]	1.01 [0.92, 1.11]	0.96 [0.87, 1.05]	0.99 [0.91, 1.1]	1.17** [1.06, 1.29]	0.96 [0.88, 1.06]
Prior drug use (ref. no)	1.44 [0.89, 2.31]	1.43 [0.89, 2.32]	0.98 [0.62, 1.58]	1.67* [1.05, 2.65]	1.32 [0.82, 2.12]	0.95 [0.59, 1.52]	0.66 [0.41, 1.06]	1.75* [1.09, 2.80]
Knowing people with drug addiction (ref. no)	0.78 [0.48, 1.26]	1.11 [0.68, 1.81]	1.08 [0.67, 1.75]	0.54* [0.33, 0.89]	1.18 [0.72, 1.94]	1.26 [0.78, 2.06]	2.61*** [1.60, 4.25]	0.41*** [0.25, 0.67]

†*Odds ratios (95%-confidence intervals in brackets). *p < 0.05; **p < 0.01; ***p < 0.001 (two-tailed).*

in a multi-factorial analysis of stigmatization processes in the relatively under-investigated context of drug addiction: (a) to better understand these processes and (b) to be able to develop evidence-based anti-stigma initiatives. Such research can help to identify people at risk of being stigmatized (and who may therefore be avoiding such treatment). It can also offer particular help to provide adequate anti-stigma education to people at risk of stigmatizing others; for example, their family members, health care practitioners, and also people with addiction when interacting with others with addiction (e.g., when visiting rehabilitation facilities).

Findings Concerning Attribution Theory

Aggressive behavior: A person with addiction, who displays aggressive behavior causes negative cognitions, negative affect, and discriminatory inclinations. Dangerousness has been found to be a main stereotype related to substance use disorder (76, 77) and it might be exacerbated if a person with such a disorder behaves aggressively. People with a substance use disorder have been particularly viewed as unpredictable and uncontrollable, but also at risk of becoming criminal (10). In line with Attribution Theory and prior research, performing aggressive behaviors serves as a signal for a negative outcome of drug addiction that often results in perceptions such as aggressive. This then, is what evokes negative emotions such as fear and in turn discriminatory inclinations such as the wish to segregate such aggressive individuals (21, 26, 33, 78). Negative behaviors are more likely to be attributed to internal causes and people performing such behaviors are rated more responsible for their actions and therefore tend to receive more social rejection (15). Such attributions have also been described as a mechanism to protect oneself and society from individuals perceived as dangerous (7). One interpretation for the observed effect of aggressive behavior on fear in women could be related to common self-attributions of being vulnerable and weak. In our study, blame and coercion were especially pronounced for men. Although, we are not aware of other research scrutinizing why blame and coercion were especially pronounced for men, one explanation could be that men are more likely to experience or observe drug-related violence on the street and outside. This elevated exposure might make them more willing to be coercive to change this situation. Moreover, in Iranian society with prevalent traditional role-models (79), men

TABLE 4 | Multivariate ordered logit regression models† on the Attribution Questionnaire (AQ) for men ($N = 320$), with EM-imputation.

Model	1	2	3	4	5	6	7	8
Stigma dimension	**Negative cognitions**		**Negative affects**		**Discriminatory inclinations**			
Stigma facet	**Dangerous**	**Blame**	**Fear**	**Anger**	**Avoidance**	**Coercion**	**No help**	**Segregation**
Vignette dimensions								
Age: old (ref. young)	0.97 [0.65, 1.44]	1.18 [0.79, 1.75]	0.84 [0.55, 1.28]	1.29 [0.87, 1.92]	1.09 [0.73, 1.62]	1.06 [0.71, 1.59]	0.96 [0.65, 1.42]	1.18 [0.79, 1.74]
Precipitating event: drug from friend (ref. from medical doctor)	1.04 [0.71, 1.54]	1.44 [0.97, 2.13]	1.10 [0.72, 1.67]	1.05 [0.71, 1.56]	1.74** [1.17, 2.59]	1.06 [0.7, 1.59]	1.29 [0.87, 1.92]	1.07 [0.72, 1.58]
Drug of addiction: heroin (ref. opium)	1.33 [0.89, 1.97]	1.25 [0.83, 1.86]	1.49 [0.97, 2.26]	1.28 [0.86, 1.91]	1.38 [0.92, 2.06]	1.13 [0.74, 1.70]	0.77 [0.52, 1.15]	1.35 [0.91, 2.01]
Controllability: high (ref. low)	1.01 [0.67, 1.5]	1.05 [0.71, 1.55]	1.28 [0.84, 1.94]	0.84 [0.57, 1.24]	1.00 [0.68, 1.49]	0.67* [0.44, 0.99]	1.07 [0.72, 1.58]	0.97 [0.65, 1.42]
Aggressive behavior: yes (ref. no)	7.75*** [4.98, 12.09]	1.85** [1.24, 2.75]	3.58*** [2.32, 5.52]	1.68** [1.14, 2.51]	2.05** [1.37, 3.06]	1.82** [1.22, 2.75]	1.16 [0.78, 1.72]	1.87** [1.26, 2.78]
Respondent characteristics								
Age	0.99 [0.97, 1.00]	0.98* [0.96, 0.99]	0.98 [0.96, 1.00]	0.96*** [0.95, 0.98]	0.98** [0.96, 0.99]	0.97** [0.95, 0.99]	1.00 [0.98, 1.02]	0.98* [0.96, 1.00]
Educational level (ref. University degree)								
• Illiterate	0.73 [0.23,2.38]	1.70 [0.42, 6.96]	1.95 [0.45, 8.41]	3.18 [0.81, 12.4]	0.74 [0.18, 2.94]	0.32 [0.07, 1.43]	0.72 [0.21, 2.49]	2.85 [0.86, 9.39]
• No high school diploma	0.69 [0.35, 1.34]	1.37 [0.71, 2.63]	1.21 [0.61, 2.42]	0.75 [0.39, 1.45]	0.53 [0.27, 1.02]	0.45* [0.23, 0.89]	0.64 [0.32, 1.26]	0.97 [0.5, 1.86]
• High school diploma	0.72 [0.46, 1.14]	1.16 [0.74, 1.82]	1.29 [0.79, 2.10]	1.02 [0.65, 1.59]	0.72 [0.46, 1.13]	0.66 [0.41, 1.05]	0.83 [0.53, 1.31]	1.11 [0.7, 1.75]
Self-reported knowledge about addiction	0.97 [0.9, 1.05]	1.08* [1, 1.17]	1.00 [0.93, 1.09]	0.94 [0.87, 1.01]	0.99 [0.93, 1.07]	0.90** [0.83, 0.97]	1.08* [1, 1.17]	1.01 [0.94, 1.09]
Prior drug use (ref. no)	1.67 [0.96, 2.9]	1.53 [0.88, 2.66]	1.26 [0.70, 2.24]	1.37 [0.79, 2.39]	3.69*** [2.04, 6.70]	2.55** [1.42, 4.56]	1.62 [0.94, 2.79]	1.31 [0.76, 2.26]
Knowing people with drug addiction (ref. no)	1.45 [0.90, 2.33]	0.82 [0.51, 1.33]	1.48 [0.89, 2.44]	0.83 [0.51, 1.34]	1.27 [0.79, 2.03]	0.91 [0.56, 1.46]	0.84 [0.52, 1.35]	1.20 [0.74, 1.95]

†*Odds ratios (95%-confidence intervals in brackets). *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$ (two-tailed).*

might feel a stronger need to keep the community safer for their family.

Precipitating event: Consistent with the theory and recent studies, becoming addicted after receiving prescription drugs through a physician decreased stigmatization (4, 80) in comparison to drug use through social contagion (i.e., through a friend). This has been explained by lower attributions of accountability when a medical doctor (who may be expected to oversight drug use and warn from addiction) is involved. In comparison, when starting to use drugs obtained from a friend (81), more personal control over the onset of drug use (and thus more responsibility) is attributed.

Drug of addiction: Results show that the drug of addiction affected stigmatization only for women. Heroin (compared to opium) can be seen as the "harder," more "addictive" and "dangerous" drug with a frequent route of administration (injection) that might further elevate stigma. Previous research also found, consistent with Attribution Theory, that "harder" drugs, for example, cocaine compared to alcohol, evoked higher levels of blame, fear, avoidance, withholding help, or segregation (27, 30, 82). Such higher levels of discrimination are also mirrored by studies asking about alcohol users in comparison to cocaine users (21). Moreover, using heroin (in comparison to cocaine) might be viewed as more irresponsible (in terms of risking negative consequences for oneself and others) and as less irreversible (in terms of a more severe addiction) (8, 14, 21). Furthermore, women who use heroin might be perceived more as being involved in selling sex (44), which is also stigmatized. In the study setting (Kerman in Iran), opium is a very common drug (83).

Controllability: Having more control over the addiction in terms of being able to resist the impulse to use partially lowered stigmatizing behavioral intentions. This finding is similar to research showing that attempts to stop an addiction can lower stigmatization (21). Also aligning with Attribution Theory, it can be argued that more stigmatization is expected if the person has lower control on resisting drugs, i.e., a lack of ability to offset the addiction (84).

Age: Attribution Theory explains higher age-related stigma with higher attributed responsibility for using drugs to older

people (who should be less likely to be vulnerable and less likely to be influenced by peers) (27, 28) and to more difficulties in the irreversibility (offset) of the addiction. While prior studies reported elevated stigma toward older people with addiction (21, 27, 28), we only found limited support for this assertion. The greater acceptance of drug use in the older vignette figures can be due to the prevalent use in hospitalized elderly patients, leading to a common belief that opium is useful in treating certain chronic illnesses (55).

Findings in Relation to Familiarity Hypothesis

Prior drug use: In our study, almost twice as many men as women self-report a lifetime history of drug use. While the Familiarity Hypothesis postulated that such personal experience should increase sympathy as well as understanding and thus lower stigma—our findings do not support this. Such stigma increases have been also reported in other research. Possible explanations for these unexpected results mention a self-image bias and stereotype agreement of people who use(d) drugs (85). Therefore, they may attribute more control and more dispositional drivers to the drug use of others as compared to themselves (86) and in turn more responsibility to others behavior (87). Psychological and social distancing from people with drug addiction might be used to not problematize one's own current or prior drug use to oneself, to keep a positive self-image and to avoid collateral stigmatization (21).

Knowing people with drug addiction: While knowing a drug user is assumed to promote more empathy and understanding toward a person in similar circumstances (15, 35, 88), we only found partial support for this hypothesis, and only for women. However, we also found that women who have relatives or peers who are addicted to drugs, tended to withhold help. Similarly, one study found that women stigmatized their peers who use drugs as being bad women or mothers (44). Likewise, other prior research revealed ambiguous findings regarding such contact (8). This might be also a function of the quality of the contact (88).

Self-reported knowledge about addiction: By asking respondents to report their knowledge about the brain mechanisms of addiction, we captured a specific dimension of familiarity with addiction (37). Congruent with other research using identical or related measures of this dimension, we also found mixed evidence, e.g., more knowledge was associated with less coercion but with more blame (14, 35, 89), which is difficult to interpret and warrants further research.

Education: Education can be seen as a more general proxy of knowledge about mental illnesses and addiction, that might go along with a stronger rejection of myths and orientation toward facts that counteract inaccurate stereotypes (8, 15, 21). Although, several studies show destigmatizing effects of education (36, 70, 90, 91), other studies found no or opposing effects (8, 15, 21) as we did, which underlines the need to also further investigate potential reasons for these inconsistencies.

Additional Findings

While we found that older age was negatively associated with several stigma dimensions only in men, existing research on age-effects is mixed. Several studies find a negative association (21, 92, 93); others showed either no effects (8, 92, 94), or positive associations (90). One way to interpret negative associations is that with age, respondents might have more life experience and even a larger time-span for having a history of drug use (44), making them more flexible to accept different people with different choices (44, 90).

Strengths, Limitations, and Directions for Future Research

While other studies in the field with traditional survey instruments or static vignettes complicate the causal interpretation of the findings (e.g., due to potential confounding and multi-collinearity), our study uses a factorial survey approach with vignettes (95, 96). These vignettes have been experimentally varied along five signals and signaling events informed by Attribution Theory, which holds prominence in stigma research. This experimental design lends credit to the causal interpretation of the findings. Moreover, vignette studies are suitable for investigating attitudes and behavior that are difficult to observe or manipulate in the real world (67, 97, 98). Another feature of vignette studies is to offer low levels of socially desired responding (68, 69, 99), which is advantageous when investigating stigmatization (that may cause such responding as well as item non-response). The very low levels item non-response (between 0.2 and 0.3% per item Attribution Questionnaire item) might also be due to this. We, however, still employed an imputation strategy to account for missing values, but found very similar results compared to non-imputed data.

It has to be further acknowledged that the questions about lifetime use of opium and heroin can be perceived as sensitive and provoke socially desired responding. However, the high prevalence found in this study (almost one fifth of women and one third of men reported a prior use of the mentioned drugs) and also the very low number of missing cases (none for women and 1% for men) can be seen as indicators that respondents were willing to report on drug use. Still, we cannot rule out biased responses. Therefore, we suggest that future studies should be used to verify the results using other methodology that offer higher levels of anonymity such as web-based assessments (100–102).

The vignette used in this study does not provide the respondents with detailed information about the severity of the described person's addiction and its consequences, nor does it describe the vignette character with regard to all potentially influence information (e.g., with more stereotypical features), which might have caused more severe stigma. However, the vignette dimension "controllability" gives the respondents a partial indication of the strength of the addiction partially as it either describes a person that can easily resist the urge to take the drug vs. a person that cannot resist (103). Moreover, the dimension "aggressive behavior" might be also interpreted as a consequence of the addiction (i.e., the aggressive behavior that has been described). However, future studies may also describe other features of the addiction and, for example, physical

appearance, addiction-related habits, or living conditions of the person.

While we employed a convenience street-based sampling strategy (which still yielded a high response rate) due to its feasibility in the study context (61), future research should aim for national samples to counteract potential sampling biases.

It may be that the baseline stigma or effects on stigma are be more pronounced in Iran (especially for women), because addiction is highly stigmatized in Iranian society (83). This could be also true for other countries with strong religious ties and traditional gender roles (59, 60). On the other hand, the use of opium, for example, has some popularity in this society (104), which can also reduce stigma. However, while we found partial overlap in the results with studies in "Western" countries, the aim of our study was not about comparing stigmatization in "Western" and "non-Western" countries. Thus, examining the possibility of generalizing our findings (within and across different cultural contexts) with identical methods is an important task for future internationally comparative research. Another important task is to examine factors that may change stigmatization over time (e.g., changing cultural norms or knowledge about addiction in the population).

CONCLUSION

To increase our understanding of stigma toward people with drug addiction in the context of Iran and beyond, this study investigated the effect of information about the stigmatized person, conditions of the addiction, and characteristics of potential stigmatizers along two theoretical strands. Our results suggest that predictions made in Attribution Theory point to relevant signals and signalizing events that exacerbate stigma. For example, a person with addiction, who displays aggressive behavior causes negative cognitions, negative affect, and discriminatory inclinations. Also, consistent with the theory, the precipitating event of the drug use in the form of social contagion (i.e., through a friend), the use of "harder" drugs, as well as having less controllability over using drugs are signals and signaling events that contribute to stigmatization. Yet, they did not affect all three stigma dimensions (cognitions, affects, and behavior). Therefore, they ought to be explored in further studies, which may, if observed more frequently, imply a revision of the theory (21).

Our study also examined predictions of the Familiarity Hypothesis. While several findings suggest stigma-reducing effects of familiarity (e.g., through having friends or relatives with drug addiction and self-reported knowledge about drug addiction), several findings contradict the Familiarity Hypothesis either with null findings or with effects opposite to the prediction. For example, we found that respondents with a drug history are more likely to stigmatize. This observation of a double-edged role of familiarity is not new to the field and has been interpreted as a form of self-image bias and stereotype agreement (85, 86). It removes the positive image of familiarity and might demand for a specification of what kind of familiarity someone has (e.g., knowledge about addiction, its causes, and consequences as well as the attached stigma or the specific positive and negative experiences in interacting with addicted people) [e.g., (38)], but it also has practical implications in anti-stigma programs. Such programs may try to increase knowledge about the causes of addiction and potential treatments, and they should also highlight the detrimental consequences of stigmatization and how they can be avoided by developing empathy toward people with addiction.

Despite the assumption of more in-group favoritism and out-group derogation within groups of men and women (105), we can conclude from our results that stigmatization occurs within both groups and that the drivers of stigmatization are partially gender-specific. It might be that competitive attitudes and the wish to distance the self from group stereotypes and to the felt need to punish and correct such outsiders may contribute to these processes (46). Therefore, anti-stigma initiatives should also reflect that gender might play a role in experiencing particular forms of stigma when being addicted as well as in stigmatizing. Such gender-specific processes also need further attention given that gender-matched services for people with addiction are not only provided in Iran (58). Further knowledge should be also gathered to find out whether men and women who use drugs might receive different levels and forms of stigma from peers, family members, and health care providers of their own gender. This knowledge could enable better planning and anti-stigma strategies for respective target groups in Iran and elsewhere. Two exemplary conclusions from our study for such strategies could be that swift replacement therapies (e.g., with methadone or buprenorphine) could help to reduce the especially high stigma toward women using stronger drugs (heroin instead of opioids) and it could also reduce the risk of death by overdose (106). Men with addiction might be informed that displaying any aggression might be judged and treated very harshly by others. By helping them train their affective and behavioral control (107, 108), stigma and its further consequences might be reduced. We thus hope that our findings regarding basic attribution and familiarity effects will inform stigma research and prevention in- and outside of Iran.

DATA AVAILABILITY STATEMENT

The original contributions generated for this study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Research Ethics Committee at the Kerman University of Medical Sciences (IR.KMU.REC.1398.104). The patients/participants provided their written informed consent to participate in this study. Written informed consent was not obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

SS, FZ, MB, and SA conceptualized the study, developed the study design as well as the stimulus materials and assessments. FZ

acquired financial support for the project and was responsible for the research activity planning. SA collected the data. MB, JG, and SA cleaned the data and conducted the analyses. SS and FZ wrote the initial draft of the manuscript. SS led revisions. All authors provided critical feedback on the analyses, contributed to editing and revising the manuscript, and approved it for submission.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2021.652876/full#supplementary-material

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Trends in Research Related to Premenstrual Syndrome and Premenstrual Dysphoric Disorder From 1945 to 2018: A Bibliometric Analysis

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Background: The global incidence of premenstrual syndrome (PMS) and premenstrual dysphoric disorder (PMDD) is increasing, with increasing suicide reports. However, the bibliometric analysis of global research on PMS and PMDD is rare. We aimed to evaluate the global scientific output of research on PMS and PMDD and to explore their research hotspots and frontiers from 1945 to 2018 using a bibliometric analysis methodology.

Methods: Articles with research on PMS and PMDD between 1945 and 2018 were retrieved from the Web of Science Core Collection (WoSCC). We used the bibliometric method, CiteSpace V and VOSviewer to analyze publication years, journals, countries, institutions, authors, research hotspots, and trends. We plotted the reference co-citation network, and we used keywords to analyze the research hotspots and trends.

Results: We identified 2,833 publications on PMS and PMDD research from 1945 to 2018, and the annual publication number increased with time, with fluctuations. Psychoneuroendocrinology published the highest number of articles. The USA ranked the highest among the countries with the most publications, and the leading institute was UNIV PENN. Keyword and reference analysis indicated that the menstrual cycle, depression and ovarian hormones were the research hotspots, whereas prevalence, systematic review, anxiety and depression and young women were the research frontiers.

Conclusions: We depicted overall research on PMS and PMDD by a bibliometric analysis methodology. Prevalence and impact in young women, systematic review evaluations of risk factors, and the association of anxiety and depression with menstrual cycle phases are the latest research frontiers that will pioneer the direction of research in the next few years.

Keywords: PMS/PMDD, CiteSpace, menstrual cycle, trend, bibliometric analysis

INTRODUCTION

Premenstrual syndrome (PMS), a common cyclical and recurrent disorder of the reproductive female population, is characterized by psychological and somatic symptoms that consistently occur during the luteal phase of the menstrual cycle (1). Women with more severe affective symptoms are classified as having premenstrual dysphoric disorder (PMDD), which is hereby designated as a depressive disorder in the DSM-5 (2, 3). Studies have shown that 75% of women of reproductive age are affected by disturbing premenstrual symptoms (4) and 5–8% of women thus suffer from severe PMS (2), and PMDD affects 3–8% of menstruating women (5). Diagnostic criteria for PMDD have been revised and updated, referring to newly discovered results from the Diagnostic and Statistical Manual of Mental Disorders IV (DSM-4) (6) to the Diagnostic and Statistical Manual of Mental Disorders V (DSM-5) (7). In clinical diagnosis, the DSM-5 requires at least five specified symptoms for PMDD, while the ICD-10 requires only one distressing symptom for diagnosis of PMS (8).

Clinically, depression, anxiety, and irritability are seen as the three most studied symptoms of PMDD (9). And abdominal bloating, cramps or abdominal pain, irritability, and joint/muscle/back pains were the most prevalent symptoms in patients from France, Germany, Hungary, Italy, Spain, UK, Brazil, Mexico, Hong Kong, Pakistan, and Thailand (10). Recently, anger appears to be an important problem that makes life more difficult for subjects with PMDD (11). And there is a strong, independent association between PMS/PMDD and trait anger among a representative sample of female suicide attempters (12). Besides, recent evidence from studies indicates that sex steroids (progesterone, allopregnanolone, and estrogen) and central neurotransmitters (serotonin, gamma-aminobutyric acid, glutamate and beta endorphins) maybe core mechanism (13–16). Psychological factors including perceived stress, tobacco consumption (17), neuroticism and coping strategies (negative cognitive styles) are strongly related to PMS/PMDD (18). It has been suggested that PMDD is a manifestation of the underlying depressive disorder which is associated with the inability to regulate emotions in an adaptive manner (19).

As research in PMS/PMDD advances rapidly, there still have been no attempts to systematically analyze the data on publications with so many scholarly papers published in journals in PMS/PMDD research over the past decade. Luckily, a bibliometric analysis methodology is widely used to assess trends in research activities as a quantitative analysis combining mathematical and statistical methods (20). Bibliometric analysis was utilized to detect the knowledge structure and emerging trends by quantitative analysis (21). In this study, CiteSpace (22) and VOSviewer (23) were applied to conduct a bibliometric analysis of related references derived from the Science Citation Index-Expanded (SCI-E) of the Web of Science database from 1945 to 2018. And this comprehensive bibliometric analysis that we will make aims to provide an overview of the status and to keep abreast of emerging trends and critical turns of the development of global research of PMS/PMDD.

Abbreviations: PMS, premenstrual syndrome; PMDD, premenstrual dysphoric disorder; WoSCC, Web of Science Core Collection; DSM-5, Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition.

METHODS

Data Source and Search Strategy

Literature retrieval was performed online through the SCI-E of the Web of Science Core Collection (WoSCC) on September 23, 2018. All searches were performed within the same day to avoid the bias caused by the daily database updates. The search queries are listed in **Table 1**.

Inclusion and Exclusion Criteria

Articles or reviews that met the following criteria were included: (1) articles published between 1945 and September 23, 2018; (2) articles indexed in the WoSCC; (3) articles on PMS/PMDD research, including original research and reviews; and (4) articles with basic information. The following documents were excluded: (1) meeting abstracts, proceedings, corrected articles, and repeated articles; (2) unpublished documents without enough information for further analysis; and (3) non-English publications. The screening and review strategy is illustrated in **Figure 1**.

Data Collection

Raw data from the WoSCC were initially downloaded and verified by two authors (Mingzhou Gao and Hui Sun) independently. The data were then imported into Excel 2019, VOSviewer and CiteSpace V and systematically analyzed.

Statistical Methods

A descriptive analysis was used to present the characteristics of the included studies by publication years, countries, journals, and authors. Then, we used CiteSpace V (version 5.3. R4) to construct knowledge maps. In addition, we also used VOSviewer software (version 1.6.9) for better network visualizations in some cases. Finally, we also applied burst detection to investigate the growth rate of citations or keywords with CiteSpace V.

RESULTS

Annual Publication Outputs

As showed in **Figure 2**, we counted the number of publications each year. Overall, there was an upward trend in publications from 1950 to 2008, but there were fluctuations in some years. However, we can see that the number of papers published in a single year reached a maximum of 124 in 2008. Then, there was a gradual downward trend from 2008 to 2018. Moreover, we can see that the trend in output was not stable; since 2000, there were fluctuations in 2001, 2007, 2009, 2012, 2016, and 2017. This finding may be due to the publication cycle. On the one hand, an upward trend indicates that PMS/PMDD research is becoming

TABLE 1 | Search queries for premenstrual syndrome and premenstrual dysphoric disorder.

Mark	Number	Queries
# 1	3064	TS=(Premenstrual Syndrome) OR TS=(Premenstrual Syndromes) OR TS=(Syndrome, Premenstrual) OR TS=(Syndromes, Premenstrual) OR TS=(Premenstrual Tension) OR TS=(Premenstrual Tensions) OR TS=(Tension, Premenstrual) OR TS=(Tensions, Premenstrual) Index =SCI-EXPANDED, CCR-EXPANDED, IC Time Span = All years
# 2	1583	TS=(Premenstrual Dysphoric Disorder) OR TS=(Disorder, Premenstrual Dysphoric) OR TS=(Dysphoric Disorder, Premenstrual) OR TS=(Premenstrual Dysphoric Syndrome) OR TS=(Syndrome, Premenstrual Dysphoric) Index =SCI-EXPANDED, CCR-EXPANDED, IC Time Span = All years
# 3	3852	#2 OR #1 Index =SCI-EXPANDED, CCR-EXPANDED, IC Time Span = All years
# 4	2833	#3 Refining basis: [Exclusion] Document type: (PROCEEDINGS PAPER OR NEWS ITEM OR REPRINT OR EDITORIAL MATERIAL OR CORRECTION OR ABSTRACT OF PUBLISHED ITEM OR MEETING ABSTRACT OR NOTE OR BOOK CHAPTER OR CORRECTION ADDITION OR LETTER OR BOOK REVIEW OR DISCUSSION) AND language: (ENGLISH) Time Span: all year. Index: SCI-EXPANDED, SSCI, CCR-EXPANDED, IC.

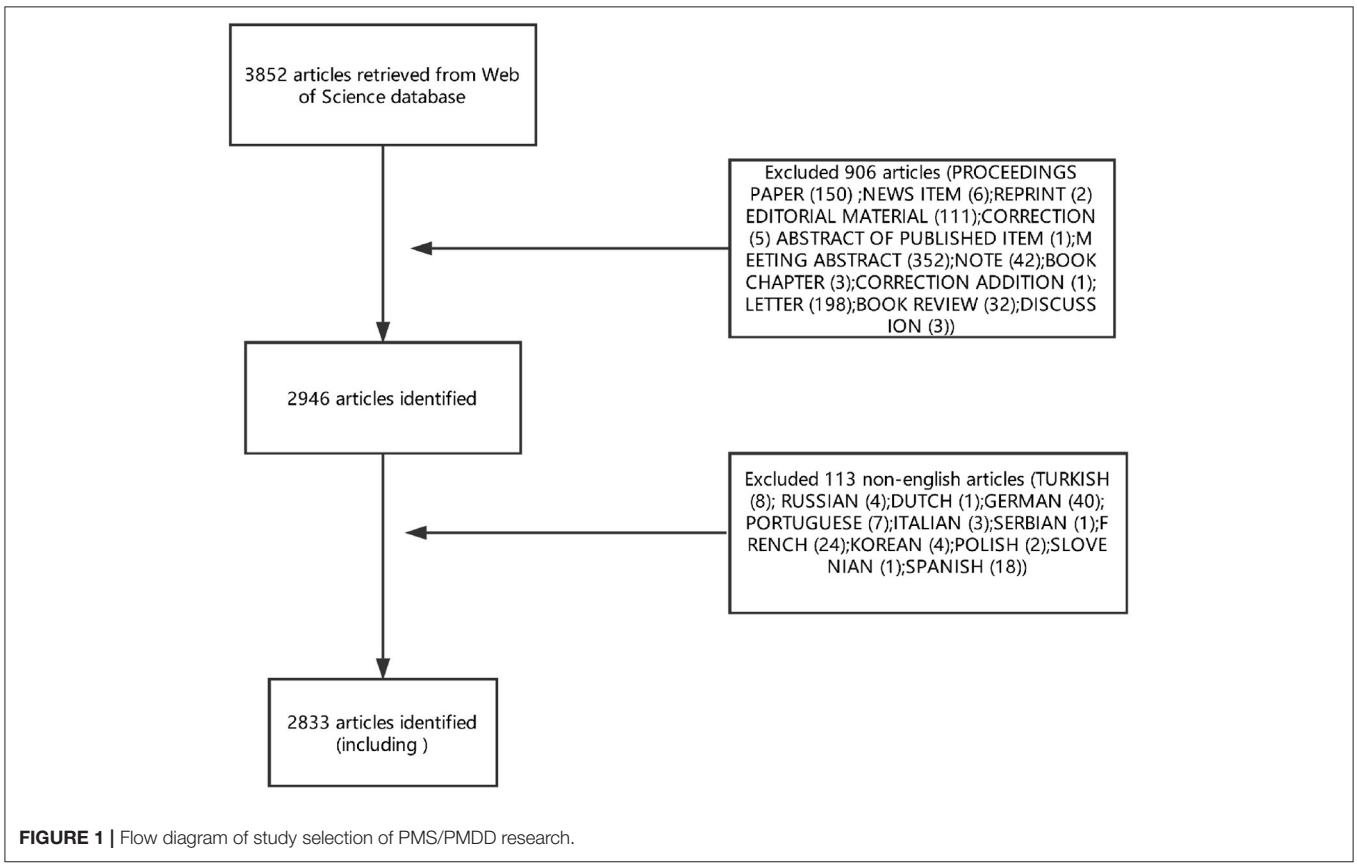


FIGURE 1 | Flow diagram of study selection of PMS/PMDD research.

a hotspot, but a download trendency indicates that PMS/PMDD research attention tends to be flat.

Distribution of Journals and Co-cited Journals

In total, 295 academic journals have published articles on PMS/PMDD. According to the Journal Citation Reports (JCR) 2017 standards, the top 15 journals contributing to PMS/PMDD are shown in **Table 2**. Psychneuroendocrinology [impact factor (IF) 2017 = 4.731] published the most papers (79 publications, 2.789%), followed by the Journal of Psychosomatic Obstetrics and Gynecology (IF 2017 = 1.900, 61 publications; 2.153%), the American Journal of Obstetrics and Gynecology (IF 2017= 5.732, 50 publications; 1.765%) and Gynecological Endocrinology (IF 2017 = 1.453, 49 publications; 1.730%).

In addition, Biological Psychiatry (IF 2018 = 11.982) had an IF higher than 10, and Gynecology (IF 2018 = 5.732) had an IF between 10 and five. Five journals, Obstetrics and Gynecology (IF 2018 = 4.982), Psychoneuroendocrinology (IF 2018 = 4.731), the Journal of Clinical Psychiatry (IF 2018 = 4.247), Psychosomatic Medicine (IF 2018 = 3.810), and the Journal of Affective Disorders (IF 2018 = 3.786), had an IF between five and three.

We used CiteSpace's dual-map overlay function to construct a citation dual-map to visualize a more comprehensive view of

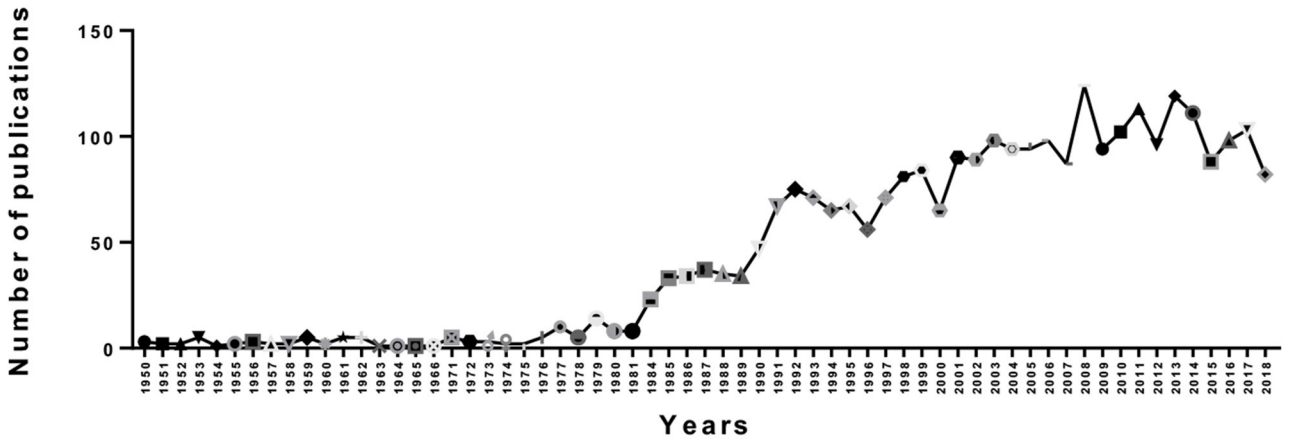


FIGURE 2 | The number of annual publications on PMS/PMDD research from 1950 to 2018.

TABLE 2 | The top 15 journals with publications on PMS/PMDD research from 1945 to 2017.

Journal	Count	% of 2,833	IF 2017
Psychoneuroendocrinology	79	2.789	4.731
Journal of Psychosomatic Obstetrics and Gynecology	61	2.153	1.900
American Journal of Obstetrics and Gynecology	50	1.765	5.732
Gynecological Endocrinology	49	1.73	1.453
Journal of Affective Disorders	49	1.73	3.786
Obstetrics and Gynecology	47	1.659	4.982
Archives of Women's Mental Health	42	1.483	2.565
Journal of Reproductive Medicine	38	1.341	0.452
Journal of Women's Health	38	1.341	2.097
Journal of Psychosomatic Research	37	1.306	2.947
Journal of Clinical Psychiatry	35	1.235	4.247
Biological Psychiatry	31	1.094	11.982
Acta Obstetricia et Gynecologica Scandinavica	29	1.024	2.649
Psychosomatic Medicine	29	1.024	3.810

the citation state of PMS/PMDD. As showed in **Figure 3**, dual-map overlays could show the interactions of journals. And the left and right sides correspond to the citing and cited journal maps, respectively. The labels represent the disciplines covered by the journal. The lines on the map starting from the left and ending at the right represent the citation links.

There is eight citation paths in the dual-map overlays. The upward yellow path shows that papers published in immunology/biology journals mostly cited journals in the area of biology/genetics. The downward yellow path shows that papers published in immunology/biology journals mostly cited journals in education/social areas. The upward green path shows that papers published in medicine/medical/clinical journals mostly cited journals in the area of molecular biology/biology/genetics. The middle green path shows that papers published in medical/clinical journals partially cited journals in the health/nursing area. The bottom green path shows that papers published in medicine/medical/clinical journals partially cited journals in the psychology/education/social area. The upward blue path shows that papers published in psychology/education/health journals mostly cited journals in the molecular biology/biology/genetics area. The middle blue path shows that papers published in psychology/education/health journals partially cited journals in the health/nursing/medicine area. The bottom blue path shows that papers published in psychology/education/health journals partially cited journals in the psychology/education/social area (**Figure 3**).

Distribution of Countries/Regions and Institutes

The 2,833 publications on PMS/PMDD were contributed by 76 countries/regions. There was extensive collaboration between countries/regions (**Figure 4**). As showed in **Figure 4**, colors showed different research directions. The larger nodes represented the more influential countries in this field. In relation to the top 10 countries that contributed PMS/PMDD research, the USA had the largest number of publications (1242), pursued by England (274), Sweden (2267), and Canada (940) (**Table 3**). Among the top 10 countries/regions in PMS/PMDD research, there is two Asian countries, China and Japan. China is the sole country from the developing world to be in the top 10 countries that contributed PMS/PMDD research, showing its vast progress in life science over the past decade.

Over 1,700 institutions contributed to the publications on PMS/PMDD. Compared with countries, there was very little cooperation between the institutions (**Figure 5**). The lines between nodes represent the cooperative relationships among institutes. The length and thickness of the lines is the degree of cooperation among countries. The top 10 institutions contributed to 570 articles, which accounted for 20.12% of the total number of publications. The University of Pennsylvania

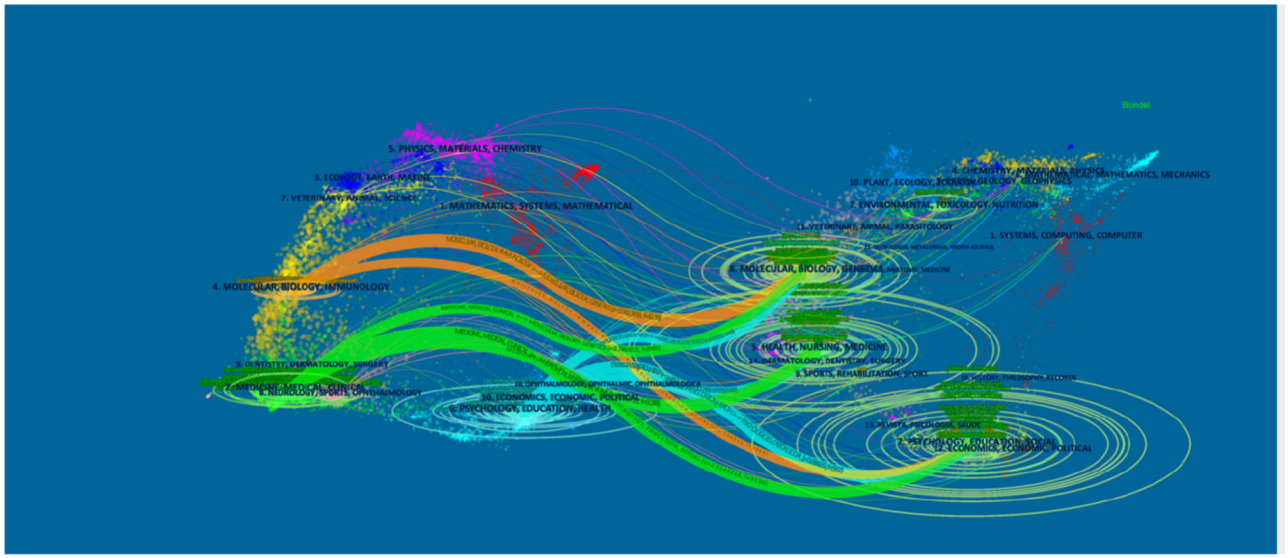


FIGURE 3 | The dual-map overlay of journals related to PMS/PMDD research. The left and right sides corresponded to the citing and cited journals maps, respectively. The labels represented the disciplines covered by the journal. The lines on the map started from the left and ended on the right, representing the citation links.

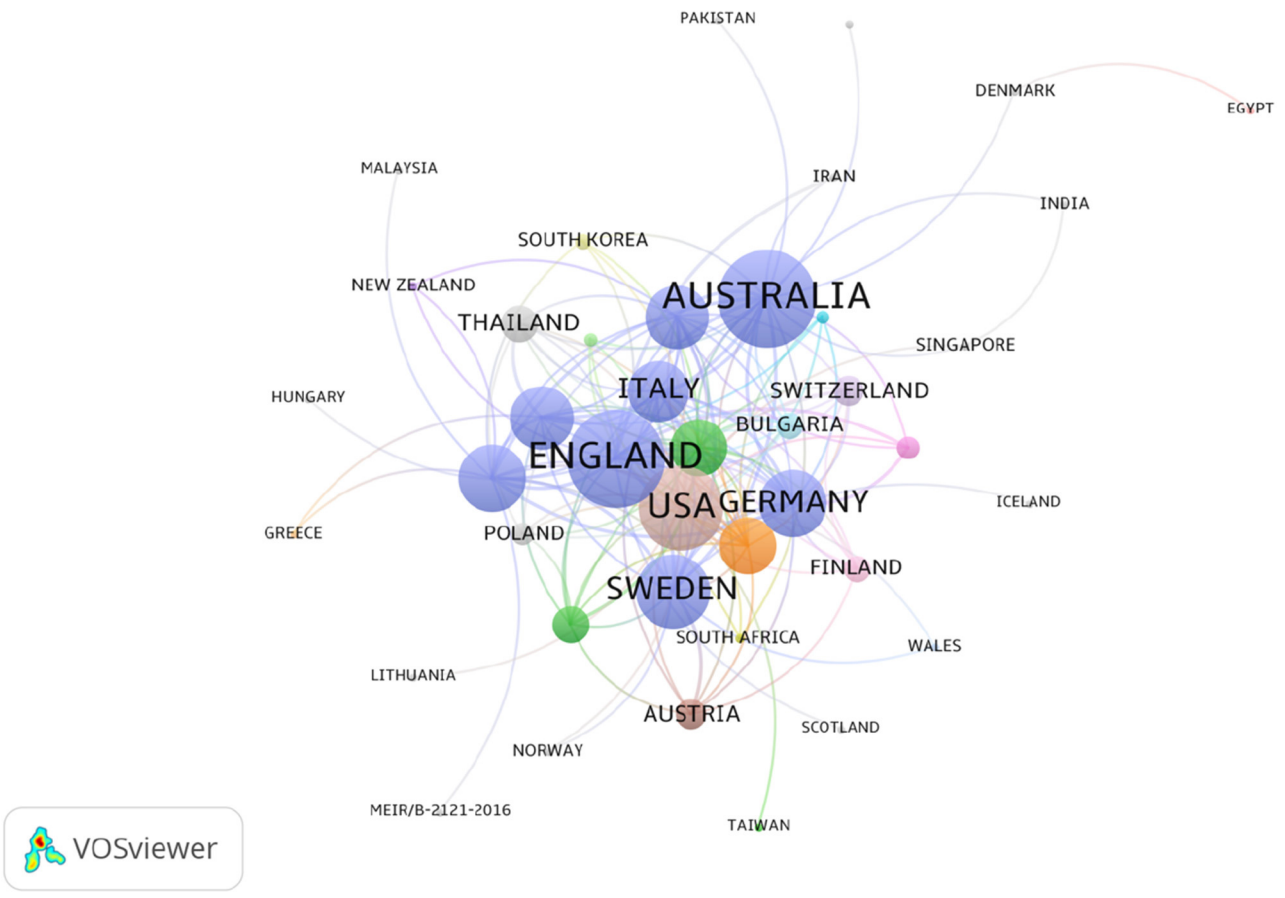


FIGURE 4 | Map of countries/regions that published articles on PMS/PMDD during 1945–2018.

led the first research echelon, followed by the National Institute of Mental Health H, University of California, Los Angeles, Umea University, University of North Carolina, and Harvard University (**Table 3**).

Analysis of Author and Co-cited Author

More than 6,640 authors contributed to the total number of publications. The cooperation between authors is provided in a network map (**Figure 6**). The size of the nodes is equal to the number of citations. For authors who had the most publications, Backstrom T ranked the first (105 publications), followed by Rubinow DR (59 publications), Freeman EW (49 publications), and Schmidt PJ (45 publications) (**Figure 6** and **Table 3**).

Author citations tend to estimate the scientific relevance of publications. The top ranked author by citation count is Halbreich U (1978), with a citation count of 890. The second one is Steiner M (1980), with a citation count of 699. The third is **the American Psychiatric Association (1986), with a citation count of 616. The 4th is Freeman EW (1988), with a citation count of 603. The 5th is Rubinow DR (1985), with a citation count of 492. The 6th is Yonkers KA (1996), with a citation count of 491. The 7th is Endicott J (1984), with a citation count of 467. The 8th is Schmidt PJ (1992), with a citation count of 463. The 9th is Rapkin AJ (1990), with a citation count of 428. The 10th is Backstrom T (1978), with a citation count of 393 (**Table 4** and **Figure 7**).

TABLE 3 | The top 10 country/regions and institutions of PMS/PMDD research.

Rank	Country/region	Count	Institute	Count
1	USA	1,242	University of Pennsylvania	71
2	England	274	National Institute of Mental Health	70
3	Sweden	194	University of California, Los Angeles	70
4	Canada	174	Umea University	60
5	Australia	140	University of North Carolina	57
6	Italy	125	Harvard University	51
7	Germany	100	Yale University	51
8	Netherlands	77	McMaster University	49
9	Japan	74	University of California, San Diego	47
10	Peoples R China	62	Suny Buffalo	44

Analysis of Co-cited References

We generated a cited reference co-citation map by selecting the top 10 articles per year and mapping them in 485 nodes and 241 links (**Figure 8**). An analysis in terms of co-citation counts (**Table 5** and **Figure 8**) revealed that the data on this topic over the past years were generally in the form of randomized trials, comparisons of diagnostic criteria (PSST) (28), pathogenesis (GABAA Receptor) and so on. For stance, Su et al. (24) performed a double-blind, placebo-controlled, crossover trial of fluoxetine in 17 women with PMDD and they confirmed that fluoxetine is an effective treatment of PMDD with highest frequency. And pathogenesis was studied focusing on endogenous steroid, GABAA Receptor, progesterone, and gamma-aminobutyric acid (29–31).

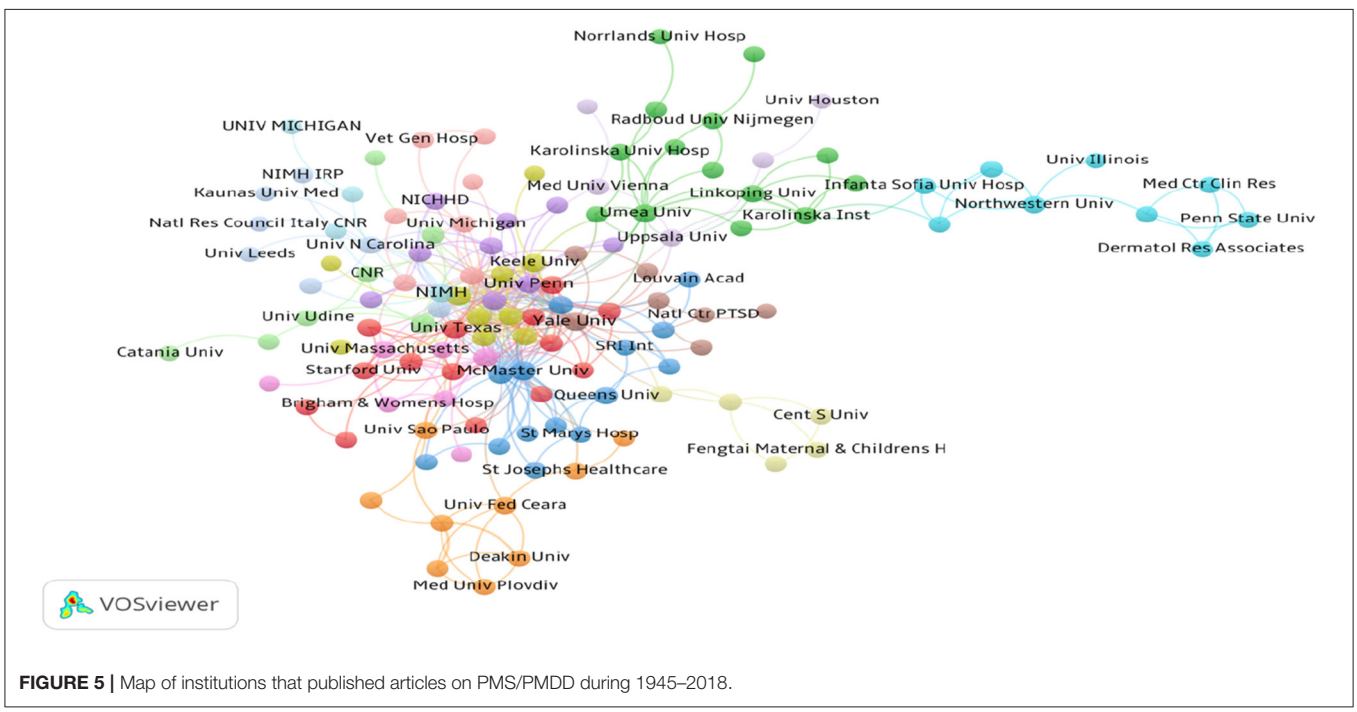


FIGURE 5 | Map of institutions that published articles on PMS/PMDD during 1945–2018.

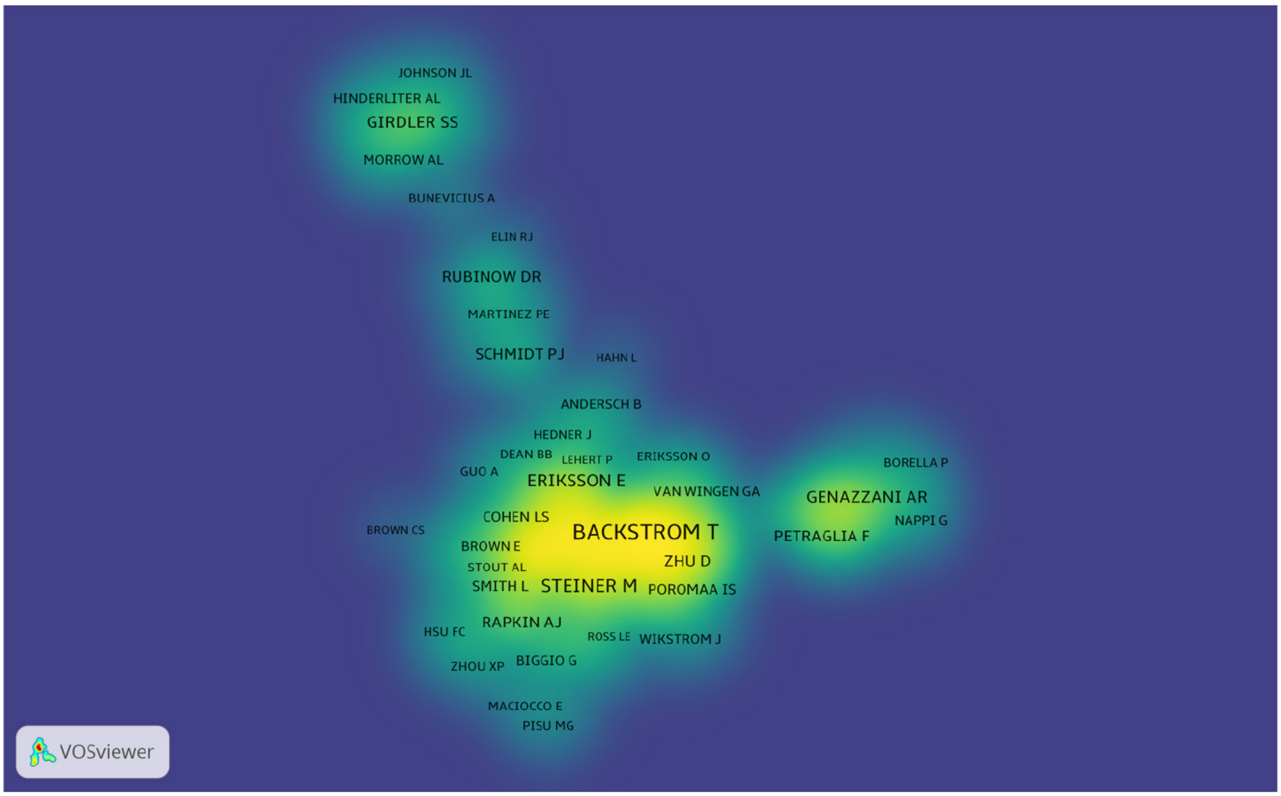


FIGURE 6 | Map of authors that published articles on PMS/PMDD during 1945–2018.

TABLE 4 | The top 10 active authors with publications on PMS/PMDD research from 1995 to 2018.

Rank	Author	Count	Co-cited author	Count
1	Backstrom T	105	Halbreich U	890
2	Rubinow DR	59	Steiner M	699
3	Freeman EW	49	American Psychiatric Association	616
4	Schmidt PJ	45	Freeman EW	603
5	Halbreich U	43	Rubinow DR	492
6	Steiner M	42	Yonkers KA	491
7	Eriksson E	33	Endicott J	467
8	Nyberg S	32	Schmidt PJ	463
9	Girdler SS	31	Rapkin AJ	428
10	Yonkers KA	31	Backstrom T	393

Analysis of Co-occurring Keywords and Burst Terms

Over time, a knowledge map of keyword co-occurrence could reflect hot topics, and burst keywords (keywords that are cited frequently over a period of time) could indicate frontier topics. CiteSpace was utilized to construct a knowledge map of co-occurring keywords and identify the top 20 keywords in publications from 1945 to 2018 according to frequency, citation counts, and centrality (**Table 6**). Generating a keyword co-occurrence map resulted in 150 nodes and 842 links (**Figure 9**). Among the listed keywords, "premenstrual syndrome, menstrual cycle, premenstrual dysphoric disorder, women, symptom, luteal phase, depression, dysphoric disorder, premenstrual symptom, prevalence, double blind, progesterone, mood, oral contraceptive, and major depression" ranked ahead in both frequency and centrality, which suggested that they were the hotspots in the field. As we can see, "premenstrual syndrome and premenstrual dysphoric disorder" is ranked in the top three keywords, which is reasonable because they are our search terms. Except for them, other keywords actually reflect hotspots and topics that researchers are focusing on.

Research Hotspots and Topics of PMS/PMDD

Judging from the analysis of research hotspots, hot research topics revolve around the relationship of women's menstrual cycle with symptoms and progesterone. PMS/PMDD occurs only in women. According to the DSM-5, women with PMDD must have at least five predominantly affective symptoms with functional impairment, of which affective symptoms make up the largest proportion, such as mood swings, irritability, anger, and depressed mood. Therefore, the relationship between PMS/PMDD and the menstrual cycle has become a research

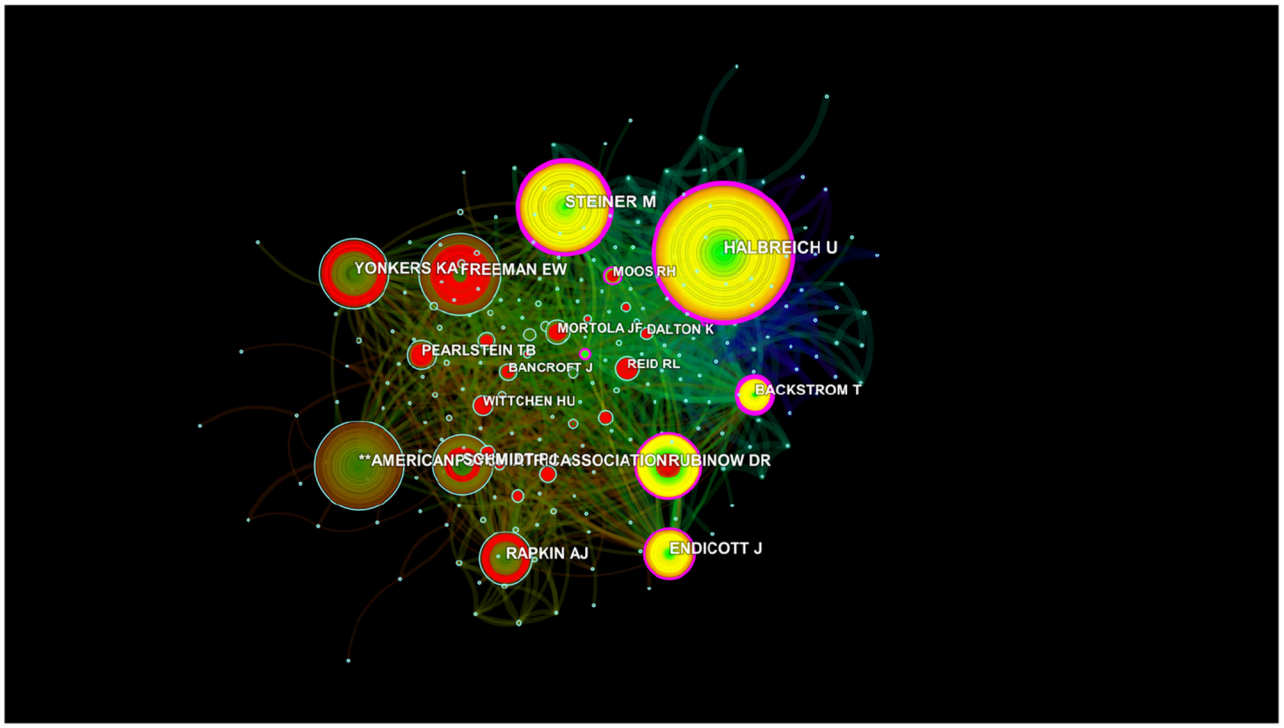


FIGURE 7 | Map of co-cited authors that published articles on PMS/PMDD during 1945–2018.

hotspot, many studies have explored this area (9, 32, 33). Besides, PMDD subtypes research represents one of the hotspots (34). For instance, Chinese scholars proved that liver-qi invasion syndrome and liver-qi depression syndrome are the major subtypes of PMS/PMDD with epidemiological research (35, 36). Regarding cyclic mood disorders, cognitive, sensory, and emotional changes are linked to the menstrual cycle. The reason for this association is the ovarian hormones, especially the hormones progesterone and estrogen (37). Progesterone and its metabolites (e.g., isoallopregnanolone) have been recognized as hot topics in scientific research on PMS/PMDD (13, 38). Most studies confirmed that PMDD pathophysiology is rooted in impaired GABAA-R response to dynamic ALLO fluctuations across the menstrual cycle, manifesting in affective symptoms and poor regulation of physiologic stress response (39–41).

Research Frontiers of PMS/PMDD

So-called "burst words" represent words that are cited frequently over a period of time. CiteSpace was used to detect burst keywords, which are deemed to be indicators of research frontier topics over time. In **Figure 10**, the time intervals are plotted on the green lines, while the periods of burst keywords are marked in red, indicating the beginning and end of the time interval of each burst. Among them, the keywords with citation bursts after 2008 were as follows: "prevalence" (2008–2018), "systematic review" (2009–2018), "impact" (2011–2018), "dysmenorrhea" (2011–2018), "confidence interval" (2011–2018), "menstrual cycle phase" (2012–2018), "risk factor" (2013–2018), "anxiety" (2013–2018), "postpartum depression" (2013–2018), "premenstrual phase" (2014–2018), "dysphoric disorder" (2014–2018), "control group" (2015–2018), "quality of life" (2016–2018), and "young women" (2016–2018).

(1) Prevalence and impact in young women:

Currently, it is estimated that 3–8% of women of reproductive age meet the strict criteria for PMDD (42). The assessment of published reports demonstrated that the prevalence of clinically relevant PMS/PMDD is probably higher due to the strict diagnostic criteria. Although DSM-IV or DSM-5 are the main diagnostic criteria for PMDD, we found an interesting phenomenon in which researchers used a wide variety of diagnostic tools to identify the incidence of the disease in searching for cold-related literature. There continue to be many problems in the implementation of diagnostic criteria (43). For one, patients need to report bothersome premenstrual symptoms, and clinicians should become more proficient in the diagnostic process to prevent the under diagnosis of these disorders (44). Estimating the prevalence of PMS/PMDD in greater scope and depth in different countries/regions is becoming increasingly important. In further studies, we found that young women are becoming the center of research, such as women in the Ukraine (45), in universities in Jordan (46), and in Japanese colleges (47), Israeli students (19), and other students all over the world. On the one hand, research

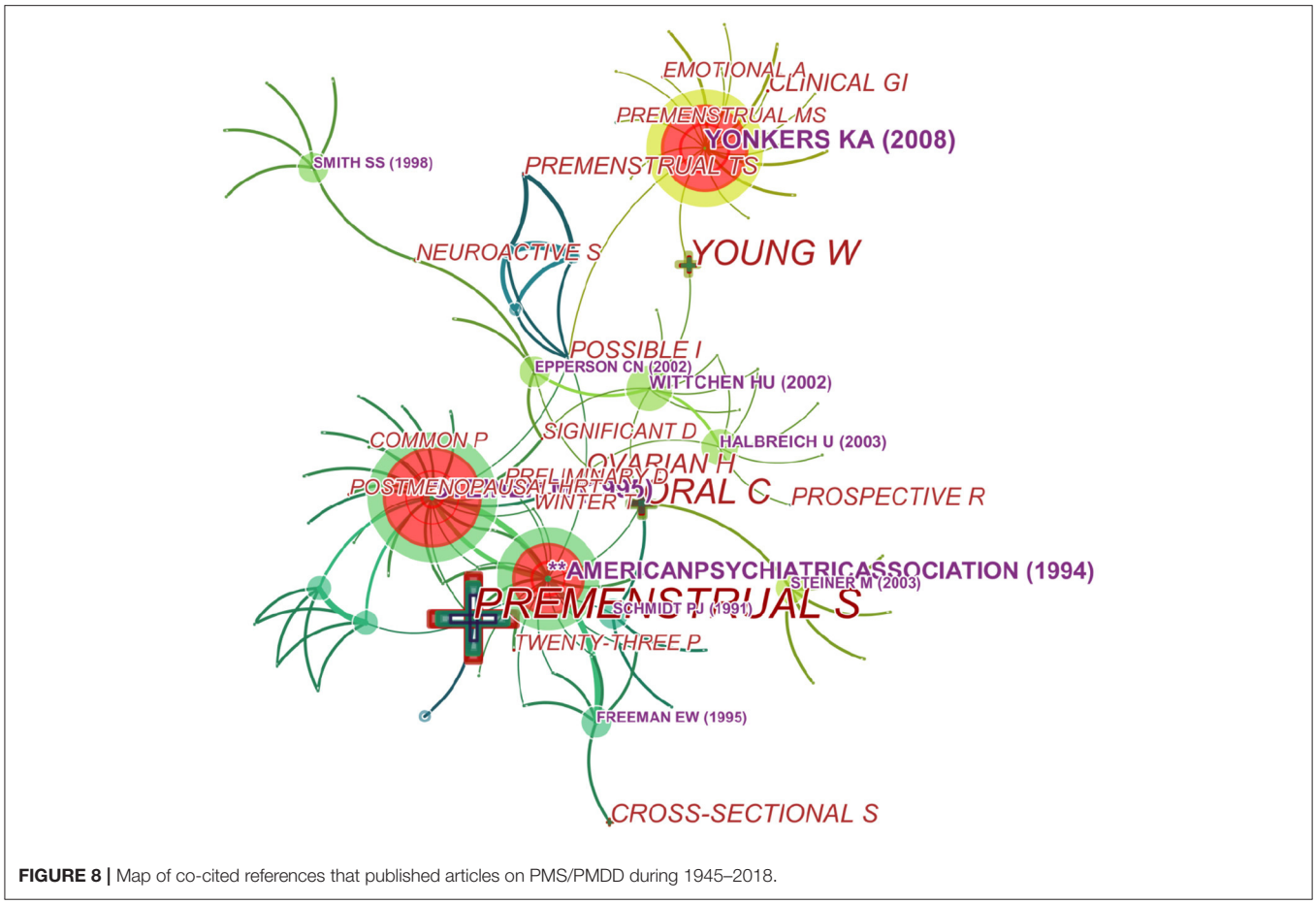


FIGURE 8 | Map of co-cited references that published articles on PMS/PMDD during 1945–2018.

TABLE 5 | The top 10 co-cited references on PMS/PMDD during 1945–2018.

Rank	Freq	Author	Year	Source	Title
1	21	Steiner M (24)	1995	New Engl J Med	Fluoxetine in the Treatment of Premenstrual Dysphoria
2	19	Yonkers KA (2)	2008	Lancet	Premenstrual Syndrome
3	17	American Psychiatric Association (6)	1994	Diagn Stat Man Ment	Diagnostic and Statistical Manual of Mental Disorders (4th ed.)
4	9	Reid RL (25)	1981	Am J Obstet Gynecol	Premenstrual Syndrome
5	8	Steiner M (26)	1980	Acta Psychiat Scand	Treatment of Premenstrual Tension with Lithium Carbonate. A Pilot Study
6	7	Wittchen HU (27)	2002	Psychol Med	Prevalence, Incidence and Stability of Premenstrual Dysphoric Disorder in the Community.
7	5	Steiner M (28)	2003	Arch Womens Ment Health	The Premenstrual Symptoms Screening Tool (PSST) for Clinicians
8	5	Smith SS (29)	1998	Nature	GABAA Receptor α4 Subunit Suppression Prevents withdrawal Properties of an Endogenous Steroid
9	5	Munday MR (30)	1981	Clin Endocrinol	Correlations between Progesterone, Estradiol and Aldosterone Levels in the Premenstrual Syndrome
10	5	Epperson CN (31)	2002	Arch Gen Psychiat	Cortical Gamma-aminobutyric Acid Levels across the Menstrual Cycle in Healthy Women and those with Premenstrual Dysphoric Disorder: a Proton Magnetic Resonance Spectroscopy Study

output on the prevalence and impact of PMS/PMDD is also increasing around the world, such as consequences on female students' behavior, cognitive abilities, mental health status, and academic performance (48) and the impact of symptoms on the quality of life (49). However, researchers have not yet fully grasped the prevalence of the disease, lacking systematic reviews on prevalence.

(2) Systematic Review evaluating risk factors:

Systematic reviews typically are about a detailed and comprehensive plan and search strategy derived *a priori*, with

TABLE 6 | Top 20 keywords in terms of frequency and centrality in PMS/PMDD research.

Ranking	Freq	Keyword	Centrality	Keyword
1	1556	Premenstrual syndrome	0.33	premenstrual syndrome
2	1024	Menstrual cycle	0.2	Symptom
3	845	Premenstrual dysphoric disorder	0.2	Premenstrual symptom
4	678	Women	0.14	Menstrual cycle
5	458	Symptom	0.12	Premenstrual dysphoric disorder
6	416	Luteal phase	0.12	Women
7	372	Depression	0.12	Dysphoric disorder
8	309	Dysphoric disorder	0.1	Luteal phase
9	306	Premenstrual symptom	0.1	Depression
10	276	Prevalence	0.08	Double blind
11	235	Double blind	0.08	Progesterone
12	223	Progesterone	0.06	Mood
13	193	Mood	0.06	Oral contraceptive
14	174	Oral contraceptive	0.06	Late luteal phase
15	162	Major depression	0.05	Prevalence
16	157	Follicular phase	0.05	Physical symptom
17	128	Estrogen	0.04	major depression
18	123	Significant difference	0.04	follicular phase
19	104	Late luteal phase	0.04	Estrogen
20	99	Controlled trial	0.04	Mood disorder

the goal of synthesizing findings qualitatively or quantitatively (50). Systematic reviews of randomized controlled trials are fundamental to the practice of evidence-based medicine and to evaluate the effectiveness of drugs and methods for the treatment of uncomfortable symptoms. For example, cognitive-behavioral therapy (43), herbs (51), and vitamins and minerals are employed in the treatment of premenstrual syndrome (52). A systematic review of acupuncture and acupressure showed improvements in both the physical and psychological symptoms of PMS when compared to a sham control (53). A systematic review of treatment pointed out the curative effect of herbal remedies for the treatment of PMS (51, 52).

(3) Association of anxiety and depression with menstrual cycle phases:

Menstrual-related mood disorders such as PMDD are mood disorders related to the menstrual cycle. As major symptoms of many emotional disorders, anxiety and depression are the key directions of research. Moreover, some studies regarded PMS/PMDD as a risk factor for postpartum depression (54–56). Symptoms of irritability, emotional hypersensitivity, increased anxiety and food cravings, sleep difficulties, and decreased concentration characterize PMDD as well as depression, particularly atypical depression. A lifetime history of depression ranges from ∼20 to 76% in samples of women diagnosed with PMS or PMDD (57). Recent studies have shown that menopause and menstrual cycle phases are time of intense hormonal fluctuation that can cause increased vulnerability to depression and anxiety (58). Besides, neuroimaging indicated that the emotional distress and dysregulation related to PMDD

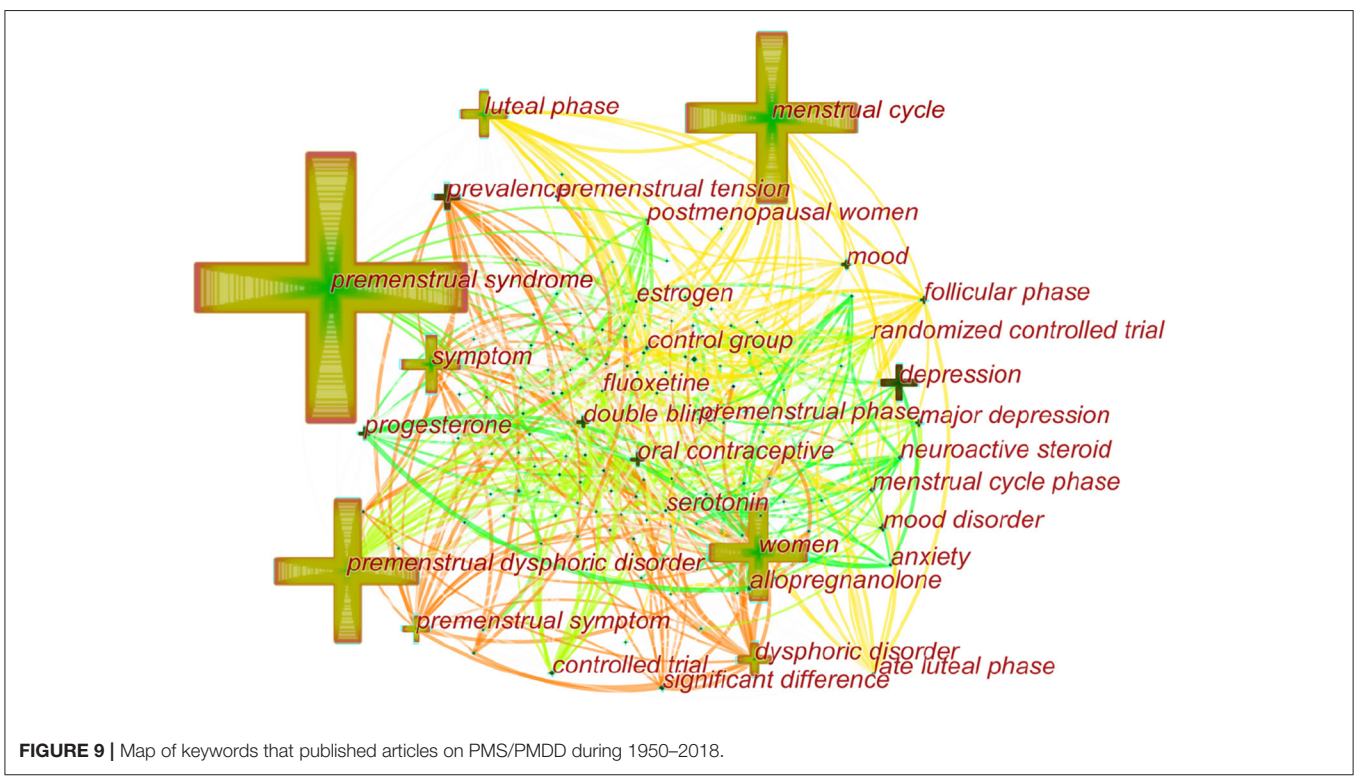


FIGURE 9 | Map of keywords that published articles on PMS/PMDD during 1950–2018.

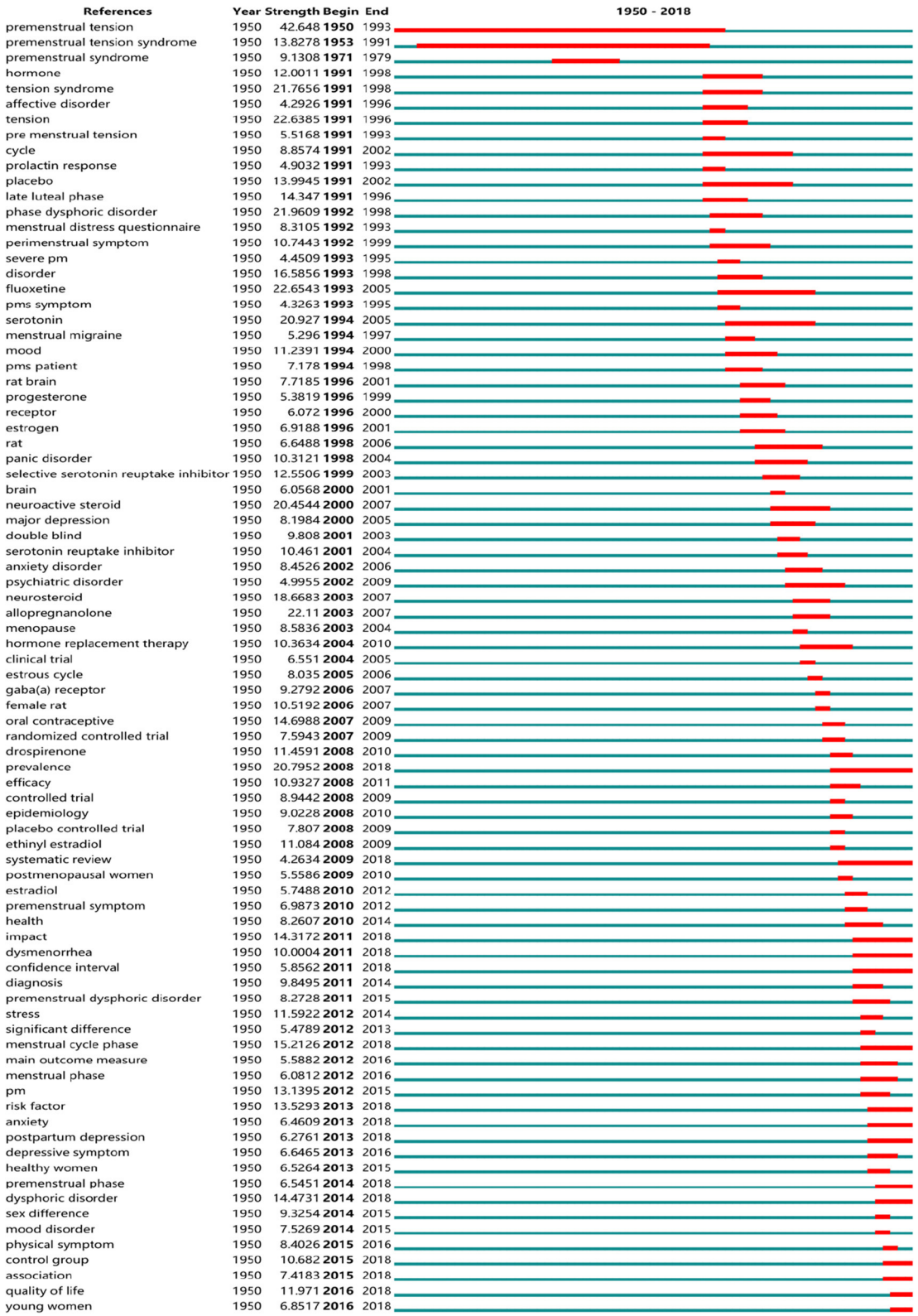


FIGURE 10 | Top 84 keywords with the strongest citation bursts.

seem to be determined by structural, chemical, and functional brain signatures (59).

DISCUSSION

In this study, we have formulated research strategies to comprehensively analyze the current situation and development trend of PMDD research from 1945 to 2018 using a bibliometric analysis methodology. And we collected 2,833 papers for bibliographic records after evaluating 3,852 original results from the search for PMS/PMDD-related papers published in the Web of Science from 1945 to 2018 on the basis of the inclusion and exclusion criteria. Publications about PMS/PMDD could go back to 1950. In 1950, three articles were published: "Nephrotic syndrome with exaggerated premenstrual water and salt retention," written by Lippman (60); "Premenstrual tension," written by Morton (61), who worked at the New York Medical College; and "Premenstrual tension treated with vitamin A," written by Argonz and Abinzano (62). Since then, PMDD research has gradually developed.

Our finding indicated that PMS/PMDD research is currently an area of active investigation and numerous findings are constantly emerging. Journals related to gynecology and endocrinology published most of PMS/PMDD research, such as Psychneuroendocrinology and Journal of Psychosomatic Obstetrics and Gynecology. USA had the largest number of publications, but China was the only country from the developing world to be in the top 10 countries that contributed PMS/PMDD research, showing its vast progress in life science over the past decade. And Research institutions were mainly in the USA (University of Rochester). Backstrom T ranked the first in more than 6,640 authors who contributed to the total number of publications, but Halbreich U leads the research direction.

In addition, we also find out the hotspots and trend of PMS/PMDD research through co-occurring keywords and burst terms, as described above. Prevalence and impact in young women, systematic review evaluating risk factors and association of anxiety and depression with menstrual cycle phases are research frontiers of PMS/PMDD. These forecasts have been confirmed in 2020–2021, such as research in Japanese college students (63) and systematic review on addictive behaviors across the menstrual cycle (64). But there are limitations in our research. Due to the large time span of submission of research papers, the statistical data of this paper is up to 2018. Even so, this study is enough to reflect the research hot spots and trends from 1945 to 2018.

CONCLUSION

To the best of our understanding, this paper is the first bibliometric analysis of trends in PMS/PMDD research over the past decade. The data analysis process was relatively unbiased. The number of publications in PMS/PMDD research has been growing over the past decade. The USA, ENGLAND and SWEDEN were the top three countries contributing to PMS/PMDD studies. There was active collaboration between developed countries. China was the sole developing country that made it into the list of the top ten countries contributing to PMS/PMDD studies. The USA and its institutions still occupy the leading position. UNIV PENN, the NIMH, and UNIV CALIF LOS ANGELES may be ideal candidates for academic cooperation. Prevalence and impact in young women, systematic review evaluations of risk factors, and the association of anxiety and depression with menstrual cycle phases may be frontiers in this field, and researchers should follow closely relevant studies in the coming years.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

MG conceived and designed the studies and drafted the manuscript. MG, HS, and DG performed the experiments, analyzed the data, contributed materials/analysis tools, prepared figures and/or tables, and approved the final draft. XC, LA, and MQ provide critical services. Fund support was supplied by DG and MQ. All authors read and approved the final manuscript.

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Prioritizing the Mental Health and Well-Being of Healthcare Workers: An Urgent Global Public Health Priority

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The COVID-19 pandemic has had an unprecedented impact on health systems in most countries, and in particular, on the mental health and well-being of health workers on the frontlines of pandemic response efforts. The purpose of this article is to provide an evidence-based overview of the adverse mental health impacts on healthcare workers during times of crisis and other challenging working conditions and to highlight the importance of prioritizing and protecting the mental health and well-being of the healthcare workforce, particularly in the context of the COVID-19 pandemic. First, we provide a broad overview of the elevated risk of stress, burnout, moral injury, depression, trauma, and other mental health challenges among healthcare workers. Second, we consider how public health emergencies exacerbate these concerns, as reflected in emerging research on the negative mental health impacts of the COVID-19 pandemic on healthcare workers. Further, we consider potential approaches for overcoming these threats to mental health by exploring the value of practicing self-care strategies, and implementing evidence based interventions and organizational measures to help protect and support the mental health and well-being of the healthcare workforce. Lastly, we highlight systemic changes to empower healthcare workers and protect their mental health and well-being in the long run, and propose policy recommendations to guide healthcare leaders and health systems in this endeavor. This paper acknowledges the stressors, burdens, and psychological needs of the healthcare workforce across health systems and disciplines, and calls for renewed efforts to mitigate

these challenges among those working on the frontlines during public health emergencies such as the COVID-19 pandemic.

Keywords: mental health, healthcare workers, COVID-19, public health emergencies, burnout, self-care, psychological interventions, healthcare policies

INTRODUCTION

With the emergence of the coronavirus disease (COVID-19) pandemic in late 2019, and the World Health Organization declaring it a global pandemic on 11th March 2020, health systems in many countries have been at times overwhelmed and stretched past their limits in terms of capacity and resources while striving toward continued delivery of quality care. The challenges for health systems, further complicated by the emergence of new more infectious variants of the virus, are likely to persist—even though infection rates have decreased in many parts of the world and the vaccine roll out progresses at a rapid pace at the time of writing this article—because we are now facing a second and equally serious pandemic of mental health challenges. The threats to mental health run deep within communities and are far reaching, affecting the millions of individuals who have been traumatized during national or regional lockdowns, left vulnerable to substance use or loneliness, those who have lost loved ones to the virus or face heightened anxieties of getting sick, or among those facing the dire economic consequences of the pandemic (1–3). In this challenging recovery phase of the pandemic, the mental health needs of healthcare workers and those on the frontlines of the pandemic response cannot be overlooked.

During recent years, the mental health needs of healthcare providers have been gaining attention as a major public health concern and threat to quality care delivery. Healthcare professionals are exposed to multiple stress factors within their work, which may influence their physical, mental, and emotional well-being in negative ways (4–6). The World Health Organization estimates a projected shortfall of 18 million health workers by 2030, mostly in low- and lower-middle income countries. However, countries at all levels of socioeconomic development face, to varying degrees, difficulties in the education, employment, deployment, retention, and performance of their workforce (7). The COVID-19 pandemic is likely to exacerbate these issues among healthcare workers across the globe. In this article we reflect on the mental health impacts on healthcare professionals during times of crisis and other challenging working conditions against a backdrop of the current COVID-19 pandemic. First, we provide a broad overview of the elevated risk of stress, burnout, moral injury, and mental health challenges experienced among health workers. Next, we consider how public health emergencies, such as pandemics, can exacerbate these concerns and pose additional challenges to reaching and supporting health workers. Further, we consider promising approaches for protecting and promoting the mental health of health workers through self-care and other evidence-based interventions. Lastly, we highlight the need for organizational measures, policies, and systemic changes needed to address these challenges and empower healthcare workers going forwards.

STRESS, BURNOUT, AND MENTAL HEALTH CHALLENGES AMONG HEALTHCARE WORKERS

Numerous factors contribute to elevated stress among healthcare workers, including heavy workloads, long shifts, a high pace, lack of physical or psychological safety, chronicity of care, moral conflicts, perceived job security, and workplace related bullying or lack of social support. The resulting psychological distress can lead to burnout, depression, anxiety disorders, sleeping disorders, and other illnesses (5, 6, 8, 9). Work related stress can have a negative impact on health care providers' professionalism, quality of care delivery, efficiency, and overall quality of life. Therefore, it is critical to identify and mitigate these work-related risk factors to protect the mental health and well-being of healthcare workers.

Working in a stressful or challenging environment for long periods with little recovery time is a risk factor for burnout. Burnout is defined as an occupational phenomenon in ICD-11: "Burnout is a syndrome conceptualized as resulting from chronic workplace stress that has not been successfully managed. It is characterized by three dimensions: (1) feelings of energy depletion or exhaustion; (2) increased mental distance from one's job, or feelings of negativism or cynicism related to one's job; and (3) reduced professional efficacy. Burnout refers specifically to phenomena in the occupational context and should not be applied to describe experiences in other areas of life" (10). Maslach et al. describe burnout as that point at which important, meaningful, and challenging work becomes unpleasant, unfulfilling, and meaningless. Energy turns into exhaustion, involvement (also referred to as engagement) becomes cynicism and efficacy is replaced by ineffectiveness (11).

A study investigating burnout and work-life integration in physicians between 2011 and 2017 in the US, found that about 44% of physicians reported at least one symptom of burnout in 2017 compared with about 54% in 2014 and about 45% in 2011 (12). This indicates some fluctuation in physician burnout in the years before the COVID-19 pandemic, yet the levels of burnout among physicians remained significant. Even when adjusting for age, sex, relationship status, and hours worked per week, physicians were found to be at increased risk for burnout and less likely to be satisfied with work-life integration compared with other working US adults (12). Studies have shown that physicians in clinical practice can be at risk for burnout as a result of both work and structural issues. Work related risk factors include work overload (e.g., large patient volumes, insufficient resources, or feeling poorly managed), lack of control

over one's work environment, having to spend time on tasks inconsistent with one's career goals and high levels of work-home interference (4, 13). Structural issues predisposing physicians to burnout include being female, working in a solo practice, being early in one's career, lacking a sense of personal control over events, and attributing success to chance instead of personal accomplishments (14, 15). Also, in many low and middle income countries the ratio between healthcare workers and the overall population is a major issue which adds to healthcare workers' work burden, stress, and burnout. Additionally, many frontline health workers in lower income countries are predominantly women, and are therefore typically at the bottom of health system hierarchies, leaving them with limited autonomy and at elevated risk of burnout (16).

Burnout in healthcare workers can also have adverse impacts on patient care. Several cross-sectional studies have linked burnout to suboptimal patient care practices [e.g., (17–20)]—as well as with a doubled risk of medical error and a 17% increased odds of being named in a medical malpractice suit (21). Self-perceived major medical errors were also associated with worsening burnout, depressive symptoms, and a decrease in quality of life. This suggests a bidirectional relationship between medical errors and distress (22). Burnout has also been shown to contribute to a higher risk of motor vehicle accidents (even after adjusting for fatigue) among physicians (23). Other consequences of burnout include absenteeism, low organizational commitment, increased turnover of skilled staff, and greater patient dissatisfaction (11).

Ethical dilemmas [e.g., (24, 25)] and moral injury [e.g., (26, 27)] are other issues that healthcare workers are faced with while providing care within challenging healthcare contexts. Moral injury is defined as the psychological distress that results from actions, or their absence, that violate someone's moral or ethical code (28). The concept of moral injury describes the ambivalence and guilt felt when one's decisions or actions are not in accordance with one's own moral values. It has been characterized as an invisible epidemic among healthcare providers (29). Examples might include where a healthcare worker has to make the difficult decision as to who will get oxygen or be put on a ventilator and who will not if there are a finite number of life saving oxygen points or ventilators available.

Moral injury is not a mental illness, but those who do develop moral damage are likely to see themselves negatively, question their actions and experience feelings of guilt and shame (30). These negative thoughts may contribute to the development of mental illness issues like depression, suicidal ideation and post-traumatic stress disorder (PTSD), as well as thoughts about leaving one's profession (31–35). We could expect increased cases of moral injury when dealing with a health crisis or challenging and stressful working environments; where important decisions—perhaps concerning life and death—are required to be made fast and where the ability to follow optimal care protocols is reduced. Feelings of individual or unclear responsibility is likely to be another risk factor in this context.

The concept of *vicarious traumatization*, also defined as secondary traumatic stress, has also been gaining increased attention during the last decades (36). This condition is associated with different psychological abnormalities derived from the sympathy of healthcare workers toward people who are experiencing primary trauma. Common symptoms associated with vicarious traumatization are loss of appetite, fatigue, irritability, inattention, numbness, sleep disorders, fear, and despair. Frequently, these symptoms are accompanied by trauma responses and interpersonal conflicts. However, the symptoms often remain at subclinical levels (37, 38).

Further, studies have indicated that healthcare practitioners are likely to suffer in silence due to the perceived stigma associated with experiencing "stress" and "mental illness," as well as fear of getting their medical license withdrawn (39). The stigma accociated with mental health issues has inward-facing impacts for health professionals' willingness to seek help or disclose a mental health problem, which can result in an over-reliance on self-treatment, low peer support—including ostracization and judgment from co-workers if disclosure does occur—and increased risk of suicide (40). A systematic review and meta-analysis of various studies which have been conducted across the world showed high suicide rates among medical professionals across countires, especially among women (41). It also showed that some medical specialties might be at higher risk; such as anesthesiologists, psychiatrists, general practitioners, and general surgeons. There was an overall rate of 1.0% suicide attempts and 17% suicidal ideation among physicians (41). Further, mental health problems, stress, compassion fatigue, and burnout at work are leading causes of healthcare workers thinking about leaving their profession around the world (42–45). When healthcare workers quit, or when they are tragically lost to suicide, they take many years of invaluable training and experience with them. Beyond the individual health workers and their immediate families, this has devastating consequences to their co-workers and to entire health systems, while creating further challenges to meeting the needs of diverse patient groups.

Overall, according to the World Medical Association "physicians in many countries are experiencing great frustration in practicing their profession, whether because of limited resources, government and/or corporate micro-management of healthcare delivery, sensationalist media reports of medical errors and unethical physician conduct, or challenges to their authority and skills by patients and other health care providers" (46). Other subgroups of healthcare workers face similar frustrations and challenges.

MENTAL HEALTH OF HEALTHCARE WORKERS IN TIMES OF PANDEMICS AND CRISIS

During the COVID-19 pandemic, which has been the cause of more than 2.85 million deaths worldwide to date (5th April, 2021) and rising, many healthcare workers, both within medical care and the mental health sector, have been experiencing challenges in adapting quickly to changes in patient volume, mounting demands, clinical roles, new technologies, and ways of working. They have also faced quite high risk of infection together with limitations in protective equipment, as well as managing the

anxieties of patients and facing uncertainty in how to effectively treat and respond to complex manifestations of the virus. Perhaps left with no other choice than to adapt as best as they can to ensure the continuation of their obligations and services, many health workers have experienced elevated psychological distress, burnout, and increased risk of mental illness (47). The recovery phase had hardly begun in many countries around the world, when they were faced with a "second wave" or even a "third wave" of the pandemic—and there will probably be several more waves to come as new variants emerge and as we are assessing immunity following vaccination. This means that healthcare providers need to prepare for a continuation of challenging working conditions for quite some time to come. Based on such working conditions and being deployed on the frontlines in the pandemic response, it is perhaps no surprise that issues related to mental health among healthcare workers have drawn interest since the early days of the COVID-19 pandemic (9, 34, 48). Recent surveys, reviews and meta-analyses are pointing to early evidence suggesting that a considerable proportion of healthcare workers have experienced stress, anxiety, depression, and sleep disturbances during the pandemic, raising concerns about risks to mental health (5, 49, 50). Specifically, a recent systematic review and meta-analysis conducted by Li et al. (51) across 65 studies, involving 97,333 health care workers in 21 countries, has identified a high prevalence of moderate depression (21.7%), anxiety (22.1%), and PTSD (21.5%) among healthcare workers during the COVID-19 pandemic. Further, a review evaluated seven studies on COVID-19 related traumatic stress, where five assessed traumatic stress response, one assessed acute stress symptoms and one focused on vicarious traumatization. The findings in all the included studies highlighted the presence of trauma-related stress, with a prevalence ranging from 7.4 to 35%, particularly among women, nurses, frontline workers and in workers who experienced physical symptoms (52). A survey by Li et al. (38), utilizing a mobile phone app-based questionnaire, found evidence of vicarious traumatization in the general public ($n = 214$), frontline nurses ($n = 234$), and non-frontline nurses ($n = 292$) aiding in COVID-19 control during the outbreak in China in February 2020. Another survey conducted among physicians ($n = 2{,}334$) in the US in August 2020 found that 58 percent of physicians reported to often have feelings of burnout, compared to 40 percent in 2018. Further, nearly 1 in 4 physicians (22 percent) reported to know a physician who has committed suicide, while 26 percent know a physician who has considered suicide. Furthermore, 18 percent of physicians reported to have increased their use of medications, alcohol, or illicit drugs as a result of COVID-19's effects on their practice or employment situation (53).

Vizheh et al. (9) conducted a systematic review of 11 studies assessing health workers' psychological well-being during the COVID-19 pandemic. These studies showed that various factors were associated with mental pressures experienced by the healthcare workers. Working in areas with a high incidence of infection was significantly associated with higher stress and psychological disturbance. Further, sex-aggregated case data collated by the UN show that more than 70% of COVID-19 infections in healthcare workers in the USA, Italy and Spain are in women (54). In an analysis of the results from a survey investigating how gender and race affect the ways in which health professionals experience the pandemic in Brazil, Lotta et al. (55) found that this rate can partly be explained by the absence of necessary resources provided to these healthcare workers: women, and black women in particular, have less access to personal protective equipment and training. Furter, they argue that female healthcare workers worldwide are also facing the downstream effects of their work, including mental health issues, increased physical violence, alternative arrangements for their families so as to not expose them to risk, and physical exhaustion (56).

These types of issues and concerns may be further exacerbated in difficult work environments, such as in impoverished settings and in low-income or middle-income countries where access to personal protective equipment may be severely limited (3, 57). A scoping review was conducted of 51 studies relevant to mental health conditions among healthcare workers during COVID-19, with a focus on low and middle income countries. Symptoms of depression, anxiety, psychological trauma, insomnia and poor sleep quality, workplace burnout and fatigue, and distress were the main adverse mental health outcomes found across these studies. Further, females, younger-aged, frontline workers, and non-physician workers were found to be affected more than other subgroups (58). In a factor analysis study conducted in the early phases of the pandemic, 140 healthcare workers of a tertiary care hospital in India were assessed for perceived stress and insomnia. The factor analysis yielded four factors which were identified as (1) Insomnia, (2) Stress-related Anxiety, (3) Stress-related Irritability, and (4) Stress-related Hopelessness. These four factors explained 62.2% of the variance. Doctors were found to have the highest level of anxiety among all healthcare workers. Both doctors and nurses perceived a greater level of overload related irritability than the other healthcare workers. Compared to doctors and nurses, other healthcare workers were more likely to experience insomnia (59).

The increased negative mental health impact on healthcare providers during times of health crises is not a new concern. Prior reviews have reported on the dire consequences of public health emergencies for frontline health workers, with the most severe impacts often observed in lower-income countries where health systems are fragmented and where there are few protections in place for frontline health workers (16). Several months after the peak of the 2003 SARS outbreak in Hong Kong, healthcare workers reported high levels of ongoing mental distress (60). Studies conducted at the time of the SARS outbreak have also shown that emergency department staff are at higher risk of developing posttraumatic stress disorder (PTSD). Healthcare workers who volunteered in West Africa during the 2013–2016 Ebola epidemic reported symptoms of isolation, depression, stigmatization, interpersonal difficulties, and extreme stress after they returned home (61). About 64% of medical staff working during the initial stages of the MERS outbreak reported PTSD-like symptoms. Staff who performed MERS-related tasks showed the highest risk for post-traumatic stress disorder symptoms even

after time had elapsed. The risk increased even after home quarantine (62).

Prior research has reported that disasters have significant adverse effects on the mental well-being of medical responders. Nurses have been found to report higher levels of adverse outcomes, like depression and PTSD, than physicians. Lack of social support and communication, maladaptive coping, and lack of training are important risk factors for developing negative psychological outcomes across different types of disasters (63). Moreover, studies related to emergency situations and disasters, show that long shifts over a longer period of time and risk of personal injury or contamination is associated with an increased risk of sleep disturbances, harmful alcohol use, anxiety, depression, and PTSD among first responders (64–66). These conditions can be broadly similar to those frontline workers are faced with while working with patients with COVID-19 and wearing limited personal protective equipment. These individuals have been putting their own health and safety at risk for long periods of time, striving to help as many people as they can—while working long hours within stressful environments. Sadly, the COVID-19 pandemic is likely to increase healthcare professionals' mental health issues and suicide rates, especially in low-resource settings and countries with few or limited protective measures in place. In the coming months and years, when the "fight or flight" phase of the crisis is over—we will start to see all the different mental health impacts much more clearly. Should history repeat itself, the negative health impacts of COVID-19 on frontline health workers and all types of healthcare professionals are likely to continue for years or even decades to come (67).

While evaluating the emerging research on the mental health impacts of the pandemic, it is important to note that some of the conducted surveys are using screeners which are focused on the immediate effects and which only pick up "diagnostically valid" issues or disorders. However, mental well-being is not just an absence of a mental disorder. Chronic stress, fatigue, fear or guilt of transmitting the infection to loved ones, overwork, self-blame, fear of infection and mortality, lack of breaks or leaves and inflexibility in work schedules can all adversely affect the mental health of healthcare workers—whether they fulfill a set of criterion of a disorder, or not.

Several larger research projects are now in place on national level around the world (e.g., in Norway led by the Norwegian Institute of Public Health) to collect data on both short term and long term mental health impacts on frontline workers and other healthcare staff during the COVID-19 response. As data from such studies starts to emerge, along with the collection of invaluable first-person accounts and qualitative data, the total picture of the COVID-19 related and long-term mental health impacts on healthcare staff will get clearer.

THE IMPORTANCE OF PRACTICING SELF-CARE

Most health care professionals are trained to put patients first. Self-care is not always prioritized among clinicians, as they may fear judgment from others or feel selfish at the thought of attending their own needs. Practicing self-care could however be imperative to coping with the obligations, workload, and demands of their profession, and help health professionals gain a better balance or integration between their work and their spare time—as well as help protect their health, well-being, and satisfaction with both their work and overall life.

Research has indicated that effective self-care practices involves self-awareness, self-compassion, the practice of altruism and the implementation of a variety of strategies across physical, social and inner self-care domains (68–70). In a national study of Australian nurses and doctors within palliative care units, 100% of those using a self-care plan reported it to be an effective strategy, while 70% of those not currently using a self-care plan indicated they would consider developing a self-care plan if they were supported to do so (70).

Two recent reviews (71, 72) point to the importance of balancing one's personal needs and the needs of others and recommend self-care as the first line of defense for healthcare workers to manage COVID-19 patient care demands, the longevity of the crisis, and its disruption of normal life routines. In this regard, these reviews highlight the importance of using supportive tools and techniques to combat mental health issues and compassion fatigue among healthcare workers. Some of the suggested preventive self-care strategies include spiritual practices and relaxation techniques, using e-mental health services and enhancing interpersonal skills. Other evidence-based self-care strategies include prioritizing close relationships such as those with family, maintaining a healthy lifestyle by ensuring adequate sleep, regular exercise, and time for vacations, fostering recreational activities and hobbies, and practicing mindfulness and meditation (73).

Practicing self-care is important for all healthcare workers, especially during times of crisis, uncertainty and higher demands. This can be done by frequently checking in with and being aware of one's own emotional level and stress level, taking breaks whenever possible, practicing healthy daily routines like eating healthy food, exercising, or taking walks in nature, getting enough sleep, and allowing emotional processing whenever possible and through the means preferred—whether it is through relaxation, mindfulness and meditation exercises, journaling, taking a run, dancing, engaging in arts or creative work, spending time in nature, calling a friend, or crying in solitude. Allowing emotional expression on a continuous basis—as opposed to repressing emotions—helps build emotional resilience and mental well-being in the long run (74). The beneficial effects of appropriate self-care for healthcare workers include improved physical, mental, and emotional well-being (75), as well as being able to provide care for their patients in a more sustainable way with greater compassion, sensitivity, effectiveness, and empathy (76). Practicing self-care can also help healthcare workers create some structure and predictability amidst chaos and uncertainty and make them able to manage high levels of stress in more constructive ways. A qualitative study based on semi-structured interviews with 172 physicians working in COVID-designated centers across India, found support for resilience as a learned and evolving process: Most of the participants mentioned resilience as a continuum developed through experiencing and facing an

unprecedented crisis, aided by social support and past encounters with stress. The results suggested that the consistent living through hardships and adversities of the COVID-19 crisis with responsible risk-taking, helped pave the way for problem-solving, personal efficiency and coping in the physicians (77). Empathy, optimism, and self-efficacy can also improve personal health-risk perception, which is vital for psychological resilience during pandemics (77, 78).

The recovery phase is when the healthcare workers will have more time for reflection, contemplation and rumination around the experiences they have been through during a crisis. It is essential for their recovery that they have professional support and appropriate mental health and self-care tools—and knowledge about how to use them—during this phase. Especially when the time of recovery is short, and interrupted with new waves of virus outbreaks or other challenging crises. It's also essential that healthcare providers focus on their strengths, instead of engaging in self-critical thinking about things they could have done better. To avoid accumulation of stress during times of crisis or other challenging working conditions, healthcare workers should try to prioritize and simplify tasks; focus on one task at a time whenever possible; set healthy boundaries; communicate in a self-assertive way; and seek support for important clinical decisions. For some, practicing self-care and being able to debrief with colleagues will be enough, while for others who might be traumatized or who experience high levels or stress, anxiety or depression, stronger measures, and opportunities for professional support over time will be needed.

PROACTIVE PREVENTION MEASURES AND INTERVENTIONS

Short-term mood boosters have been widely practiced during the COVID-19 pandemic. These have included free lunches or snacks during the working day, or clapping, posters, and songs thanking "healthcare heroes" for their efforts. While this may offer temporary acknowledgment, it can also seem like a distraction or excuse from attending to the serious challenges frontline workers and other health professionals face in regards to protecting their own health and well-being at work (79). In fact, repeatedly referring to healthcare workers as "heroes" may actually act as a barrier to them seeking help (i.e., heroes help others; they don't need help). Healthcare workers need to be seen as fellow human beings who are not invincible and whose resilience also has limits. Instead of superficial or temporary appraisal and reward, we need to invest in and accelerate protective and preventive measures to reduce the burden on healthcare workers on a more permanent basis. This should also involve leveraging existing evidence-based interventions for alleviating psychological distress in public health emergencies.

As we have seen, healthcare providers who have worked on the frontline, humanitarian aid workers, lay providers, as well as mental health professionals providing psychological first-aid and mental health care for those affected during these times of crisis, are all exposed to, and can be expected to experience significant negative health impacts like post-traumatic stress, anxiety, insomnia, and depression. As mentioned, we also know that physicians and other healthcare providers may be hesitant to seek mental healthcare, often due to concerns about confidentiality and its potential impact on their careers (39).

For too long, the responsibility has been on the individual healthcare worker to recognize and manage their own stress, burnout or depression, with few avenues or tools made available for them to successfully do so. COVID-19 has clearly demonstrated the need to invest in protecting the mental health of the healthcare workforce. Based on the current situation and working conditions for healthcare practitioners, as well as earlier research findings on the negative mental health impacts from emergency situations and the difficult and stressful working conditions in general, it should be of highest priority to prevent a parallel pandemic of mental health issues among the healthcare workforce in the times to come.

Thus, it is imperative to provide necessary mental health support for healthcare staff during these times. Healthcare workers across the medical and mental health sector should be offered psychological first aid during times of crisis, heavy workload, or challenging working conditions, as well as long-term support through accessible mental health support programs (e.g., resilience, self-care, or mindfulness courses). For instance, there are brief psychological interventions that have proven to be effective in managing stress in humanitarian emergencies. The World Health Organization's Self-Help Plus (SH+) stress management intervention (80) may be ideal for addressing the elevated psychological stress and risks of burnout and mental distress among healthcare workers responding to the COVID-19 pandemic. SH+ is based on acceptance and commitment therapy (ACT), which can reduce symptoms of depression and anxiety (81), and combines elements of cognitive behavioral therapy (CBT) including psychoeducation, mindfulness exercises, and promoting psychological flexibility where individuals learn new ways to open up to and cope with difficult thoughts and feelings consistent with their own values, rather than avoiding these thoughts (82). One key feature of SH+ is the broad focus on reducing psychological distress associated with adversity and difficult life experiences (80), which increases scalability by not requiring use of diagnostic procedures or targeting specific syndromes. It is important to recognize that even though health workers during the pandemic are experiencing high rates of distress, this does not mean they have a diagnosable mental disorder, emphasizing the need for early intervention and self-help in alleviating stress. SH+ has demonstrated effectiveness in significantly reducing psychological stress among women in humanitarian settings in Uganda, as reflected in a cluster-randomized trial with 14 villages enrolling 694 participants (83).

The use of telemedicine centers, platforms, and solutions is a promising strategy to provide more effective care for patients, while reducing the workload and taking off pressure on healthcare workers. During the COVID-19 outbreak in China there have been positive experiences with using remote consultations to connect medical experts in a telemedicine center with frontline health workers in the Hubei province (and other less developed areas) to share medical images, record data, and

test results. A telemedicine platform was also set up where medical workers could share their opinions and experiences with each other in order to achieve more suitable treatment methods. The platform was also used to provide psychological counseling for frontline doctors through videoconferencing to help them cope with stress and anxiety. This was found to greatly reduce the pressure on frontline medical staff. Other potential benefits with this approach are reduced needs for face-to-face consultations, protection of experts from exposure to viruses and saved costs (84). Thus, telemedicine approaches can help prevent work overload, burnout, and mitigate negative mental health impacts in healthcare workers in real time.

Mindfulness practice and stress management approaches are two additional health interventions with evidence of efficacy and measurable outcomes for reducing burnout and promoting resilience in clinicians (85, 86). Maunder et al. (87) found that computer-assisted resilience training in healthcare workers appeared to be of significant benefit under pandemic conditions. Peer-to-peer support groups and buddy teams are other helpful interventions that could give healthcare workers a possibility to debrief their experiences with others with similar experiences (30). The use of reflective practice groups or "reflective rounds" (e.g., Balint, Schwartz) have a growing evidence base in helping clinicians manage stressful encounters and in reducing the impact of burnout. For example, eight face-to-face reflective rounds were arranged for staff in Southampton Children's Hospital in the UK, from September 2017 to February 2020 with a further virtual round in July 2020 during the COVID-19 pandemic. Each round was facilitated by a clinical psychologist and consultant. For each round, up to three volunteer panelists from different staff groups were invited to share their personal experiences on a pre-selected subject to the large group. The group would then contribute to the discussion by offering their own reflections. Feedback on this practice was received from 202 participants. The results showed that the majority (98%) would recommend the rounds to colleagues with 64 participants (32%) rating the rounds as "exceptional" and 91 (45%) as "excellent." The virtual round received similar positive feedback (88).

Such evidence-based prevention measures and interventions will help protect and strengthen the mental health and resilience of healthcare workers in the long run, and make them better prepared to manage and thrive in their work during challenging circumstances. It will also help facilitate their personal and professional development on an ongoing basis.

WORKPLACE CULTURE AND LEADERSHIP

Unfortunately, no measures to prevent burnout or other mental health issues will be effective unless attention is paid to enhancing a positive work environment, defined as one "that attracts individuals into the health profession, encourages them to remain in the health workforce and enables them to perform effectively to facilitate better adaptation" (89). Healthcare leaders and decision makers should seek to lead by example and work toward reducing the stigma associated with mental health issues among healthcare staff, and foster a work culture of transparency, trust, respect, openness, equality, empathy, and support. Healthcare leaders should especially be mindful of promoting a culture of inclusion, collaboration, and support, instead of comparison and competition.

It is crucial that healthcare leaders and decision makers step up and take long-term responsibility when it comes to highlighting the importance of protecting the mental health of the healthcare workforce on an ongoing basis. Normalizing discussions about mental health among physicians and other healthcare workers can help reduce some of this stigma, while establishing long term screening and prevention programs will be critical to monitoring early signs and preventing burnout, PTSD and other mental health issues on a continuous basis. Since the risk of moral injury can be high when faced with a heavy workload, stressful environments, limited equipment or difficult choices, especially during times of public health emergencies, it is a topic worth more attention and interventions from the leadership of health and care organizations. Managers can help staff make sense of morally challenging decisions and their psychological response to these difficult decisions by being straightforward and honest about possible ethical dilemmas. Also, support from colleagues and line managers helps to protect the mental health of healthcare workers in these regards (90).

A study involving a total of 214 healthcare workers in Turkey found that in order to raise the psychological resilience of healthcare professionals working during the COVID-19 pandemic their quality of sleep, positive emotions, and life satisfaction need to be enhanced. The study also concludes that in order to enhance positive emotions and weaken negative emotions of healthcare professionals, the workers' needs ought to be prioritized in any practice (91). Rieckert et al. (92) conducted a scoping review of 73 papers focusing on the impact of COVID-19-like working conditions on the physical and/or mental health of healthcare professionals in a hospital setting, as well as on interventions, measures and policies to preserve physical and/or mental health. The review was supplemented with expert interviews to validate the findings. The results showed that recommendations fostering resilience prior to the outbreak included optimal provision of education and training, resilience training, and interventions to create a feeling of being prepared. Recommendations during the outbreak consisted of (1) enhancing resilience by proper provision of information, psychosocial support, and treatment (e.g., create enabling conditions such as forming a psychosocial support team), monitoring the health status of professionals and using various forms and content of psychosocial support (e.g., encouraging peer support, sharing, and celebrating successes), (2) tasks and responsibilities, in which attention should be paid to kind of tasks, task mix, and responsibilities as well as the intensity and weight of these tasks and (3) work patterns and working conditions.

In line with such findings, healthcare staff should be given the opportunities to express their needs and the means to have these needs met. Further, turning personalized self-care plans and approaches to build resilience into standard organizational cultural practice is important in assisting with overcoming barriers and prioritizing self-care among healthcare workers. At

an organizational level, time to and ventures of practicing self-care should be recognized as a needed and essential part, both in terms of preventing mental health issues and building resilience and for increasing motivation, job satisfaction, patient safety, and quality of care. The self-care, resilience, and workplace policy interventions which are promoted on an organizational level could involve mandatory breaks (including power naps, taking walks, access to silent rooms, etc), use of mini-breaks before every meeting, policies to have all meetings to start on the hour and other approaches to improving the workplace environment.

Also, a limit on the length of work shifts should be put in place, and there should be opportunities to enroll in professional mental health support programs and to engage in peer-to-peer support groups, reflective rounds, or buddy teams to debrief their experiences on a regular basis. Furthermore, hospitals and other care facilities should establish adequate parental and sick leave policies that do not burden a healthcare provider's colleagues. Departments should schedule in protected time for personal doctor, therapist, and dentist appointments. Other aspects of policy change likely to have a positive impact on the well-being of healthcare professionals is in relation to non-punitive responses to medical errors (93) and a trauma-informed approach to stress in the workplace. In addition to common challenges and needs which are necessary to address within the healthcare workforce as a whole, the reviewed literature has also pointed toward heterogeneous needs among healthcare workers based on specific challenges, predispositions, socio-economic factors, gender, race, and other factors. It is important that healthcare leaders and decision makers are aware of such differences in needs, and that their policies and interventions help reduce the extra burdens on those who are most vulnerable to experience adverse mental health impacts as a result of their working conditions.

Essentially, protecting the mental health and the professional and personal development of healthcare staff, should be a high priority not only in times of crisis, but on an ongoing basis. A recent report from the National Academy of Medicine in the US (2019) recommended that medical societies, state licensing boards, specialty certification boards and medical education and health care delivery organizations all need to take concrete steps to reduce the stigma for clinicians of seeking help for psychological distress and make assistance more easily available. These recommendations are even more relevant during the COVID-19 pandemic.

TOWARDS A SYSTEMIC SHIFT

A survey conducted by the World Health Organization on the impact of COVID-19 on mental, neurological, and substance use services in 130 countries, clearly indicates that mental health systems have been compromised at a time when they are likely to be needed the most (94). Healthcare systems should be reimagined to reduce the increasing burden on healthcare professionals, and promote their health, well-being and thus their ability to provide care and achieve optimal outcomes. We need healthcare systems that are driven by the needs of patients and healthcare providers; and not by demands of increased efficiency and economic interests only. This change should be reflected by policies, professional guidelines or other means of self-regulation.

A recent policy brief by United Nations on COVID-19 and the need for action on mental health suggests that the implementation of the following systemic actions by national decision-makers will help minimize and address the mental health consequences of the pandemic in general: (1) Apply a whole-of-society approach to promote, protect and care for mental health, (2) ensure widespread availability of emergency mental health and psychosocial support, and (3) support recovery from COVID-19 by building mental health services for the future (95).

Furthermore, involving both healthcare providers and patients in evaluations and improvements of healthcare services, so called *co-production* (96, 97), can help share power (98) and provide valuable insights on both individual and organizational level. Exercising the principles of co-production, healthcare workers should be involved in the process of decision making, development, implementation, testing, and evaluation of interventions and efforts aimed at preventing psychological distress and mental health issues and improving their health, well-being, and job satisfaction in the long run. Further, including feedback from both patients and healthcare providers about perceived quality of care and working conditions, may also result in other important organizational benefits like financial support for improvements from higher management bodies such as the hospital's medical staff and Board of Directors. Such input can then be used as an instrument to gain legitimacy and set necessary improvements in motion (99). Exercising the concept of co-production within healthcare systems, could therefore help improve both the quality of care and the working conditions and well-being for overworked health care providers.

Similarly, it is important to address stigmatization within healthcare facilities as a systemic issue and keep those who fear or are being burdened by stigmatization at the center of any response to stigma. This includes working to empower people or groups experiencing stigma (including patients, caregivers, and healthcare workers), for example, by building skills and efficacy to address internalized stigma and cope with and challenge stigma, as well as building partnerships with gatekeepers and opinion leaders for change (100). Focused social and organizational support and understanding of the distress faced by healthcare workers during times of crisis and in general, can help reduce the stigma and improve social connections while reducing barriers to utilization of mental health interventions aimed at supporting healthcare workers. This has been termed an "epidemic of empathy" and has the potential of bringing together science and humanism in a way that might be beneficial even after cessation of the pandemic (77, 101).

Finally, there is a need for prioritizing and promoting global collaboration on research, including longitudinal and qualitative studies, on the mental health impacts on healthcare workers during the pandemic and in the post-pandemic aftermath. The voices and first-person accounts of frontline workers and other healthcare staff who have served during the COVID-19 pandemic across the globe will bring invaluable contributions to the field

and help foster needed systemic changes, rather than relying on quantitative studies and mere statistics or survey studies alone.

Implementing and promoting such systemic changes will be especially important in low and middle-income countries, where the vast majority of the world's population reside; yet, access to effective mental health care services remains severely constrained. It is in these lower resource settings where advances in the delivery of mental health care will be especially impactful at a population level, by advocating for the inclusion of these services as part of efforts to achieve universal health coverage, and more specifically, by recognizing the needs of healthcare providers delivering mental health services to vulnerable population groups across diverse settings.

POLICY RECOMMENDATIONS

Based on the findings in the reviewed research and the points raised in our discussion, we propose the following policy recommendations:

- Enact national and local evidence based interventions and programs to support frontline healthcare workers health and well-being in a long-term perspective. Leverage the necessary expertise of health, wellness and behavioral science experts to guide the implementation of these solutions and ensure clear evaluation design, analysis, and iteration to inform continual evaluation and improvement.
- Share and distribute these resources across the organization, network of partners, patients, and others.
- Create national knowledge-bases (information, tools, and resources) designed to improve the resilience and well-being needs of workers and their leaders in times of crisis, recovery, and rebuilding.
- Ensure adequate staffing levels in healthcare systems and fair pay for workers.
- Encourage help-seeking and ensure available mental health resources for frontline health workers in distress.
- Condemn and combat the stigmatization of frontline healthcare workers. Increase efforts to de-stigmatize mental health across society.
- Ensure a wider and more actionable dialogue about mental health in the workplace.
- Engage frontline healthcare workers in the political decision-making processes and in co-creating new policy development.
- Reallocate research funds to explore paths for future preparedness for frontline healthcare workers.
- Consider the opportunity for digital technology and other innovative approaches to ensure access to effective training and ongoing support and guidance among frontline workers and in the overall healthcare workforce.

CONCLUSIONS

Healthcare workers across health systems and disciplines are facing significant stressors, burdens, and mental health challenges as a result of their work. This is especially the case for those who work on the frontlines during public health emergencies—with further challenges faced by those who work in impoverished and low-resource settings or in settings where stigmatization is high. The COVID-19 pandemic has acutely reminded us of the important and invaluable work that frontline workers and other healthcare professionals do on a daily basis in challenging circumstances, and has exposed the limitations of healthcare systems around the world. Before the memory of the pandemic response starts to fade, appropriate evidence-based measures and interventions must be put in place and actioned to protect the mental health and well-being of the healthcare workforce—not only during public health crises, but on a day-to-day basis. The measures and policy recommendations outlined in this article are a few of the many meaningful interventions that can reduce the risk of healthcare providers incurring ongoing, long-term psychological damage in the wake of COVID-19 and beyond.

Healthcare workers should be respected for the vital work they do to keep populations healthy, meaning we have a duty to find ways to meet their psychological needs and improve their welfare. The authors are hopeful that the acknowledgment and appreciation of the healthcare workforce will continue and become more permanent in the times to come. Empathy, transparency, open disclosure, and effective and supportive communication will solidify the partnership and collaboration between healthcare leaders, healthcare providers and patients as well as other stakeholders. This will then in turn provide the foundation of a healthcare system that revolves around the improvement of experiences and well-being outcomes of all involved.

World leaders and other decision makers need to fully realize the crucial importance and value of investing in the mental health and well-being of the healthcare workforce, on individual, organizational, and societal level. As well as the personal, economical, and societal benefits of doing so. Let us learn from our past and thank our essential healthcare workers by demanding and promoting real reforms within our healthcare systems. We cannot afford the cost of failing in this aim.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

LS conceived the main conceptual ideas, drafted the manuscript, and performed the main literature review as well as subsequent editing and corrections. JN contributed with a critical review, helped drafting the introduction section, and contributed with additions, literature citations, and edits to the different sub sections of the manuscript. AK contributed with a critical review, literature citations, and edits in different sub sections of the manuscript. SS contributed with a critical review, literature

citations, and edits in specific sub sections of the manuscript. MWQ provided early support for the main conceptual ideas and contributed with literature citations and input for different sub sections of the manuscript. CG contributed with literature citations and edits to specific sections of the manuscript. LM contributed with comments and suggestions to specific sub sections of the manuscript. All authors contributed to the article and approved the submitted version.

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OPINION
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A Visualization of a Socio-Ecological Model for Urban Public Mental Health Approaches

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Keywords: mental health, social determinansts of health, public health, socio – ecological system, urban health

INTRODUCTION

According to the latest data from the Global Burden of Disease, over 1 billion people globally are affected by mental and addictive disorders, which cause 19% of all years lived with disability worldwide (1). It is clear that such an extensive issue requires an urgent and committed public health effort. To that end, a range of population-level approaches have emerged, though the frameworks used and adopted vary widely.

FROM GENOME TO EXPOSOME

In recent years, a broad social agenda of psychiatric genetic research has emerged highlighting that genes account for a minority of our emotional and behavioral development, leaving the majority determined by social and physical environmental influences (2). Mental health must therefore be considered a dynamic state, whereby individual psychosocial development is influenced by multiple layers of intersecting social and environmental factors.

This starts in the womb with the mental and physical health status of mothers during pregnancy impacting the developing fetus. The very early years are greatly affected by parental bonding and the home environment. Thereafter, factors such as neglect or abuse in childhood; unemployment, poverty, and physical health problems in adulthood; and levels of social and community connectedness in later life all have a part to play in influencing an individual's ability and opportunity to access mental health protection, such as can be found in positive relationships, quality employment, and healthy living conditions. This picture is often complicated by the role of issues such as intergenerational trauma and the far-reaching and sustained impact of adversity in childhood, which suggests that upstream interventions are critical when taking a public mental health approach (3).

These factors (an indicative range of which is presented in **Figure 1**) can and often do have a cumulative and intersecting effect across the course of life. Exposure to adverse experiences can be particularly common and clustered within some families and communities as well as specific settings, such as schools and workplaces, that are already experiencing other destabilizing factors. Hence, in many ways one's postal code is more important than one's genetic code (4), and the term "exposome" has been proposed as a new paradigm to encompass the totality of human environmental (meaning all non-genetic) exposures from conception onward, complementing the genome, and impacting human health (2). It is therefore crucial that if mental health problems are to be prevented, the social, economic, health, and ecological environment in which they are developing needs to be addressed (5). Understanding how these factors influence risk and how this can be mitigated is vital, as is communicating them in an accessible, visual way.

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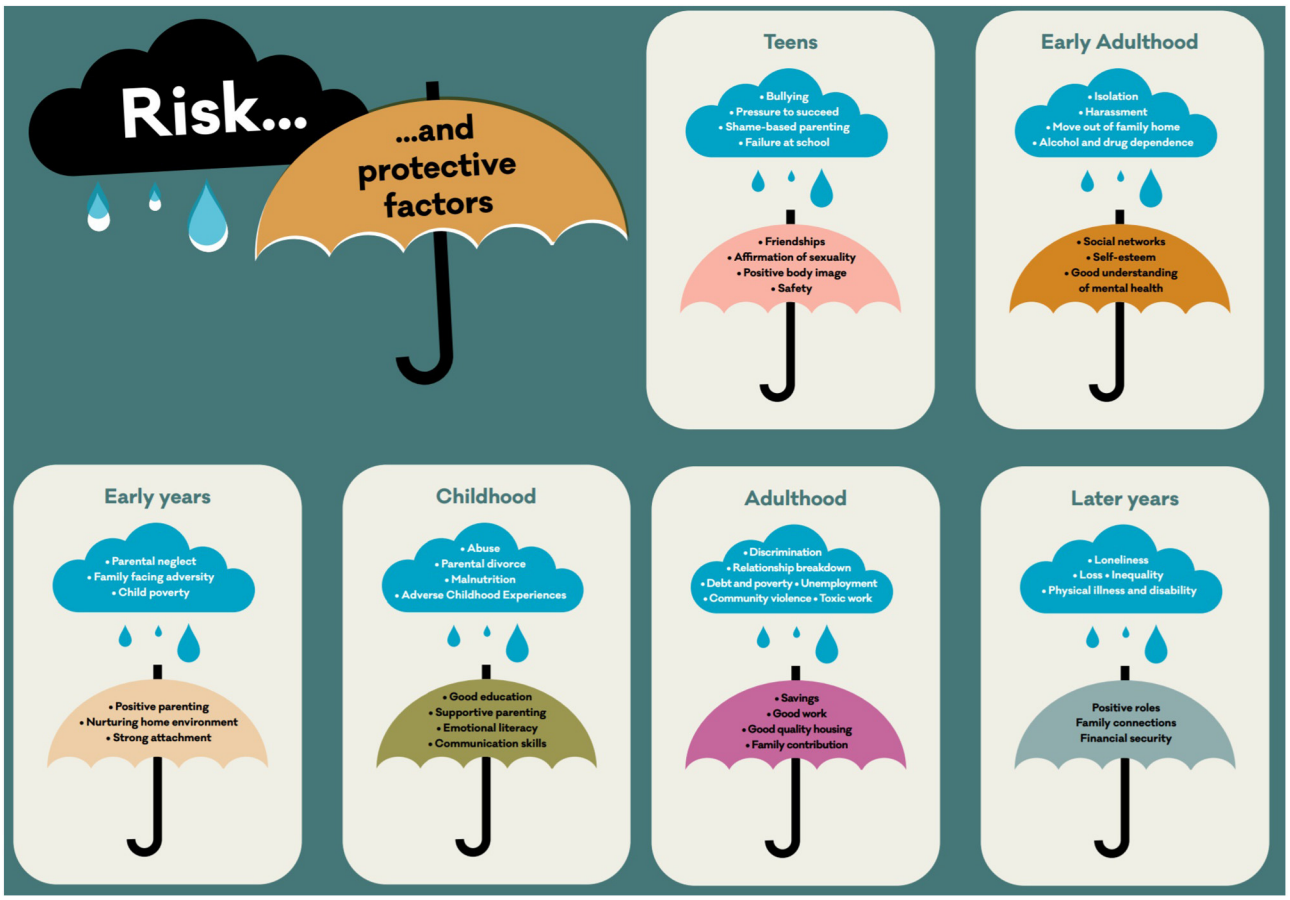


FIGURE 1 | Visualization of some indicative risk and protective factors across various stages of the course of life. (c) Kousoulis, Mental Health Foundation.

FROM PUBLIC HEALTH TO PUBLIC MENTAL HEALTH

Within public health there is indeed recognition that health is determined by a multi-dimensional and symbiotic relationship between the individual and the layers of their environment from the family home, through to the wider social and physical environment in which we live, including its cultural and political context. This describes a socio-ecological approach to health that has been advocated for almost three decades (6) and is still in line with the modern proposed definition of public health: "Public health is what we build together as a society when we shape our communities so everyone can achieve optimal health." (7).

This public health view has much to offer within a mental health context where there can be a tendency to focus attention on the individual in isolation from the social and ecological conditions in which they exist. Hence, applying such an approach to mental health would make sense given the established knowledge behind the social determinants of mental ill-health (8). While ecological approaches have been proposed before in association with rural workforce and family-focused practice (9), the built environment (e.g., urban design and planning, green space access), and the social environment (e.g., prosocial spaces, civic participation, cultural resources) of cities lend themselves well to a population mental health approach (10). It is expected then that this socio-ecological factor could be more readily applied in urban settings, which include a more limited and specific built environment and better defined authority and resources (11).

In fact, more than half of the world's population currently lives in cities, and the trend for further urbanization is rapidly increasing (12). However, cities do not work for everyone. The bond between health and place is broken. Health systems treat acute illness, while urban systems promote chronic distress (13). To turn the tide on creating healthy urban places, we need to influence the culture, structure, and beliefs that drive priorities and values for healthy places by recognizing that humans need to live with meaning, including having a sense of purpose and of being of value and having a place where they belong.

To facilitate this conversation, we are proposing a new visualization for the traditional socio-ecological model approach to help frame urban public mental health programs (**Figure 2**).

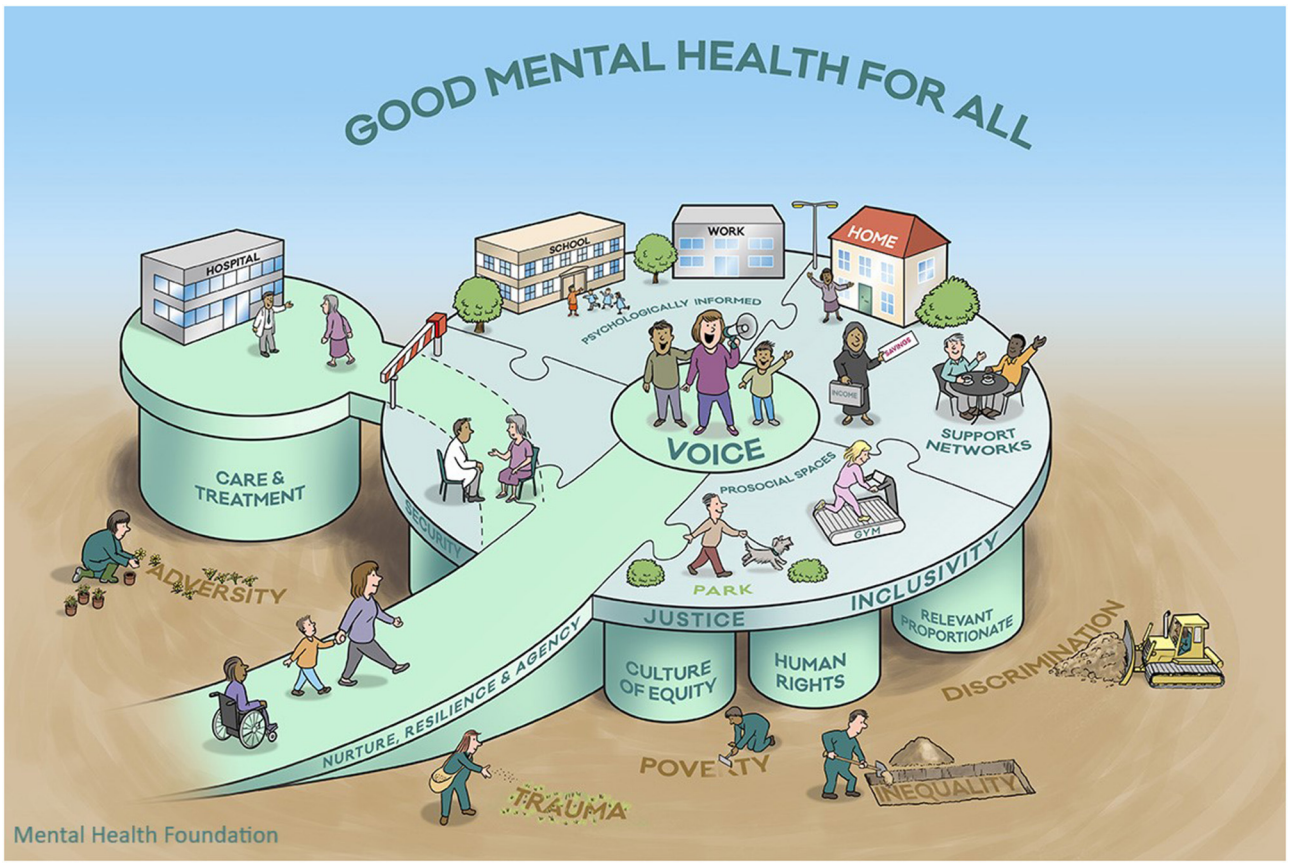


FIGURE 2 | Visualization of a whole-city socio-ecological model for public mental health. (c) Kousoulis, Goldie, Mental Health Foundation.

DISCUSSION

In creating this new visualization for a socio-ecological model in public mental health, we have respected representation of the following evidence so that the visual image should:

(1) Look at both the individual person and that person's environment, family, and community, as well as the wider structures, culture, and beliefs, taking a universally proportionate and culturally relevant approach across the whole life course (14).
(2) Be relevant to the environments that impact human development. These classically include four systems (15):
a) Microsystems: immediate social and physical surroundings (home, family, neighborhood, friendship groups);
b) Mesosystems: wider systems within the environment (schools, health care);
c) Exosystems: social, political and economic conditions (policy and legal environment including housing and welfare systems, cost, and standards of living);
d) Macrosystems: beliefs and attitudes shared by members of society (including stigma and prejudice, views on social justice, equality, and inclusion).
(3) Apply a Health in All Policies (HiAP) approach, as there are limitations to funding, planning, and developing solutions in a health service silo (16). Health needs to be understood as a central factor in not only our individual success but that of society. This is even more important in the consideration of mental health, which has a powerful and pervasive influence on our ability to perform and be productive across a range of areas.
(4) Adopt a Whole Communities Approach. This acknowledges that mental health improvement interventions must operate across multiple system levels. Much of the improvement impact will be experienced not only within the health system through a reduction in more acute and long-term mental health and social care support services, but also across systems that rely on social capital (workplaces, schools), the public support infrastructure (health and welfare systems, housing, community/urban planning, and regeneration), and those parts of the system that are the endpoint for those whose distress has not been addressed at an earlier stage (criminal justice, homelessness) (17).
(5) Draw from Socio-Ecological Systems Theory (18), by acknowledging the central influence of beliefs and ideologies across society in systems development, while taking account of the interconnections and dependencies among community members.
(6) Acknowledge the way in which stigma and discrimination shape the cultural context of how mental health is viewed

and valued and the level of effort society members are willing to expend to address the adversity and structural risk factors behind this (5).

(7) Position the voice of those with lived experience of mental health problems at the core of any decision-making process and ensure coproduction (working in equal partnership) is championed in designing services, campaigns, or prevention programs (5).

We invite a critique and conversation in using this strongly evidence-informed visualization when taking whole-city approaches and modern public health service design.

AUTHOR CONTRIBUTIONS

All authors participated in the conception, drafting, and editing of the manuscript and are accountable for the content of the work.

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ORIGINAL RESEARCH
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Social Capital and Depressive Episodes: Gender Differences in the ELSA-Brasil Cohort

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Introduction: The association between social capital and depression is a frequent research topic in developed countries, often with inconclusive results. Furthermore, for both social capital and depression, there are gender differences established in the literature. This study investigates gender differences in the association of social capital with the incidence and maintenance of depressive episodes.

Methods: Baseline and second wave data (4 years of follow-up) from the Longitudinal Study of Adult Health (ELSA-Brasil), a multicenter cohort of civil servants with 15,105 workers aged 35–74 years, were used. Social capital was assessed using the Resource Generator, a scale composed of two different dimensions: "social support" and "prestige and education." Depressive episodes were assessed using the Clinical Interview Schedule - Revised (CIS-R). The statistical analysis was performed using multinomial regression with adjustments for possible confounding factors.

Results: Among men, low social capital in the "social support" dimension was associated with the incidence of depressive episodes (RR = 1.66; 95% CI: 1.01–2.72). Among women, social support was associated with the maintenance of depressive episodes (RR = 2.66; 95% CI: 1.61–4.41). Social capital was not associated with the incidence or maintenance of depressive episodes in the "prestige and education" dimension in both genders.

Conclusion: The results highlight the importance of the dimension "social support" in both genders in its association with mental health. The resource-based social capital approach proved to be adequate for investigating mental health and confirms the idea that social networks can be useful in the treatment and prevention of depressive episodes.

Keywords: depression, social capital, gender difference, Brazil, cohort studies, multinomial regression

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INTRODUCTION

It is estimated that, among mental disorders, depression should be the main cause of health problems and premature death in the world in 2030 (1). It is a multifactorial and heterogeneous disease, which has a major impact on mental health, affecting more than 300 million people globally (its prevalence was estimated at 4.4%). Currently depression is one of the main risk factors for suicide and the biggest contributor to YLD (years lived with disability), corresponding to 7.5% of all years lived with disability in 2015 (2).

Different risk factors are attributed to the incidence or recurrence of depression. While sociodemographic characteristics such as gender, marital status and socioeconomic status seem to be linked to the incidence, recurrence is more associated with factors related to vulnerability to depression, such as family history of depression and the presence of certain symptoms or their severity in the first depressive episode (3).

Investigations on how social capital can be an important factor in understanding the emergence of depression have been increasingly frequent in recent years (4–7). Social capital is a multidimensional construct focused on the presence of resources that individuals or groups can access through a network of relationships. This construct discusses the role of social networks to access these embedded resources, and it has been investigated concerning various outcomes in mental health, like common mental disorders, depression, child mental illness (8). Its elements are presented by several authors who approach it in an interconnected way, describing it as social trust, social support, reciprocity, civic engagement and social control (9–11).

Aware of the importance of social networks in maintaining psychological well-being (12), the main theories that seek to elucidate the mechanisms by which specific aspects of social networks lead to the maintenance or improvement of psychological well-being state that they can act directly (through social control) or act as a protection mechanism against stress (13). In the conception developed by Bourdieu (9), social capital refers to social resources made available through networks that help the individual to obtain benefits.

An expanded view of social capital, provided by Putnam (11), places it as group property, developed and enjoyed in a community collectively. However, we can understand that the basis for generating individual or collective resources are social networks characterized by social trust (14) and that the investigation of the availability of resources can translate the importance of social capital for individuals and/or for the society.

Theoretical advances in social capital research also classify it as having cognitive components (perceptions of social support and trust) and structural components (related to the structure of the social network) (15). Cognitive social capital is more often linked to mental health outcomes (16) compared to structural social capital. It is also known that the association between social capital measured only at the collective level and mental health has less explored than the association with social capital at the individual level (8).

Studies that investigate the presence of social capital linked to resources available on networks, also find associations with positive effects on mental health and depression. The association between less access to social capital resources and the presence of common mental disorders has been identified in the United Kingdom (17). In parallel, the association between low levels of social capital and depressive traits was identified in a study with women from Southeast Asia (18).

A model of vulnerability to stress can be used to link the way that social capital protects against the incidence or relapse of a depressive episode. These models postulate that individual vulnerabilities interact with adverse life events or stressors to cause a certain pathology (19). Vulnerability models that explore the interaction between genetics and the environment for the development of depression are frequent (20, 21). Similarly, an extension to the vulnerability model developed by Harris (22) considers the psychosocial aspects in the development of depression, suggesting that the presence of social capital made available through social networks can influence its course. In this model, the absence of social capital would constitute an individual vulnerability capable of promoting the appearance of depression or its maintenance.

Thus, understanding the importance of social networks in investigating the occurrence and course of depression, this study seeks to examine the association of different dimensions of social capital, in the incidence and maintenance of depressive episodes in a large Brazilian cohort of workers. The need and importance of studying social capital and health longitudinally has been indicated in the international literature (23, 24). This is the first Brazilian study to investigate gender differences in the association between social capital and depressive episodes in a prospective manner and similar to existing cross-sectional studies (17, 18, 25), and its main hypothesis is that a higher level of social capital is inversely associated with the occurrence and maintenance of depressive episodes and that this association is differentiated according to the gender of the participants.

MATERIALS AND METHODS

Study Design, Population and Data Collection

The Longitudinal Study of Adult Health (ELSA-Brasil) is a prospective and multicenter cohort study, with a baseline composed of 15,105 civil servants from six Brazilian teaching and research institutions (FIOCRUZ, UFBA, UFES, UFMG, UFRGS and USP), aged between 35 and 74 years old. This study was primarily designed to investigate the incidence and progression of cardiovascular diseases and diabetes and its social, occupational, environmental, psychological and biological determinants, which gives it a multidisciplinary character.

Baseline data collection was carried out between 2008 and 2010, consisting of interviews and exams applied by trained and certified staff. As planned, a second wave of exams and interviews was carried out between 2012 and 2014. In addition, the monitoring of outcomes has been carried out through annual telephone contacts, at which time information about hospitalizations, new diagnoses of diseases and deaths is collected. More detailed descriptions of the methodological

aspects of ELSA-Brasil can be found in Schmidt et al. (26). As illustrated in **Figure 1**, to compose the study population, from the participants in the first follow-up, those who failed to answer any of the social capital items, or the questions that make up the depressive episode classification in the CIS-R (Clinical Interview Schedule - Revised), were excluded in both waves. No participant presented missing data in the adjustment variables. We also excluded participants who had a depressive episode only at the baseline. Thus, 554 people were excluded, resulting in an analyzed population of 13,460 participants.

ELSA-Brasil had its protocols submitted and approved by the Research Ethics Committees of the Oswaldo Cruz Foundation (FIOCRUZ) and the National Commission for Research Ethics (CONEP). This project was submitted and approved by the Institution's Ethics Committee (CEP 02392412.0.0000.5240).

Study Variables

Social Capital - the Brazilian version of the Resource Generator (RG) was used (27). Such a scale is considered a simple and objective instrument to quantify access to the resources available on social networks. Elaborated in the tradition of network analysis, this scale captures structural data (quantity and source of resources) directly and allows inferring cognitive aspects as it incorporates the concepts of trust and reciprocity in social networks. The original version (28) consists of 33 items that aim to evaluate different dimensions of Social Capital. The questions, operationalized in one or two stages, present some everyday situations to discriminate the reach to different types of resources. The individual answers whether or not they have access to a particular resource and soon after, if the answer is positive, they specify the source of the resource (family, friends or acquaintances).

The Brazilian version underwent reliability and validity studies that assessed the adequacy of the translation and items and their dimensional structure (27, 29). Thus, the scale used in this research follows the structure proposed in the validity study, which considers only two dimensions of the scale: "prestige and education" (13 items) and "social support" (10 items). In addition, we consider only the presence of the resource; and not its source.

In each dimension, social capital was classified as low, medium and high, dividing the score approximately into terciles and thus the dimension of prestige and education had scores between 0 and 9, 10 and 12, and 13 points and in the dimension of social support, the scores were between 0 and 7, 8 and 9, and 10 points, respectively. The social capital scale was applied only at the baseline, considering that the level of social capital is a stable variable, which does not show significant variations in the short time between the two measures (4 years).

Depression

The presence of depression in the last 7 days was investigated using a Brazilian Portuguese version of the CIS-R (30). The CIS-R is a structured psychiatric interview, relatively brief and suitable for lay interviewers. It was applied in face-to-face interviews and the presence of depressive episodes was determined by algorithms based on the ICD-10 (international classification of diseases−10th revision) diagnostic criteria for depressive episodes (group F32.xx) without psychotic symptoms. Introductory questions from the CIS-R that consider appetite and weight variation were not used, which may underestimate the prevalence of depressive episodes.

In the two waves of data collection, depressive episodes [mild, moderate (with or without somatic symptoms) and severe] were grouped into a dichotomous variable such as the presence or absence of a depressive episode. For this study, these dichotomous variables present in the two waves make up a third variable with three categories, as follows:

The presence of a depressive episode at baseline and in the first follow-up was called "maintenance of depression" (value = 1). The "incidence" (value = 2) corresponded to the presence of a depressive episode only in the first follow-up, while the category "not depressed" (value = 3), used as a reference, was named for the participants who were not classified for depressive episodes in either wave. Participants who had depressive episodes only at the baseline were excluded.

Covariables

Age (continuous), marital status (single, separated/divorced, married/united and widowed) and education (complete elementary school, complete high school and complete higher education/postgraduate).

Data Analysis

Gender differences in associations previously investigated in the literature (6, 31) motivated the stratification by gender in the analyzes. The distribution of confounding variables and the variation of social capital at three levels in the two dimensions of social capital were assessed through comparisons using the chi-square test for categorical variables. This analysis was performed at a 5% level of significance. For the selection of variables that were inserted in the multivariate analysis, the level of significance was 10%.

A series of multinomial regression models were implemented to separately assess the association between the two dimensions of social capital and depressive symptoms. The Relative Risk (RR) and respective 95% confidence intervals (95% CI) were estimated, considering the three categories of the outcome (not depressed, incidence and maintenance). The multinomial models (the two dimensions of social capital with depression) suffered sequential adjustments from the gross estimate (Model 0), as follows: inclusion of age (Model 1), education (Model 2) and marital status (Model 3). The variables maintained in the final models were those that remained associated with the response variables at a significance level of 5%. The analysis was performed using the R program (v.3.4.1).

RESULTS

We observed a higher proportion of women (54.0%), with a similar average age (52 ± 9 years) for men and women. More than half of men (50.5%) and women (55.7%) had at least a complete higher education level. 82.2% of men and 55.1% of women were married (**Table 1**). The incidence of depression was

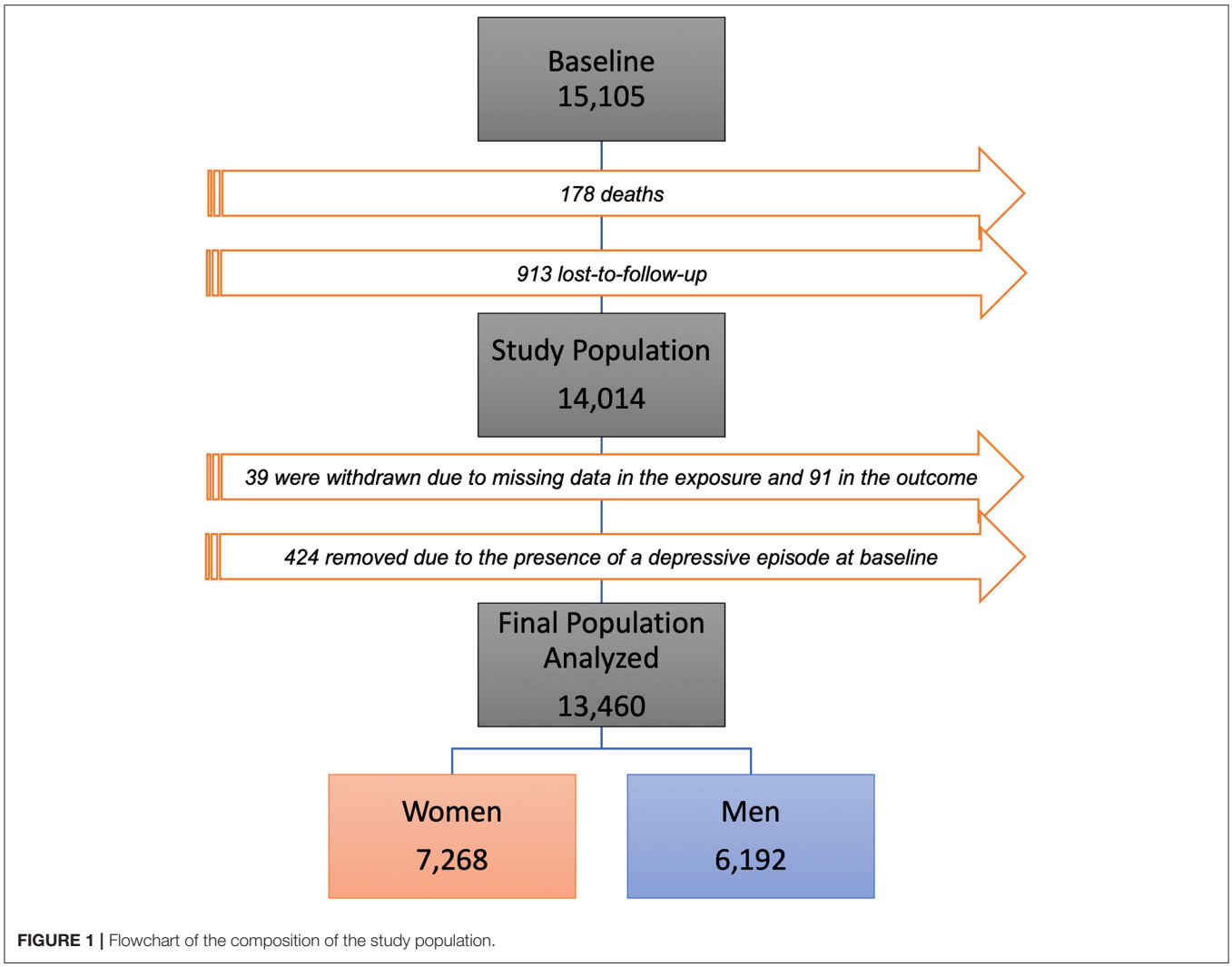


FIGURE 1 | Flowchart of the composition of the study population.

2.4 and 4.8% and maintenance was 0.5 and 1.8%, respectively, in men and women.

The distribution of social capital was similar between the genders, with higher frequencies of availability of high social capital being observed for both. For the "prestige and education" dimension, the frequencies of low, medium and high social capital for men were 18.7, 32.1, and 49% and among women 16.4, 35.0, and 48, 6%. For the "social support" dimension, 11.4, 27.7, and 60.9% for men and 10.2, 27.4, and 62.4% for women, respectively.

It has also been observed that the incidence of depression decreases and maintenance increases slightly among older men. In women, the age group with the highest incidence and maintenance of depression is between 45 and 54 years old. Only among men there was no association between the dimensions of social capital and the presence of depressive episodes (**Table 1**).

Among men, we found no association between having low social capital in both dimensions and maintaining depressive episodes, when compared to men with high social capital. However, in the dimension of social support, after adjustments by the variables, men with low social capital have a 66% higher incidence of depression than those with high social capital (**Table 2**).

Among women, we did not observe significant associations in the final model in the dimension "prestige and education" in the incidence and maintenance of depressive episodes. However, low social capital showed a significant association with the maintenance of depressive episodes before the inclusion of the covariable education level [Model 1: RR = 2.10 (1.33–3.31)]. The other adjustments decrease the strength of the association and the confidence interval makes it non-significant (**Table 3**).

Similar to the "prestige and education" dimension, among women, in the "social support" dimension, social capital was not associated with the incidence of depression. However, it was observed that in the final model, compared to women with high social capital, those with low social capital have a 166% higher risk of maintaining depressive episodes (**Table 3**).

DISCUSSION

Research with the objective of explaining the association between social capital and depression, although frequent, is conducted

TABLE 1 | Characterization of men and women according to the level of social capital of ELSA-Brasil.

Variables	Categories	*n* total (%)	Depression		
			Not depressed (%)	Incidence (%)	Maintenance (%)
			MEN *n* = 6,192		
Prestige and Education	Low	1,115 (18.0)	96.7	2.6	0.7
	Average	1,988 (32.1)	97.7	2.0	0.4
	High	3,089 (49.9)	97.1	2.5	0.4
Social Support	Low	669 (10.8)	95.5	3.6	0.9
	Average	1,684 (27.2)	97.4	2.1	0.5
	High	3,839 (62.0)	97.4	2.3	0.4
Age	35–44	1,448 (23.4)	96.5	3.1	0.4*
	45–54	2,446 (39.5)	97.0	2.6	0.4
	55–64	1,639 (26.5)	97.7	1.8	0.5
	65–74	659 (10.6)	98.0	1.4	0.6
Education	Complete elementary school	917 (14.8)	96.4	2.8	0.8*
	Complete high school	1,972 (31.8)	96.4	2.7	0.8
	Complete higher education/Postgraduate	3,129 (50.5)	97.9	1.9	0.2
Marital status	Single	322 (5.2)	97.2	2.5	0.3*
	Divorced	713 (11.5)	96.1	3.1	0.8
	Married/united	5,089 (82.2)	95.9	2.2	0.4
	Widowed	68 (1.1)	97.4	2.9	1.5
			WOMEN *n* = 7,268		
Prestige and Education	Low	1,125 (15.5)	92.4	5.3	2.8*
	Average	2,546 (35.0)	93.8	4.2	1.9
	High	3,597 (49.5)	93.3	4.9	1.4
Social Support	Low	684 (9.4)	91.5	5.0	3.5*
	Average	1,975 (27.2)	92.8	4.7	2.5
	High	4,609 (63.4)	93.8	4.9	1.3
Age	35–44	1,614 (22.2)	93.3	4.6	2.0*
	45–54	2,908 (40.0)	92.3	5.5	2.2
	55–64	2,081 (28.6)	94.0	4.8	1.2
	65–74	665 (9.2)	96.1	2.6	1.4
Education	Complete elementary school	627 (8.6)	90.3	6.4	3.3*
	Complete high school	2,594 (35.7)	91.5	5.9	2.5
	Complete higher education/Postgraduate	4,047 (55.7)	95.0	3.9	1.1
Marital status	Single	1,065 (14.7)	95.4	3.3	1.2*
	Divorced	1,940 (26.7)	92.0	5.4	2.6
	Married/united	4,008 (55.1)	93.6	4.9	1.6
	Widow	467 (6.4)	92.1	6.1	1.7

*p-value < 0.05.

mainly in developed countries with inconclusive results. In addition, although differences between the genders regarding social capital and depression are established in the literature, few studies consider and investigate these differences. The aim of this study was to examine the association of social capital, the incidence and maintenance of depressive episodes in a cohort of workers. This is possibly the most extensive investigation ever carried out in Brazil on the influence of social capital in depressive episodes, and the study of the differences between men and women found in this association.

The models showed different results between genders. Among women, an association between the dimension of "social support" and the maintenance of depressive episodes was identified. Among men, low "social support" was associated with the incidence of depressive episodes. These findings helped to clarify how social capital works in the course of depression and has differences related to gender. Additionally, the results showed that not all elements of the social capital evaluated are associated with depressive episodes, since the associations were restricted to the "social support" dimension.

TABLE 2 | Association between social capital, incidence and maintenance of depression among men from ELSA-Brasil.

	MEN (n = 6,192)			
Social capital*	**Prestige and education (RR)**		**Social support (RR)**	
Ref. not dep. (n = 6,020)	**Incidence (n = 142)**	**Maintenance (n = 28)**	**Incidence (n = 142)**	**Maintenance (n = 28)**
Model 0[a]				
Average CS	0.73 (0.49–1.09)	0.83 (0.33–2.09)	0.90 (0.60–1.34)	1.30 (0.54–3.10)
Low CS	0.96 (0.62–1.49)	1.71 (0.70–4.13)	1.51 (0.94–2.43)	2.53 (0.97–6.61)
Model 1[b]				
Average CS	0.75 (0.51–1.12)	0.82 (0.32–2.05)	0.98 (0.65–1.47)	1.26 (0.52–3.01)
Low CS	1.04 (0.67–1.63)	1.64 (0.68–3.99)	**1.81 (1.12–2.95)**	2.37 (0.89–6.31)
Model 2[c]				
Average CS	0.71 (0.47–1.06)	0.59 (0.23–1.50)	0.94 (0.62–1.41)	1.00 (0.41–2.41)
Low CS	0.87 (0.54–1.40)	0.78 (0.30–1.99)	**1.68 (1.03–2.76)**	1.60 (0.59–4.33)
Model 3[d]				
Average CS	0.71 (0.48–1.06)	0.60 (0.24–1.54)	0.93 (0.62–1.40)	0.98 (0.41–2.38)
Low CS	0.87 (0.54–1.41)	0.78 (0.30–2.00)	**1.66 (1.01–2.72)**	1.56 (0.58–4.24)

[a]*Gross Model.*
[b]*Age-adjusted model.*
[c]*Model 1 + education.*
[d]*Model 2 + marital status.*
**Reference Category: high. Significant results in bold.*

TABLE 3 | Association between social capital and the incidence and maintenance of depression among women from ELSA-Brasil.

	WOMEN (n = 7,268)			
Social capital*	**Prestige and education (RR)**		**Social support (RR)**	
Ref. not dep. (n = 6,793)	**Incidence (n = 344)**	**Maintenance (n = 131)**	**Incidence (n = 344)**	**Maintenance (n = 131)**
Model 0[a]				
Average CS	0.82 (0.65–1.05)	1.35 (0.91–2.01)	0.97 (0.75–1.25)	**2.08 (1.42–3.05)**
Low CS	0.96 (0.70–1.31)	**1.98 (1.26–3.11)**	1.08 (0.75–1.57)	**2.95 (1.82–4.79)**
Model 1[b]				
Average CS	0.83 (0.65–1.06)	1.37 (0.92–2.04)	1.01 (0.78–1.29)	**2.23 (1.52–3.29)**
Low CS	1.00 (0.73–1.36)	**2.10 (1.33–3.31)**	1.17 (0.80–1.70)	**3.41 (2.09–5.59)**
Model 2[c]				
Average CS	0.75 (0.59–0.97)	1.17 (0.78–1.75)	0.91 (0.71–1.18)	**1.94 (1.31–2.86)**
Low CS	0.77 (0.55–1.07)	1.40 (0.87–2.27)	1.00 (0.68–1.46)	**2.68 (1.62–4.45)**
Model 3[d]				
Average CS	0.75 (0.58–0.96)	1.16 (0.78–1.74)	0.91 (0.70–1.18)	**1.92 (1.30–2.85)**
Low CS	0.76 (0.54–1.06)	1.38 (0.85–2.23)	1.00 (0.68–1.47)	**2.66 (1.61–4.41)**

[a]*Raw Model.*
bAge-adjusted model.
cModel 1 + education.
dModel 2 + marital status.
**Reference Category: high. Significant results in bold.*

As in our design, some studies also chose to explore the differences between the genders in the level of social capital with outcomes in mental health and chose to stratify the population, finding more frequent associations among women (6, 31, 32). In addition, the social capital measured by network analysis has different characteristics between men and women, which can explain the strongest associations found in our study. Women have more extensive social networks (33) and higher levels of social participation (34), they maintain a greater number of intimate relationships than men, while they depend more on their financial resources. Compared to men, women mobilize more social support during periods of stress and tend to be more vulnerable when they face negative life events and do not have social support (35).

Despite the increase in scientific production on the topic of social capital, the diversity of instruments and approaches in

which we can measure it makes it difficult to understand whether opposite results are real divergences or due to methodological variability. With the measure of depression, the difficulty is similar. A study carried out with elderly people in Mexico, which measured cognitive aspects of individual social capital (perception of support, reciprocity and trust), found a higher incidence (36) of depressive episodes (measured with the geriatric depression scale) among women with low social capital. In our study, women with low social capital, compared to those with high level, did not show significant differences related to the incidence of depressive episodes in the two dimensions of social capital. This result, although not expected, can be explanatory about the differences in risk factors associated with the incidence of depression. Considering that the presence of a depressive episode increases the chances of a new episode occurring, perhaps for women, the lack of social capital is more relevant in the recurrence, since support networks do not influence the first episode, but the absence of them can be decisive for a new episode, since different factors are related to the incidence or recurrence of depression (3).

Among men, the importance of capital appeared in the incidence of depressive episodes among those who had low social capital compared to those with high social capital. We believe that the maintenance of depressive episodes is also influenced by the level of social capital, however, we have no statistical power to demonstrate. The small number of men who were classified in the category of maintenance of episodes in our study ($n = 28$), makes clearer conclusions about the role of social capital in this association difficult.

This is the first Brazilian longitudinal study that seeks to assess the influence, on mental health, of resource-based social capital using the Resource Generator, which captures a list of useful resources capable of reflecting different aspects of social capital (28). Studies that use this scale are still infrequent, since its conception is recent. However, valid results have been found in its application regarding problems in mental health in several countries (17, 31, 37).

The two dimensions of the scale seem to relate differently to mental health, corroborating the multidimensionality of social capital. Resources such as "prestige and education" may not be useful for mental health, unlike the dimension of "social support," which reflects the support given in daily activities and emotional support, such as counseling and information exchange. Similar results were found in a Chinese study that used RG among rural workers to investigate its association with mental health (measured through a dimension of the Short Form Health Survey-36). Stronger associations were found among women in the Domestic Resource and Problem Solving dimensions (which in the Brazilian adaptation corresponds to issues related to "social support") (31).

We found many studies indicating the importance of social support when associated with mental health (38, 39). The fact that only the dimension of social support was related to depressive episodes, leads us to believe that in these surveys, social capital is not measuring the same as social support. In addition, both the definition and the way to measure social support may vary among theorists (39). Thus, we understand that there may be an overlap of these two constructs, although previous studies indicate that both the conceptualization and the causal paths by which social capital and social support affect health are different (13, 40).

We can also highlight some methodological implications in the use of the Resource Generator. Network analysis scales such as Position Generator (PG) and Name Generator (NG), are referred to as scales that investigate structural social capital, and Resource Generator, despite coming from the theoretical tradition of these scales, can also be indicative of capital cognitive social, given that it captures aspects such as social trust and reciprocity when questioning the expectation of access to resources.

We also know that studies that used PG and NG (41, 42), point out their limitations when indirectly measuring social capital resources, reporting that these scales can underestimate the quantity and quality of mental health-related resources embedded in social networks. Thus, we believe that RG is an appropriate tool, available for resource-based analyzes and that its use in future studies is a good strategy to corroborate the results found.

For this study, the measurement of social capital was performed only at the baseline, and, similar to previous studies (36), it was considered that the level of social capital would remain stable in the follow-up. However, we understand that this may be a limitation in the study design. Furthermore, after an extensive literature review on the factors associated with social capital and depression, we chose to consider age, marital status, and education as covariables that may affect the association between social capital and mental health. Nevertheless, possible residual confounding may be an additional limitation of the study.

We must also consider a certain weakness in the categorization of our outcome, because although the CIS-R is an excellent tool based on the ICD-10, it refers to the last 7 days, so that our conclusions refer to a depressive episode and not to depression throughout life. Furthermore, the use of just two points in time has limited our ability to capture the fluctuations in the course of depression that many individuals experience. Thus, what we can affirm is that our reference category represents a greater probability of presenting individuals with no history of depressive episodes, that the incidence represents someone who has had at least one episode and that the maintenance category represents a greater probability of a recurrent condition. The exclusion of participants who had a depressive episode only at the baseline to focus on considering the association of social capital with depression incidence and recurring depression condition is also a potential limitation of this categorization.

Despite the limitations presented, our study was permeated by important characteristics that confer quality in all its stages. Our data, from the ELSA-Brasil cohort, were collected with strict quality control, outlined longitudinally, allowing inferences of causality, in addition to being collected in a multicenter way, with representation from several Brazilian cities. All the quality present in the planning and execution enabled great adherence and adherence to the study, given that the losses from follow-up were low (7.2%).

We know that the predictive value of social capital and its scope are not consensual and that longitudinal studies between social capital and depression are still scarce. In this way, this study helps to signal the need for longitudinal investigations that invest in valid and multidimensional instruments to capture the specific mechanisms by which social capital is associated with depression. The findings of our study, recognizing the differences in the course of depression related to gender and the different dimensions of social capital, constitute an important step in the identification of these mechanisms. They not only provide necessary information to guide intervention planning, but also help to identify the need to invest in increasing social capital, as a way to minimize the burden caused by depression in the Brazilian population.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the ELSA study has government funding and the database is available only to researchers and students of the research institutions linked to the study. Requests to access the datasets should be directed to elsa@fiocruz.br.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the research ethics committees of all six centers (Federal University of Minas Gerais—UFMG: 186/06; São Paulo University—USP: 669/06; Federal University of Rio Grande do Sul—UFRGS: 194/061; Federal University of Espírito Santo—UFES: 041/06; Federal University of Bahia—UFBA: 027/06; Oswaldo Cruz Foundation—FIOCRUZ: 343/06). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

ES, AM, and RG: Conceptualization, Methodology, and Formal analysis. RG and DC: Resources. ES: Writing-original draft preparation. ES, AM, DC, MN, RG, EM, and SB: Writing-review and editing. All authors have read and agreed to the published version of the manuscript.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Adolescents' Understanding of What Causes Emotional Distress: A Qualitative Exploration in a Non-clinical Sample Using Ideal-Type Analysis

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Background: There is increased interest in early intervention and prevention of mental health difficulties during adolescence; thus, we are seeing increased efforts to optimize well-being during this epoch. Positive emotional experiences are a central component of overall well-being. However, research exploring what adolescents perceive to be the cause(s) of their emotional difficulties is lacking. Improving understanding of this issue within non-clinical adolescent groups may provide useful insight into how to develop strategies to support young people as they navigate emotional difficulties.

Objectives: The aim of this research was to explore if meaningful categories of perceived cause(s) for emotional distress exist for non-clinical adolescent groups.

Methods: The data for this study were drawn from interviews across 6 sites in England conducted as part of the 5-year national evaluation of the HeadStart Learning Programme. The sample comprised of 32 young people aged 11–12 years from the first annual wave of qualitative data collection in 2017. Ideal type analysis—a qualitative form of person-centered analysis—was used to construct a typology of adolescents perceived cause(s) for emotional distress.

Findings: We identified five distinct categories of perceived cause: (1) *perceived lack of control*; (2) *unfair treatment*; (3) *others, their actions and judgements as the catalyst*; (4) *concerns for self and others; and*, (5) *self as cause*.

Conclusions: Our findings illustrate that distinct categories for perceived cause of emotional distress exist among adolescents considered to be "at risk" of developing mental health difficulties, which provides a foundation for future necessary work seeking to investigate the possible link between perceived cause for emotional distress and help-seeking behavior among sub-clinical groups.

Keywords: emotional distress, adolescence, perceived cause, causal attribution, help-seeking, non-clinical, at risk adolescents

INTRODUCTION

Half of all lifetime mental health conditions begin before the age of 14 (1) and three quarters by the age of 18 (2). Accordingly, there is significant interest in adolescent well-being and the fortification of adaptive functioning to prevent the onset of mental health difficulties (3, 4). Poor mental health during adolescence is associated with a host of negative outcomes, including greater suicide risk (5) and increased risk of mental health concerns later in life (6). Unfavorable outcomes, as well as the significant economic "disease burden" of mental health difficulties (1, 7), illustrate the importance of early identification and prevention (8).

Yet, recent reports indicate that the prevalence of mental health problems among adolescents appear to be significantly higher than previously thought (9); indeed, probable mental health disorders during adolescence are rising [e.g., (10, 11)]. Health and Social Care Information Centre (11), for instance, found a 12.6% increase in probable mental health disorders from 2017 to 2020 in young people aged 11–16 years. There remains debate over whether this increase is due to improved recognition and referrals, or actual deterioration (5). For instance, shifts to broader definitions of mental health disorders and changing thresholds for clinical diagnosis could be contributing to the rise in prevalence (12) Nonetheless, numerous other factors may contribute to an overall increase, including the widespread use of social media (e.g., cyber bullying and engendering a greater need for validation); greater academic pressure due to increased governmental focus on high-stakes testing; and, lower family income as a result of recession (13). In addition, the COVID-19 pandemic and its consequences (e.g., lockdowns) may pose further risks to adolescent well-being (11). These factors may exacerbate what is already considered to be a turbulent developmental period.

Adolescence is typically understood as a challenging epoch owing to significant bio-social changes unique to this period (14), which may exacerbate stress levels and impact overall well-being (15). Notably, increased stress and subsequent stress appraisal can engender emotional distress—sometimes referred to as emotional problems, emotional symptoms, or emotional difficulties—should individuals feel ill-equipped to manage their difficulties (16, 17). Emotional distress refers to a heterogeneous collection of negative affect responses such as anger, depression, anxiety and sadness (16). Most young people will experience difficult emotions to some degree during adolescence (14). Emotions have important functions (18), therefore, difficult emotions do not need to be eradicated, but may require management to prevent the onset of mental health difficulties. Indeed, it is recognized that emotional distress may manifest into more serious disorders if not managed correctly, it can also stifle optimal well-being [e.g., (19)], which is an important outcome in its own right.

It should be noted that, the absence of psychopathology does not necessarily indicate wellness (20); therefore, adolescents who do not experience clinical levels of mental ill health may still experience suboptimal levels of well-being (21), which can be burdensome in terms of quality of life. According to Seligman (22), positive emotional experiences are a central component to overall well-being, thus emphasizing the importance of supporting young people who are experiencing emotional distress, not just for prevention, but also to bolster well-being. Nevertheless, unlike behavioral difficulties, emotional difficulties are less easily identifiable (23), placing a greater responsibility on young people to seek support when struggling. Taken together, these points highlight the value of improving non-clinical adolescents' adaptive help-seeking for emotional distress. However, whilst it is likely that a quarter of adolescents will encounter emotional and psychological difficulties, a mere third of those who do will seek help (23).

Encouraging young people to seek help when facing emotional difficulties is an important aspect of prevention (8), as adaptive help-seeking is a key facilitator to accessing appropriate support (24). The World Health Organization (25), defines adolescent help-seeking as the following:

> *Any action or activity carried out by an adolescent who perceives herself/himself as needing personal, psychological, affective assistance or health and social services, with the purpose of meeting this need in a positive way.*

Thus, help-seeking is much broader and more complex than accessing therapeutic intervention through formal mental health networks. However, adolescents, more so than any other age group, are typically poor help-seekers when it comes to their mental health and emotional well-being (8, 26), and low help-seeking among adolescents remains a significant barrier to timely and effective intervention (8, 27). In a recent systematic review, Radez et al. (8) identified 4 key barriers to seeking professional help for children and adolescents, which included the following: (1) Individual factors, including limited mental health knowledge and perceptions of help-seeking; (2) Social factors, such as stigma and embarrassment; (3) Perceptions of therapeutic relationships, including considerations around trust and confidentiality; (4) Systemic and structural factors, including costs, logistics, and availability of help. The review by Radez et al. (8) focuses on professional help for (possible) clinical disorders as non-clinical samples are comparatively underexplored in help-seeking research. However, the findings do illustrate that help-seeking is a multifaceted process influenced by numerous internal and external factors. Nevertheless, despite a growing body of research investigating barriers and facilitators, poor help-seeking remains problematic within this age group. It is therefore clear that further exploration of the factors that may influence help-seeking behavior is pertinent.

According to the self-regulation model—commonly used to predict physical as well as mental illness behavior—causal beliefs are central to illness representation (27, 28). Indeed, it is well-recognized that perceived cause influences treatment and engagement preferences for physical illnesses (29, 30). Accordingly, there is a growing body of literature seeking to explore causal perceptions for mental health difficulties, and their subsequent influence on help-seeking [e.g., 29–32], in order to determine the ways in which perceived cause may be linked to help-seeking behavior. Empirical evidence has

demonstrated that adults' views regarding the cause of their mental health difficulties are linked to subsequent help-seeking behavior. For instance, early research by Goldstein and Rosselli (31) found that endorsement of biological cause of depression led to a preference for psychotherapy, whereas the endorsement of a psychological model led to a preference to self-help, later work by Nieuwsma and Pepper (32) reported similar findings. More recent research, by Houle et al. (33), however, found that social causes were more likely to lead to a preference for psychotherapy; whereas, Stolzenburg et al. (28) found that biomedical attributions for depression appeared to be the only causal factors related to increase perceived need and intention to seek help. These findings may infer that person-related cause is linked to feelings of personal responsibility to manage difficulties, whereas bio-medical explanations may be associated with less personal responsibility (28, 34), possibly making individuals more likely to seek help. Though somewhat unequivocal, these findings demonstrate that aetiological beliefs influence help-seeking behavior in adulthood. However, much of the current research tends to lean toward statistical methods and the use of surveys [e.g., (26, 31–33)].

An understanding of mental illness and its origin is based on personal experiences and insights relevant to the individual (30); thus, perceptions of cause are inextricably linked to individual experiences. Therefore, qualitative research investigating perceived cause and help-seeking may prove pragmatic, as it seeks to illustrate participants' life-worlds, thereby contributing to a more holistic understanding of social realities and patterns of meaning (35). Indeed, whilst limited, research using qualitative methods to determine links between etiology and support seeking have provided promising insights. For instance, Nunstedt et al., (30) interviewed clinically depressed adults, finding that participants' aetiological beliefs influenced whether they sought treatment. The authors found that, for some participants, a lack of understanding of what was happening and what was causing their depression lead to a lack of understanding that they could seek help. The knowledge that a lack of understanding of cause may influence help-seeking is an important finding—illustrating further that causal perceptions are salient to help-seeking outcomes. However, despite the fact that the majority of mental health disorders begin during adolescence (1, 2), much of the research in this area remains focused on adulthood.

Considering the findings with adult groups, it is likely that perceived cause for emotional difficulties may also play a key role in adolescents' decisions to seek-help (29). Understanding and attributing cause involves complex cognitive processes (30, 36); therefore, as adolescents are still developing cognitively (36, 37) there are likely differences in the ways adults and adolescents attribute cause. Accordingly, it is necessary to pay adolescents specific research attention to understand how cause and help-seeking may be linked during this epoch. In an attempt to address the gap in adolescent research, Midgley et al. (29) investigated causal perceptions of adolescents with a clinical diagnosis of depression, finding three distinct themes: (1) bewilderment about why they were depressed; (2) depression as a result of rejection, victimization, and stress; and (3) something inside is to blame. Therefore, it is likely that adolescents do engage in causal thinking regarding their difficulties, but more work is needed to determine if causal attributions influence help-seeking. Furthermore, the focus of the work by Midgley et al. (29) was perceived cause of depression, overlooking non-clinical groups of adolescents who still experience emotional distress. Indeed, much of the work in this field focuses specifically on depression [e.g., (29–33, 38)].

Understanding the etiology of depression is an important research endeavor (39), however, it negates insight into how perceptions of cause might influence help-seeking for emotional difficulties in non-clinical groups who still experience sub-optimal levels of well-being, which may have important implications for the prevention of affective disorders and improving well-being more generally. Thus, understanding the interplay between cause and help-seeking in non-clinical groups is a valuable, yet under explored, research endeavor. In order to understand the extent to which perceived cause might influence help-seeking tendencies during adolescence, however, it is first necessary to explore whether or not meaningful categories for perceived cause exist for non-clinical groups, as this information is currently lacking.

As far as the authors are aware, no study has hitherto explored perceived cause for emotional distress with a group of participants considered to be "at risk" of developing mental health difficulties. Such investigation is pertinent as research with sub-clinical groups may further offer insight into how and when to effectively intervene to prevent difficulties from manifesting, as well as improve overall well-being; further, it may also help to improve the development of appropriate mental health interventions. The present study aims to address current gaps using ideal type analysis. Although perceptions of cause for depression during adolescence have previously been successfully explored using thematic analysis, ideal type analysis offers comparative analysis within and between types (40). Thus, as perceived cause is multifaceted and complex (30), ideal type analysis allows for the development of distinct categories of causal perception whilst also allowing for recognition and discussion of the complexities within and between types of cause. This paper is the first of a two-part series, starting with perceptions of cause for emotional distress. The second paper will build on the findings presented here, to explore if categories of perceived cause for emotional distress influence help-seeking among sub-clinical adolescent groups.

METHOD

Setting for the Study

The data for this study were drawn from interviews conducted as part of the national evaluation of the HeadStart Learning Programme. The HeadStart Learning Programme is a five-year programme which aims to improve the mental health and well-being of 10–16 year olds and prevent the manifestation of serious mental health issues. This is achieved through the implementation of a wide range of preventive interventions at six sites across England. It should be noted that this research was conducted in a Western setting, as research shows that

explanatory models of mental health and well-being may differ in cross-cultural contexts (41). The HeadStart Learning Programme evaluation team are interested in assessing the effectiveness of these interventions, as well as using project data to investigate broader issues related to adolescents' mental health and well-being. The evaluation consists of survey and interview data collection, gathered annually over a 5-year period.

Participants

The sample was drawn from the first annual wave of qualitative data collection in the HeadStart Learning Programme, the interviews were conducted in 2017 and comprised interviews with 82 young people. Prior to taking part in the research, school staff were asked by the evaluation team to invite young people to take part in the qualitative evaluation if they had either already received support from the HeadStart Learning Programme or if they may do so in future. Such support could consist of targeted, universal+, or universal interventions. Accordingly, young people were considered "at risk" if they were experiencing emergent emotional difficulties (e.g., anger, worries and fears, lack of confidence, self-harm) in the context of challenging home, peer group and/or school lives that were sufficient to warrant (or considered likely to warrant in the future) intervention as part of the HeadStart Learning Programme.

Of the 82 interviews, 11 participants were excluded from the current study because of their age (9–10), given the intended focus on adolescence. The transcripts of the remaining 71 interviews with 11–12-year olds were reviewed to determine if the young person discussed personal experience of emotional distress (sadness, anger, worries, anxiety etc.) and perceived cause for said distress; those who discussed both were included in the study ($N = 32$). There were instances where young people discussed what might be perceived by others as distressing scenarios, however, they did not report feelings of distress. Likewise, some young people discussed feelings of distress but did not reflect on cause. As the current study focuses on perceived cause for emotional distress from the perspective of young people, those who did not discuss emotional distress *and* cause could not be included. The excluded participants were checked and verified by the second author.

The final sample consisted of 32 young people, 17 males (53.1%) and 15 females (46.9%). Their ages ranged from 11.08 to 12.09 years old [mean (M) = 12, standard deviation (SD) = 0.31]. See **Table 1** for further details.

The qualitative strand of the national evaluation of the HeadStart Learning Programme received ethical approval from University College London (ID Number: 7963/002). Young people were given the opportunity to participate in the interviews, which they were free to accept or decline. Researchers conducting the interviews had up-to-date Disclosure and Barring Service checks and received safeguarding training from their host institution. Before young people who decided to take part were interviewed, they and their parents were asked to read a participant information sheet detailing the study. Thereafter, informed consent was sought by parents/carer(s), and assent to take part was sought from the participants before the interviews began. Interviewees were made aware that the information they provided would remain confidential, unless they disclosed something that indicated harm to themselves or others. During the write-up phase, all identifying information was anonymised; interviewees were aware this would happen.

TABLE 1 | A summary of the demographic data for the young people included in the study.

Demographic variable	
Male	17 (53.1%)
Female	15 (46.9%)
Age range	11.08–12.09 [(M) = 12, (SD) = 0.31]
White British	22 (68.75%)
Mixed ethnic background	4 (12.5%)
Asian or Asian British	2 (6.25%)
Any other White background	3 (9.35%)
Black or Black British: African	1 (3.1%)

Data Collection

Data were generated through semi-structured interviews, ranging from ∼15 to 60 min in length ($M = 38.02$, $SD = 9.85$), which were guided by an interview schedule developed as part of the evaluation of the HeadStart Learning Programme. The schedule was developed through internal review by the research team and "young research advisors" at Common Room—a consultancy and advocacy organization that supports the views of young people in research and policy.

The interview questions asked about young people's experiences of coping with problems and difficulties in their daily lives, including questions about what coping strategies they employed and their opinions on different sources of formal [e.g., from the HeadStart Learning Programme or other professionals] and informal (e.g., from family and friends) support that they had received. The young people were asked about this in various contexts, such as school-life, home-life, family, friendships, and feelings and emotions. The semi-structured nature of the interview schedule meant that the interviewer used these broad questions as a tool to guide the conversation with participants, using follow-up probes to elicit more detail as necessary. The interviews took place between the young people and members of the research team on a one-to-one basis in a private room at the young people's schools.

The focus of the interviews was to support the evaluation of the HeadStart Learning Programme, and, therefore, the focus was not directly related to adolescents' perceived cause(s) for emotional distress. However, when the adolescents were asked about their experiences of coping in difficult times, they also often talked about the perceived causes, either spontaneously or as a result of a prompt by the interviewer seeking to elicit further detail for clarification. Exploring young people's causal

perceptions of emotional distress and help-seeking behavior also has implications relevant to the evaluation of the HeadStart Learning Programme and supporting young people's emotional well-being in general. Overall, the lack of direct focus on perceived cause for emotional distress has several benefits for the present study. The questions focus on several aspects relating to the maintenance of well-being and factors that contribute to sub-optimal functioning, thus, providing the opportunity to look at perceived cause(s) in the wider context of the participants' lives. Furthermore, understanding cause requires complex cognitive processes (30, 36) and, as they are still developing cognitively (37), young adolescents may find it difficult to consider what causes their emotional distress (29, 42). It may be more beneficial, therefore, for young people to engage in a wider conversation about their well-being where etiological beliefs can present themselves more instinctively without the pressure to directly reflect on cause.

Data Analysis

Whilst cause for emotional distress is complex and multifaceted, this research sought to discover if meaningful categories of causal perceptions existed within a non-clinical sample. Ideal type analysis is the most appropriate form of analysis to achieve this, as it provides a systematic methodology for developing a typology from qualitative data. The construction of ideal types also allows for comparative analysis between and within the cluster of cases (40). This provides an opportunity to present clear distinctions between overarching cause(s) whilst delineating the nuance between cases in the assigned categories.

The concept of ideal types was first presented by Weber (43) to describe what is essentially an amalgamation of notable attributes from similar cases brought together to reflect how a particular phenomenon is understood (44). An ideal type is not the notion of something being perceived as *perfect* (45), but rather an explanatory schema used to understand the "infinite causal web" of social phenomena (40). The word "ideal" therefore describes "something that only exists in the mind" [47, p. 217], and is useful when exploring how adolescents perceive the cause(s) of their personal emotional distress. Drawing primarily on Stapley et al.'s (46) seven steps for ideal type data analysis the following procedures were observed.

Step 1: Becoming Familiarized With the Data Set

The first author (AON) had access to the transcripts and audio files prior to the development of the study and was already acquainted with the data. To ensure familiarity, AON re-read the transcripts and re-listened to the audio files, noting initial ideas and observations. At this stage, AON also took care to reflect on potential biases that could influence the interpretation of the data, such as knowledge of interviews from future timepoints. To ensure possible biases were kept in check, multiple co-researchers were involved throughout the analysis process to ensure findings were grounded in the data (46).

Step 2: Writing the Case Reconstructions

A summary (case reconstruction) of each of the 32 interviews was created, focusing on instances where emotional distress and perceived cause for emotional distress were discussed. The summaries were shared with a co-author, who was also highly familiar with the content of the interview transcripts, for feedback—changes were made to the case reconstructions as appropriate, these included adding more detail where necessary.

Step 3: Constructing the Ideal Types

Each case was systematically compared and contrasted with the other case reconstructions to identify patterns throughout the data. This was completed initially by AON and then again with a team comprising of the first author and two additional co-researchers. After the initial ideas were discussed, AON grouped similar cases into types to construct the ideal types, these were then shared with the team for feedback, and edits were made as appropriate.

Step 4: Identifying the Optimal Case

A case from each cluster was chosen that best illustrated the ideal type; this case would then act as an orientation point for comparison of other cases within that type.

Step 5: Forming the Ideal Type Descriptions

A detailed description of each ideal type was constructed, with the optimal case for each type in mind. As it is not necessary for every feature of every individual case to be represented in the ideal type description, the cases were represented by the description to varying degrees (47).

Step 6: Credibility Checks

In line with other research (44, 45, 48, 49), credibility checks were carried out to make certain that the ideal types and descriptions clearly reflected the data, and that each case was categorized under the most suitable type. To ensure this process was rigorous, it involved the input of three co-authors, including the first author and an independent co-judge. Initially, AON grouped the cases under the most appropriate ideal type by reading each case summary and assigning it to the type that best reflected the content, forming clusters. To verify that every case was placed accurately, ES also independently placed each case under the most befitting type. The clusters formed by the respective authors were then compared, and, in instances where cases were not placed under the same type, they were discussed until the appropriate placement was agreed between AON and ES. Initial consistency between the placements was $<100\%$, therefore, discussions and feedback from the sorting processes fed into the redrafting of the ideal type descriptions to ensure absolute clarity. Finally, an independent co-judge was given the clusters, on separate occasions, without being told which type they belonged to. The co-judge was asked to assign each cluster to a type using the ideal type descriptions, this was done with 100% accuracy.

Step 7: Making Comparisons

Once homogeneity of the types was successfully delineated, the heterogeneity within the clusters was examined in order to capture the extent of the variability and nuance within the types.

RESULTS

Demographic Data

Table 2 outlines the demographic data for each of the five ideal types. As indicated, "Others" is the most ethnically diverse category. "Perceived lack of control" hosts the youngest participant, whereas the oldest participants can be found in "Unfair treatment" and "Others."

Ideal Types

It is important to note that the young people interviewed could be placed into a number of these categories, as causal perceptions for emotional distress are complex and varied. However, participants have been placed into the category which best illustrates the over-arching focus of their causal perceptions. The five types are presented below alongside ideal type descriptions, the optimal case from each group, and a summary of other cases within the cluster.

Ideal Type 1: Perceived Lack of Control

Four cases were represented, to varying degrees, by perceived lack of control.

Ideal Type Description

Young people in this group appear to be particularly affected by things they perceive to be out of their control. Being controlled by others, not being able to control who stays in their life, and feeling like they do not have control over how they feel/act are some of the instances that may cause emotional distress within this group. The young people in this group perceive their lack of control as something that affects their lives, they get distressed when things go wrong and may blame external causes for their problems—e.g., "it's the game's fault that I died," "mum's fault my dad isn't around," "his fault that I punched him" etc.

Optimal Case

The optimal case for this ideal type was Tom. Tom's emotional distress appears to manifest, in part, as a result of his struggle to define his own identity in the wake of his mother's "puppeteering." For instance, Tom feels that he is "*a completely different person*" at his mum's; he describes it as a prison because he feels like he cannot be himself. Tom perceives his mother to be controlling and feels as though she tries to make him do things against his will, such as making him clean his bedroom. Tom wants to live with his father because he believes that it will give him the freedom that he craves and does not have while living with his mother. However, Tom also fears losing his father:

> *Like, like, my mum and my dad just broke up as I was born… and… my dad told me that he, he could've been like most dads in the world… and he coulda just left and not wanted to know me, but he looked back… and he says I never want to regret that cis-, decision […] but your mum's pulling me away from you… and I don't really want to be away from you, but if it happens you're just gonna have to learn to deal with it… and it gets me upset.*

Tom also explains that his dad hit him once which made him cry. However, it was not being hit that made him upset but rather the shock and resignation that the dynamic of their relationship had changed: "*I was, like, oh, okay, don't, I can't mess with, around with daddy anymore.*" Ultimately, Tom appears to be affected by the realization that he has little say in how his father features in his life; he cannot choose to live with him, he cannot stop him from leaving, and he just has to accept when dynamics in their relationship change. However, not all of Tom's difficulties around perceived lack of control are linked to his family dynamics.

Tom states that he is physically and mentally unwell and believes he just has to "*get on with it*," implying that he does not have control over his physical and mental well-being. He also expresses that he does not feel that he has explicit control over what emotion he will feel and that his brain chooses what he feels, thus, emotional distress is caused by perceived lack of control:

> *obviously, no one wants to be sad, no one wants to be angry, so in that situation [my brain is] not just gonna pick me being angry. It's just gonna pick me being s-, it's gonna pick me being sad, and I'll just end up being that one.*

There are particular instances, nonetheless, when Tom describes explicit control over how he presents himself, such as masking sadness when around peers. However, these reactions appear to be his way of protecting himself from ridicule and seem to be prompted by previous bullying experiences, which again he sees as outside of his control. This is evidenced by his confidence that certain peers will react negatively to emotional displays, "*but if I cry I'm just gonna leave them and they'll be, like, oh, he's a wimp*," indicating that Tom knows he lacks control over the outcome of these instances.

Summary of the Other Cases Within this Type

The other young people in this cluster also present perceived lack of control as the overarching cause for their emotional distress. Some of the cases are similar to Tom; Jane, for instance, also struggles with a controlling parent and finds the lack of control difficult to manage. When speaking about her father, Jane states: "*he done like things that I didn't like, like controlling, stuff like that so. That actually made my confidence a bit lower, 'cause like, there's someone control you, it just don't feel right.*" Unlike Tom, Steve's difficulties with perceived lack of control are centered around school rather than home, such as not having the teacher he wants. Steve also finds gaming to be a trigger for emotional distress; when asked about the "*rage*" he associates with gaming, he explains: "*I get angry. Firstly, I start swearing at my phone when I'm playing this game. Then I start hitting the sofa.*" In Charlie's case, losing video games also makes him angry and he too blames the game. For Charlie, things going wrong also makes him stressed—he says that people call him a perfectionist, indicating a need for control. However, like Tom, not being able to control who stays in his life is also distressing for Charlie.

TABLE 2 | A summary of the demographic data for the young people included in the study, organized by ideal type.

	Ideal type (total *N* of cases)				
	Perceived lack of control (*N* = 4)	**Unfair treatment (*N* = 6)**	**Others (*N* = 12)**	**Concern for self and others (*N* = 4)**	**Self as cause (*N* = 6)**
Demographic variable					
Male	3 (75%)	3 (50%)	5 (42%)	3 (75%)	3 (50%)
Female	1 (25%)	3 (50%)	7 (58%)	1 (25%)	3 (50%)
Youngest participant years & months	11.8	11.10	12	12.1	11.11
Oldest participant years & months	12.4	12.9	12.9	12.7	12.5
White British	2 (50%)	5 (83%)	7 (58%)	3 (75%)	5 (83%)
Mixed ethnic background	1 (25%)		2 (17%)	1 (25%)	
Asian or Asian British	1 (25%)				1 (17%)
Any other White background		1(17%)	2 (17%)		
Black or Black British: African			1 (8%)		

Ideal type 2: Unfair Treatment

Six cases were represented, to varying degrees, by unfair treatment.

Ideal Type Description

Young people in this group feel as though they are treated differently from their counterparts and perceive this treatment to be unfair and, therefore, distressing. They may also feel that others do not understand them which causes, in their opinion, people to treat them differently and less favorably to others. For instance, the young people in this group tend to feel that teachers shout at them unfairly and do not listen to them.

Optimal Case

The optimal case for this ideal type was Anna. Anna feels that she is often on the wrong side of favoritism and finds this unfair treatment distressing. For instance, she loves dancing, but feels that her dance teacher gives other students more, "*[s]o he focuses on him more than me. So then I get upset*." Anna explains that favoritism makes her cry, indicating that it makes her feel "*[a]nger and tired, like, anger and tired*." In Anna's view, teachers tend to treat her less favorably and often do not believe her when she confides in them. She feels as though she is unjustly singled out by certain teachers, and this injustice makes her angry: "*I don't care who I work with, it's just that, like, people, people like single me out. That's what I hate.*" This perceived unfairness, above all else, appears to trigger emotional distress. Anna also believes that she was disliked and bullied at her old school because of her nationality: "*[b]ecause I'm [*states nationality*]. Like, they didn't understand what being different was.*" She feels that she was treated differently as a result which led to events that caused emotional distress, thus, she perceives unfairness to be the starting point of her distress.

Summary of the Other Cases Within this Type

Like Anna, five other young people perceived unfair treatment to be the most prominent cause of emotional distress. Chloe feels like she is treated differently by peers who treat her like a "*little kid*" and teachers who are unfair to her. When Cohan discusses things that make him angry, he states: "*[g]etting yelled at, getting made fun of, people, teachers, when they have a go at me for not doing something right… getting treated with less respect than some of the other pupils.*" Similarly, Aaron perceives receiving less respect and unfair treatment from teachers as causes of emotional distress, and Danny indicates that he also gets "wound up" a lot by unfair treatment.

Unlike Anna, Tilly focuses more on inequalities at home as a cause for emotional distress rather than at school. Tilly feels it is unfair that she has to live with her dad because he lied to social services about her mum and he appears to neglect her. Additionally, Tilly feels that her dad gives her brother more attention and that he does not really take notice of her, her brother also used to hit her and she was affected by the fact that her dad did not believe her. Like Tilly, Cohan is also affected by family issues, he feels helpless regarding family problems and appears to feel that it is unfair that he cannot do anything to help: "*Nothing, like, (sniffs) just can't, like, stop my mum from feeling pain, I can't s-, help my dad, too much… cause I'm not legal age to work.*"

Ideal type 3: Others, Their Actions, and Judgements as the Catalyst

Twelve cases were represented, to varying degrees, by others, their actions and judgements being the catalyst for emotional distress.

Ideal Type Description

Young people in this group tend to attribute their experience of emotional distress to the actions or the perceived judgement of others. For young people who fall under ideal types 1 and 2, the actions of other people indirectly influence cause as they tend to focus on injustice or the lack of control rather than the action itself. In this group, however, the explicit action(s) or perceived thoughts of others appear to act as a catalyst for emotional distress. Distress within this group can also be caused by the thought of how someone *might* act toward or judge them.

Optimal Case

The optimal case for this ideal type was Billy. Billy finds the classroom frustrating and he perceives the actions of his peers to be a cause of emotional distress: "*Kicking on the desk, little whispers of voices [Int: how does it make you feel?] Really angry, like angry, angry. And they make me feel… scared, in a weird way*." It made Billy "*really, really sad*" that a friend stopped talking to him because he uses headphones to cope with the noise—further indication that actions and perceived judgements cause him distress. Billy explains that he can often become distressed in school but suggests that he is not always taken seriously by members of staff. For instance, he used to be allowed to leave class when he felt distressed but then this was revoked by teachers, which left him feeling "confused" and "sad." Thus, Billy perceives the teacher's actions to be a cause of emotional distress to the extent that he experienced a panic attack as a result.

Billy believes that his panic attacks started because of being bullied and threatened by his peers. At one point, his panic attacks lessened, however, a further incident of threatening behavior from peers brought them on again. It is not just the actions of his peers, however that Billy perceives as a cause for emotional distress, he is also affected by their (perceived) judgements. For example, when people call him short and cute it really gets him down as he does not appear to view these as desirable qualities. He also feels that if he were popular his life would be better and that he would not experience emotional distress to the same degree: "*I could have had this big chance at being the popular one, and I wouldn't have any of these problems if I did. I have my regrets*." This further indicates that Billy perceives the judgements and actions of others to be a cause for emotional distress.

Summary of the Other Cases Within this Type

Eleven other young people were assigned to this type because they also perceive the actions and judgements of others to be the overarching cause of their emotional distress. Like Billy, Rory also finds that people making noise in school makes him feel stressed. For Rory, however, he is irritated by relentless swearing. Susie, on the other hand, appears to be very affected by what other people think of her and how they might react if she gets something wrong: "*that's what I worry about like, getting something wrong.*"

For some young people in this group, it is the actions of bullies and peers who are rude/pick on them that appears be the focus of causal perceptions. For instance, when Scott was asked what makes him upset, he stated: "*Like people cussing me. People, like, taking the mick and stuff like that*." Similarly, Flynn and Lilly have been affected by name calling and disrespect from other students. For Cathy, however, it is people starting and spreading rumors that makes her feel "*upset*" and for Samantha, it is others leaving her out that causes emotional distress: "*if they just, like, leave me out or something I'd get sad.*"

Young people in this group also indicated that they found the actions of fathers/stepfathers to be a cause for their emotional distress. For instance, Rory also expresses how he found his dad's behavior to be distressing as he is unreliable: "*All I can say is, is that he's also a let-down, that's all I can say.*" Likewise, Corry also has issues with his dad which appear to cause distress. As for Kathy, arguments at home cause her difficulties: "*I don't really cope with it.*" She says that she can get very angry during the arguments and that her stepdad makes the anger worse. Kathy further indicates that her biological father used to abuse her mum and sisters, he keeps turning up in their life uninvited. Maggie also repeatedly reports the actions of her stepdad as a cause of emotional distress. She indicates that her stepfather is aggressive and potentially has an alcohol problem: "*sometimes when he gets really angry and he's drunk beer during the day, he h- hits me. (sniffs).*" She says she sometimes gets "*really upset*" about it.

Ideal type 4: Concerns for Self and Others

Four cases were represented, to varying degrees, by concern for self and others.

Ideal Type Description

The young people in this group indicate that concern for others who are experiencing, or who may experience, difficulties causes them distress—this may be their friends, family, or stories they hear on the news. They are also concerned with their own welfare and the part they might play in affecting other people, which makes them eager not to cause disappointment or burden others with their problems.

Optimal Case

The optimal case for this ideal type was Paula. For Paula, concern for the welfare of others is a significant cause of emotional distress. For instance, she claims, "*I don't like to see my friends upset and that, like, when they get upset, I get upset as well.*" Concern as cause is also true in relation to the well-being of her family. For instance, when Paula discusses how she felt hearing that her sister had been attacked she states:

> *I found that hard, but, but at school people don't take things seriously and, like, they go ha-ha I've just been [unclear 00:22:19]. And found that hard as well and it's, like, it's not something to joke about. It's like it has happened to people... but... it is hard like to cope with things.*

It is clear that Paula perceives other people experiencing difficulties and people being mean to others to be a direct cause of emotional distress for her, as she further states:

> *[I]t's like if people, like, are being mean to people I find it, like, really upsetting. Like if I watch something I find that upsetting as well, like if it's, like, someone getting bullied I find it upsetting. And then, like, I watched this programme […] I sat on the settee and I just cried. […] It's like the other week there was this little girl and she couldn't walk or nothing and I just found it so upsetting, she had to live on the couch, [...] she couldn't move and it was upsetting.*

Not all of Paula's emotional distress in relation to concern is centered on other people. She has also felt upset because her dog had to go to hospital without her. Paula was also eager not to burden her parents with her problems when they were supporting her sister. This indicates that she did not want to take attention from her sister and was worried how her actions may have impacted her sister's welfare.

Summary of the Other Cases Within this Type

Three other participants were allocated this type as they indicated that concern for themselves and others was an overarching cause for their emotional distress. Like Paula, Matt's emotional distress is centered on concerns for the welfare of his family. However, Matt's emotional distress appears to be the result of concerns regarding how he might disappoint his family: "*well, I'm, I'm really worried about French because, honestly, [. . .] Er... how my parents will feel, especially my granddad [. . .] I'm worried that I'll disappoint them if I get bad scores on it*." Ciaran's perception of cause is also centered around concerns for himself and others. When asked what makes him worried, he states: "*if it's that I hear something that, if I hear something about maybe my parents or something that might happen to someone or what's going on now in the news*." Paul, on the other hand, states that getting in to trouble makes him sad because no one will play with him and he fears telling his parents about getting in trouble because of their potential reaction. Thus, it is concern for himself that prompts the emotional distress. However, Paul has also hurt people in the past and concern for how he has affected them has caused emotional distress, as he states: "*uh. . . hurting other people's feelings makes me upset*."

Ideal type 5: Self as Cause

Six cases were represented, to varying degrees, by self as cause.

Ideal Type Description

Young people in this group feel that they play causal role in the manifestation of their emotional distress. They will hold themselves accountable for the way in which they react to the behavior of others as cause for their distress rather than the questionable behavior. Some may feel that their disposition is the reason they experience uncomfortable emotions, for instance, they may accuse themselves as having a short fuse or being implosive. The problems that they face are, more often than not, not seen as a cause for emotional distress but the way in which they deal with the issue thereafter is. There is also an element of emotional management as a factor in perceived cause for emotional distress; the experience of one emotion appears to roll into a multitude of emotions like a domino effect. Thus, the young person feels that the way in which they managed the initial emotion plays a part in the subsequent distress.

Optimal Case

The optimal case for self as cause was Sarah. There are a number of ways in which Sarah holds herself accountable for her experience of emotional distress. For instance, Sarah acknowledges that she may overreact in situations she finds frustrating which will inevitably lead to distress: "*When sometimes like annoys me or, like irri-, irritates m, like I think I have a really short fuse, so like I've literally got about five [. . .] seconds and I will explode*." She explains she has been learning how to have more patience so "*it'll take more stuff to like. . . explode*," indicating that she views emotional distress to be linked to her capacity to mediate her response. When discussing her "*short fuse*," she states retrospectively, "*if somebody said something, like, nasty or something like that, straight away I'd snap back at 'em*," she explains that she would get really angry if she did not say anything back. Thus, the suggestion that her anger comes because of her inaction rather than what was said implies a view of self as cause for emotional distress.

Sarah also perceives personal characteristics, such as being disorganized as a cause for emotional distress. Further, she explains that she used to "*getting real, like. . . panicked in school*" because she felt like she did not fit in, again suggesting that she views personal attributes to be responsible for emotional distress. Sarah used to find it difficult to discuss her problems with others, "*I've always been really independent but like, I sort of kept it to myself and that*." She now speaks to her mum about her concerns and she sees this as a better alternative to keeping concerns inside and worrying all day, indicating that keeping things inside was the cause of worry rather than the actual concerns.

Summary of the Other Cases Within this Type

Five other cases were represented by self as cause. Ryan for instance, appears to feel that he needs to control how he might feel in reaction to his parent's behavior: *"it's like the kind of thing you can get angry about [. . .] or you feel you don't want to get angry about [. . .] For example my dad drinks a lot of alcohol and I think it's bad for him*." Similarly, Riley feels that the way in which they manage their problems is causal: *"I don't like when things are stuck inside me, like, it makes me want to feel like I need to cry [. . .] it's just like, building up inside me and just can't deal with it anymore, so I just tell someone*." Holding in problems is seen as the cause of emotional distress rather than the actual problem, thus, the self is seen as causal, Amy also feels that holding on to problems causes emotional distress. For Luke, however, he feels emotions create emotional distress, like a domino effect:

> *Like nervous, because when I'm nervous I get stressed and start asking myself questions that sometimes I can't answer. Um. . . when I'm angry and stressed. . . um. . . so. . . when I'm nervous, which makes me stress, is sometimes I bite my nails, um. . . and then that stresses me out.*

Luke claims he asks himself these questions out of stress that make him feel more stressed, further indicating that he perceives how he manages emotions to be causal. Tommy, on the other hand, feels that he is implosive: "*I feel angry sometimes but like I don't show it. I'm very implosive*." He further states that he tries to keep his feelings "*locked away*" but says sometimes they can "*leak*." This indicates that Tommy feels he plays a role in the cause of his emotional distress insofar as he failed to keep his emotions from "leaking".

DISCUSSION

The aim of this study was to develop a typology of adolescents' perceived cause(s) of emotional distress. We sought to investigate if meaningful categories of causal perception existed within a non-clinical sample, as has previously been found in clinical samples using thematic analytical approaches (29). Using ideal type analysis, we identified five distinct categories: (1) *perceived lack of control*; (2) *unfair treatment;* (3) *others, their actions and*

judgements as the catalyst; (4) *concerns for self and others; and,* (5) *self as cause*.

It is important to note that the ideal types arguably correspond to very general experiences of young adolescents. However, adolescents' emotional difficulties are often dismissed as "typical" and their individual needs tend to be overlooked (4, 50). Our participants indicated that they find certain experiences emotionally distressing, suggesting that some young people may require more help navigating these experiences than others. Further, whilst it is possible to hold several causal attributions, the young people in this study were placed into the category that best represented the overarching cause of their emotional distress; the types are broad and nuanced to reflect the complexity of the causal attributions.

The first type, *perceived lack of control*, indicates that some young people may attribute their experience of distress to a lack of perceived agency in their lives, as well as their behavior and emotions. Perceived control is an important factor for optimal psychological functioning (51, 52), therefore one's locus of control—the perceived degree to circumstances are caused by internal or external factors—has important implications for well-being. External locus of control has been linked with negative outcomes, including psychosis and depression (52–54). The participants in this category appear to be describing an external locus of control. Thus, our findings support conclusions that a lack of perceived control contributes sub-optimal well-being [e.g., (55, 56)]. The notion of a lack of control being potentially distressing to adolescents is not surprising, given that striving for independence is a quintessential feature of this epoch (57). However, it has been argued that a sense of primary control (control over the external environment) and secondary control (adjustment to and acceptance of situations) develop at different rates, with secondary control taking longer develop (58). Therefore, lack of control may be a more significant cause of emotional distress in early adolescence, and it is possible that the young people in this category have yet to develop secondary control, explaining why it has a distinct pattern.

Lack of control within this type, however, was not limited to external stimuli, but also a lack of perceived control over thoughts, emotions, and behavior. Having control over thoughts and impulses accounts for 2 of the 4 major domains of self-control (59). It has been argued that self-control facilitates coping (e.g., activities used to manage difficulties), as it allows individuals to modify the impact of undesirable emotions (60). Indeed, Finkenauer and colleagues (60) found that lower self-reported levels of self-control were strongly related to emotional and behavioral issues in early adolescence. Effective coping strategies are known to enhance resilience in the face of adversity, owing to the ways in which they help individuals manage their difficulties (61). Therefore, these particular overarching causal beliefs may exist due to the way in which lack of perceived agency impacts normative coping strategies.

The second type, *unfair treatment*, highlights that, for some young people, what they interpret as unfair treatment may become the overarching cause of their emotional distress. This supports both recent findings that perceived injustice in an educational context may have a significant impact on the lives of adolescents by potentially influencing dishonesty (62), and earlier studies showing that unfair treatment has implications for emotional states and behaviors (63, 64). Research has observed that there are variations in sensitivity to unjust treatment (62, 65), which may explain why this type is an overarching cause for some and not others. These findings, therefore, highlight that young people interpret events differently, but also demonstrate that young people may experience unfair treatment in comparison to their peers/sibling etc. The *unfair treatment* type also illustrates that those who perceived unfair treatment to be the overarching cause of their emotional distress often feel that they are being mistreated by "significant others" (teachers/parents/peers), sometimes believing this is because they are "different." Significant others are important support systems (21), thus young people who experience unfair treatment may not feel they have access to the same sources of support as their counterparts.

Ideal type 3, *Others, their actions and judgements as the catalyst,* represented the largest cluster in the study. This is perhaps unsurprising given that adolescents tend to be more sensitive to how others view them (57, 66). This category indicated, however, that it is not only the thoughts and actions of others that young people perceive as a cause of distress, but also the imagined thoughts and actions of others. Moreover, most of the individuals in this group were previous or current victims of bullying, indicating that those who have been victims of bullying may be more sensitive to the thoughts and actions of others. Indeed, globally, bullying victimization has been found to be prevalent amongst adolescents (67) and, there is little doubt among scholars that bullying is an adverse experience that will likely negatively impact well-being (68).

The fourth category, *concern for self and others*, indicates that some young people feel that concern is the overarching cause for their emotional distress. Research demonstrates that young people who have an ill family member experience distress as a result of a number of factors, one of which is concern about the progression of the illness which may affect the lives of those they care about [e.g., (69–71)]. The present research supports these findings, and adds that worries about what *might* happen to a loved one, even if they are not currently facing difficulties, can cause distress. The findings from this study indicate that some of this concern may be perpetuated by negative stories in the news or on social media. Indeed, findings from earlier research by Riddle and colleagues (72), indicates that young children may be frightened by negative news content, and are able to vividly recall disturbing news stories. The present research adds that adolescents may too be emotionally affected by negative news content.

The final cluster, *self as cause*, supports earlier findings from Midgley and colleagues (29), which indicated that young people may feel that something inside is to blame for causing their depression, resulting in negative attribution styles. The present research illustrates that self-blame transcends a clinical diagnosis and can also be observed as a perceived cause for emotional distress in "at risk" adolescent groups. These combined findings support conclusions drawn by Yeo (73) that amplify the need to change discourse around well-being to avoid focusing on

"deficiencies" and messages about "keeping positive," which infer it is the responsibility of young people to control how they feel. Young people may find attributing cause for emotional difficulties therapeutic (29). However, if they blame themselves for their difficulties it may have negative consequences for their self-perceptions, which are beginning to crystallize in adolescence (57). This amplifies the need to identify and resolve potentially negative perceptions regarding internal cause(s) of emotional difficulties before they are reinforced and form part of the young person's identity. Further, adolescents' emotional difficulties are often dismissed by influential groups of people, such as teachers and parents, as "typical teenage mood swings" and, thus their individual needs are often overlooked (4, 68). If significant others, salient to identity development, consistently reinforce a message of "typical teenage hormones" as an explanation for emotional distress, it is reasonable to theorize that adolescents may internalize cause, believing that their difficulties are innate.

IMPLICATIONS

Our study indicates that adolescents attribute numerous factors to the cause of emotional distress and that young people may be affected by these factors to varying degrees. Indeed, based on the types of perceived cause, there may be a number of practical solutions that preventive programmes could develop in order to reduce emotional distress. For instance, our study suggests that empowering young people to speak out when they feel they are being treated unfairly, as well as encouraging people in their lives to actively listen and effectively respond to these concerns, may have positive implications for well-being. Similarly, involving young people in decisions that impact their lives, and exploring ways to ensure their voices are amplified, may help reduce emotional distress. In order to support this, it is likely necessary to work with individuals in young people's lives to (a) ensure they treat young people fairly and explain the reasoning behind their actions (b) help them create meaningful ways to involve young people in decision making. Further, our findings suggest that providing resources and support to improve young people's digital literacy, with the aim of helping them navigate emotive media and diminish its impact, may work to reduce potential emotional distress.

In addition, our findings raise possible implications for help-seeking behavior. The results demonstrate that the ways in which people interact with young people, the implications of these interactions, and the degree to which young people are concerned for how they impact others may engender emotional distress to varying degrees. Therefore, to some extent, all of the types have inextricable links to the people adolescents interact with in different contexts (school, home, media etc.). These links introduce likely implications for help-seeking, particularly as significant others, including peers and teachers, are typically the key to helping struggling young people identify and access appropriate support for their difficulties [e.g., (74)], and are an important support system in their own right. Our study suggests that young people may feel ignored by or distrusting of significant others, thus removing important support systems (23). Consequently, investing in additional training to ensure those who are important in the lives of adolescents are aware of how their words and actions may be perceived, as well as how to manage their impact, may help foster a supportive environment that is conducive to help-seeking.

However, our study also indicates that some young people find the *possible* impact they have on others distressing, and may, therefore, not want to share their problems to avoid additional distress. Indeed, according to Yeo (73) some young people feel that their issues are too burdensome for others, which can prevent them from disclosing their experiences. Similarly, we found that some young people, particularly those who have been bullied, are affected by the *perceived* thoughts of others and, thus, may not seek help as a form of self-preservation. Consequently, developing ways for young people to access support anonymously may be beneficial for some groups. This could include having a dedicated area on a school website with helpful resources they can easily and privately access. It may also be worthwhile working with students to co-develop resources and alternative help-seeking routes that complement a diverse range of help-seeking needs.

Our findings provide a foundation for research seeking to investigate the causal beliefs of emotional distress in relation to help-seeking in non-clinical groups. It is clear, however, that longitudinal research on perceived cause for emotional distress is required to better understand its development and, subsequently, to allow for timely administration of targeted interventions. Likewise, work is needed to map out the ways in which perceived cause may influence help-seeking to better support the needs of students and to create practical and diverse help-seeking solutions. Future research should, therefore, endeavor to identify whether a link between perceived cause(s) for emotional distress and help-seeking exists in non-clinical groups.

LIMITATIONS

The results from the present study were generated through secondary data analysis, as the main focus of the interviews analyzed was to support the evaluation of the HeadStart Learning Programme. However, the interview questions did focus on several aspects relating to well-being and sources of support, thus, providing the opportunity to look at perceived cause(s) in the wider context of the participants' lives. Yet, the fact that perceived cause was not the sole focus of the interviews meant that the degree to which young people discussed causal perceptions in their interviews varied. Further, the sample in this study consisted only of young people who were identified by their teachers as currently receiving, or who may receive support from the HeadStart Learning Programme. Thus, the degree to which the results from this study are reflective of the causal perceptions of young people who experience elevated levels of emotional distress but are unknown to their teachers, or to the HeadStart Learning Programme is currently unknowable.

Further, as outlined by Stapley et al. (49) there are limitations to using ideal type analysis as a form of data

analysis, including the reality that smaller details of participant interviews may be omitted in the process of analysis. This is because condensing large amounts of detailed interview data is necessary in the early stages of analysis to create brief case reconstructions that reflect the aim of the study. Although less detailed, the authors took care to ensure each transcript was summarized to accurately reflect the most salient features of the interviews, ensuring pertinent details were not lost.

CONCLUSION

This study illustrates that distinct categories for perceived cause for emotional distress can be observed in non-clinical adolescent groups, a finding which may have important implications for help-seeking and overall well-being more generally. It highlights the need for future research to explore the possible links between causal beliefs and willingness to seek help. Such insight may prove beneficial to the development of timely and effective interventions that seek to improve adolescent well-being and prevent the onset of affective disorders.

DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to the following licenses/restrictions: The interviews were generated as part of a national evaluation of an early intervention programme and are held by the Anna Freud Centre. Requests to access these datasets should be directed to emily.stapley@annafreud.org.

ETHICS STATEMENT

Ethical review and approval was required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in the study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

AO'N, ES, and NH contributed to conception and design of the study. AO'N selected the participants and summarized the interviews and wrote the first and subsequent drafts of the manuscript. AO'N and ES performed the analysis, SS assisted with creating the initial categories for analysis. SS and HM checked and verified the analysis. All authors contributed to manuscript revision, read, and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Indicators for Public Mental Health: A Scoping Review

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Background: To monitor population mental health, the identification of relevant indicators is pivotal. This scoping review provides a comprehensive overview of current indicators representing the various fields of public mental health core topics. It was conducted as a first step to build up a Mental Health Surveillance for Germany.

Methods: We conducted a systematic MEDLINE search via PubMed. This search was supplemented by an extensive examination of the websites of relevant national as well as international institutions in the context of public mental health and an additional internet search via Google. To structure the data, an expert-based focus group identified superordinate topics most relevant to public mental health to which the identified indicators could be assigned to. Finally, the indicator set was screened for duplicates and appropriate content to arrive at a final set.

Results: Within the various search strategies, we identified 13.811 records. Of these records, a total of 365 records were processed for indicator extraction. The extracted indicators were then assigned to 14 topics most relevant to public mental health as identified by the expert-based focus group. After the exclusion of duplicates and those indicators not meeting criteria of specificity and target group, the final set consisted of 192 indicators.

Conclusion: The presented indicator set provides guidance in the field of current concepts in public mental health monitoring. As a comprehensive compilation, it may serve as basis for future surveillance efforts, which can be adjusted and condensed depending on the particular monitoring focus. Our work provides insights into established indicators included in former surveillance work as well as recent, not yet included indicators reflecting current developments in the field. Since our compilation mainly concludes indicators related to mental health in adults, it should be complemented with indicators specific to children and adolescents. Furthermore, our review revealed that indicators on mental health promotion and prevention are underrepresented in current literature of public mental health and should hence be focused on within future research and surveillance.

Keywords: public mental health, surveillance, monitoring, indicator, scoping review

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INTRODUCTION

One prior target emphasized by the World Health Organization (WHO) within the 2013th Mental Health Action Plan was that by the year 2020, "80% of countries will be routinely collecting and reporting at least a core set of mental health indicators every 2 years through their national health and social information systems [...]" (1). Consecutively, all WHO member states were called to systematically gather, integrate, process, analyze, interpret, and regularly report data on the mental health of the population. These data should inform about the current state as well as trends of public mental health which may allow for evaluating measures taken in mental health prevention, promotion, and healthcare. According to that, results should serve as a reliable database for evidence-based policy advice to enable political stakeholders to plan, initiate, and assess necessary health political actions (1, 2). Most recently, COVID-19 pandemic alerted policy makers to the necessity of mental health surveillance, since public mental health appeared as vulnerable asset in need of protection and immediate crisis response (3).

Following WHO's suggestions, Germany's national public health institute, Robert Koch Institute (RKI), has begun to develop a concept for a Mental Health Surveillance (MHS) in Germany on behalf of the Federal Ministry of Health in 2019. The present study was conducted as a first step to build up a MHS for Germany. The effectivity and significance of such a surveillance approach depends on the careful selection of appropriate indicators, which sufficiently depict public mental health. To establish a solid basis for a future core indicator set, the project was started by gathering a broad range of reported indicators currently used in the field. To do so, one can draw on the work of several countries which pioneered in establishing indicator based mental health surveillance systems such as Canada (4, 5), Australia (6), or Switzerland (7). Apart from that, further suitable concepts resp. indicators for monitoring population mental health are under development as research on mental health progresses; thus, they might be found mainly in scientific papers. Nevertheless, there might be mental health related issues which hitherto are neither implemented in established surveillance systems nor addressed by current research. This calls for the inclusion of further sources such as routine or administrative data within the search strategy.

Therefore, designing a mental health surveillance system from the ground up, the purpose of the current scoping review was (1) to systematically identify important indicators in the field of public mental health on a population-based level using different search strategies, (2) to assign the hereby extracted indicators to important core topics regarding public mental health to structure this large body of data and thus (3) to identify currently most relevant topics in the field and possible gaps of indicators reflecting unattended domains in relation to public mental health.

Abbreviations: AOLG, Arbeitsgemeinschaft der Obersten Landesgesundheitsbehörden; APK, Aktion Psychisch Kranke e. V.; BPtK, Bundespsychotherapeutenkammer; DGPPN, Deutsche Gesellschaft für Psychiatrie und Psychotherapie, Psychosomatik und Nervenheilkunde; DRV, Deutsche Rentenversicherung; EU, European Union; GKV Spitzenverband, Spitzenverband Bund der Krankenkassen; KBV, Kassenärztliche Bundesvereinigung; MHS, Mental Health Surveillance; OECD, Organization for Economic Co-operation and Development; RKI, Robert Koch Institute; WHO, World Health Organization.

MATERIALS AND METHODS

According to our purposes, we chose the methodology of a scoping review to depict a broad picture of the current state of knowledge. Arkey and O'Malley (8) provided a methodological framework for conducting a scoping review, which was specified by Levac et al. (9). The structure of the present work followed those recommendations and was furthermore orientated on the more recent PRISMA extension for Scoping Reviews (PRISMA-ScR) (10). Thus, the method section is itemized by (1) identifying the research questions, (2) identifying relevant studies, (3) study selection, and (4) charting the data, collating, summarizing, and reporting the results.

Identifying the Research Question

Unlike a systematic review, a scoping review does not aim to evaluate the quality of the processed studies and/or reports. Instead, it informs on the extent of work already existing in the field and should help to recognize gaps within this research (8–10). Thus, it best meets our purpose of gaining a broad overview of available and utilized indicators in the field of public mental health in order to build a MHS for Germany from the ground up. Additionally, this approach serves to identify hitherto neglected areas in recent state-of-the-art research and monitoring work. Therefore, this scoping review deals with the following research question: **Which indicators on public mental health can be identified on the base of the current state of knowledge?**

Definition of an Indicator Within the Present Work

An ongoing surveillance system depends on indicators incorporating a clear title (1st level) and a clear definition resp. operationalization by explicit numerator and denominator concepts (2nd level) leading to an explicit database (3rd level), thus enabling the pursued comparisons over time (11). Within the here presented first step of indicator compilation, indicators were processed on title level (meaning theoretical concepts with empirical application on population level are referred to as indicators) to decide on their importance within the next step toward a final indicator set for a MHS.

Identifying Relevant Studies

To meet the above-mentioned demands on depicting indicators regarding the broad field of public mental health, a comprehensive search strategy including various sources was used.

Data Sources

First, we conducted a systematic MEDLINE literature search via PubMed using the MIP (Method, Issue, Participants) schema (12).

Since public mental health inidcators are not solely reported in scientific publications available on databases as

MEDLINE, we decided to enrich the systematic approach by additional strategies:

In order to include already established surveillance indicators we scanned the websites of international organizations [European Union (EU), WHO, and Organization for Economic Co-operation and Development (OECD)] and the public health institutes of the 35 member countries of the OECD. To identify the websites of these public health institutes, a member list of the "International Association of National Public Health Institutes" (which can be found here: www.ianphi.org) was utilized. Additional Google searches were conducted if the websites of a national public health institute were not registered in this list.

In order to include routine and administrative data as well as country-specific indicators relevant to mental health care in Germany we conducted a distinct search on the websites of selected national stakeholders of mental health care, such as professional associations, service providers and federal agencies (DRV/Deutsche Rentenversicherung, KBV/Kassenärztliche Bundesvereinigung, DGPPN/Deutsche Gesellschaft für Psychiatrie und Psychotherapie, Psychosomatik und Nervenheilkunde, BPtK/Bundespsychotherapeutenkammer, APK/Aktion Psychisch Kranke e.V., GKV Spitzenverband/Spitzenverband Bund der Krankenkassen, AOLG/Arbeitsgemeinschaft der Obersten Landesgesundheitsbehörden and Kleine Anfragen) and a key word search using Google for indicators of mental health care and mental health care research in Germany.

Last, we scanned the reference lists of articles, which were found in the procedure mentioned above to identify further important information sources. The complete search was conducted from July to October 2019 and is depicted in **Figure 1**.

DP and CK were in charge of the MEDLINE search while EM searched the websites of the public health institutes of different OECD countries and international organizations. JT conducted the particular search on mental health care indicators in Germany (administrative and routine data) and screened the reference lists.

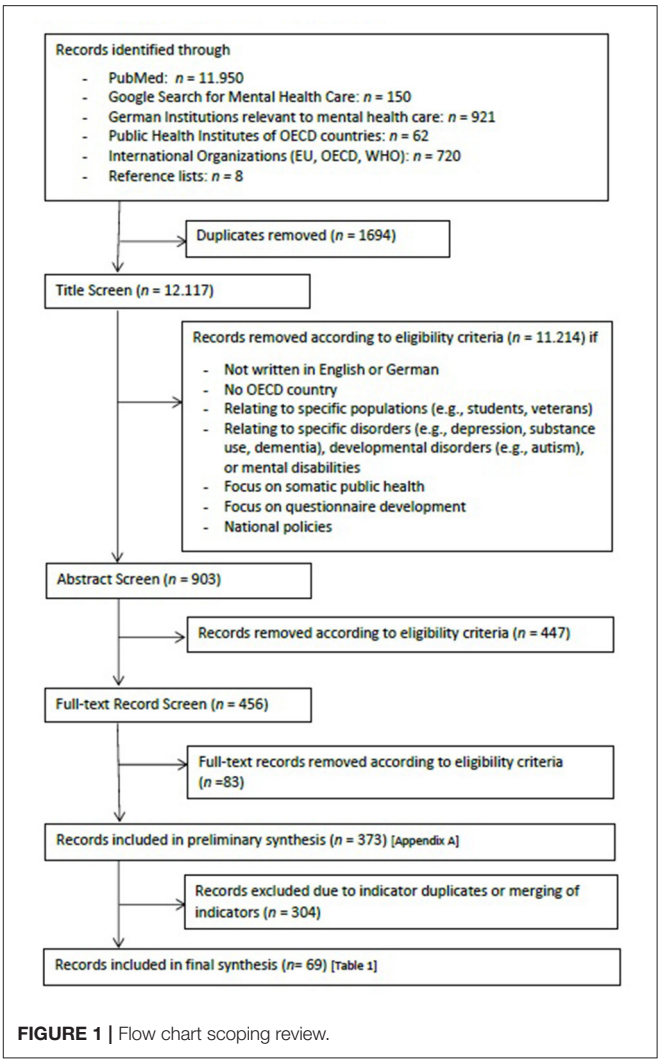


FIGURE 1 | Flow chart scoping review.

Key Words for Internet and Electronic Database Search

MEDLINE (via PubMed)

Broad research question regarding articles on surveillance/monitoring systems on mental health in the general population orientated on MIP schema:

(Surveillance [tiab] OR Surveillances [tiab] OR Monitoring [tiab] OR "Information system" [tiab] OR "Information systems" [tiab] OR "Population surveillance" [MeSH Terms] OR "Epidemiological Monitoring" [MeSH Terms]) AND ("mental health" [tiab] OR "mental-health" [tiab] OR "psychological health" [tiab] OR "mental disorder" [tiab] OR "mental disorders" [tiab] OR "mentally disordered" [tiab] OR "mental health problem" [tiab] OR "mental health problems" [tiab] OR "psychiatric disorder" [tiab] OR "psychiatric disorders" [tiab] OR "mental illness" [tiab] OR "mentally ill" [tiab] OR "mental sickness" [tiab] OR "mentally sick" [tiab] OR "mental disease" [tiab] OR "mental diseases" [tiab] OR "psychic health" [tiab] OR "psychiatric health" [tiab] OR "positive mental health" [tiab] OR "well-being" [tiab] OR "mental condition" [tiab] OR "psychological condition" [tiab] OR "mental constitution" [tiab] OR "mental health" [MeSH Terms] OR "mental disorders"[MeSH Terms]) AND ("general population" [tiab] OR "nationwide" [tiab] OR "nation-wide" [tiab] OR "representative survey" [tiab] OR "national sample" [tiab] OR "population-based" [tiab] OR "population based" [tiab] OR "Population wide" [tiab] OR "Population-wide" [tiab] OR "country wide" [tiab] OR "country-wide" [tiab] OR "representative sample" [tiab] OR national* [tiab] OR "population level" [tiab]).

Specific research question regarding articles on applied indicators within surveillance/monitoring systems on mental health in the general population orientated on MIP schema:

(Indicator [tiab] OR Indicators [tiab] OR criteria [tiab] OR criterion [tiab] OR criterions [tiab] OR measure [tiab] OR measures [tiab] OR "Health status indicators" [MeSH Terms]) AND (Surveillance [tiab] OR Surveillances [tiab] OR Monitoring [tiab] OR "Information system" [tiab] OR "Information systems" [tiab] OR "Population surveillance" [MeSH Terms] OR "Epidemiological Monitoring" [MeSH

Terms]) AND ("mental health" [tiab] OR "mental-health" [tiab] OR "psychological health" [tiab] OR "mental disorder" [tiab] OR "mental disorders" [tiab] OR "mentally disordered" [tiab] OR "mental health problem" [tiab] OR "mental health problems" [tiab] OR "psychiatric disorder" [tiab] OR "psychiatric disorders" [tiab] OR "mental illness" [tiab] OR "mentally ill" [tiab] OR "mental sickness" [tiab] OR "mentally sick" [tiab] OR "mental disease" [tiab] OR "mental diseases" [tiab] OR "psychic health" [tiab] OR "psychiatric health" [tiab] OR "positive mental health" [tiab] OR "well-being" [tiab] OR "mental condition" [tiab] OR "psychological condition" [tiab] OR "mental constitution" [tiab] OR "mental health" [MeSH Terms] OR "mental disorders"[MeSH Terms]).

Websites

- Selected national stakeholders of mental health care (e.g., professional associations, service providers, federal agencies): "Mental Disorders"
- International organizations (EU, WHO, OECD): "Mental Health Surveillance;" "Mental Health Indicators;" "Mental Health Monitoring"
- For each OECD country on www.ianphi.org: "Mental Health Surveillance;" "Mental Health Indicators;" "Mental Health Monitoring"

Google

- For each OCED listed public health institute **not** registered on www.ianphi.org "*[Country]* Mental Health Surveillance;" "*[Country]* Mental Health Indicators;" "*[Country]* Mental Health Monitoring"
- For relevant indicators on national public mental health care and mental health care research: "*Versorgungsforschung;" "psych* Versorgung Bericht;" "psych* Versorgungssituation;" "psych* Versorgungsepidemiologie." [translation: "*health care research;" "psych* health care report;" "psych* health care situation;" "psych* epidemiology of health care."]

Study Selection

First, all records found via the several search paths were merged and checked for duplicates, which were then deleted. After that, documents were sequentially screened according to the inclusion and exclusion criteria defined below via the following steps: title screen, abstract screen, full record screen (see **Figure 1**).

We screened all types of published information (such as websites, brochures, posters, reports, scientific as well as official working and consultation papers) with a particular focus on indicators used to monitor mental health at a general population level in member states of the OECD. Records that met the following inclusion criteria were included: (1) availability in English or German language; (2) focus on public mental health; (3) focus on assessment at/database on population level (in contrast to e.g., clinical research or case studies); (4) current data (date of publication after 01.01.2000).

Since mental health surveillance needs to radically reduce complexity, only higher-order concepts can be addressed. Thus, records relating to databases on specific populations (e.g., students, veterans) instead of the general population or with a focus on developmental disorders (e.g., autism), mental disabilities, or specific mental disorders (e.g., depression, substance use, dementia) instead of broader psychopathology were excluded. Further, records with a focus on somatic public health, specific health behaviors as tobacco consumption or questionnaire development were excluded. Since indicators on national policies (existence: yes/no) do not allow for depicting changes at population-based level over time, such records were excluded as well.

All screening steps were mainly done by three reviewers (DP, CK, and EM) who were supported by members of the Mental Health Research Unit within the Department of Epidemiology and Health Monitoring at RKI. The study group (DP, CK, and EM) met regularly to discuss challenges and uncertainties within the study selection process and to review and adjust inclusion and exclusion criteria in an iterative manner. Disagreement on study inclusion was reviewed in this group on a weekly base.

Charting and Collating of the Data

Charting and collating of the results required a conceptual framework, as the extensive area of public mental health needed to be structured substantially. For this purpose, the conceptual framework of an established part of the NCD surveillance at RKI [Diabetes Surveillance (13)] served as a grounded basis for a conducted expert-based focus group. This focus group consisted of nine members of the Mental Health Research Unit within the Department of Epidemiology and Health Monitoring at RKI who possessed a wide range of expert knowledge in various fields on public mental health and its monitoring (e.g., knowledge on health care, prevention & promotion, positive mental health, psychopathology, mental health across the lifespan, expertise in working with survey data or routine data, determinants of mental health). They consisted of psychologists, public health scientists, sociologists, methodologists, and trained psychotherapists. We used the technique of a focus group to pool this expert knowledge, to generate a wide range of different topics and to discuss discrepancies directly. The focus group was led by an experienced researcher (first author, DP) and took 125 min. The group was asked to collect the most important areas of public mental health surveillance, put them into writing and arrange them on a flip board; divergencies were discussed and the group itself agreed on the final topics. A comprehension of the discussion as well as the results were returned to the participants and approved by all of them.

The identified topics served as a grid to organize resulting data from each record that was considered as eligible for indicator extraction. To do so, a standardized data charting form was created in Microsoft Excel 2010 including the following information: authorship, publication year, indicator name, indicator definition (if available), assumed superordinate topic according to the focus group, whether the indicator was already contained in a surveillance resp. monitoring system and if it was specific to a certain age group.

On the basis of this data charting form, only mental health indicators on population-based level (see criteria for record inclusion above) were included. After a screen for duplicates, we excluded (1) indicators which were extracted from more than

one record or subsumed similar content [e.g., "parental mental disorders" and "substance use (alcohol and drugs) by family members" as duplicates for "family history of mental disorders"]. Furthermore, we excluded (2) indicators within appropriate content for a continued population-based assessment (e.g., context of indicator too specific: "availability of a valued safe place where an individual can and wants to go to 'escape' from things") and (3) indicators, which showed non-specification for mental health surveillance (resp. relying on broader concepts, e.g., "general health"). Since the MHS for Germany was piloted for adults only, within this step (4) indicators for children and youth were excluded as well. To adequately identify indicators for this age group, several search steps would have had to be extended.

Three reviewers (DP, CK, and EM) independently extracted indicators identified by the different search strategies with the help of the prepared data charting form. Uncertainties regarding the defined inclusion and exclusion criteria and consistency with the superior research question were discussed weekly. Afterwards, the assignment of the indicators to the single superordinate topics as well as the steps leading to the final set were aligned by the whole study group one by one.

RESULTS

A total of 13.811 records were retrieved from the search. **Figure 1** provides a detailed overview in which step and for what reason records were excluded. The various steps resulted in a total of 373 records which were processed for indicator extraction. A comprehensive list of these sources can be found in **Appendix A**.

Important Topics for Public Mental Health

The conducted expert-based focus group led to the identification of 14 superordinate topics to cover the most relevant issues in terms of public mental health monitoring. The following topics were considered important:

1. Mental Health Promotion and Prevention
2. Mental Health Resources
3. Mental Health Risks
4. Mental Health Literacy
5. Positive Mental Health
6. Psychopathology
7. Self-harm and Suicidality
8. Supply and Utilization of Mental Health Care
9. Needs, Unmet Needs and Barriers in Mental Health Care
10. Quality of Care
11. Costs of Mental Disorders
12. Burden of Disease and Mortality
13. Participation
14. [Sociodemographic Variables with an Impact on Public Mental Health]

These topics built a preliminary conceptual outline which was used to collate the records and to roughly assign the indicators to.

Indicator Assignment

In sum, $N = 1.505$ indicators could be extracted from the output generated by the literature research and were assigned to the superordinate topics. Screening for (1) duplicates ($n = 920$), (2) inappropriate content ($n = 24$), (3) non-specification for mental health surveillance ($n = 31$) and (4) indicators specified for children and youth ($n = 349$) resulted in a final set of 181 different indicators for the adult population. **Table 1** depicts these indicators assigned to their superordinate topics.

Of the 181 identified indicators, 134 stemmed from a national indicator system from at least one OECD country or an international organization. Forty-seven indicators were hitherto not included in an existing indicator system (**Table 1**; indicator marked with an *).

In total, 146 indicators were found in two or more records, 35 indicators were only found once (**Table 1**; indicator marked in *italics*).

The indicators varied in their specification from being very specific (e.g., #141 "Waiting times in psychiatric daycare") to very broad (e.g., #157 "Total expenditures on mental health services"). Some indicators were separated in sub-indicators (see # 150–152; three different indicators for coercive measures).

"Psychopathology" and "Supply and Utlilization of Mental Health Care" were the topics most indicators were assigned to while "Positive Mental Health" and "Mental Health Promotion and Prevention" were the topics with the fewest indicators.

Since sociodemographic variables such as age or gender were comprised in the majority of the screened literature in **Appendix A**, these variables were not counted resp. included in the above mentioned systematic but listed once. Instead of choosing a quantitative approach, we compared the once listed sociodemographic determinants with commonly recommended variables in global surveillance work (79) to stratify surveillance indicators, resulting in an additional set of $n = 11$ sociodemographic variables with an impact on public mental health.

DISCUSSION

Following WHO's call in monitoring the mental health of the population, this scoping review was conducted as a first step to build up an indicator-based surveillance system to observe the public mental health of the adult population in Germany on a regular base. Particularly, our present work informs about important topics and indicators in this field based on the current state of knowledge in Germany and other OECD countries.

Within the scoping review, we searched and processed all types of published information, including websites, brochures, posters, and reports to gather latest information in the field of public health, particularly on national level. This approach seems favorable to depict an exhaustive picture of important indicators in the field of public mental health based on the current state of knowledge in research, surveillance, and administrative/routine data on mental health care. Though, according to the source, indicators were very differently communicated, varying in

TABLE 1 | Indicators of public mental health in OECD countries.

#	Indicator	Reference example
1. Mental Health Promotion and Prevention [*n* = 7 indicators]		
1	*Mental health promotion budget*	(14)
2	Existence of mental health promotion programs	(15)
3	Presence of mental health promotion in schools	(14)
4	*Presence of programs to support parenting skills*	(16)
5	*Presence of suicide prevention programs*	(16)
6	*Participation in selected or indicated preventive programs on mental health*	(17)
7	*Anti-stigma movement*	(18)
2. Mental Health Resources [*n* = 19 indicators]		
8	Spirituality	(5)
9	Sleep	(19)
10	Healthy lifestyle [e.g., nutrition, physical activity, substance/alcohol consumption]	(20)
11	Self-efficacy	(21)
12	Resilience	(22)
13	Optimism	(7)
14	Personality	(19)
15	*General trust*	(20)
16	*Emotional intelligence*	(20)
17*	Self-esteem	(23)
18	Emotion regulation	(22)
19	Life-domain/Work-life balance	(7)
20	Satisfaction with work environment	(7)
21	Neighborhood environment	(20)
22	Perceived neighbourhood security	(20)
23	Sense of community belonging	(19)
24	Community involvement	(20)
25	Political participation	(20)
26	Social support/Social network	(5)
3. Mental Health Risks [*n* = 16 indicators]		
27	Chronic physical diseases	(19)
28	*Chronic pain*	(19)
29	Family history of mental disorders	(19)
30	*Family history of suicide-related behavior*	(19)
31	Critical life events trauma	(24)
32	Adverse childhood experiences	(24)
33	Violence	(20)
34	Discrimination	(20)
35	Chronic stress	(25)
36	High job strain	(7)
37*	Cognitive impairment	(26)
38	Housing conditions	(20)
39	Stressful neighborhood conditions	(20)
40	Income inequality in society	(27)
41	Homelessness	(28)
42	Loneliness	(29)
4. Mental Health Literacy [*n* = 10 indicators]		
43	Mental health-related knowledge	(28)
44*	Mental health locus of control	(30)
45	Attitudes towards mental disorders	(28)
46*	Attitude towards mental health services / Mental health care	(31)
47	Public attitudes toward people with a mental disorder	(32)
48	Social distance toward persons with mental disorders	(28)
49*	Perceived legitimacy of discrimination of persons with mental disorders	(33)
50*	Self-stigma	(31)
51*	Help-seeking attitudes	(31)
52	Competence in mental health self-management	(34)
5. Positive Mental Health [*n* = 5 indicators]		
53	Happiness	(28)
54	Health-related quality of life	(35)
55	Life satisfaction	(20)
56	Well-being [e.g., emotional/subjective well-being; psychological, social, physical]	(5)
57	*Meaning in life*	(22)
6. Psychopathology [*n* = 34 indicators]		
58	Prevalence of psychological distress	(36)
59*	*Prevalence of burnout*	(37)
60*	Incidence of any mental disorder (all F-diagnoses)	(38)
61	*Incidence of affective disorders*	(16)
62	*Incidence of anxiety disorders*	(16)
63*	*Incidence of substance use disorders*	(23)
64*	*Incidence of psychotic disorders*	(39)
65*	*Incidence personality disorders*	(38)
66	Prevalence of anxiety disorders	(36)
67*	Prevalence of mood/Affective disorders	(40)
68	Prevalence of depression	(29)
69	Prevalence of postpartum depression	(36)
70	Prevalence of bipolar disorders	(36)
71*	Prevalence manic episodes	(41)
72	Prevalence of alcohol use disorder	(42)
73	Prevalence of substance use disorder	(24)
74	*Prevalence of attention deficit hyperactivity disorders*	(43)
75	Prevalence of obsessive-compulsive disorder	(43)
76	Prevalence of schizophrenia	(43)
77*	Prevalence of psychotic disorder	(41)
78*	*Prevalence of adjustment disorder*	(41)
79	Prevalence of posttraumatic stress disorder	(43)
80	Prevalence of eating disorders	(43)
81*	Prevalence of impulse control disorders	(41)
82*	Prevalence of somatoform and dissociative disorders	(44)
83	Prevalence of personality disorders	(43)
84	Prevalence of sleep disorders	(19)
85	Prevalence of any mental disorder (all F-Diagnoses)	(22)
86	Prevalence of severe mental disorders	(43)
87	Prevalence of common/high prevalent mental disorders	(22)
88	Prevalence of depression and/or anxiety disorders	(45)
89	Prevalence of chronic mental disorders	(28)
90	Comorbidity physical disease	(22)

(Continued)

TABLE 1 | Continued

#	Indicator	Reference example
91	Comorbidity mental disorder	(46)
7. Self-Harm and Suicidality [*n* = 6 indicators]		
92	Self-harm	(19)
93	Suicidality [e.g., ideations, plans]	(19)
94	Suicide attempts	(19)
95	Suicide rate of the general population	(47)
96	Suicide rate of mental health inpatients and recently after discharge	(48)
97	PYLL due to suicide	(29)
8. Supply and Utilization of Mental Health Care [*n* = 34 indicators]		
98	Capacity of outpatient mental health care: mental health workers	(15)
99*	Capacity of outpatient mental health care: mental health specialists	(49)
100	Capacity of inpatient mental health care	(15)
101	Number of mental health hospitals	(15)
102	Number of psychiatric units in general hospitals	(15)
103	*Number of forensic inpatient units*	(15)
104	Number of mental health outpatient facilities attached to a hospital	(15)
105	Coverage of services for severe mental disorders	(50)
106	Treatment coverage for alcohol and drug dependence	(50)
107	Utilization of any health care of persons with diagnosed mental disorders**	(15)
108	Utilization of outpatient mental health care of persons with diagnosed mental disorders**	(15)
109	Utilization of primary health care of persons with diagnosed mental disorders for mental health reasons**	(29)
110	Utilization of primary health care of persons with diagnosed mental disorders for physical health reasons**	(51)
111*	*Utilization of primary health care and somatic specialist care only of persons with diagnosed mental disorders***	(52)
112*	Proportion of psychotherapy in outpatient mental health care**	(53)
113*	*Proportion of pharmacotherapy in outpatient mental health care [e.g., depression]***	(53)
114*	Treatment with psycho- and pharmacotherapy in outpatient care**	(54)
115	Utilization of inpatient care of persons with diagnosed mental disorders**	(34)
116*	Number of inpatient cases**	(55)
117	Number of days of inpatient stay**	(48)
118	Hospital discharges for mental disorders	(36)
119	*Number of long stay patients*	(17)
120	Inpatient readmissions by mental health diagnoses	(6)
121	Out-patient aftercare	(17)
122*	Utilization of psychiatric day care**	(56)
123	*Utilization of home treatment***	(51)
124	Pre-admission community care	(6)
125	Emergency room visits	(19)
126	Self-help intervention utilization	(17)
127	Assisted housing for persons with mental disorders	(29)
128*	Utilization of rehabilitation measures due to mental disorders	(57)
129*	Number of days of rehabilitation measures due to mental disorders	(58)
130	Treatment with psychotropic drugs [e.g., antidepressants, antipsychotics, narcotic, sedative and anxiolytic substances]	(59)
131	*Opioid substitution treatment*	(60)
9. Needs, Unmet Needs and Barriers in Mental Health Care [*n* = 12 indicators]		
132*	Perceived needs	(61)
133*	Help-seeking behavior due to mental disorders	(62)
134*	*Treatment latency*	(63)
135	Early intervention [e.g., in psychosis]**	(51)
136*	Met mental health care needs for adults with mental disorders**	(64)
137	Unmet mental health care needs	(19)
138*	Number of cases per registered psychiatrist /psychotherapist	(56)
139	Waiting times ambulatory mental health care	(35)
140*	Waiting times inpatient mental health care	(65)
141*	*Waiting times psychiatric daycare*	(65)
142	*Waiting times in emergency rooms*	(32)
143*	Access barriers in mental health care	(66)
10. Quality of Care [*n* = 13 indicators]		
144	Patient satisfaction with mental health care system	(22)
145	Patient reported outcome measures	(51)
146	Treatment success	(17)
147*	Drop-out from mental health care	(67)
148	Patient education and participation	(17)
149*	*Inclusion of family and social environment into treatment of mental disorders*	(68)
150	Coercive measures: involuntary admission	(51)
151	Coercive measures: compulsory treatment	(60)
152	Coercive measures: seclusion	(22)
153*	Detection of depression in primary care	(69)
154*	Guideline adherence mental disorders with S3 health care guidelines	(53)
155*	*Transfer rate from primary to secondary care*	(52)
156*	*Outpatient-sensitive hospital cases*	(70)
11. Costs due to Mental Disorders [*n* = 7 indicators]		
157	Total expenditure on mental health services	(15)
158	Direct costs due to mental disorders	(71)
159*	Direct costs due to mental disorders - outpatient care	(72)
160*	*Direct costs due to mental disorders - rehabilitation*	(73)
161*	*Indirect costs due to mental disorders*	(74)
162	Sickness compensation	(16)
163	Disability pension for mental health reasons	(75)
12. Burden of Disease and Mortality [*n* = 9 indicators]		
164	Work loss due to mental health reasons	(28)
165	Functional Impairment due to mental health reasons	(59)
166	Mentally unhealthy days	(36)

(Continued)

TABLE 1 | Continued

#	Indicator	Reference example
167	DALYs (disability-adjusted life years)	(15)
168	YLDs (years lived with disability)	(24)
169	Excess mortality of people with mental disorders	(48)
170	Mortality for persons with severe psychiatric disorders	(76)
171	Alcohol-related deaths	(77)
172	Drug-related deaths	(77)
13. Participation [*n* = 9 indicators]		
173	Proportion of people with mental illnesses in employment	(32)
174	*Existence of employment programs for people with long-term mental problems*	(14)
175*	*Poverty among persons with mental illnesses*	(78)
176	Proportion of people in prison with mental illnesses	(22)
177	Social and political participation in people with mental illnesses	(22)
178	Housing situation of people with mental illness [e.g., homelessness]	(22)
179	Discrimination due to mental health problems	(22)
180*	*Stigma-related stress*	(33)
181*	Stigma coping	(33)
14. Sociodemographic Variables with an impact on public mental health [*n* = 11 indicators]		
182	Age	(79)
183	Gender	(79)
184	Region	(79)
185	Income equality / Social deprivation of the district (GINI)	(79)
186	Urbanization /Region	(79)
187	Migration background/Ethnicity	(79)
188	Relationship status (such as marriage)	(79)
189	Unemployment	(79)
190	Level of education	(79)
191	Income/ Poverty	(79)
192	Socio-economic status	(79)

Indicator in Italics = indicator found only once.
**Indicator not included in an established surveillance system.*
***Applicable to "any diagnosis of mental disorder" or itemized by different diagnoses.*

their specification or whether an indicator could be divided in sub-indicators. Attunement regarding the broadness of scope and the consecutive operationalization should therefore be considered when processing the reported indicators for further monitoring work.

Current indicators on public mental health can be described as heterogonous as the field itself: They referred to a wide range of 14 important areas which are reflecting the mentioned topics and recommendations of the overall WHO framework (1, 79), not only with regard to mental disorders and their recovery, but also in terms of positive mental health and the field of mental health promotion and prevention. The need to sufficiently structure the broad field of mental health and chart the indicators accordingly was met by conducting an expert-based focus groups to identify these various superordinate topics.

Following the methodology of a scoping review, we included very different kinds of documents and sources. Therefore, we were able to include a wide range of indicators, developed and used in a variety of settings. For example, most of the indicators were extracted from established indicator-based surveillance systems on public mental health. This seems favorable as those indicators are likely to have been developed by an elaborate, expert-based consensus process and already been proven to predict public mental health within a monitoring system. Moreover, it can be assumed that there is an existing database for these indicators; this enables future monitoring work to compare own data with international data, such as indicators of different OECD countries. Moreover, a quarter of the extracted indicators showed to have strong significance regarding public mental health in scientific studies on the general population or routine/administrative data but are not part of any indicator system yet. Since our search approach was not limited to indicators from already existing indicator systems, it gives promising insights into these existing indicators, that reflect current issues or are of relevance in a particular part of public mental health, which otherwise might have been neglected. To build and adjust a new surveillance system from the ground up, this approach seems beneficial to identify specific and recently important concepts with appropriate indicators reflecting them.

Most of the indicators were found more than once resp. could be extracted from more than one data source. This gives a first indication regarding the emphasis and/or importance of these indicators in former surveillance or research work and thus for the mental health of the population. Furthermore, it shows that our literature search has mainly identified established concepts that are supported by multiple sources as relevant public mental health indicators. Though, the identification of hitherto less used indicators might direct to new trends in important fields (as for example stigma-related content, see indicator #180) and should be considered in building up new surveillance systems.

Most indicators were assigned to the topics "Psychopathology" and "Supply and Utilization of Mental Health Care." On the contrary, our findings revealed that indicators on "Positive Mental Health" and particularly measures on "Mental Health Prevention and Promotion" were underrepresented regarding both the number of assigned indicators as well as their diversity of content. In terms of strengthening and promoting mental health at population level, a stronger focus on this area seems important in future monitoring work—particularly in light of the current COVID-19 pandemic and an immediate response to its impact.

Limitations and Future Research

Since this scoping review was conducted as a first step in piloting a MHS for Germany, our comprehensive search was restricted regarding the following points:

It mainly focused on indicators for adults. Future research in the field should extend this compilation by searching and depicting indicators which reflect aspects of public mental health across the whole lifespan, including particular indicators for children and adolescents who differ in their age-specific risks and resources of mental health as well as mental disorders and

their assessment. These should be searched explicitly with the help of extended search strings and inclusion of institutions and monitoring systems with a focus on this age group.

Since we were interested to depict characteristics of the German health care system in building up a national MHS, some of the indicators were specific to the German system like for example "Guideline adherence mental disorders with S3 health care guidelines" (#154) which is explicitly oriented to a national health care guideline. Thus, particularly indicators regarding mental health care based on administrative and routine data that require a specific data basis (e.g., the mapping of outpatient and inpatient care of the total population, which in Germany is divided into different data bodies of different service providers) should be checked carefully before processing. Further monitoring work has to consider their own national or international specifications to appropriately align the indicators with their system.

Moreover, our concentrated search on mental health care (to include information from administrative and routine data) might have led to an overemphasizing of these indicators in the extracted indicator compilation. However, research and practice in the field of public mental health generally rather concentrated on mental health care services, recovery, and rehabilitation than on prevention or promotion. Nevertheless, prioritizing mental health efforts on prevention and promotion of mental health as well as enhancing resources and positive mental health is demanded (1, 5, 79). Future efforts should thus focus on identifying and researching indicators to assess and monitor measures of population mental health promotion and prevention, even in early states of research.

Lastly, the focus group to structure the broad field of mental health consisted of experts that were not independent of each other, so there may have been influences from hierarchy or previous relationship. It was tried to counteract these effects by emphasizing the importance of the opinion of everyone, managing speaking times and initial individual brainstorming. However, the results were solely used to give a structure when charting the indicators. Our approach has shown to be beneficial, since all of these identified topics could be filled with indicators and could thus facilitate the appropriate communication of results.

CONCLUSION

This scoping review presents a wide range of currently utilized indicators important to the broad field of public mental health. Our comprehensive compilation intended to serve as a solid basis on which future research and surveillance projects might build on. To do so, all or a selection of the identified indicators could be used and adjusted to the individual constitutional needs.

Furthermore, the introduced indicators might be supplemented or condensed depending on individual national or international demands and tailored to particular research questions or monitoring focus. As our compilation mostly reflects indicators related to mental health in adults, it should be extended with indicators specific to children's and adolescents' mental health to depict the whole lifespan.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

EM, DP, JT, and CK conducted the literature search. EM, DP, and CK reviewed documents for inclusion, performed the data extraction, analyzed, and interpreted the data. DP provided methodological guidance with respect to the identification, selection of documents, to charting and reporting of results, and drafted the manuscript with substantial input from JT and EM. CK and DP compiled the attachments. CK did the final language proofreading. All authors contributed to the conception, design of the study, read, and approved the submitted manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2021.714497/full#supplementary-material

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Lifetime and 1-Month Prevalence of Mental Disorders in Hebei Province, China: A Community-Based Cross-Sectional Study

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Background: The prevalence of mental disorders is an important topic, which has been reported in different countries in the world. In China, some studies were also conducted to get the prevalence of mental disorders at the national level and in some metropolitan cities. However, the prevalence of mental disorders in Chinese underdeveloped provinces has not been reported internationally in recent decades. Due to the discrepancy in the social-economic development of different Chinese provinces, we also have reasons to believe the different prevalence of mental disorders between underdeveloped provinces and other provinces.

Method: A community-based cross-sectional study was conducted among community residents aged 18 years and older in Hebei province, China. We screened 20,884 community residents in this study, and a Structured Clinical Interview for Diagnostic and Statistical Manual (DSM-IV) Axis I disorders was used to make the diagnoses of mental disorders.

Results: The weighted lifetime prevalence of mental disorders was 15.87% (95% CI 15.38–16.38%), and the 1-month prevalence was 10.79% (95% CI 10.37–11.22%). Anxiety disorder ranked first in the classification of mental disorders for both lifetime (6.56%) and 1-month prevalence (6.25%). The weighted lifetime and 1-month region–gender–age-specific prevalence of mental disorders was also analyzed in this study.

Conclusions: Mental disorders have been an important issue in Chinese economically underdeveloped regions, and the prevalence was at a high level compared with the results in the 2000s. There are several serious challenges in the work of Chinese mental disorders, which should be paid more attention to.

Keywords: mental disorder, prevalence, community resident, cross-sectional study, China

INTRODUCTION

Mental disorders have been recognized as an important health problem in the world (1, 2). WHO reported that the burden of mental disorders continued to grow with significant impacts on health and major social, human rights, and economic consequences in all countries of the world (3). As we know, studies about the prevalence of mental disorders are fundamental works for controlling mental disorders, and it can help us to allocate the health resources and set up interventions, which should be explored in all the countries of the world (4, 5).

In the previous decades, the worldwide prevalence of mental disorders has been explored in the World Mental Health Survey (WMHS) (6, 7), and the prevalence of some kinds of mental disorders has been reported, such as social anxiety disorder (8), posttraumatic stress disorder (9), and so on (10, 11). Studies were also conducted in different countries to obtain the prevalence of mental disorders, such as the United State of America (USA) (12, 13), European countries (14), Singapore (15), Finland (16), India (17), and so on (18).

In China, there were also some studies, which explored the prevalence of mental disorders. Michael R Phillips et al. reported the prevalence of mental disorders in four provinces during 2001–2005 (19). Huang et al. reported the prevalence of mental disorders in 2013 (20). There were also some studies conducted in Chinese metropolitan cities (21, 22). All of these studies gave us more instructions for the theories and methods of epidemiological investigation in mental disorders (23). However, the prevalence of mental disorders in Chinese underdeveloped provinces has not been reported internationally in recent years. Due to the discrepancy in social-economic development in different Chinese provinces and the effect of economics on mental disorders (24), we have reasons to believe that the prevalence of mental disorders in the underdeveloped province may be also different.

To fill this gap, we conducted a community-based cross-sectional study to get the lifetime and 1-month prevalence of mental disorders in 2018 in Hebei province, China. Hebei is an economically underdeveloped province located in the middle of China, and the GDP per capita ranked 22nd in all of the 31 provinces of the Chinese mainland in 2018. The findings for this study are not only helpful for us to allocate the mental health resources and set up interventions in Hebei province, but they also can give us implications about the distribution of mental disorders in other Chinese economically underdeveloped regions.

METHOD

Study Design and Sample

Hebei is an economically underdeveloped province located in the middle of China. Between April and August 2016, we conducted a cross-sectional study to get the prevalence of mental disorders among community residents aged 18 years and older in Hebei province. In the current study, we interviewed 20,884 community residents, and 6,769 (32.41%) of them were selected to be diagnosed with mental disorders.

To obtain the prevalence of mental disorders in Hebei province, probability proportionate to size was used to sample for the current study. First, we calculated the sample size using the formula: $N = \frac{Z^2_{1-\frac{\alpha}{2}} p(1-p)}{\delta^2}$; where $z^2_{1-\frac{\alpha}{2}}$ (level of significance of 95% with two-tailed test) = 1.96; p (the prevalence of schizophrenia, one of the lowest prevalence in mental disorders) = 0.50% [referred from a previous cross-sectional epidemiological study in Hebei province (25)]; δ (tolerable error) = 0.001. Then, the calculated minimum sample size was 19,112. Considering a response rate of 80%, we set the sample size as 24,000 in the current study. Second, the number of rural and urban samples was proportional to the region-specific population in each of the cities. Third, we randomly selected 1/3 of the districts and 1/5 of the counties in each city, and one street/town was also randomly selected in each district/county. Fourth, at the community and village level, one to three persons were randomly selected according to the sample size in this area. Finally, residents who have been living in the community/village for more than 6 months were chosen in this study. Then, we ranked these residents by age, and 1/10 of them were systematically selected to be interviewed. For the people who rejected the interview or could not be reached, their neighbors of the same gender and age were interviewed in the current study.

Interview Procedure

In the current study, the survey was organized in two stages. In the first stage, the subjects were screened by a Chinese version general health questionnaire (GHQ) and other eight questions about the risk factors of mental disorders. The risk factors were as follows: (1) poor physical health status in the recent month; (2) poor mental health status in the recent month; (3) thinking or doing things without control in the recent month; (4) restriction behaviors because of phobias in the recent month; (5) feeling nervous or anxious in the recent year; (6) experiencing troubles due to alcohol in the recent year; (7) seeking help because of psychological or psychiatric problems; (8) hospitalization because of psychological or psychiatric problems. Subjects who gave one or more positive responses among these eight questions were defined as "with risk factors." For the scores of GHQ, we divided them into three groups (high-risk group, average-risk group, and low-risk group). The high-risk group contained subjects with GHQ scores equal to or higher than 4. The average-risk group contained subjects with GHQ scores equal to 2 or 3. The low-risk group contained subjects with GHQ scores equal to 0 or 1.

In the second stage, we selected the subjects to be screened by Structured Clinical Interview for Diagnostic and Statistical Manual (DSM-IV) Axis I disorders (SCID) according to the results of GHQ scores and risk factors of mental disorders. First, all subjects with risk factors or in the high-risk group were screened by SCID. Second, subjects in the average-risk group

Abbreviations: WHO, World Health Organization; WMHS, World Mental Health Survey; USA, United State of America; GHQ, General Health Questionnaire; SCID, Structured Clinical Interview for Diagnostic and Statistical Manual (DSM-IV) Axis I disorders; CI, Confidence Interval; NOS, Not Otherwise Specified; GMC, General Medical Condition.

with tail numbers 1–4 were screened by SCID. Third, subjects in the low-risk group with tail number 1 were screened by SCID. A similar selection method was also used in many previous studies (19, 26). The study flow diagram is presented in **Figure 1**. The Human Research Ethics Committee of Hebei Mental health Center approved the study protocol. Written informed consent was obtained from all the participants in the current study.

Quality Control

In the whole process of this study, strict quality control was employed to ensure the study quality. First, before the survey, all of the interviewers must be trained for 2 days to make sure they had fully understood the questionnaire and study flow. They were also asked to record the interview. Second, supervisors monitored throughout the survey and randomly checked the interview. Third, SCID diagnoses should be made by psychiatrists with more than 5 years of clinical experience. Fourth, all the questionnaires interviewed in the daytime should be checked again by other interviewers each night. Fifth, subjects with tail number 55 or 66 needed to be retested 5–7 days later by other interviewers in blind. For the subjects with different results, the psychiatrists needed to listen to the interview records and discussed the case to determine the final diagnosis. Finally, double-entry was used to make sure the precision of the data.

Measures

The Chinese version of the SCID was used to generate the diagnoses of mental disorders (27). The Chinese version of the SCID had been used in many epidemiological studies among Chinese populations, and it was identified with sound reliability and validity (19, 21).

The Chinese version of the General Health Questionnaire (GHQ) was used to select the subjects who were interviewed by SCID (28). This scale also had been used in the Chinese population for many years with good reliability and validity (29–31).

We also collected the gender, age, and region information of the subjects. Gender was indicated by male or female. Age was evaluated by the number of years, and we recorded it into four groups (18–34 years, 35–44 years, 45–59 years, and ≥60 years), which can be seen as an adolescent, young adults, midlife, and elder, respectively. The region was assessed as urban or rural where they lived. All of the subjects should live in the current region for more than 6 months.

Statistical Methods

IBM SPSS statistics 24.0 for Windows (web edition) and Microsoft Office Excel 2016 for Windows were used for the data analyses. Due to the rules of data collection, we needed to weigh the samples to get the prevalence of mental disorders. The weight used in the current study was generated by three steps (32). In the first step, the subjects with SCID diagnoses (6,769 subjects) were weighted into the number of participants (20,884 subjects) based on the selection of SCID interviews. In the second step, poststratification weights were used to generate the weight of gender–age–region distribution in Hebei province. The distribution of gender, age, and region were based on the data of the 1% population sampling survey in 2015 (33). Finally, we multiplied these two weights to calculate the final weight used for the data analyses.

A chi-square test was applied to compare the significance among different social-demographic populations. The 95% confidence interval for the proportion was calculated by the Wilson score method without continuity correction (34). All tests were two-tailed and a $p \leq 0.05$ was considered statistically significant.

RESULTS

In the current study, 23,675 participants were invited to participate in the survey, and 20,884 (88.21%) subjects agreed and completed the questionnaires. With the rules about the scores of GHQ and risk factors of mental disorders, 6,769 (32.41%) of them were selected to diagnose by SCID, and 2,371 (35.03%) subjects were positively diagnosed. **Figure 1** was the study flow, which displayed the detailed interview process. We also analyzed the social-demographic information in each stage in **Table 1**.

After weighing the sample, we calculated the lifetime and 1-month prevalence of mental disorders. The results showed that the weighted lifetime prevalence of mental disorders was 15.87% (95% CI 15.38–16.38%), and the 1-month prevalence was 10.79% (95% CI 10.37–11.22%). Anxiety disorder ranked first in the classification of mental disorders for both lifetime (6.56%) and 1-month prevalence (6.25%). For lifetime prevalence, the following order was substance use disorder (6.20%), mood disorder (4.58%), psychotic disorders (1.03%), and other mental disorders (0.06%). For 1-month prevalence, the following order was substance use disorder (3.69%), mood disorder (3.06%), psychotic disorders (0.74%), and other mental disorders (0.32%). For the detailed diagnoses, the top five lifetime persons were alcohol use disorders (5.93%), anxiety disorder not otherwise specified (NOS) (3.80%), major depressive disorder (2.93%), specific phobias (1.39%), and depressive disorder NOS (0.99%). Moreover, the top five 1-month disorders were anxiety disorder NOS (3.70%), alcohol use disorders (3.51%), major depressive disorder (1.29%), specific phobias (1.16%), and depressive disorder NOS (0.79%). The detailed lifetime and 1-month prevalence of mental disorders are presented in **Table 2**.

We also calculated the gender-specific lifetime and 1-month prevalence of mental disorders. The lifetime and 1-month prevalence of mood disorders and anxiety disorders among women were higher, but the prevalence of substance use disorders was lower. For other mental disorders, the lifetime prevalence was higher in men, but the 1-month prevalence was lower. For men, the top five diagnoses of the weighted lifetime prevalence of mental disorders were alcohol use disorders (11.41%), anxiety disorder NOS (2.77%), major depressive disorder (2.23%), specific phobias (1.00%), and depressive disorder NOS (0.83%). However, for women, posttraumatic stress disorder (1.21%) was in the top five diagnoses instead of alcohol use disorders (0.48%). When we considered the 1-month prevalence among men, the top five were alcohol use disorders (6.80%), anxiety disorder NOS (2.72%), specific phobias (0.82%), major depressive disorder

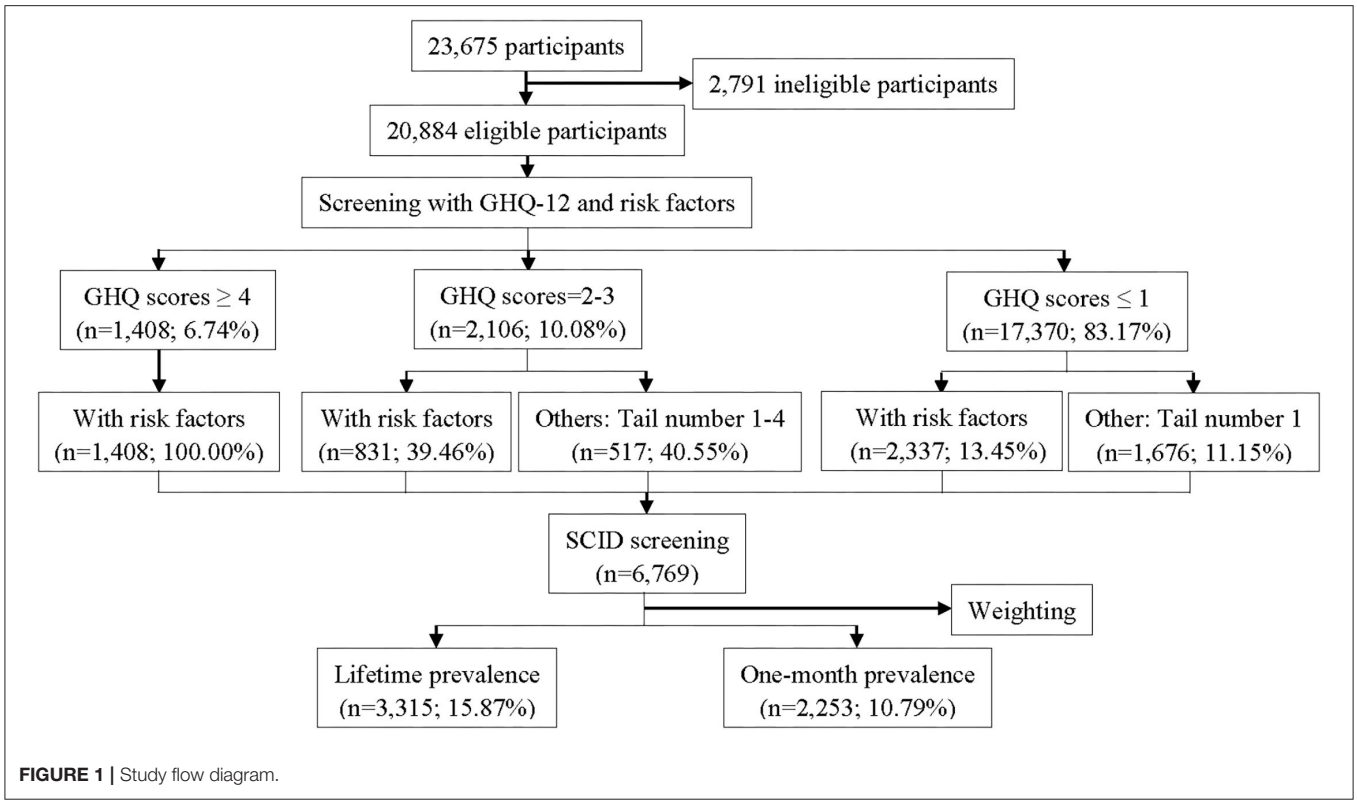


FIGURE 1 | Study flow diagram.

TABLE 1 | Social-demographic characteristics of the participants (n = 20,884).

Variable	Valid sample [n_1 (n_1/n)]	Valid SCID screening [n_2 (n_2/n_1)]	Valid SCID diagnoses [n_3 (n_3/n_2)]
Gender			
Male	10,703 (51.25%)	3,004 (28.07%)	1,085 (36.12%)
Female	10,181 (48.75%)	3,765 (36.98%)	1,286 (34.16%)
Age (years old)			
15–34	5,011 (23.99%)	981 (19.58%)	249 (25.38%)
35–44	3,427 (16.41%)	818 (23.87%)	254 (31.05%)
45–59	6,216 (29.76%)	2,251 (36.21%)	867 (38.52%)
≥60	6,230 (29.83%)	2,719 (43.64%)	1,001 (36.82%)
Region			
Urban	6,056 (29.00%)	1,935 (31.95%)	754 (38.97%)
Region	14,828 (71.00%)	4,834 (32.60%)	1,617 (33.45%)
Total	20,884 (100.00%)	6,769 (32.41%)	2,371 (35.03%)

(0.81%), depressive disorder NOS (0.62%) and schizophrenia (0.62%). Nevertheless, for women, dysthymic disorder (1.04%) displaced alcohol use disorders (0.24%) and rose into the top five diagnoses. We also compared the prevalence of each diagnosis between men and women, and most of them were different between men and women ($p<0.05$). The detailed information was shown in **Table 3**.

In **Tables 4**, **5**, we analyzed the weighted lifetime and 1-month age-specific prevalence of mental disorders, respectively. We also compared the prevalence among the different age groups in these two tables. Generally, both lifetime and 1-month prevalence of mood disorders and anxiety disorders increased with age. For substance use disorder, the lifetime and 1-month prevalence also increased with the age, with an exception of elders (aged ≥60 years).For people aged 18–34 years and 35–44 years, the top five diagnoses of the weighted lifetime prevalence were alcohol use disorders (4.43%, 4.90%), anxiety disorder NOS (2.44%, 3.56%), specific phobias (1.24%, 0.71%), major depressive disorder (1.21%, 1.70%), and schizophrenia (0.51%, 1.23%). For people aged 45–59 years and ≥60 years, depressive

TABLE 2 | Weighted and unweighted lifetime and 1-month prevalence of mental disorders in Hebei province, China (n = 20,884).

Mental disorders	Lifetime prevalence			1-month prevalence		
	Unweighted *n*	Weighted *n*	Weighted % (95% CI)	Unweighted *n*	Weighted *n*	Weighted % (95% CI)
Mood disorders	802	957	4.58 (4.31, 4.87)	637	640	3.06 (2.84, 3.31)
Bipolar I disorder	30	32	0.15 (0.11, 0.22)	15	16	0.08 (0.05, 0.12)
Bipolar II disorders	8	8	0.04 (0.02, 0.08)	7	7	0.03 (0.02, 0.07)
Other bipolar disorders	8	15	0.07 (0.04, 0.12)	6	7	0.03 (0.02, 0.07)
Major depressive disorder	499	612	2.93 (2.71, 3.17)	289	270	1.29 (1.15, 1.46)
Dysthymic disorder*	–	–	–	135	138	0.66 (0.56, 0.78)
Depressive disorder NOS	165	207	0.99 (0.87, 1.13)	141	164	0.79 (0.67, 0.91)
Mood disorder due to GMC	98	90	0.43 (0.35, 0.53)	77	72	0.34 (0.27, 0.43)
Substance-induced mood disorder	5	5	0.02 (0.01, 0.06)	3	3	0.01 (<0.01, 0.04)
Anxiety disorders	1,043	1,370	6.56 (6.23, 6.90)	1,015	1,306	6.25 (5.93, 6.59)
Panic disorder	88	89	0.43 (0.35, 0.52)	68	72	0.34 (0.27, 0.43)
Agoraphobia without panic	19	21	0.10 (0.07, 0.15)	15	17	0.08 (0.05, 0.13)
Social phobia	19	34	0.16 (0.12, 0.23)	12	10	0.05 (0.03, 0.09)
Specific phobias	177	290	1.39 (1.24, 1.56)	139	242	1.16 (1.02, 1.31)
Obsessive compulsive disorder	29	31	0.15 (0.10, 0.21)	24	21	0.10 (0.07, 0.15)
Post-traumatic stress disorder	118	161	0.77 (0.66, 0.90)	41	58	0.28 (0.21, 0.36)
Generalized anxiety disorder*	–	–	–	122	128	0.61 (0.52, 0.73)
Anxiety disorders due to GMC	57	52	0.25 (0.19, 0.33)	54	46	0.22 (0.17, 0.29)
Substance-induced anxiety disorder	6	6	0.03 (0.01, 0.06)	6	6	0.03 (0.01, 0.06)
Anxiety disorder NOS	620	793	3.80 (3.55, 4.06)	607	772	3.70 (3.45, 3.96)
Substance use disorders	621	1,294	6.20 (5.88, 6.53)	400	771	3.69 (3.44, 3.96)
Alcohol use disorders	565	1,239	5.93 (5.62, 6.26)	357	734	3.51 (3.27, 3.77)
Sedative/hypnotic/anxiolytic drug use disorders	51	51	0.24 (0.19, 0.32)	42	37	0.18 (0.13, 0.24)
Other substance use disorders†	10	9	0.04 (0.02, 0.08)	7	10	0.05 (0.03, 0.09)
Psychotic disorders	168	215	1.03 (0.90, 1.18)	125	155	0.74 (0.63, 0.87)
Schizophrenia	124	150	0.72 (0.61, 0.84)	99	125	0.60 (0.50, 0.71)
Schizophreniform disorder	2	6	0.03 (0.01, 0.06)	1	5	0.02 (0.01, 0.06)
Schizoaffective disorder	2	2	0.01 (<0.01, 0.03)	2	2	0.01 (<0.01, 0.03)
Delusional disorder	15	15	0.07 (0.04, 0.12)	7	6	0.03 (0.01, 0.06)
Brief psychotic disorder	4	3	0.01 (<0.01, 0.04)	0	0	0.00 (0.00, 0.00)
Psychotic disorder due to GMC	5	5	0.02 (0.01, 0.06)	4	4	0.02 (0.01, 0.05)
Substance-induced psychotic disorder	1	1	<0.01 (<0.01, 0.03)	1	1	<0.01 (<0.01, 0.03)
Psychotic disorder NOS	15	33	0.16 (0.11, 0.22)	11	12	0.06 (0.03, 0.10)
Other mental disorders	4	12	0.06 (0.03, 0.10)	64	66	0.32 (0.25, 0.40)
Somatization disorder*	–	–	–	8	9	0.04 (0.02, 0.08)
Pain disorder*	–	–	–	32	29	0.14 (0.10, 0.20)
Somatoform disorder NOS*	–	–	–	11	9	0.04 (0.02, 0.08)
Hypochondriasis*	–	–	–	7	6	0.03 (0.01, 0.06)
Dysmorphic disorder*	–	–	–	1	1	<0.01 (<0.01, 0.03)
Adjustment disorder*	–	–	–	6	5	0.02 (0.01, 0.06)
Eating disorders‡	1	1	<0.01 (<0.01, 0.03)	1	1	<0.01 (<0.01, 0.03)
Other DSM axis I disorders	3	10	0.05 (0.03, 0.09)	3	10	0.05 (0.03, 0.09)
Any mental disorder (excluding dementia)	2,219	3,315	15.87 (15.38, 16.38)	1,881	2,253	10.79 (10.37, 11.22)

CI, Confidence interval; NOS, Not otherwise specified; GMC, General medical condition.

**: Only have a current diagnosis. †: Cannabis, stimulant, opioid, cocaine, hallucinogen, multiple drugs, and other substance use disorders; ‡: Anorexia nervosa, bulimia nervosa, and binge eating disorders.*

disorder NOS replaced schizophrenia and rose into the top five diagnoses. When we conducted to the weighted 1-month prevalence of mental disorders, the top five diagnoses for people aged 18–34 years were alcohol use disorders (2.62%), anxiety disorder NOS (2.37%), specific phobias (1.13%), schizophrenia (0.44%), and depressive disorder NOS (0.38%). For people

TABLE 3 | Weighted lifetime and 1-month prevalence of mental disorders by gender in Hebei province, China (n = 20,884).

Mental disorders	Lifetime prevalence			1-month prevalence		
	Male [% (95% CI)]	Female [% (95% CI)]	*p*	Male [% (95% CI)]	Female [% (95% CI)]	*p*
Mood disorders	3.62 (3.28, 3.99)	5.54 (5.12, 6.00)	<0.001	2.13 (1.87, 2.43)	4.00 (3.64, 4.39)	<0.001
Bipolar I disorder	0.15 (0.09, 0.25)	0.15 (0.09, 0.25)	0.992	0.07 (0.03, 0.14)	0.09 (0.05, 0.16)	0.622
Bipolar II disorders	0.07 (0.03, 0.14)	0.02 (0.01, 0.07)	0.109	0.07 (0.03, 0.14)	0.01 (<0.01, 0.05)	
Other bipolar disorders	0.05 (0.02, 0.11)	0.10 (0.05, 0.18)	0.199	0.01 (0.01, 0.03)	0.02 (0.01, 0.07)	0.288
Major depressive disorder	2.23 (1.96, 2.53)	3.63 (3.29, 4.01)	<0.001	0.81 (0.65, 1.00)	1.78 (1.54, 2.05)	<0.001
Dysthymic disorder*	–	–	–	0.28 (0.19, 0.40)	1.04 (0.86, 1.26)	<0.001
Depressive disorder NOS	0.83 (0.67, 1.02)	1.16 (0.97, 1.38)	0.016	0.62 (0.49, 0.79)	0.94 (0.77, 1.14)	0.010
Mood disorder due to GMC	0.31 (0.22, 0.43)	0.55 (0.43, 0.72)	0.006	0.30 (0.21, 0.42)	0.39 (0.29, 0.53)	0.244
Substance-induced mood disorder	0.04 (0.01, 0.10)	0.01 (<0.01, 0.05)	0.178	0.03 (0.01, 0.08)	0.00 (0.00, 0.00)	0.124
Anxiety disorders	4.62 (4.24, 5.04)	8.49 (7.97, 9.04)	<0.001	4.46 (4.08, 4.87)	8.04 (7.53, 8.58)	<0.001
Panic disorder	0.16 (0.10, 0.26)	0.69 (0.55, 0.87)	<0.001	0.12 (0.07, 0.21)	0.56 (0.44, 0.73)	<0.001
Agoraphobia without panic	0.02 (0.01, 0.07)	0.19 (0.12, 0.30)	<0.001	0.02 (0.01, 0.07)	0.15 (0.09, 0.25)	0.001
Social phobia	0.22 (0.15, 0.33)	0.11 (0.06, 0.19)	0.038	0.03 (0.01, 0.08)	0.07 (0.03, 0.14)	0.344
Specific phobias	1.00 (0.82, 1.21)	1.78 (1.54, 2.05)	<0.001	0.82 (0.66, 1.01)	1.51 (1.29, 1.76)	<0.001
Obsessive compulsive disorder	0.13 (0.08, 0.23)	0.16 (0.10, 0.26)	0.597	0.06 (0.03, 0.13)	0.14 (0.09, 0.24)	0.050
Post-traumatic stress disorder	0.32 (0.23, 0.44)	1.21 (1.02, 1.44)	<0.001	0.08 (0.04, 0.15)	0.49 (0.37, 0.64)	<0.001
Generalized anxiety disorder*	–	–	–	0.57 (0.44, 0.73)	0.66 (0.52, 0.83)	0.387
Anxiety disorders due to GMC	0.19 (0.12, 0.30)	0.31 (0.22, 0.43)	0.098	0.13 (0.08, 0.23)	0.31 (0.22, 0.43)	0.008
Substance-induced anxiety disorder	0.04 (0.01, 0.10)	0.02 (0.01, 0.07)	0.412	0.04 (0.01, 0.10)	0.02 (0.01, 0.07)	0.452
Anxiety disorder NOS	2.77 (2.47, 3.11)	4.83 (4.43, 5.26)	<0.001	2.72 (2.43, 3.06)	4.66 (4.28, 5.09)	<0.001
Substance use disorders	11.61 (11.01, 12.24)	0.79 (0.64, 0.98)	<0.001	6.96 (6.48, 7.46)	0.44 (0.33, 0.59)	<0.001
Alcohol use disorders	11.41 (10.81, 12.03)	0.48 (0.36, 0.63)	<0.001	6.80 (6.33, 7.30)	0.24 (0.16, 0.35)	<0.001
Sedative/hypnotic/anxiolytic drug use disorders	0.23 (0.15, 0.34)	0.26 (0.18, 0.38)	0.684	0.17 (0.11, 0.27)	0.18 (0.12, 0.28)	0.878
Other substance use disorders†	0.02 (0.01, 0.07)	0.07 (0.03, 0.14)	0.180	0.07 (0.03, 0.14)	0.03 (0.01, 0.08)	0.226
Psychotic disorders	1.07 (0.89, 1.29)	0.98 (0.81, 1.19)	0.520	0.78 (0.63, 0.96)	0.71 (0.56, 0.89)	0.557
Schizophrenia	0.71 (0.57, 0.89)	0.74 (0.59, 0.92)	0.823	0.62 (0.49, 0.79)	0.57 (0.45, 0.74)	0.639
Schizophreniform disorder	0.06 (0.03, 0.13)	0.00 (0.00, 0.00)	0.014	0.05 (0.02, 0.11)	0.00 (0.00, 0.00)	0.031
Schizoaffective disorder	0.00 (0.00, 0.00)	0.02 (0.01, 0.07)	0.500	0.00 (0.00, 0.00)	0.02 (0.01, 0.07)	0.500
Delusional disorder	0.03 (0.01, 0.08)	0.11 (0.07, 0.20)	0.020	0.01 (<0.01, 0.05)	0.06 (0.03, 0.13)	0.125
Brief psychotic disorder	0.02 (0.01, 0.07)	0.02 (0.01, 0.07)	1.000	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	–
Psychotic disorder due to GMC	0.03 (0.01, 0.08)	0.02 (0.01, 0.07)	0.687	0.03 (0.01, 0.08)	0.01 (<0.01, 0.05)	0.374
Substance-induced psychotic disorder	0.00 (0.00, 0.00)	0.01 (<0.01, 0.05)	1.000	0.00 (0.00, 0.00)	0.01 (<0.01, 0.05)	1.000
Psychotic disorder NOS	0.24 (0.16, 0.35)	0.09 (0.05, 0.16)	0.006	0.07 (0.03, 0.14)	0.05 (0.02, 0.11)	0.559
Other mental disorders	0.09 (0.05, 0.16)	0.02 (0.01, 0.07)	0.034	0.21 (0.14, 0.32)	0.42 (0.31, 0.56)	0.007
Somatization disorder*	–	–	–	0.01 (<0.01, 0.05)	0.08 (0.04, 0.15)	0.039
Pain disorder*	–	–	–	0.08 (0.04, 0.15)	0.21 (0.14, 0.32)	0.011
Somatoform disorder NOS*	–	–	–	0.02 (0.01, 0.07)	0.07 (0.03, 0.14)	0.180
Hypochondriasis*	–	–	–	0.02 (0.01, 0.07)	0.04 (0.01, 0.10)	0.687
Dysmorphic disorder*	–	–	–	0.00 (0.00, 0.00)	0.01 (<0.01, 0.05)	1.000
Adjustment disorder*	–	–	–	0.01 (<0.01, 0.05)	0.04 (0.01, 0.10)	0.375
Eating disorders‡	0.00 (0.00, 0.00)	0.01 (<0.01, 0.05)	0.318	0.00 (0.00, 0.00)	0.01 (<0.01, 0.05)	1.000
Other DSM axis I disorders	0.09 (0.05, 0.16)	0.01 (<0.01, 0.05)	0.011	0.09 (0.05, 0.16)	0.01 (<0.01, 0.05)	0.012
Any mental disorder (excluding dementia)	18.13 (17.41, 18.88)	13.62 (12.98, 14.29)	<0.001	12.72 (12.10, 13.38)	11.73 (11.13, 12.36)	0.029

CI, Confidence interval; NOS, Not otherwise specified; GMC, General medical condition.

**: Only have a current diagnosis. †: Cannabis, stimulant, opioid, cocaine, hallucinogen, multiple drugs, and other substance use disorders; ‡: Anorexia nervosa, bulimia nervosa, and binge eating disorders.*

TABLE 4 | Weighted lifetime prevalence of mental disorders by age in Hebei province, China ($n = 20,884$).

Mental disorders	18–34years [% (95% CI)]	35–44 years [% (95% CI)]	45–59 years [% (95% CI)]	≥60 years [% (95% CI)]	*p*
Mood disorders	1.86 (1.56, 2.20)	2.71 (2.23, 3.29)	6.54 (5.95, 7.20)	7.73 (6.98, 8.56)	<0.001
Bipolar I disorder	0.09 (0.04, 0.19)	0.14 (0.06, 0.32)	0.18 (0.10, 0.33)	0.23 (0.12, 0.42)	0.267
Bipolar II disorders	0.03 (0.01, 0.11)	0.00 (0.00, 0.00)	0.08 (0.04, 0.19)	0.05 (0.01, 0.17)	0.247
Other bipolar disorders	0.04 (0.01, 0.13)	0.03 (<0.01, 0.15)	0.05 (0.02, 0.15)	0.21 (0.11, 0.39)	0.007
Major depressive disorder	1.21 (0.98, 1.50)	1.70 (1.33, 2.17)	4.20 (3.72, 4.73)	4.91 (4.31, 5.59)	<0.001
Depressive disorder NOS	0.39 (0.27, 0.57)	0.66 (0.44, 0.98)	1.40 (1.13, 1.73)	1.62 (1.29, 2.04)	<0.001
Mood disorder due to GMC	0.13 (0.07, 0.25)	0.14 (0.06, 0.32)	0.70 (0.52, 0.94)	0.78 (0.56, 1.08)	<0.001
Substance-induced mood disorder	0.01 (<0.01, 0.08)	0.08 (0.03, 0.24)	0.00 (0.00, 0.00)	0.02 (<0.01, 0.13)	0.097
Anxiety disorders	4.21 (3.76, 4.71)	4.52 (3.89, 5.24)	7.93 (7.27, 8.64)	10.13 (9.27, 11.06)	<0.001
Panic disorder	0.06 (0.02, 0.15)	0.03(<0.01, 0.15)	0.63 (0.46, 0.87)	1.07 (0.81, 1.42)	<0.001
Agoraphobia without panic	0.04 (0.01, 0.13)	0.05 (0.02, 0.20)	0.12 (0.06, 0.24)	0.21 (0.11, 0.39)	0.057
Social phobia	0.28 (0.18, 0.43)	0.14 (0.06, 0.32)	0.08 (0.04, 0.19)	0.09 (0.04, 0.23)	0.022
Specific phobias	1.24 (1.01, 1.53)	0.71 (0.49, 1.04)	1.65 (1.36, 2.00)	1.83 (1.47, 2.27)	<0.001
Obsessive compulsive disorder	0.09 (0.04, 0.19)	0.00 (0.00, 0.00)	0.18 (0.10, 0.33)	0.32 (0.19, 0.54)	0.001
Post-traumatic stress disorder	0.32 (0.21, 0.49)	0.22 (0.11, 0.43)	1.05 (0.82, 1.34)	1.55 (1.23, 1.96)	<0.001
Anxiety disorders due to GMC	0.04 (0.01, 0.13)	0.08 (0.03, 0.24)	0.38 (0.26, 0.57)	0.52 (0.35, 0.79)	<0.001
Substance-induced anxiety disorder	0.00 (0.00, 0.00)	0.03 (<0.01, 0.15)	0.05 (0.02, 0.15)	0.05 (0.01, 0.17)	0.166
Anxiety disorder NOS	2.44 (2.10, 2.83)	3.56 (3.00, 4.21)	4.33 (3.84, 4.88)	5.41 (4.78, 6.12)	<0.001
Substance use disorders	4.44 (3.98, 4.96)	5.01 (4.35, 5.77)	7.96 (7.30, 8.67)	7.48 (6.74, 8.30)	<0.001
Alcohol use disorders	4.43 (3.97, 4.94)	4.90 (4.25, 5.65)	7.73 (7.08, 8.43)	6.66 (5.96, 7.44)	<0.001
Sedative/hypnotic/anxiolytic drug use disorders	0.00 (0.00, 0.00)	0.08 (0.03, 0.24)	0.25 (0.15, 0.41)	0.75 (0.54, 1.06)	<0.001
Other substance use disorders†	0.01 (<0.01, 0.08)	0.03 (<0.01, 0.15)	0.05 (0.02, 0.15)	0.09 (0.04, 0.23)	0.282
Psychotic disorders	0.95 (0.75, 1.21)	1.42 (1.09, 1.86)	0.92 (0.70, 1.19)	0.96 (0.71, 1.29)	0.072
Schizophrenia	0.51 (0.37, 0.71)	1.23 (0.92, 1.64)	0.63 (0.46, 0.87)	0.73 (0.52, 1.03)	<0.001
Schizophreniform disorder	0.07 (0.03, 0.17)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.02 (<0.01, 0.13)	0.057
Schizoaffective disorder	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.02 (<0.01, 0.09)	0.02 (<0.01, 0.13)	0.416
Delusional disorder	0.01 (<0.01, 0.08)	0.11 (0.04, 0.28)	0.10 (0.05, 0.22)	0.07 (0.02, 0.20)	0.190
Brief psychotic disorder	0.00 (0.00, 0.00)	0.03 (<0.01, 0.15)	0.02 (<0.01, 0.09)	0.05 (0.01, 0.17)	0.272
Psychotic disorder due to GMC	0.04 (0.01, 0.13)	0.00 (0.00, 0.00)	0.02 (<0.01, 0.09)	0.02 (<0.01, 0.13)	0.422
Substance-induced psychotic disorder	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.02 (<0.01, 0.09)	0.00 (0.00, 0.00)	0.477
Psychotic disorder NOS	0.31 (0.20, 0.47)	0.03 (<0.01, 0.15)	0.15(0.08, 0.28)	0.07 (0.02, 0.20)	0.002
Other mental disorders	0.01 (<0.01, 0.08)	0.00 (0.00, 0.00)	0.15 (0.08, 0.28)	0.02 (<0.01, 0.13)	0.002
Eating disorders‡	0.01 (<0.01, 0.08)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.526
Other DSM axis I disorders	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.15 (0.08, 0.28)	0.02 (<0.01, 0.13)	<0.001
Any mental disorder r(excluding dementia)	10.36 (9.66, 11.10)	12.13 (11.11, 13.23)	20.03 (19.04, 21.06)	21.90 (20.70, 23.15)	<0.001

CI, Confidence interval; NOS, Not otherwise specified; GMC, General medical condition.

†: Cannabis, stimulant, opioid, cocaine, hallucinogen, multiple drugs, and other substance use disorders; ‡: Anorexia nervosa, bulimia nervosa, and binge eating disorders.

aged 35–44 years, the order changed into alcohol use disorders (3.53%), anxiety disorder NOS (3.48%), schizophrenia (1.01%), major depressive disorder (0.68%), specific phobias (0.63%), and depressive disorder NOS (0.63%). For people aged 45–59 years, the order was alcohol use disorders (4.45%), anxiety disorder NOS (4.15%), major depressive disorder (1.93%), specific phobias (1.15%), and depressive disorder NOS (1.03%). For elders (≥60 years), the order was anxiety disorder NOS (5.34%), alcohol use disorders (3.61%), major depressive disorder (2.44%), Specific phobias (1.69%), and dysthymic disorder (1.32%).

Region-specific prevalence is shown in **Table 6**. We also compared the different prevalence between rural and urban regions. All of the classifications of mental disorders were statistically significant ($p < 0.05$) between the rural and urban regions, apart from other mental disorders. The weighted lifetime and 1-month prevalence of mood disorders and psychotic disorders were higher in the rural region, but the prevalence of anxiety disorders and substance use disorders was lower. Alcohol use disorders, anxiety disorder NOS, major depressive disorder, specific phobias, depressive disorder NOS were the top five diagnoses in the urban and rural region.

In **Figures 2**, **3**, we calculated the weighted lifetime and 1-month region–gender–age-specific prevalence of mental

TABLE 5 | Weighted 1-month prevalence of mental disorders by age in Hebei province, China (*n*=20,884).

Mental disorders	18–34 years [% (95% CI)]	35–44 years [% (95% CI)]	45–59 years [% (95% CI)]	≥60 years [% (95% CI)]	*p*
Mood disorders	1.07 (0.85, 1.34)	1.83 (1.45, 2.32)	4.30 (3.81, 4.84)	5.52 (4.88, 6.24)	<0.001
Bipolar I disorder	0.06 (0.02, 0.15)	0.05 (0.02, 0.20)	0.08 (0.04, 0.19)	0.11 (0.05, 0.27)	0.728
Bipolar II disorders	0.03 (0.01, 0.11)	0.00 (0.00, 0.00)	0.07 (0.03, 0.17)	0.05 (0.01, 0.17)	0.257
Other bipolar disorders	0.04 (0.01, 0.13)	0.03 (<0.01, 0.15)	0.03 (0.01, 0.12)	0.05 (0.01, 0.17)	0.964
Major depressive disorder	0.32 (0.21, 0.49)	0.68 (0.46, 1.01)	1.93 (1.61, 2.31)	2.44 (2.02, 2.94)	<0.001
Dysthymic disorder	0.12 (0.06, 0.23)	0.41 (0.25, 0.68)	0.93 (0.72, 1.21)	1.32 (1.03, 1.71)	<0.001
Depressive disorder NOS	0.38 (0.26, 0.56)	0.63 (0.42, 0.94)	1.03 (0.81, 1.32)	1.21 (0.93, 1.58)	<0.001
Mood disorder due to GMC	0.12 (0.06, 0.23)	0.03 (<0.01, 0.15)	0.53 (0.38, 0.75)	0.68 (0.48, 0.98)	<0.001
Substance-induced mood disorder	0.00 (0.00, 0.00)	0.03 (<0.01, 0.15)	0.00 (0.00, 0.00)	0.02 (<0.01, 0.13)	0.280
Anxiety disorders	3.97 (3.54, 4.46)	4.46 (3.84, 5.18)	7.36 (6.73, 8.05)	9.79 (8.94, 10.70)	<0.001
Panic disorder	0.06 (0.02, 0.15)	0.00 (0.00, 0.00)	0.43 (0.30, 0.63)	0.96 (0.71, 1.29)	<0.001
Agoraphobia without panic	0.01 (<0.01, 0.08)	0.05 (0.02, 0.20)	0.10 (0.05, 0.22)	0.18 (0.09, 0.36)	0.016
Social phobia	0.00 (0.00, 0.00)	0.05 (0.02, 0.20)	0.07 (0.03, 0.17)	0.09 (0.04, 0.23)	0.039
Specific phobias	1.13 (0.90, 1.40)	0.63 (0.42, 0.94)	1.15 (0.91, 1.45)	1.69 (1.35, 2.11)	<0.001
Obsessive compulsive disorder	0.09 (0.04, 0.19)	0.00 (0.00, 0.00)	0.15 (0.08, 0.28)	0.14 (0.06, 0.30)	0.026
Post-traumatic stress disorder	0.12 (0.06, 0.23)	0.11 (0.04, 0.28)	0.35 (0.23, 0.53)	0.59 (0.41, 0.87)	<0.001
Generalized anxiety disorder	0.26 (0.17, 0.42)	0.22 (0.11, 0.43)	0.93 (0.72, 1.21)	1.07 (0.81, 1.42)	<0.001
Anxiety disorders due to GMC	0.04 (0.01, 0.13)	0.08 (0.03, 0.24)	0.38 (0.26, 0.57)	0.39 (0.24, 0.62)	<0.001
Substance-induced anxiety disorder	0.00 (0.00, 0.00)	0.03 (<0.01, 0.15)	0.05 (0.02, 0.15)	0.05 (0.01, 0.17)	0.166
Anxiety disorder NOS	2.37 (2.03, 2.75)	3.48 (2.93, 4.12)	4.15 (3.67, 4.68)	5.34 (4.71, 6.05)	<0.001
Substance use disorders	2.62 (2.26, 3.02)	3.61 (3.05, 4.27)	4.60 (4.10, 5.16)	4.20 (3.64, 4.83)	<0.001
Alcohol use disorders	2.62 (2.26, 3.02)	3.53 (2.98, 4.18)	4.45 (3.95, 5.00)	3.61 (3.09, 4.20)	<0.001
Sedative/hypnotic/anxiolytic drug use disorders	0.00 (0.00, 0.00)	0.08 (0.03, 0.24)	0.18 (0.10, 0.33)	0.52 (0.35, 0.79)	<0.001
Other substance use disorders†	0.07 (0.03, 0.17)	0.00 (0.00, 0.00)	0.02 (<0.01, 0.09)	0.09 (0.04, 0.23)	0.064
Psychotic disorders	0.60 (0.44, 0.81)	1.04 (0.76, 1.42)	0.70 (0.52, 0.94)	0.78 (0.56, 1.08)	0.089
Schizophrenia	0.44 (0.31, 0.63)	1.01 (0.74, 1.39)	0.53 (0.38, 0.75)	0.59 (0.41, 0.87)	0.003
Schizophreniform disorder	0.07 (0.03, 0.17)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.011
Schizoaffective disorder	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.02 (<0.01, 0.09)	0.02 (<0.01, 0.13)	0.416
Delusional disorder	0.01 (<0.01, 0.08)	0.00 (0.00, 0.00)	0.03 (0.01, 0.12)	0.07 (0.02, 0.20)	0.217
Brief psychotic disorder	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	1.000
Psychotic disorder due to GMC	0.03 (0.01, 0.11)	0.00 (0.00, 0.00)	0.02 (<0.01, 0.09)	0.02 (<0.01, 0.13)	0.624
Substance-induced psychotic disorder	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.02 (<0.01, 0.09)	0.00 (0.00, 0.00)	0.477
Psychotic disorder NOS	0.04 (0.01, 0.13)	0.03 (<0.01, 0.15)	0.08 (0.04, 0.19)	0.07 (0.02, 0.20)	0.647
Other mental disorders	0.01 (<0.01, 0.08)	0.16 (0.08, 0.36)	0.53 (0.38, 0.75)	0.82 (0.59, 1.14)	<0.001
Somatization disorder	0.00 (0.00, 0.00)	0.03 (<0.01, 0.15)	0.10 (0.05, 0.22)	0.05 (0.01, 0.17)	0.024
Pain disorder	0.00 (0.00, 0.00)	0.05 (0.02, 0.20)	0.23 (0.14, 0.39)	0.30 (0.17, 0.51)	<0.001
Somatoform disorder NOS	0.00 (0.00, 0.00)	0.08 (0.03, 0.24)	0.02 (<0.01, 0.09)	0.14 (0.06, 0.30)	0.003
Hypochondriasis	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.05 (0.02, 0.15)	0.07 (0.02, 0.20)	0.036
Dysmorphic disorder	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.02 (<0.01, 0.09)	0.00 (0.00, 0.00)	0.477
Adjustment disorder	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.02 (<0.01, 0.09)	0.09 (0.04, 0.23)	0.019
Eating disorders‡	0.01 (<0.01, 0.08)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.526
Other DSM axis I disorders	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0.15 (0.08, 0.28)	0.02 (<0.01, 0.13)	<0.001
Any mental disorder (excluding dementia)	7.86 (7.25, 8.52)	9.72 (8.80, 10.72)	14.82 (13.95, 15.74)	17.57 (16.47, 18.72)	<0.001

CI, Confidence interval; NOS, Not otherwise specified; GMC, General medical condition.

†: Cannabis, stimulant, opioid, cocaine, hallucinogen, multiple drugs, and other substance use disorders; ‡: Anorexia nervosa, bulimia nervosa, and binge eating disorders.

disorders. The results implied that substance use disorders in men and anxiety disorders in women were the most serious problems in Hebei province. In the rural region, the prevalence of anxiety increased rapidly after people aged 35 years. The prevalence of mood disorders was higher in the urban region and increased with age. For psychotic disorders, the prevalence in rural males aged 18–44 years and rural females aged 60+ was higher.

Finally, we analyzed the comorbidity of the weighted lifetime and 1-month diagnoses of mental disorders in **Table 7**. For

TABLE 6 | Weighted lifetime and 1-month prevalence of mental disorders by region in Hebei province, China (*n*=20,884).

Mental disorders	Lifetime prevalence			1-month prevalence		
	Urban [% (95% CI)]	Rural [% (95% CI)]	*p*	Urban [% (95% CI)]	Rural [% (95% CI)]	*p*
Mood disorders	3.93 (3.42, 4.52)	4.78 (4.46, 5.12)	0.014	2.36 (1.97, 2.83)	3.27 (3.01, 3.56)	0.001
Bipolar I disorder	0.17 (0.08, 0.33)	0.15 (0.10, 0.22)	0.776	0.04 (0.01, 0.15)	0.09 (0.05, 0.15)	0.550
Bipolar II disorders	0.00 (0.00, 0.00)	0.05 (0.03, 0.10)	0.123	0.00 (0.00, 0.00)	0.04 (0.02, 0.09)	0.363
Other bipolar disorders	0.06 (0.02, 0.18)	0.07 (0.04, 0.13)	0.790	0.06 (0.02, 0.18)	0.02 (0.01, 0.05)	0.137
Major depressive disorder	2.51 (2.10, 2.99)	3.06 (2.81, 3.34)	0.047	0.73 (0.53, 1.02)	1.46 (1.29, 1.66)	<0.001
Dysthymic disorder*	–	–	–	0.52 (0.35, 0.77)	0.70 (0.58, 0.84)	0.195
Depressive disorder NOS	0.84 (0.62, 1.14)	1.04 (0.89, 1.21)	0.220	0.75 (0.54, 1.04)	0.79 (0.67, 0.94)	0.774
Mood disorder due to GMC	0.36 (0.22, 0.57)	0.45 (0.36, 0.57)	0.365	0.29 (0.17, 0.49)	0.36 (0.28, 0.47)	0.486
Substance-induced mood disorder	0.02 (<0.01, 0.12)	0.03 (0.01, 0.07)	0.717	0.02 (<0.01, 0.12)	0.01 (<0.01, 0.05)	0.542
Anxiety disorders	7.91 (7.17, 8.71)	6.17 (5.81, 6.55)	<0.001	7.80 (7.07, 8.60)	5.80 (5.45, 6.17)	<0.001
Panic disorder	0.31 (0.19, 0.52)	0.46 (0.37, 0.58)	0.174	0.19 (0.10, 0.36)	0.39 (0.30, 0.49)	0.040
Agoraphobia without panic	0.15 (0.07, 0.30)	0.09 (0.06, 0.15)	0.319	0.13 (0.06, 0.27)	0.07 (0.04, 0.12)	0.247
Social phobia	0.06 (0.02, 0.18)	0.19 (0.14, 0.27)	0.051	0.04 (0.01, 0.15)	0.05 (0.03, 0.10)	1.000
Specific phobias	1.38 (1.09, 1.75)	1.39 (1.22, 1.58)	0.956	0.96 (0.72, 1.28)	1.22 (1.06, 1.41)	0.139
Obsessive compulsive disorder	0.17 (0.08, 0.33)	0.14 (0.10, 0.21)	0.699	0.15 (0.07, 0.30)	0.09 (0.05, 0.15)	0.296
Post-traumatic stress disorder	0.23 (0.13, 0.41)	0.93 (0.79, 1.09)	<0.001	0.06 (0.02, 0.18)	0.34 (0.26, 0.44)	0.001
Generalized anxiety disorder*	–	–	–	0.67 (0.47, 0.94)	0.60 (0.49, 0.73)	0.604
Anxiety disorders due to GMC	0.19 (0.10, 0.36)	0.27 (0.20, 0.36)	0.338	0.08 (0.03, 0.21)	0.26 (0.19, 0.35)	0.022
Substance-induced anxiety disorder	0.00 (0.00, 0.00)	0.04 (0.02, 0.08)	0.348	0.00 (0.00, 0.00)	0.04 (0.02, 0.08)	0.348
Anxiety disorder NOS	5.92 (5.29, 6.62)	3.17 (2.91, 3.46)	<0.001	5.79 (5.17, 6.49)	3.07 (2.82, 3.35)	<0.001
Substance use disorders	8.47 (7.71, 9.29)	5.52 (5.18, 5.88)	<0.001	4.12 (3.59, 4.72)	3.56 (3.28, 3.86)	0.070
Alcohol use disorders	8.03 (7.30, 8.84)	5.30 (4.97, 5.66)	<0.001	3.91 (3.40, 4.50)	3.40 (3.13, 3.69)	0.090
Sedative/hypnotic/anxiolytic drug use disorders	0.42 (0.27, 0.65)	0.19 (0.13, 0.27)	0.006	0.25 (0.14, 0.44)	0.16 (0.11, 0.23)	0.167
Other substance use disorders†	0.02 (<0.01, 0.12)	0.05 (0.03, 0.10)	0.694	0.00 (0.00, 0.00)	0.06 (0.03, 0.11)	0.130
Psychotic disorders	0.59 (0.41, 0.85)	1.16 (1.01, 1.34)	0.001	0.48 (0.32, 0.72)	0.82 (0.69, 0.97)	0.017
Schizophrenia	0.44 (0.29, 0.67)	0.80 (0.67, 0.95)	0.009	0.40 (0.25, 0.62)	0.66 (0.54, 0.80)	0.040
Schizophreniform disorder	0.00 (0.00, 0.00)	0.04 (0.02, 0.08)	0.348	0.00 (0.00, 0.00)	0.03 (0.01, 0.07)	0.595
Schizoaffective disorder	0.00 (0.00, 0.00)	0.01 (<0.01, 0.05)	1.000	0.00 (0.00, 0.00)	0.01 (<0.01, 0.05)	1.000
Delusional disorder	0.00 (0.00, 0.00)	0.09 (0.06, 0.15)	0.030	0.00 (0.00, 0.00)	0.04 (0.02, 0.08)	0.348
Brief psychotic disorder	0.02 (<0.01, 0.12)	0.02 (0.01, 0.05)	1.000	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	1.000
Psychotic disorder due to GMC	0.06 (0.02, 0.18)	0.01 (<0.01, 0.05)	0.082	0.04 (0.01, 0.15)	0.01 (<0.01, 0.05)	0.227
Substance-induced psychotic disorder	0.00 (0.00, 0.00)	0.01 (<0.01, 0.04)	1.000	0.06 (0.03, 0.11)	0.01 (<0.01, 0.04)	1.000
Psychotic disorder NOS	0.06 (0.02, 0.18)	0.19 (0.13, 0.27)	0.059	0.06 (0.02, 0.18)	0.06 (0.03, 0.11)	1.000
Other mental disorders	0.04 (0.01, 0.15)	0.06 (0.03, 0.11)	1.000	0.27 (0.16, 0.46)	0.33 (0.25, 0.43)	0.536
Somatization disorder*	–	–	–	0.00 (0.00, 0.00)	0.06 (0.03, 0.11)	0.225
Pain disorder*	–	–	–	0.15 (0.07, 0.30)	0.14 (0.09, 0.21)	0.827
Somatoform disorder NOS*	–	–	–	0.08 (0.03, 0.21)	0.03 (0.01, 0.07)	0.129
Hypochondriasis*	–	–	–	0.00 (0.00, 0.00)	0.03 (0.01, 0.07)	0.595
Dysmorphic disorder*	–	–	–	0.00 (0.00, 0.00)	0.01 (<0.01, 0.04)	1.000
Adjustment disorder*	–	–	–	0.00 (0.00, 0.00)	0.03 (0.01, 0.07)	0.595
Eating disorders‡	0.02 (<0.01, 0.12)	0.00 (0.00, 0.00)	0.229	0.02 (<0.01, 0.12)	0.00 (0.00, 0.00)	0.229
Other DSM axis I disorders	0.00 (0.00, 0.00)	0.06 (0.03, 0.11)	0.130	0.00 (0.00, 0.00)	0.06 (0.03, 0.11)	0.130
Any mental disorder (excluding dementia)	19.06 (17.97, 20.20)	14.93 (14.39, 15.49)	<0.001	13.43 (12.49, 14.42)	11.87 (11.38, 12.38)	0.004

CI, Confidence interval; NOS, Not otherwise specified; GMC, General medical condition.

**: Only have a current diagnosis. †: Cannabis, stimulant, opioid, cocaine, hallucinogen, multiple drugs, and other substance use disorders; ‡: Anorexia nervosa, bulimia nervosa, and binge eating disorders.*

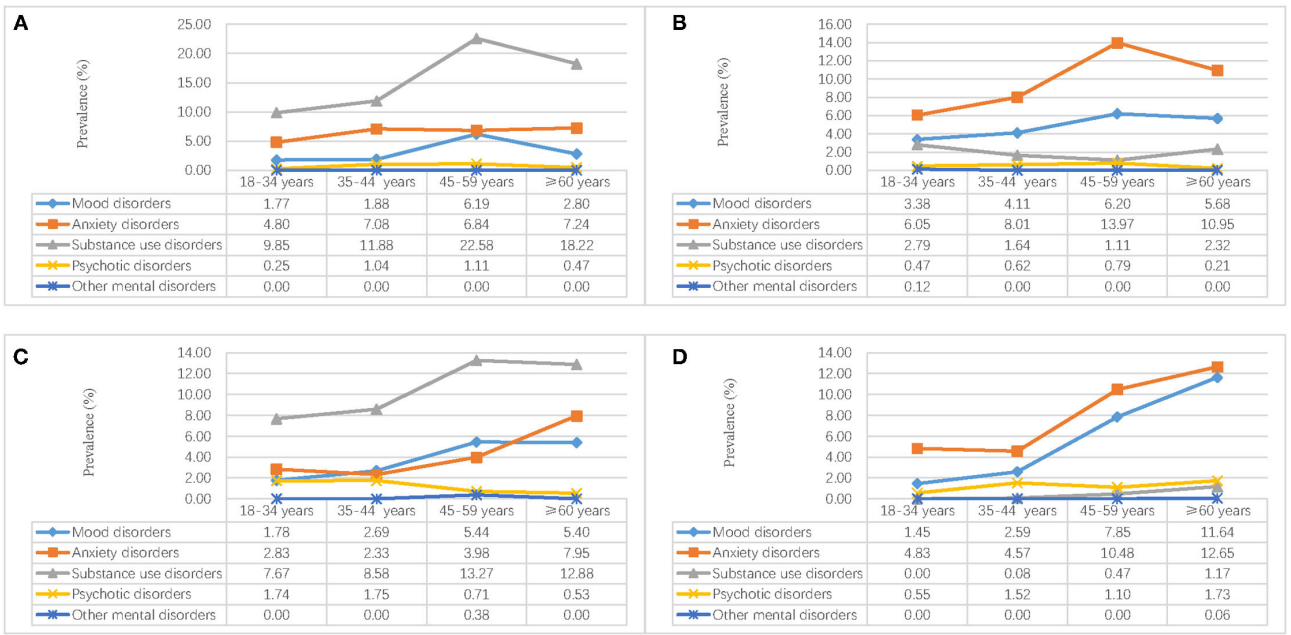


FIGURE 2 | Weighted region-gender-age-specific lifetime prevalence of mental disorders in Hebei province, China. **(A)** Urban male; **(B)** Urban female; **(C)** Rural male; **(D)** Rural female.

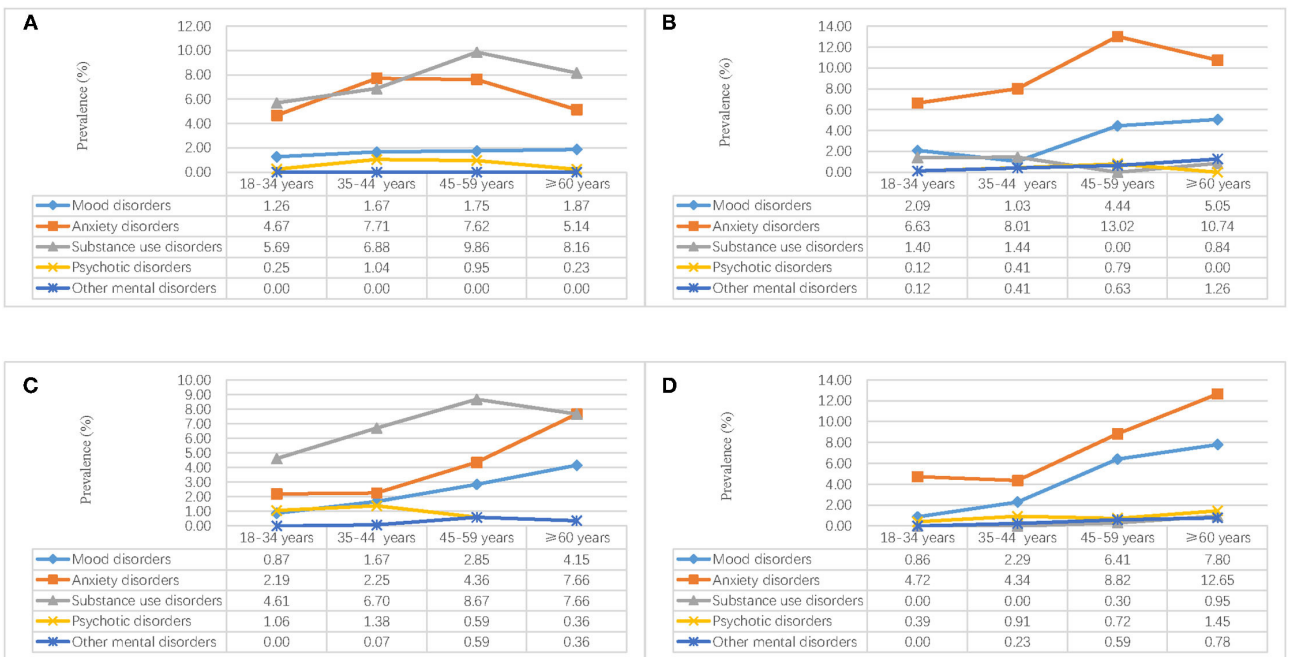


FIGURE 3 | Weighted region-gender-age-specific 1-month prevalence of mental disorders in Hebei province, China. **(A)** Urban male; **(B)** Urban female; **(C)** Rural male; **(D)** Rural female.

lifetime diagnoses, the results showed that there were 491 (2.35%) subjects who met the diagnoses criteria for two, and 76 (0.36%) subjects met the diagnoses criteria for three or more. Similarly, 344 (1.65%) subjects met the diagnoses criteria for two, and 71 (0.34%) subjects met the diagnoses criteria for three or more for the1-month diagnoses.

TABLE 7 | Comorbidity of the weighted lifetime and 1-month diagnoses of mental disorders [*n* (%)].

Number of diagnoses	Weighted lifetime diagnoses	Weighted 1-monthdiagnoses
0	17,569 (84.13)	18,331 (87.78)
1	2,749 (13.16)	2,138 (10.24)
2	491 (2.35)	344 (1.65)
≥3	76 (0.36)	71 (0.34)
Total	20,884 (100.00)	20,884 (100.00)

DISCUSSION

The current study was conducted in Hebei province, an economically underdeveloped region in China, to get the lifetime and 1-month prevalence of mental disorders. The results found that the lifetime prevalence of mental disorders was 15.87% (95% CI: 15.38–16.38%) and the 1-month prevalence of mental disorders was 10.79% (95% CI: 10.37–11.22%). Comparing with the Chinese studies, it is similar to the results in CMHS (16.6%, 9.3%) (20), but it is higher than the results in TJMHS (23.6%, 12.8%) (21). The reason may be explained by regional differences. The current study was interviewed in an underdeveloped province, but TJMHS was implemented in metropolitan China. People who lived in metropolitan had a higher level of life and work stress, which are risk factors for mental disorders (35).

However, when we compared the findings with many other Western countries, it is much lower. According to the WHO's World Mental Health Survey, the lifetime prevalence of mental disorders ranged from 12.0% in Nigeria to 47.4% in the USA, and most of the available data are higher than the prevalence in the current study (36). In the NCS-R study in the USA, the lifetime prevalence of mental disorders was 26.2% in 2001–2002 (37), and it is higher than the prevalence in the current study. The Global Burden of Disease (GBD) 2017 showed that 11,46,401.2 thousand people were with mental disorders and substance use disorders. They mean that the prevalence of mental disorders was about 15%. This data was similar to our findings (16.6%).

In the current study, we also found that the prevalence of anxiety disorders was highest in all of the classifications of mental disorders. It is consistent with recent Chinese studies in CMHS (20), TJMHS (21). However, in the last decades, a study in four Chinese provinces supported mood disorders rank first in the classification of mental disorders (19). In recent years, China is one of the few countries with high-speed development in the world, and Chinese society changes very fast. People need to adapt to the changing society, which is also a risk factor for anxiety disorders (38). This may be a reason for changing the order of anxiety and mood disorders.

The prevalence of some diagnoses with NOS is at a high level in the results, such as anxiety NOS, depressive disorder NOS. This may be caused by the characteristics of mental disorders NOS. Sometimes, we can also see them as the "subthreshold disorders (39, 40)," but they are also at a higher risk of developing full-down psychiatric disorders (41). Thus, the findings imply to us that there are many residents at high risk of full-down psychiatric disorders, and we need to pay more attention and work on them to control the development of mental disorders.

Gender differences were also supported for other kinds of mental disorders, and the prevalence for men is higher than for women. It was mainly caused by substance use disorders, and the other kinds of mental disorders were higher for women. The results align with the previous studies in China and other countries (42, 43). In China, the differences in the lifetime prevalence of substance use disorders are larger than most of the other countries (11.61 vs. 0.79%), and there are more male alcohol drinkers than females. The gap is also very big, especially in the north of China (44, 45). One of the reasons is the Confucian culture in China. The gender differences for other kinds of mental disorders, it may be caused by the sex hormone (46, 47).

We also found that mood and anxiety disorders increased with age, but substance use and psychotic disorders were higher in residents aged 35–44 years. In the rural region, mood disorders and psychotic disorders were higher, and anxiety disorders and substance use disorders were higher in the urban region. Similar findings were also found for the 1-month prevalence of mental disorders expect for substance use disorders. All of these findings were consistent with previous studies in China and other countries (7, 20, 48). Comparing with the rural region, people who live in the urban region have heavier work-load and life stress (49, 50), and they may be at higher risk of mental disorders. Substance use disorders, one way to deal with stress, maybe also in higher-level for rural residents. However, for rural residents, most of them were lower educated, and they were lack of coping skills, which are also risk factors for mood disorders and psychotic disorders (51, 52).

We also analyzed the comorbidity of the diagnoses for the mental disorders, and the results showed that most of the residents were diagnosed with one mental disorder (13.16% for lifetime prevalence and 10.4% for 1-month prevalence). Few residences can be diagnosed with more than two kinds of mental disorders (2.71% for lifetime prevalence and 1.99% for 1-month prevalence). They are lower than the percentages found from the NCSR (3.8%) (37). As we discussed before, the prevalence of mental disorders was lower than in other Western countries, and the severity of mental disorders was not at a high level. Thus, the comorbidity of the diagnoses for the mental disorders was lower than findings from other studies.

There are some limitations, which should be considered when we interpret the findings. First, the sample in the current were community residents aged 18 years and older, and people aged lower than 18 years and who lived in construction sites, armed services, schools, and hospitals were not included in the design. Second, all of the diagnoses were from SCID axis I, and the Axis II diagnoses and dementia were not reported in the current study. Third, the sample size was calculated by the prevalence of schizophrenia, and the prevalence of some mental disorders with lower prevalence is not confident in the current study. Finally, the time frame for the current prevalence was 1 month, and the results cannot be compared with others with different time frames.

Despite these limitations, this is the first large-scale mental health epidemiological study, which conducted in a Chinese economically underdeveloped province using SCID diagnoses.

The results are more confident compared with other studies in China in the recent 10 years because of the instruments and strict quality control. The results also can help us to allocate health resources and set up interventions.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The Human Research Ethics Committee of Hebei Mental Health Center. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

LS analyzed the data and wrote the manuscript. YZ was a major contributor in writing the manuscript. KL designed this study and gave important comments on the manuscript. LC, JL, LL, XS, YL, and LZ collected the data. All authors read and approved the final manuscript.

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Effects of Polyphenol Supplementations on Improving Depression, Anxiety, and Quality of Life in Patients With Depression

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Background: Increased prevalence of mental disorders has become a significant public health concern. Recent studies have linked nutrition to depression and anxiety, suggesting that dietary changes or nutritional supplementation may be beneficial in improving mental disorders. Polyphenols have anti-inflammatory and antioxidant properties that may counteract physiological changes in depression and anxiety. This study examined the effectiveness of polyphenol supplementation in improving depression, anxiety and quality of life (QoL).

Methods: Randomized controlled trials in English and with polyphenol supplementation as the intervention were searched. The primary outcome was depression, and secondary outcomes were anxiety and QoL. Only studies of at least moderate quality based on the Physiotherapy Evidence Database tool were included. Comprehensive systematic review and meta-analysis were then used to determine the effect of polyphenol supplementations on improving depression, anxiety and quality of life (QoL) in patients with depression.

Results: Nineteen studies with 1,523 participants were included; 18 studies ($n = 1,523$) were included in the depression meta-analysis, and 5 ($n = 188$) and 6 ($n = 391$) in the QoL and anxiety meta-analyses, respectively. Twelve of the 18 studies found significant improvements in depression with polyphenol use, while the meta-analyses results also indicated that polyphenol supplementation significantly improved depression score as compared to control conditions (MD: −2.280, 95% CI: −1.759, −0.133, $I^2 = 99.465$). Although subgroup analyses were conducted a significantly high heterogeneity was still found amongst subgroups. Only 2 of the 5 studies found significant improvements in QoL following polyphenol supplementation and meta-analyses found that polyphenol use did not benefit QoL (MD: −1.344, $p < 0.05$, $I^2 = 55.763$). For anxiety, 5 of the 6 studies found significant reductions in depression score following polyphenol use but meta-analyses found no significant differences in anxiety score (MD: −0.705, CI: −1.897, 0.487, $I^2 = 84.06$) between polyphenol supplementation and control.

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Conclusion: The results suggest that polyphenol supplementation is effective in improving depression. Physical illness may act as a risk factor that worsens depression, suggesting the need for preventative supplementation to improve depression. Polyphenol types may have varying effects, which suggests that different populations with depression may benefit from different polyphenols.

Keywords: depression, nutrition, quality of life, polyphenol, anxiety

INTRODUCTION

Major depressive disorder is a mood disorder characterized by depressed mood, anhedonia and altered cognitive function (1), and affects both psychological and physical functioning. Globally, depression has been identified as the leading cause of disability by the World Health Organization, and has been predicted to be the leading cause of disease burden by 2030 (2). Depression is a common comorbidity diagnosed among patients with chronic disease (3). In addition to depression, anxiety is another common mood disorder that affects patients diagnosed with physical illness because of increased concern about the implications of the diagnosis and stress associated with future disease management and lifestyle changes (3). In patients with chronic diseases, mood changes associated with comorbid depression and anxiety create barriers to achieving treatment adherence, and lifestyle changes critical to the management of disease (4), increasing disease severity and mortality rates (5).

Anxiety and depression are associated with poor physical and psychological well-being, which refers to quality of life (QoL) (6). QoL captures how a person perceives their overall health using a self-administered questionnaire that examines both physical and psychological well-being. This acts as an important outcome measure in patients with mental illness as it allows clinicians to understand the impact of the mental illness on patients' everyday life. Patients with comorbid depression have worse QoL, with depressed patients reporting poorer physical and psychological functioning compared with non-depressed patients (5). In postmenopausal women, depression can also significantly reduce QoL because of social impairment and cognitive dysfunction (7). Further, higher physical and psychological QoL score and overall health-related QoL have been associated with lower mortality risk (8), emphasizing the influence of mental illness on patients' perceived health and revealing the importance of QoL as a measure of patients' overall health.

Although there are various etiologies and factors that contribute to the onset of depression and anxiety, the pathophysiology of both mental illnesses is similar. Depression over-activates stress pathways (9), increases oxidative stress (10) and elevates inflammatory markers (11), resulting in altered neurotransmission, brain structural changes, mitochondrial dysfunction and neuron atrophy, which precipitate depressive symptoms (12). In a similar manner, anxiety is often triggered by overwhelming stress that results in increased oxidative stress (13) and heightened inflammatory state (14). Currently, a wide range of treatments are available for depressed and anxious patients, each targeting different etiologies. In recent years, links between nutrition and mental health have been found. Specifically, diets or supplements that are high in antioxidants and anti-inflammatories may be potentially therapeutic. A past randomized controlled trial (RCT) indicated that 6 weeks of antioxidant supplementation significantly increased plasma antioxidant levels in depressed individuals, which correlated with significantly reduced depression symptoms (15). Among the many different types of antioxidant supplementation available, polyphenols emerge as a class of antioxidant that provides a range of physiological benefits that help counteract both mental illnesses (16).

Polyphenols are natural compounds found in many plant products and are categorized into four classes: phenolic acids, flavonoids, stilbenes and lignans (17). As antioxidant agents, polyphenols exert their protective effects by upregulating the body's antioxidant reserve to reduce oxidative damage (18). Polyphenols also have anti-inflammatory properties that counteract increased inflammation in the pathophysiology of depression and anxiety. Other benefits of polyphenols include their ability to modulate cellular signaling pathways to provide neuro-protective effects and to reverse cognitive and behavioral deficits (18). Prior meta-analyses conducted on various plant extracts with polyphenols as the active nutrient have revealed significant improvements in depression associated with polyphenol supplement intake (19, 20). The effectiveness of polyphenol supplementation on improving mood and physical symptoms in specific populations, including menopausal women (21) and obese patients (22) have been indicated previously. However, the effectiveness of polyphenols in improving depression, QoL and anxiety across a range of populations is not known. Quality of life is an outcome that represents both physical and psychological well-being, while depression and anxiety are two of the most common mental disorders contributing to disabilities globally (23). These beneficial findings are limited to specific types of plant extract or diet (16), and no studies have investigated the effects of polyphenol supplementation and different types of polyphenol on depression. Thus, this meta-analysis aimed to address the gaps in current literature regarding the effectiveness of polyphenol supplementation in reduction of depression and anxiety symptoms and improvement of QoL.

Abbreviations: PEDro, Physiotherapy Evidence Database; PICO, Population, Intervention, Control, Outcome; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analysis; QoL, quality of life; RCT, randomized controlled trial.

METHODS

This systematic review and meta-analyses followed the Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) approach (24). The methodology utilized has also been registered with the International Prospective Register of Systematic Reviews (https://www.crd.york.ac.uk/prospero/, Registration ID: CRD42020200069).

Literature Search Strategy

The Population, Intervention, Control, Outcome (PICO) principle was utilized to search and identify relevant studies for this review. Two independent reviewers conducted advanced searches in PubMed, Scopus, Embase and Cochrane. The following keywords were used to identify relevant studies through advanced searches: (polyphenol OR phenolic acids OR flavonoids OR stilbenes OR lignans) AND (depression OR major depressive disorder) AND controlled studies. Reference lists of meta-analyses and systematic reviews published in the same field of research were also searched to identify additional studies. The literature search was not confined to any time frame to ensure as many relevant studies were included as possible.

Inclusion and Exclusion Criteria

The inclusion criteria for eligible studies in this meta-analysis were:

1. Participants were over 18 years in age.
2. Participants were diagnosed with depression by using an established diagnostic tool or diagnostic inventory or diagnostic scale.
3. The study design was an RCT. The intervention used was polyphenol supplementation including four main types of polyphenol (phenolic acids or flavonoids or stilbenes or lignans). The control conditions included placebo supplementation.
4. The outcome measures were depression, QoL and anxiety.

The exclusion criteria for the studies in this meta-analysis were:

1. Depression was only measured at follow-up.
2. There were insufficient data reported for analysis.
3. The results were only reported in graphs.
4. No control group was used.

Polyphenol supplementation is the only intervention examined to elucidate the effectiveness of polyphenol on depression, anxiety and QoL as compared to control conditions. Only adults over the age of 18 were included in this analysis as adult patients and children often have different presentations and respond to treatment differently and the difference in adult participants and children would contribute to further heterogeneity. Therefore, only adults over the age of 18 were included in this study.

Literature Screening and Data Extraction

We searched articles published between January 2000 to August 2021. All articles identified from the initial search were screened by two authors according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines. After duplicate studies were disregarded, two authors independently examined the eligibility for each study by reading the title and abstract to first identify any potentially relevant studies. Any discrepancies were resolved through discussion with a third author. The full text of relevant studies identified was then assessed against the inclusion and exclusion criteria.

Data were then extracted from studies that met the eligibility criteria by using a data-collection form. The data extracted were characteristics of the study and its participants, and included study design; study population; sample size; type of polyphenol supplementation; frequency, route and duration of polyphenol supplementation; and type of depression scale used. Outcomes measured from selected studies were also recorded. For studies with incomplete data, the authors were contacted. However, no responses were received.

Quality Assessment

Quality assessment was conducted on eligible studies using the Physiotherapy Evidence Database (PEDro) scale to assess their methodology. The PEDro scale includes 10 criteria: random allocation of subjects; allocation concealment; similarity at baseline between groups; attrition rate; blinding to subjects, assessors and researchers; use of "intention to treat" analysis; use of variability measures; and use of between-group comparison. Studies are classified into three levels according to quality: high quality (8 points or more), moderate quality (4–7 points) and low quality (3 points or less). Only studies of at least moderate quality were included in this study, and all studies included in this review scored at least 6 points on the PEDro scale.

Statistical Analysis

The extracted data of the included studies were analyzed using the Comprehensive Meta-Analysis software version 3. A separate meta-analysis was conducted for each outcome (depression, anxiety and QoL). The overall effect size was described using random-effects meta-analyses, while standardized mean difference and 95% confidence interval were determined for each outcome. Both pooled effect size and standardized mean difference were used to measure the effectiveness of polyphenol on depression, anxiety and QoL. I^2 statistics of heterogeneity were used to examine sample heterogeneity between studies. An $I^2 > 50\%$ or a $p < 0.05$ indicated significant heterogeneity.

Subgroup analyses were also conducted using data extracted regarding study and participant characteristics to identify potential mediating factors that might have influenced study outcomes. The factors examined for subgroup analysis included patient health status (healthy or has other pre-existing comorbidities), type of polyphenol supplementation used (isoflavone, hypericum extract or other), dose (<300, ≥ 300 mg), attrition rate (≥ 15, $<15\%$), supplement form (tablet, capsule, or other), duration of supplementation (≤ 3, >3 months), frequency (once or more than once a day) and type of depression scale used (self-rated or clinician-rated). Because of the lack of studies that measured anxiety and QoL outcomes, subgroup analyses were only conducted for depression.

For assessment of publication bias, Egger's regression analysis and visualization of funnel plots were used. In Egger's regression

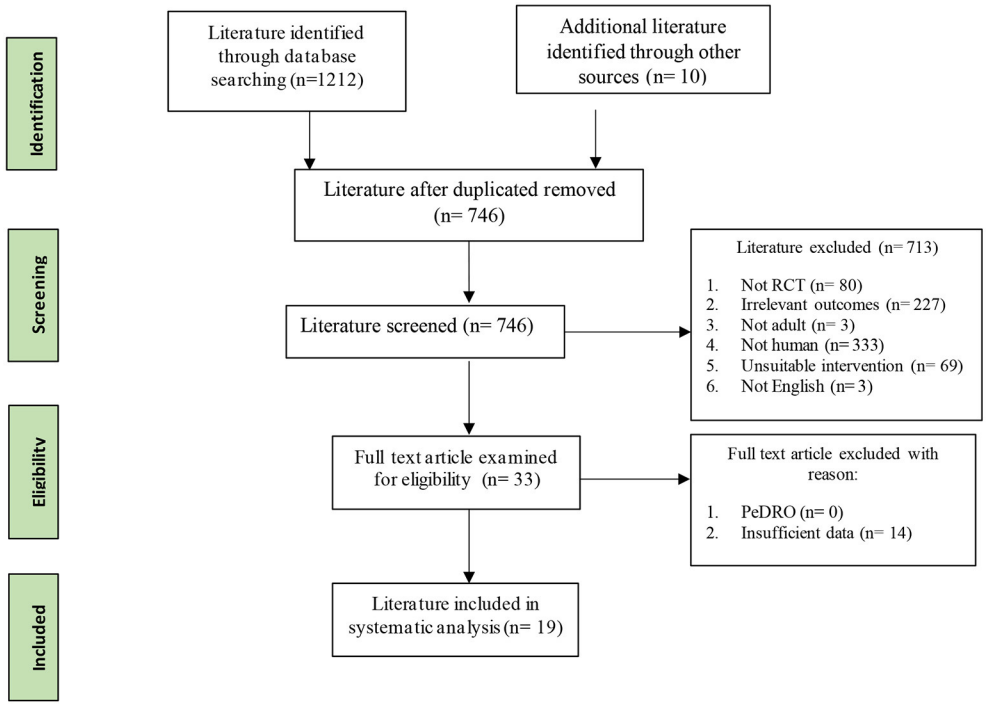


FIGURE 1 | PRISMA flowchart.

analysis, $p < 0.05$ indicates significant publication bias, while $p \geq 0.05$ suggests no significant publication bias. In addition, an asymmetrical funnel plot indicates possible publication bias, while a symmetrical funnel plot suggests no significant publication bias.

RESULTS

Search Results—PRISMA

As displayed in the PRISMA flowchart (**Figure 1**), 1,222 studies were identified in the initial search by two assessors. All identified articles were imported into EndNote, and 476 duplicates were removed. The remaining 746 studies were then screened for relevance by using titles and abstracts. Of these, 713 did not fulfill the inclusion criteria and were excluded (227 measured irrelevant outcomes; 69 used irrelevant interventions; 333 were not human studies; 3 included non-adult participants; 80 were not RCTs; 1 was not in English). Data were then extracted from the remaining 33 studies that met the inclusion criteria. However, insufficient data were reported from 15 studies. Thus, 19 studies were included in the final analysis. All included studies were of at least of moderate quality on the Pedro scale, scoring above 6 (see **Supplementary Table 1**).

Characteristics of Included Studies

The detailed characteristics of included studies are displayed in **Table 1**. A total of 1,523 participants were included in the 19 RCTs. These studies were performed across primary, secondary and tertiary settings in Israel, Germany, Spain, Australia, Brazil, Iran, Norway, Austria, the United States, Taiwan and Korea. Eighteen studies included were analyzed for depression, while five were analyzed for QoL and six for anxiety. Of the 19 studies included, eight were designed for patients with other pre-existing health conditions and 11 were designed for participants who were only diagnosed with depression and no other comorbidities. In terms of type of polyphenol supplementation used, six studies used isoflavone, four used hypericum and eight used other types of polyphenol supplementation.

Polyphenol Supplementation

A range of polyphenols were assessed in the 19 articles included in this study. Six studies used isoflavone, 4 studies used hypericum, and 4 studies used curcumin. Other polyphenol supplementation used included genistein, cognigrape extract, cocoa extract, N. menthoides and pycnogenol. In terms of dosage, 8 studies used polyphenol supplements with a dosage $<$300 mg, while 11 studies used polyphenol supplements with a dosage $\geq$ 300 mg. A range of supplement formulation was used amongst the included studies. Nine studies administered the supplement in the form of a capsule, 7 studies provided tablet supplementation, while the remaining 3 studies administered polyphenol through ready to eat meals, pill formulation and powder. The amount of times polyphenol supplementation was administered within a day also differed. Seven studies administered supplementation once a day, participants from 9 studies took the supplement more than once a day, while 3 studies did not report the frequency of supplementation intake in a day. Another difference between studies was the

TABLE 1 | Summary of studies included in meta-analysis.

References	Design & location	Duration of treatment (months)	Route of administration	Depression/ anxiety/ QoL scale used	Population	Intervention			Control					Quality of study
						Participants (n)	Mean age (SD)	Sex M (F)	Intervention	Participants (n)	Mean age (SD)	Sex M (F)	Control	Key intervention outcomes standardized mean difference (intervention/ control)	
Atteritano et al. (25)	DB, USA	24.00	Oral	Zung Self-rating depression scale/-/36-Item Short Form Survey	Osteopenic post-menopausal women	139	53.0 (2.0)	0 (139)	Genistein	39	52.0 (2.0)	0 (123)	placebo tablet (vit D and calcium carbonate)	Depression (-5/2)	9/11
Bergman et al. (26)	DB, Israel	1.25	Oral	Hamilton Depression Rating Scale, Motgomery-Asberg Depression Scale/-/-	Patients with first episode of depression	20	65.8 (10.7)	11 (9)	Curcumin	12	61.3 (15.2)	6 (14)	placebo capsule	Depression (-2/-1.5)	9/11
Bjerkenstedt et al. (27)	DB, Sweden	1.00	Oral	Hamilton Depression Rating Scale, Motgomery-Asberg Depression Scale/-/-	Patients with mild to moderate depression	52	49.1 (12.0)	11 (43)	Hypericum extract	20	51.4 (11.8)	10 (45)	placebo tablet	Depression (9.9/9.7)	10/11
Calapai et al. (28)	DB, Italy	3.00	Oral	Beck Depression Inventory, Hospital Anxiety and Depression Scale, Mini Mental State Examination/-/-	Healthy older adults	57	66.9 (5.3)	27 (30)	Cognigrape extract	60	66.9 (5.2)	26 (28)	maltodextrin	Depression (1.3/0.1)	10/11
de Sousa-Munoz and Filizola (29)	DB, Brazil	4.00	Oral	Center for Epidemiological Studies Depression/-/-	climacteric outpatients	39	-	-	Isoflavone	73	-	-	placebo tablet	Depression (-4.3/-3.6)	7/11
Firoozabadi et al. (30)	DB. Iran	1.00	Oral	Beck Depression Inventory/Beck Anxiety Inventory/-	Patients with anxiety and depression	34			N. menthoides	42	36 (9.8)	9 (27)		QoL (-11.8/-5)	11/11
Hirose et al. (31)	DB, Japan	2.00	Oral	Hospital Anxiety and Depression Scale/-/Menopausal Symptom Scale	Menopausal women	29	47.6 (4.9)	0 (29)	Isoflavone	29	48.0 (5.7)	0 (29)	Placebo tablet	Depression (-1.1/-0.3), QoL (-1.2/ 1)	8/11
Davidson et al. (32)	DB, USA	6.25	Oral	Hamilton Depression Rating Scale/-/-	Patients with major depressive disorder	113	43.1 (13.5)	40 (73)	Hypericum extract	16	40.1 (12.2)	39 (77)	Placebo	Depression (-7.8/−6.8)	8/11
Ibero-Baraibar et al. (33)	RCT, Spain	1.00	Oral	Beck Depression Inventor/Spanish translation of the State–Trait Anxiety Inventory/-	Overweight or obese adult	23	58.0 (5.6)	11 (12)	Cocoa extract	30	57.0 (5.0)	11 (13)	Lactose	Depression (-3.7/-5.7), Anxiety(-0.8/1.2)	8/11

(Continued)

TABLE 1 | Continued

References	Design & location	Duration of treatment (months)	Route of administration	Depression/ anxiety/ QoL scale used	Population	Intervention			Control					Quality of study
						Participants (n)	Mean age (SD)	Sex M (F)	Intervention	Participants (n)	Mean age (SD)	Sex M (F)	Control	Key intervention outcomes standardized mean difference (intervention/ control)	
Ishiwata et al. (34)	RCT, Japan	3.00	Oral	Profile of Mood States/Profile of Mood States/ Menopausal Symptom Scale	Menopausal women	10	50.5 (4.7)	0 (10)	Isoflavone	25	50.6 (4.9)	0 (14)	placebo capsule	Depression (1.8/ 0.1), QoL (4.9/6.2), Anxiety (-0.7/0.6)	8/11
Kanchanatawan et al. (35)	DB, Thailand	3.00	Oral	Montgomery-Asberg Depression Rating Scale/-/-	Patients with major depressive disorder	33	42.6 (13.6)	9 (27)	Curcumin	1,046	46.2 (13.4)	10 (22)	Placebo tablet	Depression (-15/-7)	8/11
Lingaerde et al. (36)	DB, Norway	2.25	Oral	Montgomery-Asberg Depression Rating Scale/-/Visual Analog Scale	Patients with seasonal affective disorder	15	40.6 (8.0)	4 (11)	Flavone	1,046	40.1 (10.5)	2 (10)	Placebo tablet	Depression (7.3/4.7)	8/11
Lipovac et al. (21)	DB, Austria	3.00	Oral	Hospital Anxiety and Depression Scale/Hospital Anxiety and Depression Scale/-	Post-menopausal women	50	54.5 (6.2)	0 (50)	Isoflavone	26	53.7 (7.8)	0 (59)	Placebo capsule	Depression (-7.4/-1.7), Anxiety (-7.6/-1.9)	9/11
Lopresti et al. (37)	DB, Australia	2.00	Oral	Inventory of Depressive Symptomatology/ Spielberger State-Trait Anxiety Inventory/-	Patients with major depressive disorder	28	44.0 (11.9)	8 (20)	Curcumin	9	48.5 (11.7)	8 (20)	Cellulose capsule	Depression (-10.3/-7.2), Anxiety (-9.7/-7.1)	10/11
Miodownik et al. (38)	DB, Isarel	6	Oral	Calgary Depression Scale/-/-	Patients with chronic schizophrenia	20	54.1 (12.9)	14 (6)	Curcumin	36	53.4 (14.9)	11 (7)	Placebo capsule	Depression (-1.4/−1.1)	8/11
Rapaport et al. (39)	RCT, USA	3	Oral	Hamilton Depression Rating Scale/-/Quality of Life Enjoyment and Satisfaction Questionnaire	Patients with minor depression	26	42.2 (14.1)	13 (13)	St. John's Wart	1,458	51.4 (16.6)	12 (11)	Placebo tablet	Depression (-5.6/-7.1), QoL (7.2/9)	10/11
Jung-Gum et al. (40)	DB, Korea	3	Oral	Beck Depression Inventory/-/Visual Analog Scale	Single Women	16	25.9 (4.8)	0 (16)	Hypericum extract	26	25.6 (4.3)	0 (14)	Lactose, cellulose	Depression (2.5/ 1.3), QoL (0.1/ 0.4)	7/11
Santos-Galduróz et al. (41)	DB, Brazil	4.00	Oral	Geriatric Depression Scale/-/-	Menopausal Women	19	54.4 (4.3)	0 (19)	Isoflavone	94	56.6 (3.6)	0 (19)	Placebo tablet	Depression (-2.7/-5.1)	6/11
Yang et al. (42)	DB, Taiwan	6.00	Oral	Women's Heath Questionnaire/ Women's Health Questionnaire/-	Peri-menopausal Women	80	46.7 (5.1)	0 (80)	Pycnogenol	44	47.0 (4.2)	0 (75)	Placebo capsule	Depression (0.4/0), Anxiety (0.4/0.02)	8/11

duration of the supplementation period, with 13 studies having a supplementation period ≤3 months and 6 studies with a supplementation period >3 months.

Polyphenol Supplementation Treatment Effects

Effects on Depression

The effect of polyphenol supplementation on depression was reported by 18 of the included studies with a total sample of 1,523 participants. Overall, majority of the studies included found a significant association with polyphenol use and improvement in depression scores. The effect of polyphenol on depression and other outcomes have been summarized in **Table 2**. Twelve of the 18 studies included for analyses found significant association improvement in depression scores after polyphenol supplementation while 6 studies found no statistically significant improvements associated with polyphenol used. Both self-rated and clinician rated depression scales were used to determine the participants depression score. Six studies used self-rated depression scales and 13 studies used clinician rated depression scales. Both studies with patient populations with and without other comorbidities were included. Ten studies had patients that were otherwise healthy (26–29, 32, 35, 36, 39–41) and 8 studies had patients diagnosed with additional comorbidities. A proportion of the studies ($n = 6$) examined menopausal women (21, 25, 29, 31, 34, 42). Other comorbidities within patient populations included obesity (33) and schizophrenia (38). Some of the studies found significant improvements in systematic symptoms such as fatigue and insomnia (29, 31). Other studies have also identified improved somatic symptoms, especially amongst post-menopausal populations.

The estimated mean difference in depression score was −2.280 (CI: −1.759, −0.133), which suggested significant improvements in depression associated with polyphenol supplementations. Significant heterogeneity between the studies included ($I^2 = 99.465\%$, $p = <0.05$) were noted. Forest plots for the effect of polyphenol on depression has also been provided in **Figure 2**.

TABLE 2 | Standardized mean difference and effect size of polyphenol intervention on depression, anxiety and QoL.

			Mean difference			Effect size		
Variables	**Studies (n)**	**Participants**	**MD (95% CI)**	**I^2 (%)**	**Q-test**	**Effect size (95% CI)**	**I^2 (%)**	**Q-test**
Depression	18	1,523	−2.280 (−1.759, −0.133)*	99.465*	3179.05	−0.1562 (−1.076, 0.758)	98.128*	907.925
Anxiety	6	461	−0.705 (−1.8978, 0.487)	84.06***	37.641	−0.217 (−0.777, 0.342)	82.454***	34.197
QoL	5	188	−1.344 (−2.300, −0.387)*	55.763	9.042	−0.530 (−1.077, 0.017)	68.980*	12.895

*$p \leq 0.05$, ***$p \leq 0.001$.
QoL, Quality of life.

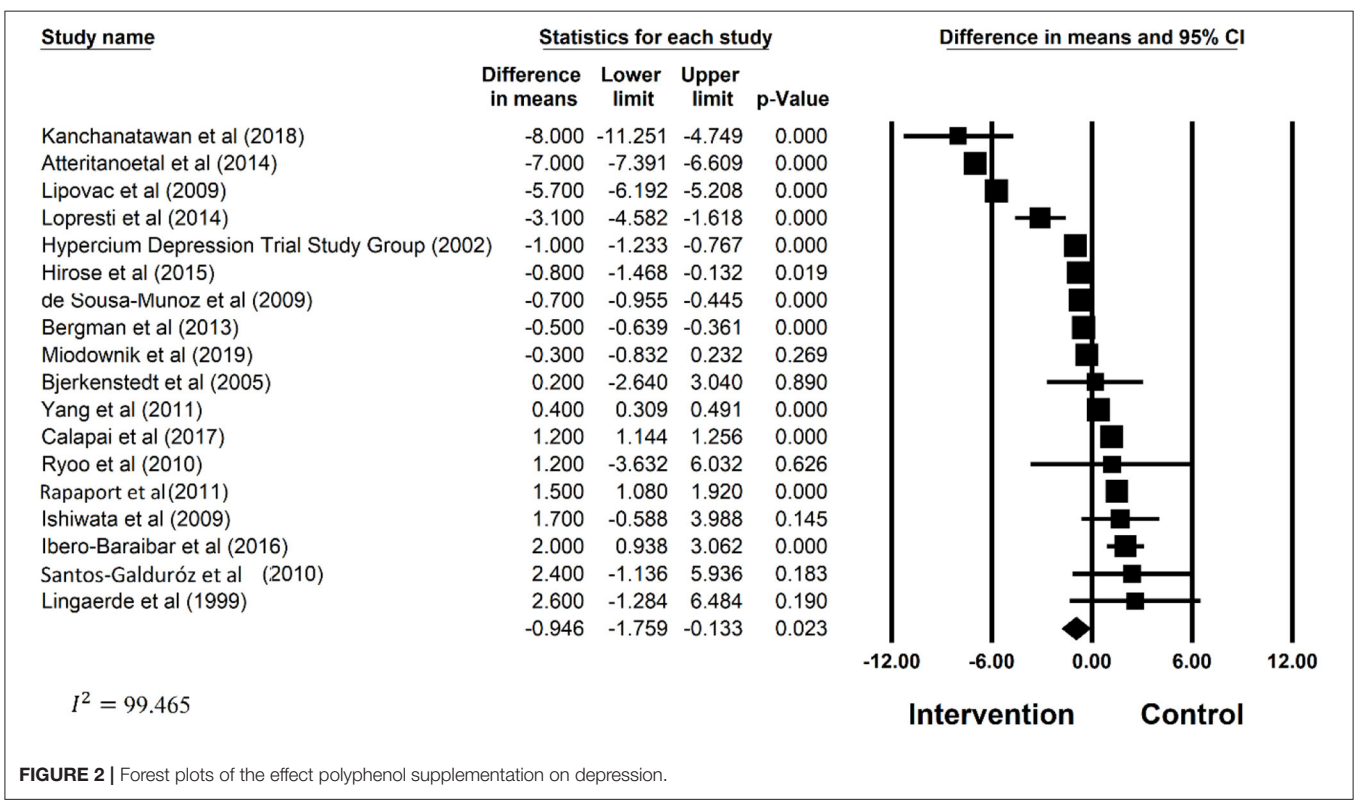


FIGURE 2 | Forest plots of the effect polyphenol supplementation on depression.

TABLE 3 | Subgroup analysis on the effect of polyphenol on depression.

Subgroups	Effect size					
	Studies (n)	Participants	I^2 (%)	Q-test	Effect size (95% CI)	*P*-value
Health status						
Pre-existing condition	8	731	98.746	558.026	−0.652 (−0.841, −0.463)	<0.001
Healthy	10	792	97.414	348.075	−0.481 (−0.641, −0.321)	<0.001
Drop out						
>/= 15%	4	463	98.053	154.110	0.061 (−0.138, 0.261)	0.548
< 15%	14	1,060	98.132	695.755	−0.921 (−1.075, −0.766)	<0.001
Duration						
</= 3 months	10	798	97.629	463.938	−0.218 (−0.395, −0.040)	0.016
> 3months	8	725	98.803	417.870	−0.857 (−1.025, −0.687)	<0.001
Form						
Tablet	8	568	98.573	490.402	−0.339 (−0.535, −0.143)	0.0007
Capsule	7	745	98.314	355.773	−0.925 (−1.094, −0.755)	<0.001
Others	3	210	43.198	3.521	0.676 (0.270, 1.082)	0.001
Type of supplement						
Isoflavone	6	332	96.465	141.457	−0.891 (−1.145, −0.636)	<0.001
Hypercium extract/SJW	4	417	96.228	79.534	−0.398 (−0.602, −0.194)	<0.001
Others	8	774	98.967	677.651	−0.499 (−0.689, −0.308)	<0.001
Treatment frequency						
Once a day	6	432	98.058	257.523	−0.168 (−0.394, 0.057)	0.144
More than once a day	9	671	95.238	168.351	−0.178 (−0.340, −0.015)	0.032
Others/not reported	3	420	99.212	253.761	−2.902 (−3.230, −2.574)	<0.001
Dosage						
< 300 mg	8	705	98.830	598.154	−1.380 (−1.597, −1.163)	<0.001
>/= 300 mg	10	818	96.050	227.822	−0.167 (−0.315, −0.019)	0.027
Type of depression scale used						
Self-rating		799	98.811	672.661	−0.262 (−0.445, −0.076)	0.005
Clinician Rated		724	96.238	217.847	−0.786 (−0.950, −0.621)	<0.001

TABLE 4 | Egger's regression analysis on publication bias of included studies.

Outcomes	Studies(n)	*T*-value	95% CI	*P*-value
Depression	18	2.095	−15.265, 0.090	0.052
QoL	5	0.300	−8.063, 6.491	0.779
Anxiety	6	2.141	−31.528, 6.171	0.122

Subgroup analysis on patient health status, type of polyphenol supplementation used, dosage, attrition rate, supplement form, duration of other supplementation, frequency and type of depression scale was examined. The results of subgroup analysis has been displayed in **Table 3**. Polyphenol supplementation were significantly more effective in improving depression in patients with other pre-existing comorbidities (Effect Size: −0.652, $p < 0.001$) as compared to depressed patients without other pre-existing comorbidities. In terms of the type of polyphenol supplementation used, isoflavone (Effect Size: −0.891, $p < 0.001$) was most effective in improving depression followed by other types of polyphenol (Effect Size: −0.499, $p < 0.001$) and lastly, hypercium extract (Effect Size: −0.398, $p < 0.001$). Additionally, polyphenol supplements were most effective in reducing depression when supplements were administered in capsule form (Effect Size: −0.925, $p < 0.05$), followed by other forms (Effect Size: 0.676, $p < 0.001$), then tablet form (Effect Size: −0.339, $p < 0.001$). Subgroup analysis also found that polyphenol supplementation was more effective in improving depression in studies with the following study characteristics: attrition rate <15%, study duration >3 months, studies with polyphenol dosage < 300 mg, and studies where a clinician rated depression scale was used. Despite the stratification of several significant mediating factors, the heterogeneity still remained high for the studies within each subgroup.

Effects on Anxiety

Six articles ($n = 461$) included in this study measured the effects of polyphenol supplementation on anxiety scores. The majority of the studies ($n = 5$) found a statistically significant improvement with anxiety score following the use of polyphenol supplementation. One study (21) found a significant improvement in anxiety score by 76% following polyphenol supplementation as compared to a 21.7% improvement in the placebo group. Another study also found significant improvements in anxiety throughout the 6 months

supplementation period (42). The anxiety score improved from baseline of 2.85–3.27 after 3 months of supplementation and remained at 3.27 following 6 months of supplementation, while the placebo group had no significant improvements in anxiety score at all time points.

Two of the studies included post-menopausal and peri-menopausal female participants and thus utilized scales specific to women including the Menopausal symptom scale and the Women Health Questionnaire (WHQ) to measure anxiety score (34, 42). Two other studies both used State-Trait Anxiety Inventory (STAI) (37), with one of the study using a validated Spanish translation version for the Spanish population (33). Lastly, one study used the Hospital Anxiety and Depression Scale (HADS) to assess anxiety (31), and another study using the Beck Anxiety Inventory (BAI) (30). Five of the 6 studies also measured depression.

The mean difference in anxiety score between supplementation group and control was −0.705 (CI: −1.897, 0.487) with significant level of heterogeneity ($I^2 = 84.06$, $p < 0.05$) No further subgroup analysis could be conducted due to the lack of studies in each subgroup.

Effects on Quality of Life

To determine the effectiveness of polyphenol supplementation on QoL, 5 studies with a population size of 188 were included. In comparison to depression and anxiety outcomes, less than half ($n = 2$) of the studies reported a statistically significant association between polyphenol supplementation and improved QoL. Both physical and psychological aspects of QoL was measured across the studies included. Two studies used visual analog scales (VAS) to measure a range of QoL related factors including energy level, tiredness, appetite, and depression (36, 40). One study used the Menopausal Symptom Scale (MSS) to measure physical symptoms and mood (34). Another study used Quality of Life Enjoyment & Satisfaction questionnaire (Q-LES-Q) (39), and one study used Athens Insomnia Scale (AIS) (31). All five studies included for QoL assessment also measured depression and one of the studies also reported anxiety results. One study found significant improvements in somatic and vasomotor symptoms associated with menopause following polyphenol supplementation (34). Another study also found significant improvements in somatic symptoms in menopausal women, as well as improved insomnia (34). Overall, only studies with populations of menopausal women found significant improvements in Qol (31, 34). In contrast, in a study with a population of women with an average age of 25.7, no significant improvements in premenstrual syndrome symptoms including fatigue or mood were found (40). Other 2 studies that included participants without other comorbidities also found no significant improvements in QoL (36, 39, 40).

A significant mean difference of −1.344 (95% CI: −2.300, −0.387) in QoL score was estimated, indicating that polyphenol supplementation did not result in an improvement in Qol when compared to placebo. Although statistically insignificant, a significant level of heterogeneity ($I^2 = 55.763$, $p = 0.060$) was found. No further subgroup analysis was conducted due to the lack of studies in each subgroup.

Publication Bias

The results of publication bias assessment has been presented in **Table 4**. Egger's regression analysis indicated that no significant publication bias was found for all outcomes—depression, anxiety and QoL. The funnel plots for all outcomes were symmetrically dispersed, further indicating minimal publication bias.

DISCUSSION

Effects on Depression

In line with prior studies, this meta-analysis found that polyphenol supplementation significantly reduced depression score compared with the control. A past meta-analysis found significant associations between consumption of Mediterranean diets high in polyphenols and improved depression score and reduced depression symptoms (16). Many included studies tested the effectiveness of polyphenol supplementation on depressed individuals with other comorbidities. Previous studies as well as studies included in this review found significant improvements in somatic symptoms that contributes to depression (34, 43). The reduced severity of physical symptoms may help explain improved depression in populations with additional comorbidities reviewed in this study. Those with pre-existing conditions and chronic illnesses are often associated with worsened depression outcomes and symptoms (44, 45). Progression of depression also positively correlated with progression of chronic disease (45). The worsened depression state in patients with chronic conditions may be explained by the effects of somatic symptoms including chronic fatigue and pain linked with their physical illnesses (3). This suggest that physical illness and especially chronic conditions may pose as a threat on patient's mental health due to increased stress from the diagnosis, management, and economic burden of disease (44). Thus, participants with pre-existing conditions may have a greater depression score due to the impact of their physical illness on their mental health. Patients with pre-existing conditions may also benefit from polyphenol supplementations more than those without pre-existing conditions.

Among participants with pre-existing conditions in this meta-analysis, a notable proportion were from studies with postmenopausal women. Depression in this population is often associated with increased oxidative stress linked to reduced estrogen levels (46) due to loss of ovarian and follicle development after menopause. Estrogen has antioxidant properties, so the lowered estrogen levels increase the risk of various physical illnesses including cardiovascular disease, stroke and depression. Polyphenols have antioxidant properties that can counteract the elevated oxidative stress following menopause. Prior studies have also demonstrated that polyphenols' antioxidant properties may help improve depression through targeting neuronal survival, regeneration and development (47). Further, as a lipid-rich organ, the brain is highly susceptible to oxidative damage (48), meaning that improved antioxidant status from polyphenol supplementation may further aid in countering depression-induced disturbances in neurotransmission.

Thus, with polyphenol's potent antioxidant and anti-inflammatory properties, all types of polyphenols analyzed in this study resulted in a significant improvement in depression score. Although all supplements included in this review are classified as polyphenols, each supplement have additional benefits that may improve depressive mood in different ways. Isoflavone is considered as phytoestrogens that is often used a supplement post-menopause as they exert estrogen-like effects that decline after menopause. In line with this study, previous meta-analyses have indicated that phytoestrogens with isoflavone as the active ingredient had a significant positive effect in postmenopausal women with depression and anxiety disorders (21, 49). The additional estrogen-like effects that isoflavone has may improve depression as estrogen interacts with dopaminergic, serotonergic, and cholinergic systems, and brain regions involved in the control of mood and higher cognitive functions (50). Thus, the additional benefits of isoflavone as a phytoestrogen may explain why isoflavone appears to be the most effective polyphenol in improving depression. Nonetheless, this review demonstrated that polyphenols supplementation may improve depression regardless of the type of polyphenol supplemented.

A variety of depression scales were also used amongst the studies included for review, which may have affected the results. Past studies have also showed varying results regarding self-assessed and clinician assessed depression scores. One study indicated moderate to strong correlations between self-reported questionnaires and clinician-rated depression scales (51), while another indicated that self-reported and clinician-assessed depression scores are not equivalent (52). Despite the discrepancies, both methods have been recognized as a valid measure of depression in clinical studies. One study demonstrated a slight advantage with the use of clinician-rated scales and hypothesized that clinician-rated depressions scales may be more sensitive to change (53). However, because of the small number of papers collected for this study, further study needs to focus on more objective and sensitive measures in depression. Further, because of differences in results, some investigators have suggested the need to include both measures for a more complete assessment (52).

Effects on Anxiety

Although 5 of the 6 studies included identified a significant improvement in anxiety score following polyphenol supplementation, no significant improvements were found through meta-analyses. This differed from previous studies that found previous meta-analyses have indicated that phytoestrogens with isoflavone as the active ingredient had a significant positive effect in postmenopausal women with depression and anxiety disorders (21). The difference in results may be due to the similarity between anxiety and depression symptoms, making it difficult to distinguish especially when utilizing a self-rating scale. The use of self-administered questionnaires to assess depression and anxiety may not be as sensitive as clinician-rated scales (53), and may only measure general psychological distress (54). Moreover, patients experiencing psychological distress are often comorbid with both depression and anxiety, further complicating the assessment process (55).

Effects on Quality of Life

Two of the 5 studies included in the meta-analysis found significant improvements in QoL. However, the overall meta-analyses result found that polyphenol supplementation was not associated with improved overall QoL score. The 2 studies that found a significant association both examined the effects of polyphenol on women with menopause (31, 34), suggesting that the beneficial effect of polyphenol on QoL may be limited to menopausal women. Both studies found significant improvements in various aspects of menopausal symptoms, including significantly reduced depression, anxiety and somatic symptoms.

The significant improvements in physical functioning and mental health in populations of menopausal women may be associated with the beneficial antioxidant effects of polyphenol. Following menopause, oxidative stress increases with reduced estrogen levels (46). Polyphenols have antioxidant properties that can target depression through targeting neuronal survival, regeneration and development (47) and physical functioning by reducing fatigue and pain (33, 56). Thus, polyphenol supplementation may potentially target both impacted mental health and physical functioning in menopause to result in an improvement in overall QoL.

In contrast, 3 studies included in the analyses found no significant improvement in QoL. Although meta-analyses in this study found significant mean difference in QoL following polyphenol use, the significant difference found did not favor polyphenol use. The non-beneficial effect found here may be due to the lack of studies included for QoL analysis. Of the 18 studies included for depression meta-analyses only 5 measured QoL outcomes, which reduced the power of the meta-analyses results for QoL. To determine the effects of polyphenol on QoL, more studies must be included in future meta-analyses. Effects on physical functioning could also be analyzed in addition to mental health to elucidate the overall effect of polyphenol on QoL.

Limitations

This study included 19 RCTs that used polyphenol supplementation as an intervention for depression or anxiety treatment and yielded high quality results. However, one significant limitation is the high level of significant heterogeneity found amongst the studies included. Despite the conduction of subgroup analysis, the heterogeneity remained high within subgroups stratified. The high level of heterogeneity may be explained by the varied dosage, forms of polyphenol supplementation and duration of intervention use. Another limitation is the disproportionately high number of females included in the analysis, as many of the studies examined the use of polyphenol supplementation in post-menopause women. The population examined in this study also only included adult participants over the age of 18, which limits the applicability of the results. Lastly, the results of this study are limited to the short term effects of polyphenol supplementation as the supplementation were only administered for <4 months in most

studies. Thus, given these limitations, the results of this study must be read and interpreted with caution.

CONCLUSION

Findings from this meta-analyses and systematic review have demonstrated the effectiveness of a range of polyphenol supplementation on reducing depression level and improving anxiety. A range of different polyphenol supplementations was investigated across the current literature and both participants with and without additional comorbidities other than depression have also been studied. This review found that a great proportion of the included studies had female participants only and aimed to investigate the effectiveness of polyphenol supplementation on psychological symptoms surrounding menopause. Thus, a gap in literature exists between the effectiveness of polyphenols on men. Meta-analyses results found no significant association between polyphenol use and anxiety, while polyphenol use did not improve QoL. Nevertheless, all types of polyphenol supplementation analyzed in this study produced a significant improvement in depression score, providing substantial evidence that supports the links between use of polyphenol supplementation and mental disorders. The significant improvement in depression further supports the addition of polyphenol as an adjunct nutrient to complement current treatment regimes.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

JS has contributed to study design, conceptualization of the study and study design, supervision of the study team, analyzed data, and wrote up of the manuscript. KL contributed to the literature search, data extraction, and draft write up. YL contributed to the literature search. ET and LW contributed to the critical review of the manuscript. All authors contributed to the article and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyt.2021.765485/full#supplementary-material

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Food Insecurity and Bullying Victimization Among 170,618 Adolescents in 59 Countries

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Background: Bullying victimization can impose long-lasting impacts on adolescent's current and subsequent well-being. Understanding the correlates of bullying victimization and how to prevent its occurrence is an urgent need. Food insecurity, an indicator of low socioeconomic status, may be related to bullying victimization. However, research on the association between food insecurity and bullying victimization is limited. Using a representative global sample, this study aimed to investigate the association between food insecurity and bullying victimization in adolescents and whether the association varied between country income levels, sexes, and age groups.

Methods: Using cross-sectional, school-based data by 170,618 adolescents in 59 countries from the Global School-based Student Health Survey, multivariable logistic regression and meta-analysis were conducted to investigate the overall, country-stratified, sex-stratified, and age-stratified associations.

Results: The prevalence of bullying victimization was 33.3%. In the total sample, adolescents with food insecurity showed significantly higher odds for bullying victimization than those without no food insecurity with a pooled odds ratio (OR) being 1.37 (1.28, 1.47). Further, the association was stronger in higher-income countries, females, and older adolescents.

Conclusions: Bullying victimization is prevalent among global adolescents with food insecurity being a significant correlate. The identification of adolescents with perceptions of food insecurity and remedying this condition may be important to reduce the prevalence of bullying. This highlights the need to design and implement sex- and age-specific interventions focusing on remedying food insecurity and bullying victimization among in-school adolescents by taking country income levels into account.

Keywords: food insecurity, bully victimization, adolescents, Global School-based Student Health Survey, meta-analysis

INTRODUCTION

Bullying victimization can be defined as the experience of any intentional physical (e.g., hitting), verbal (e.g., abusive), and psychological aggression from peers, which are repeated and intended to cause harm (1). Increasing evidence indicates that being bullied is a common phenomenon during childhood and adolescence. Recently, a global survey revealed that the estimated prevalence of bullying victimization was 30.5%, with the highest proportion being 45.1% in the Eastern Mediterranean region (2). Besides, data from 11 European countries indicated that almost 30% of adolescents are bullied by their peers (3), whilst 37% of American adolescents reported being bullied (4). Evidence from South Asia suggested that 41 to 53% of students experienced bullying (5–7), and a high prevalence of being bullied was also found in Chinese adolescents, where 35.6% and 31.4% of samples experienced traditional bullying and cyberbullying, respectively (8). The risks of being bullied have been well documented, including aggression (9), violence-related behaviors (10), worse academic performance (11, 12), substance misuse (e.g., problematic alcohol use) (11, 13), disorder eating behaviors, depressive symptoms (11, 13), and even suicide ideation (14, 15). Furthermore, being bullied during childhood and adolescence can have long-lasting impacts on later life (16, 17). Owing to the harms of bullying victimization in adolescents, it is important to prevent the occurrence of bullying victimization in adolescents.

A prior and necessary step to preventing bullying victimization is understanding its correlates. Some theories and conceptual frameworks have been applied or proposed to elucidate the dynamics or organize various factors of bullying involvement in recent years. Based on these theories, socioeconomic status (SES) may be an important factor in explaining bullying. Specifically, grounded in general strain theory, experiencing economic problems was identified as a strong signal of bullying by social big data analysis (18). According to social disorganization theory, environments with a high concentration of poverty are more likely to experience disorganization and may increase the risk of developing attitudes and behaviors that are related to bullying (19). Similarly, based on socio-ecological theory, socioeconomic status may play a role in bullying (20). Regarding social capital theory, it can be assumed that low social status (e.g., low SES) serves to maintain bullying victimization (21). Despite the theories mentioned above focusing on the occurrence of bullying perpetration (rather than bullying victimization), some empirical studies have also documented the association between low SES or poverty and bullying victimization. However, effect sizes reported in these studies vary greatly, with some studies reporting moderate to strong associations (22, 23) whilst others reporting weak ones (24). To determine more precisely the exact nature and strength of the relationship between SES and bullying, Tippett and Wolke conducted the first systematic review and meta-analysis and concluded that poverty or low SES was associated with a higher probability of bully victimization (25). Besides, they pointed out that the strength of association between SES and bullying might differ between SES indicators. Different indicators of SES assess distinct aspects of social status and thus may influence adolescent's development in unique ways. Besides, some studies show that subjective SES (i.e., individual perceptions) was more predictive of adverse health outcomes than objective SES (e.g., household income, parental education) (26–28). However, in existing studies investigating the association between SES and bullying, SES was mainly indicated by household income or parental education (25). This may have failed to identify families experiencing the most extreme forms of low SES involving material deprivation (consistently unable to pay for basic necessities), because, for families with the same income level, there may be remarkable variation in access to these resources due to differences in family size, lifestyle, residence, etc.

Food insecurity refers to the lack of adequate nutrition and safe food, or the inability to obtain food in a socially acceptable manner (e.g., resorting to emergency food supply and stealing food) (29). Food insecurity and low SES, despite being discrete constructs, are closely related. Low SES can result in inadequate access to food, and thus subsequently lead to food insecurity (30). Hence, individual perceptions of food insecurity or hunger often coexist with low SES (31) and could be regarded as a subjective measure of SES. Besides, as aforementioned, low SES is a multi-dimensional phenomenon while food insecurity can be viewed as one marker that can capture material deprivation resulting from extreme low SES. Indeed, studies revealed that food insecurity could add additional independent influence on children and adolescent's health outcomes above and beyond the detrimental impact of low SES (32, 33). Long-term food insecurity or perpetuated hunger has adverse impacts on individual's physical and mental health, leading to undesirable developmental outcomes in adolescents, including nutritional deficiencies, obesity, poor academic performance, and even mental disorders (e.g., depression and anxiety) (33–35). These adverse outcomes would further pose adolescents at a high risk of being bullied as those being too distinct from peers (e.g., too short, too tall, too heavy, too skinny, or not smart enough) often become targets for bullying victims (21). With the potential pathway from food insecurity to bullying victimization, food insecurity may be a factor that might underpin bullying victimization.

Indeed, some studies have empirically examined the connection between food insecurity and bullying, but the results are inconsistent and far from consensual. A previous study with a representative US sample found that food-insecure students were more likely to be victims of bullying than their counterparts (36). Another study using data from the School-based Student Health Survey (GSHS) indicated that Algerian adolescents who experienced food insecurity were more likely to report suffering from bullying victimization compared with their counterparts (37). Of note, also using data from the GSHS, research on adolescents in Ghana revealed limited or no association between food insecurity and bully victimization (38). Part of the reason for these inconsistent results may be that the study samples were from different countries. Previous research found that the association between food insecurity and suicide attempts was stronger in countries with a lower prevalence of food insecurity (i.e., higher-income countries) (39), which suggests that the impact of food insecurity may vary between country

income levels. Besides, previous research has shown that sex and age were significant correlates of food insecurity and bullying victimization (40). However, the moderating effects of sex and age on the association between SES or food insecurity and bullying remain unclear given the small number of studies on this topic. Therefore, based on the representative multi-country data from the GSHS, this study aimed to explore the association between food insecurity and bullying victimization among adolescents globally and to examine whether the association varies between country income levels, sexes, and age groups.

METHODS

Study Survey

The GSHS was implemented to identify the risks and protective factors of major non-communicable diseases among school-aged adolescents. Participating countries selected core modules from GSHS Questionnaire addressing the leading causes of morbidity and mortality among children and adults worldwide (e.g., dietary behaviors, physical activity, mental health) in their country-specific questionnaire. GSHS uses a standardized two-stage probability design for the sample selection process within each participating country. Data selection was performed at the unit of a regular class. Sampling bias was considered by adding weight, stratum, and PSU to every student record in a GSHS data file in the weighting process. All three variables are required to be used when analyzing GSHS data to appropriately represent the weighting process and the 2-stage sample design. Weighting accounts for the probability of selection of schools and classrooms and non-responding schools and students, and distribution of the population by grade and sex. Weighting allows GSHS results to be generalized to the entire population of students, not just those who took the survey. All GSHS surveys, as conducted in each respective country, were approved by institutional ethical reviews. Student's participation was fully anonymous and voluntary, and informed consent was sought and obtained, as appropriate, from the students, parents, and/or school officials. Further information can be accessed at https://extranet.who.int/ncdsmicrodata/index.php/catalog/GSHS and https://www.cdc.gov/gshs/index.htm.

Public-use data from 92 countries collected between 2003 and 2017 were available when we conducted the secondary data analysis in March 2021. After checking whether there were variables required for this study, we finally included 59 countries (33 countries were excluded for not including the variables required). One of the purposes of the GSHS is to establish trends in the prevalence of health behaviors and protective factors for evaluating school health and youth health promotion. For this purpose, some countries would conduct or have conducted GSHS more than once to monitor the development trend of youth health behaviors while other countries only conducted once limited by insufficient funds, staff turnover, or other in-country barriers. If there were more than two datasets from the same country, we selected the most recent dataset. There were 181,912 adolescents in the 59 included countries. After excluding data of 11,294 participants reporting 11 years or younger and 18 years or older, a total of 170,618 adolescents in 59 countries (7 low-income countries, 24 lower-middle-income countries, 16 upper-middle-income countries, and 12 high-income countries) consist of the final analytical sample (no missing data). The sample characteristics are provided in **Table 1**.

Food Insecurity (Independent Variable)

Food insecurity was inferred by the frequency of going hungry due to lack of food provision at home during the past 30 days. Options included: never, rarely, sometimes, most of the time, and always. Items very similar to the item adopted in GSHS have shown acceptable sensitivity, specificity, and reliability to detect food insecurity (41, 42). In GSHS data, each question except demographic questions and height and weight has a corresponding dichotomized variable. According to GSHS Data User's Guide (https://www.cdc.gov/gshs/pdf/gshs-data-users-guide.pdf), dichotomized variables are created by combining responses from the original question into the Response of Interest (ROI) which is the way that variables are most typically reported. Dichotomous variables are created during data processing and are the same for all GSHS data files. Their presence makes it easier to conduct comparative analyses across countries. In line with previous studies (39, 43), the dichotomous form of food insecurity were created by dividing participants into two groups: no food insecurity (combining never, rarely, and sometimes) and food insecurity (combining most of the time and always).

Bullying Victimization (Dependent Variable)

Bullying victimization was assessed by asking participants about the number of days of being bullied during the past 30 days. The available responses varied from 0 to 30 days. In line with previous studies (44, 45), participants with a response of at least 1 day were considered bullying victims.

Covariates

Based on the associations established in the extant literature (38, 39, 46, 47) and, more importantly, their availability in the GSHS dataset, the following variables were included as covariates; sex, age, physical fighting, current cigarette use, loneliness, number of close friends, peer support, parental connectedness, and parental bonding were considered as control variables. Specifically, to facilitate the age-stratified analysis, we classified participants into two categories: younger adolescents (aged 12–14 years) and older adolescents (aged 15–17 years) based on the common age groups used to distinguish adolescence stages (48). Items to assess these variables can be found at https://www.who.int/teams/noncommunicable-diseases/surveillance/systems-tools/global-school-based-student-health-survey/questionnaire.

Statistical Analysis

Firstly, descriptive analyses were conducted to calculate the overall, country-stratified, sex-stratified, and age-stratified prevalence of food insecurity and bully victimization. Secondly, multivariate logistic regression was performed to investigate the country-stratified association between food insecurity and

TABLE 1 | Prevalence of food insecurity and bullying victimization by countries, sexes, and age groups.

			Sample size	Food insecurity (%)	*p*-value	Bully victimization (%)	*p*-value
Income level	Low-income countries	Afghanistan	1,515	21.0	<0.001	41.0	<0.001
		Kenya	2,239	12.7		54.5	
		Liberia	831	10.9		46.4	
		Mozambique	1,018	10.5		42.2	
		Nepal	5,333	4.0		50.6	
		Tanzania	1,572	3.4		23.3	
		Uganda	2,352	8.4		43.6	
		Subtotal	1,4860	8.3		48.5	
	Lower middle-income countries	Bangladesh	2,647	13.0		24.0	
		Belize	1,391	14.1		44.3	
		Bolivia	3,061	8.2		30.6	
		Ecuador	1,673	4.2		25.9	
		Egypt	1,942	3.8		68.6	
		Ghana	1,138	13.7		60.6	
		Guyana	2,031	7.1		35.9	
		Honduras	1,484	3.9		30.6	
		Indonesia	9,451	3.8		20.2	
		Jordan	1,592	12.3		39.0	
		Lao	3,273	1.2		11.5	
		Mauritania	1,559	9.6		43.5	
		Mongolia	4,717	1.5		27.5	
		Morocco	4,717	8.3		36.2	
		Pakistan	4,294	5.1		40.8	
		Philippines	7,580	7.1		48.6	
		Solomon Islands	1,039	10.1		64.3	
		Sri Lanka	3,063	2.8		37.8	
		Timor-Leste	2,234	10.4		26.0	
		Tonga	2,502	10.3		36.9	
		Tunisia	2,161	7.7		30.4	
		Vanuatu	1,673	7.9		49.2	
		Viet Nam	2,792	1.0		23.3	
		Yemen	1,790	9.7		38.1	
		Subtotal	69,731	5.8		33.7	
	Upper middle-income countries	Antigua and Barbuda	1,011	6.6		23.8	
		Argentina	1,559	2.7		24.4	
		Costa Rica	2,448	1.3		18.8	
		Dominica	1,081	1.6		23.9	
		Fiji	2,596	10.5		24.5	
		Grenada	1,091	6.6		27.4	
		Jamaica	1,378	5.9		23.5	
		Lebanon	4,183	2.5		15.6	
		Malaysia	23,185	4.5		17.4	
		Maldives	2,537	5.2		24.9	
		Mauritius	2,589	6.5		23.2	
		Namibia	2,760	9.1		43.8	
		Samoa	1,365	11.7		34.0	
		St. Lucia	1,060	6.0		25.4	
		Suriname	1,709	10.6		25.2	

(Continued)

TABLE 1 | Continued

		Sample size	Food insecurity (%)	*p*-value	Bully victimization (%)	*p*-value
	Thailand	2,194	2.7		26.7	
	Subtotal	52,746	3.5		22.9	
High-income countries	Bahamas	1,100	6.9		21.4	
	Bahrain	6,314	10.6		28.0	
	Brunei Darussalam	2,316	6.3		20.6	
	Curacao	1,888	3.3		26.5	
	French Polynesia	2,506	9.9		22.9	
	Kuwait	2,606	6.4		28.0	
	Oman	2,709	4.0		41.5	
	Qatar	1,120	6.2		32.4	
	Seychelles	1,995	11.4		44.6	
	Trinidad and Tobago	2,950	7.7		14.3	
	United Arab Emirates	4,671	7.7		23.4	
	Uruguay	3,106	1.4		18.5	
	Subtotal	33,281	6.1		27.2	
Sex	Male	79,907	6.2	0.006	35.8	<0.001
	Female	90,711	5.2		30.8	
Age	Younger	83,496	5.9	0.313	35.3	<0.001
	Older	87,122	5.7		30.9	
Total		170,618	5.7		33.3	

bully victimization. Higgin's I^2 statistics were calculated and used to evaluate the heterogeneity between countries, where an $I^2 < 40\%$ indicates negligible, and 40 to 60% represents moderate heterogeneity (49). A pooled odds ratio (OR) of the association between food insecurity and bully victimization was obtained by combining the ORs for each country into the random-effects meta-analysis. Sex, age, physical fighting, current cigarette use, loneliness, number of close friends, peer support, parental connectedness, and parental bonding were adjusted. Third, we conducted multivariate logistic regression to analyze the sex-stratified association between food insecurity and bully victimization. Country, age, physical fighting, current cigarette use, loneliness, number of close friends, peer support, parental connectedness, and parental bonding were adjusted. Fourth, to investigate the age-stratified association between food insecurity and bully victimization, we classified samples into two aged groups: younger (aged 12–14 years) and older (aged 15–17 years). Then we performed multivariate logistic regression in the age-stratified sample adjusting for country, sex, physical fighting, current cigarette use, loneliness, number of close friends, peer support, parental connectedness, and parental bonding. The results of logistic regression were presented as ORs with 95% confidence intervals (CIs). Complete case analysis was conducted prior to formal analysis. Sampling weights and the clustered sampling design of the surveys were considered in order to obtain nationally representative estimates. Control variables were adjusted for in all multivariate logistic models. Statistical significance was accepted, *a priori*, at $p < 0.05$. The above analyses were performed using SPSS 26 and Stata 16.

RESULTS

Prevalence of Food Insecurity and Bullying Victimization by Countries, Sexes, and Age Groups

Table 1 provides the prevalence of each country, sex, and age group in our study. Among the 170,618 adolescents (46.8% males) included in the final sample, 48.9% belonged to the younger age groups (12–14 years) and 51.1% belonged to the older age groups (15–17 years). The pooled prevalence of food insecurity was 5.7%, varied from 3.5% in upper middle-income countries to 8.3% in low-income countries ($p < 0.001$). The prevalence of food insecurity in males was higher than that in females (males: 6.2%, females: 5.2%, $p = 0.006$). The prevalence of food insecurity was similar between younger and older adolescents (younger: 5.9%, older: 5.7%, $p = 0.313$). The pooled prevalence of bullying victimization was 33.3%, ranging from 22.9% in upper-income countries to 48.5% in low-income countries ($p < 0.001$). The prevalence of bullying victimization in males was higher than that in females (males: 35.8%, females: 30.9%, $p < 0.001$). The prevalence of bullying victimization in younger adolescents was higher than that in older ones (younger: 35.3%, older: 30.9%, $p < 0.001$).

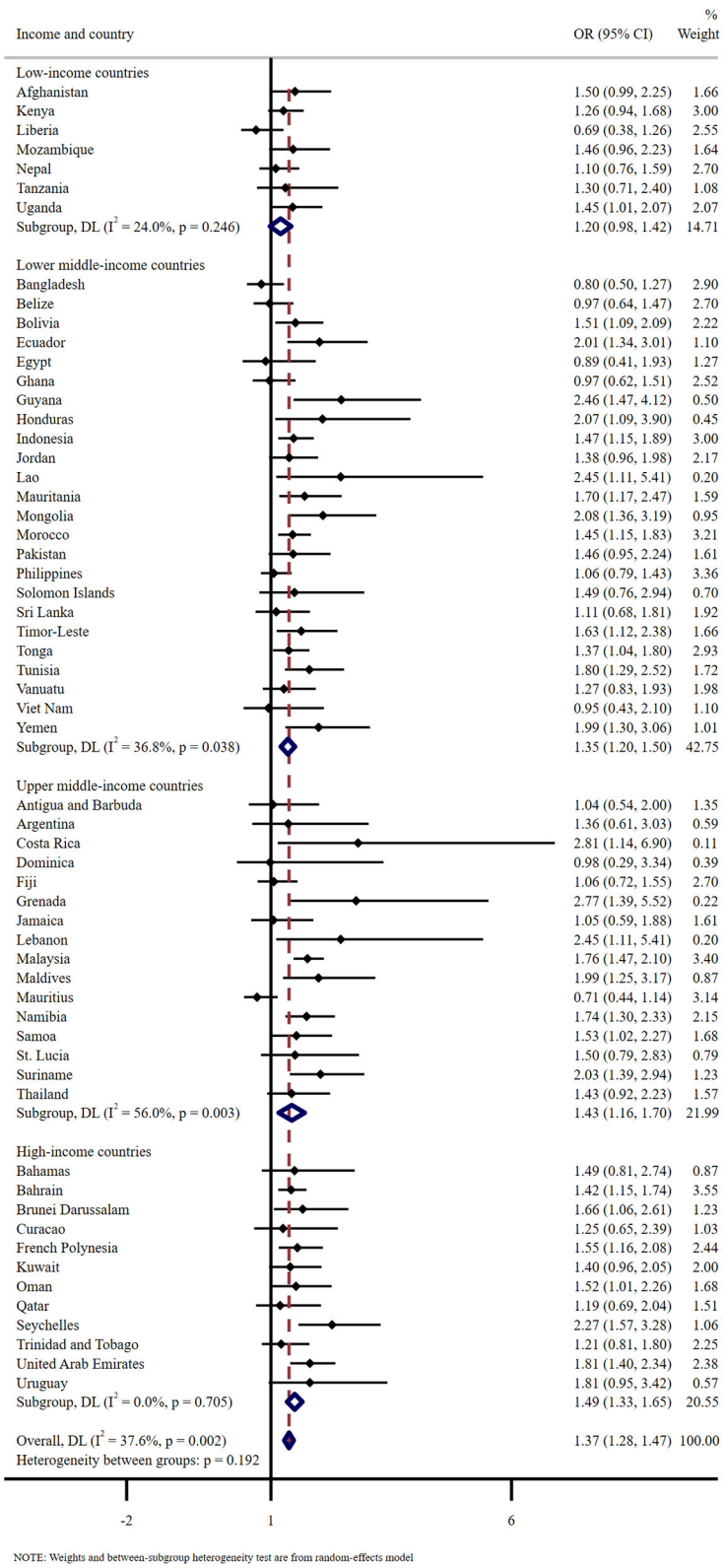


FIGURE 1 | Overall and country-stratified association between food insecurity and bully victimization. The reference category is no food insecurity. Sex, age, physical fighting, current cigarette use, loneliness, number of close friends, peer support, parental connectedness, and parental bonding were adjusted. Overall estimates were obtained by meta-analysis with random effects.

TABLE 2 | Sex-stratified and age-stratified association between levels of food insecurity and bullying victimization.

		OR (95% CI)
Sex	Male	1.15 (0.99, 1.34)[a]
	Female	1.29 (1.12, 1.49)[a]
Age	Younger	1.15 (0.99, 1.33)[b]
	Older	1.26 (1.10, 1.45)[b]

The reference category is no food insecurity. [a]Adjusted for country, age, physical fighting, current cigarette use, loneliness, number of close friends, peer support, parental connectedness, and parental bonding. [b]Adjusted for country, sex, physical fighting, current cigarette use, loneliness, number of close friends, peer support, parental connectedness, and parental bonding.

Overall and Country-Stratified Association Between Food Insecurity and Bully Victimization

Figure 1 details the results for sub-group meta-analysis according to country income levels. Overall, compared to no food insecurity, food insecurity was associated with significantly higher odds for bully victimization. The pooled OR (95% CI) was 1.37 (1.28–1.47) with negligible heterogeneity (I^2 = 37.6%). Specifically, the association was stronger in higher income countries [low-income countries: OR = 1.20 (0.98, 1.42), lower middle-income countries: OR = 1.35 (1.20, 1.50), upper middle-income countries: OR = 1.43 (1.16, 1.70), high-income countries: OR = 1.49 (1.33, 1.65)].

Sex-Stratified and Age-Stratified Association Between Food Insecurity and Bully Victimization

As **Table 2** shows, the association slightly differed between sexes and age groups. Adolescents with food insecurity were more likely to experience bullying victimization in both sexes [males: OR = 1.15 (0.99, 1.34), females: OR = 1.29 (1.12, 1.49)], with stronger association observed in females. Adolescents with food insecurity also tended to experience bullying victimization in both age groups [younger: OR = 1.15 (0.99, 1.33), older: OR = 1.26 (1.10, 1.45)], and the association was more stronger in older adolescents.

DISCUSSION

Using a multi-country sample derived from 170,618 adolescents in 59 countries participating in GSHS surveys, this study sought to explore the relationship between adolescent's subjective food insecurity and bullying victimization, along with the moderating effect of country income level, sex, and age. Generally, compared with adolescents without food insecurity, those with food insecurity showed significantly higher odds for experiencing bullying victimization in the total sample after adjusting for covariates. The association between food insecurity and bullying victimization was moderated by country income level, sex, and age groups.

Consistent with previous research reporting an association between food insecurity and bullying victimization among adolescents from the high-income country (USA) (36), our study further provides supporting evidence by including both relatively low-income and relatively high-income countries. Seeing food insecurity as a proxy measure of socioeconomic disadvantage or low SES (31), our findings also support a systematic review and meta-analysis indicating that the low SES may lead to higher risks of bullying victimization in adolescents (25), as well as more recent empirical studies reporting similar results (24, 36). Adolescents in low-income, food-insecure households tend to have low diet quality (50), which might cause an abnormal BMI and unhealthy body shape, leading to being too fat or too thin (51, 52). Additionally, adolescents from food-insecure households may not have enough decent clothes due to the tight household budget. Inferior physical appearance would make adolescents being alien in the school or community settings, which could result in discrimination and subsequent bullying perpetration from others (53, 54). Besides, adolescents who come from low SES families appear to have a weak sense of self-esteem (55), which may be perceived as being vulnerable or submissive that can also increase the risk for peer victimization and serves to maintain victimization (56). Generally, our finding, combined with previous literature, provide supportive evidence to the application or extension of related theories in explaining bullying involvement, especially the social capital theory (21): adolescents with low social capital (e.g., low SES), such as being food insecure, are more likely to be bullying victims than their peers.

This study also found that the association between food insecurity and bullying victimization in adolescents varied across countries with different income levels. The association was stronger in higher-income countries whereas weaker in lower-income countries, which verifies previous research on the association between food insecurity and suicide attempts (39). Food insecurity and bullying victimization were common among lower-income countries, which might attenuate the association. Besides, previous studies have shown that the individual's sense of whether he or she is better off than other people (subjective SES) is more strongly associated with mental disorders than objective indicators of SES (26, 28, 32). Other scholars have argued that socioeconomic inequality, can give rise to a sense of relative deprivation and impaired well-being (57, 58). Hence, food insecurity in countries with large socioeconomic disparities may have exaggerated impacts on adolescent's psychosocial development and thus produce a stronger association with bullying victimization. Additionally, the association was stronger among females and older adolescents. We cannot interpret the results clearly due to the limited research on similar topics. Studies have shown that females tended to be impacted more in low SES or food insecurity (59–61); the impact of food insecurity on adolescent's health outcomes varied by age groups (62, 63). Nevertheless, more research is needed to clarify the moderating effect of sex and age on the association between various SES indicators and development outcomes among adolescents.

Limitations and Strengths

Two major study limitations must be acknowledged for a better understanding of our research findings. First, this study is a secondary data analysis and therefore cannot be replicated in the same way. Second, using data with a cross-sectional nature, which precludes causal inferences. Third, data were collected by self-reported measures to assess food insecurity and bullying victimization as well as other variables, which could increase recall bias and social desirability. Fourth, related variables such as BMI and nutrition status may provide more details to the association between food insecurity and bullying victimization, but the GSHS datasets did not include these variables. Fifth, though our data involved nearly 60 countries, we still failed to cover many countries, such as countries that are members of the Organization for Economic Cooperation and Development Economic (OECD), which limited the external validity. Future studies are encouraged to address these limitations to secure more robust evidence concerning the association between food insecurity and bullying victimization in adolescents. However, some study strengths should be mentioned. One of the strengths is the large sample (more than 170, 000) from nearly 60 countries with various income levels; so, our research findings likely have a wider range of research generalizability than many single-country studies. Second, to our knowledge, our study is one of the very few studies to assess the association between food insecurity and bullying victimization, which may increase insight into understanding bullying victimization in adolescents across the world. Third, with the large sample, we have done country-stratified, sex-stratified, and age-stratified analyses, which provided nuance information regarding the association.

Theoretical and Practical Implications

This study further deepen our understanding of food insecurity and bullying victimization, including the impact of food insecurity and predictors of bullying victimization, which would provide implications for theory and practice. The findings of the current study are consistent with conceptual frameworks assuming individual's SES potentially serves as a strong predictor of bullying victimization (18, 21). Although theories, such as social capital theory (21), have mentioned that social status could predict bullying involvement, they stress more on bullying perpetration than bullying victimization. Our findings add supporting evidence to a more comprehensive understanding of applying these theories in bullying involvement. From a practical perspective, these findings can be applied in public health promotion and school-based bullying intervention by informing interventions to target adolescents from families at low SES. Enhancing family socioeconomic level to address adolescent's perception of food insecurity should be considered, though this action is a challenging matter and needs multiple efforts across the whole society. Considering the high prevalence of bullying victimization among adolescents, policymakers and school authorities should design and implement policies and anti-bullying interventions to address related behavioral issues. Given that partial formation of the pathway from food insecurity to bullying victimization may be attributed to the lack of social capital, some programs to increase adolescent's interpersonal competence or self-esteem could be vitalized to help strengthen in-school adolescent's school climate and social environments. This may help to mitigate the burden of bullying victimization and other related undesirable development outcomes. Moreover, owing to the association between food insecurity and bullying victimization varied across different countries, sexes, and age groups, it is extremely important to take into account the characteristics of each subgroup when conducting related interventions and research.

CONCLUSION

This multi-country study highlighted that food insecurity or socioeconomic disadvantage was a correlate of bullying victimization in adolescents globally, with a stronger correlation appearing in higher-income countries, females, and older adolescents. Findings have theoretical and practical implications for understanding and addressing bullying involvement of adolescents with food insecurity or low SES.

DATA AVAILABILITY STATEMENT

Publicly available datasets were analyzed in this study. This data can be found at: https://extranet.who.int/ncdsmicrodata/index.php/catalog/GSHS.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by all GSHS surveys, as conducted in each respective country, institutional ethical reviews. Written informed consent to participate in this study was provided by the participant's legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

KL: formal analysis and writing-original draft. XC: writing-review and editing and project administration. S-TC: conceptualization, methodology, and writing-review and editing. CC and YZ: writing-review and editing. JW: supervision and funding acquisition. All authors contributed to and have approved the final manuscript.

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Are There Heterogeneous Impacts of Air Pollution on Mental Health?

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Many studies reveal that air pollution is related to mental health. However, the level of impact and the regulatory mechanism of air pollution on different types of mental health are unknown. This paper examines the heterogeneous impact and mediating mechanisms of air pollution on mental health based on data of 51 countries from 2010 to 2017 by using panel Tobit random effect model, mediating effect model, and bootstrap test. The findings show that, firstly, there is heterogeneous impact of air pollution on different types of mental health. Specifically, air pollution has a significant positive impact on depression; and the impacts on happiness and anxiety are closely related to income level. Secondly, the heterogeneous impact of air pollution on mental health is contingent on income levels. Thirdly, the heterogeneous impacts under different income levels are exacerbated by different levels of education and population density. Lastly, the mediating effect of physical health on different types of mental health is also heterogeneous. To be specific, the effects of air pollution on depression and anxiety are partly mediated by physical health; whereas the effect on happiness is not. These findings contribute to the understanding of air pollution on public health, and have significant implication for social and public health policy makers.

Keywords: air pollution, mental health, heterogeneous impact, mediating effect, income

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INTRODUCTION

Mental health has become an important global public health problem and a prominent social problem especially during the COVID-19 pandemic. According to the Public Health Agency of Canada, mental health is the capacity to feel, think, and act in ways that enhance human ability to enjoy life and deal with challenges (1). Mental health has significant impacts on daily life. Among mental disorders, depression and anxiety are two of the most common and psychological diseases, which affect people's physical and mental health leading to other disease and social consequences. The World Health Organization (WHO) reports that 92% of the world's population was living in an area where air quality exceeds WHO limits (2), which stimulates research on how air pollution affects mental health. In this paper, types of mental health refer to happiness, depression and anxiety disorder that are most commonly used by researchers (3–6). This research aims to examine the impact of air pollution on different types of mental health and the underlying economic and social factors and the mechanisms. The results will inform policy making for effective prevention and intervention mechanisms of mental health.

Mental disorders are conceptualized as behavioral or psychological syndromes that occur in a person in response to distress, disability or suffering, which include manic-depressive illness,

schizophrenia, substance Abuse, post-traumatic stress and organically a disorder usually involving anxiety and depression (7). There are certain factors that cause mental disorders. On the one hand, some factors of individuals, family and social determinants, such as gender (8, 9), age (10), marital status (11), education level (12), physical status (13), unemployment (14, 15), incomes (16, 17), family status (18, 19), and so on.

On the other hand, many studies have explained the "Easterlin Paradox" from the perspectives of omitted variables. Some social factors, such as: economic status, occupation, social support, public welfare, especially for people's living environment (20, 21), are also found related to mental health. It is widely speculated that severe environmental pollution not only harms body functioning, but also negatively affects people's mental health (22–24). According to the extant studies, environmental pollution affects human nervous system with notable consequences on mental health. According to the extant studies, environmental pollution affects the human nervous system with remarkable consequences on their mental health, as well as impact on the generating a social stress related to unhealthy and poor living (24, 25), or act as a psychogenic agent since psychogenic disorders are the result of stress, shock, or any kind of psychological traumas in childhood, adolescence or adulthood (7). In general, these studies show that the influencing factors of mental health are varied, including family environment, social environment, and own conditions. However, these researches ignore air pollution or environmental pollution as an important factor.

Studies concerning the impact of environmental pollution on mental health mainly focus on air pollution leading to different mental disorders. Researchers have studied the effects of air pollution on life satisfaction, happiness, schizophrenia, autism, depression and negative emotions concerning older adults, adolescents and children. For instance, psychological research shows that air pollution can impair life satisfaction and subjective well-being (22, 26–32), which leads individuals to negative emotions (33). Gu et al. verified that the concentration of PM2.5 in the air leads to four types of negative emotions of tension, depression, weakness and restlessness (34). Mendoza et al. examined socio-economic data with annual mean PM10 and PM2.5 data, and found that air pollution significantly reduces life satisfaction among Chileans (35). A study conducted in Denmark (36) found that pollution exposure with higher concentrations of oxy-nitrogen and NO2 in childhood were highly associated with the risk of schizophrenia (36). Earlier studies also suggested that concentrations of PM2.5 and PM10 were significantly correlated with autism spectrum disorders for children after birth within 3 years (37). Exposure to air pollution for a long time increases the probability of chronic mental diseases, and significantly increase their probability of mental disorders with physical health problems (38). These studies have reached a consistent conclusion that air pollution has a negative impact on different mental health and mental disease in different countries. However, it is also unclear whether there is difference in the impact of air pollution on different types of mental health.

In addition, some scholars also paid attention to the impact of subjective air pollution on mental health. Subjective air pollution refers to the subjective evaluation of the objective air quality, which has a direct impact on people's mental state (3, 4). For example, the concentrations pollutants of SO_2, NO_2, $PM_{2.5}$, or PM_{10} in the same objective air environment may lead to different subjective air pollution indexes because different individuals may have different sensitivity to air pollution. Rehdanz and Maddison denoted that subjective air pollution and subjective noise pollution had a significant negative effect on German residents' well-being (6). Mackerron and Mourato proved that objective and subjective air pollution significantly reduced people's happiness by taking London residents' self-rated air pollution level of their street or community as a measure of subjective air pollution (5).

There are gaps in the literature on this contemporary topic. To note a few, studies analyzing the heterogeneous impact of air pollution on subjective well-being from perspectives of income levels, regional environmental laws and regulations, gender, and region (30, 39), inadequately consider different types of mental health. The impact of air pollution on mental health correlates with the subjective cognitive ability (40), which is directly related to the level of education, but there is no empirical study to analyze the impact of air pollution on mental health of groups with different education levels. There is little research on the influence of population density on the relationship between air pollution and mental health. It is well-known that air pollution affects physical health—e.g., air pollutants can reach the brain through the blood-brain barrier, or arrive their cerebrum-along the olfactory nerve, then trigger neuroinflammation when air pollution is severe (41). Besides, air pollution brought adverse effects such as man-made bad climate change (sulfur particles reflect sunlight and cause temperature drop) (42), as well as increased the incidence rate and premature death risk of cardiovascular and respiratory diseases (43, 44), or other immune function degradation (42, 45–48). These physical health problems further influence people's mental health. The mediating role of physical health in the effects of air pollution on different types of mental health has not been fully explored.

From the above, although many studies proved that air pollution has an impact on mental health, it still remains unclear how air pollution influences different types of mental health all over the world, and the underlying economic and social factors. For example, it is unclear whether there are differences in the impact of air pollution on different types of mental health under different income levels. In addition, people's different education level may lead to different subjective feeling and cognition for air pollution, which may cause different impact of air pollution on mental health. Moreover, population density may also contribute to mental health. Hence, this paper aims to address these issues, and the results will help bridge the gaps outlined above.

The remainder of this paper is arranged as follows: Section Research Methodology introduces research methods, variable selection, data sources, and basic tests. Section Results reports empirical results, which including the heterogeneous impacts of air pollution on different types of mental health, examined under different income level, and the heterogeneity of mediating effect. The subsequent section Discussion discusses the results with a comparison to the existing research. Lastly, section Conclusions

concludes our paper with policy recommendations, as well as the shortcomings and further prospects.

RESEARCH METHODOLOGY

Empirical Strategy

Benchmark Regression Model

In this empirical study, the dependent variables are happiness, depression and anxiety. The data of happiness is obtained through the questionnaire, and its observation value is >0. The data of depression and anxiety are expressed as the increment of the prevalence of depression and anxiety, and the value ranges from−1 to 1. To a certain extent, the dependent variable is limited, that is, the data distribution of mental health is not continuous, but truncated. Besides, the Tobit model is a limited value dependent variable model, so it can be used to investigate the impact of air pollution on mental health (49–52). Because a consistent unbiased estimator cannot be obtained from the fixed effect Tobit model, the random effect Tobit model that can do better. The basic form of the panel Tobit model is constructed as below:

$$mental_{it} = \max(0, \beta_0 + \beta_1 * air_{it} + \lambda * Control_{it}) \quad (1)$$

Where *mental* represents mental health, which including happiness, depression and anxiety; *air* stands for air pollution; *control* denotes for a series of control variables; β_0 is the constant term, β_1 and λ are the regression coefficients.

Verification Model of Mediating Effect

Air pollution is one of the causes to many diseases (53, 54). Physical health affects mental health. In order to further explore the heterogeneity of the mediating effect of physical health in the impact of air pollution on different types of mental health, with reference to Li et al. (55), the following mediating effect test models are constructed.

$$mental_{it} = \max(0, \beta_0 + \beta_1 * air_{it} + \lambda * Control_{it}) \quad (2)$$

$$physical_{it} = \max(0, \beta_0 + \beta_2 * air_{it} + \lambda * Control_{it}) \quad (3)$$

$$mental_{it} = \max(0, \beta_0 + \beta_3 * air_{it} + \beta_4 * physical_{it} + \lambda * Control_{it}) \quad (4)$$

Where formula (2), (3), and (4) are the models of mediating effect. Among them, *physical* represents physical health, which is selected as proxy variable from life expectancy. Based on these formulas, the improved causal test and stepwise regression method were used based on the work of Wen and Ye (56). The specific inspection steps are as follows:

Step 1 is to test the regression coefficient β_1 in formula (2). If β_1 is significant, it continues step 2, otherwise, the test will be stopped.

Step 2 is to test regression coefficient β_2 and β_4, respectively in formula (3) and (4). If β_2 and β_4 are significant, it has a mediating effect and continues to step 3. Otherwise, the test will be stopped for lacking a mediating effect.

Step 3 is to test regression coefficient β_3 in formula (4). If β_3 is significant, it means physical health has partial mediating effect, and there may be other mediating effects on the impact of air pollution on mental health; If it is not significant, it indicates that there is a complete mediating effect on physical health, that is, air pollution does not directly affect mental health, but completely affects mental health through physical health.

Data

Variables Selection and Data Resource

(1) Explained variable. The explained variable in this paper is mental health, including happiness, depression and anxiety. Proxy variables for happiness are measured in the Gallup World Poll (https://www.gallup.com/topic/world_poll.aspx). The data refers to the national average of responses to life evaluation questions. The prevalence of depression and anxiety disorders are determined by the increase in the proportion of the sample with depressive and anxiety disorders divided by the total number; namely, the increase in the prevalence of depression and anxiety disorders (57). They come from Global Burden of Disease (GBD) (https://vizhub.healthdata.org/gbd-compare/).

(2) Explanatory variables. The association between air pollution and mental health has been well-documented in the medical literature, which showed the correlation between long-term exposure to fine particles (mainly related to road traffic) and mental health (58–61). At the same time, particulate matter has become a major problem of air pollution. Compared with other pollutants, PM2.5 has a greater impact on people, and is more harmful to human health. The main components of particulate matter are sulfate, nitrate, ammonia, sodium chloride, carbon, mineral dust and water, which are composed of a complex mixture of solid and liquid particles of organic and inorganic substances suspended in the air. Most of the urban and rural populations in both developed and developing countries are currently exposed to particulate matter at high enough levels to have an impact on mental health. Therefore, the average annual exposure concentration of $PM_{2.5}$ is selected as the air pollution measure in this paper. This indicator is based on data drawn from the World Bank (WD) database. The database is updated and covers continuous data for nearly 200 countries from 2010 to 2017 on the annual average exposure levels of fine particulate matter $PM_{2.5}$ across the world. The World Health Organization (WHO) issued Air Quality Guidelines in 2005 with an effort to keep the concentration as low as possible, and set a guideline value for particulate matter $PM_{2.5}$ for the first time (http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/pre2009/air-quality-guidelines). Specifically, the standard value of annual average concentration is 10 $\mu g/ m^3$; that is to say, when the concentration is lower than this value, the harm to health can be minimized. Based on this, the average annual exposure concentration of $PM_{2.5}$ that is higher than 10 g/m^3 in countries are selected as sample countries according to this guideline values.

(3) Control variables. According to relevant literature (62, 63), the control variables in this paper include income level, social support, unemployment, generosity, positive emotion and

TABLE 1 | Variables measurement and data source.

Type of variable	Variable	Measurement	Range	Data source
Explained variable	Happiness	Imagine a ladder, with steps numbered from 0 at the bottom to 10 at the top. The top of the ladder represents the best possible life for you and the bottom of the ladder represents the worst possible life for you. On which step of the ladder would you say you personally feel you stand at this time.	[0, 10]	GWP
	Depression	Rate of increase in prevalence of depression disorders	[−1, 1]	GBD
	Anxiety	Rate of increase in prevalence of anxiety disorders	[−1, 1]	GBD
Explanatory variables	Air pollution	PM2.5 Annual exposure	-	WB
Control variables	Income	Per capita values for gross national income	-	WD
	Social support	National average of the binary responses to the GWP question "If you were in trouble, do you have relatives or friends you can count on to help you whenever you need them, or not?"	[0, 1]	GWP
	Unemployment	Unemployment, total (% of total labor force)	[0, 1]	WDI
	Generosity	Residual of regressing national average of response to the GWP question "Have you donated money to a charity in the past month?" on GDP per capita.	-	GWP
	Negative affect	Average measures of previous-day affect for worry, sadness, and anger for all waves.	[0, 1]	GWP
	Positive affect	Average of three positive affect measures for happiness, laughter and enjoyment in the Gallup World Poll.	[0, 1]	GWP
Grouping variable	Education	Mean years of schooling (year)	-	UNDP
	population density	Total population/administrative area	-	WDI
Mediate variable	Physical health	Healthy life expectancies at birth	-	WHO

GWP, Gallup World Poll; GBD, Global Health Data; WDI, World Development Indicators; WB, World Bank; UNDP, United Nations Development Programme; WHO, World Health Organization.

negative emotion. Among them, income level is measured by per capita values for gross national income (64), and the data comes from the World Bank database; Social support, generosity, positive and negative emotions are from the Gallup World Poll (65); Unemployment data is from the World Development Indicators Database (WDI).

(4) Other variables. This paper selects subjective and objective factors as grouping variables. The level of education is a subjective factor, which is measured by the Mean years of schooling (year) from the United Nations Development Programme; the population density is an objective factor, which equals the total population of each country divided by the administrative area; that is, the population per 10,000 km. In addition, the mediating effect of physical health is further explored. The proxy variable of physical health is life expectancy, which comes from the World Health Organization (WHO). The measurements and sources of all variables are shown in **Table 1** as below.

TABLE 2 | Descriptive statistics of full sample.

Variable	Obs	Mean	Std. Dev.	Min	Max
Happiness	408	5.546	1.014	2.903	7.788
Deppression	408	0.000118	0.000157	−0.0007	0.0005
Anxiety	408	4.099E−05	0.000123	−0.0006	0.0003
Air pollution	408	3.25	0.629	2.227	5.317
Income	408	8.417	1.268	5.826	11.069
Unemployment	408	0.061	0.043	0.003	0.271
Social support	408	0.823	0.098	0.510	0.975
Generosity	408	−0.015	0.148	−0.303	0.549
Positive effect	408	0.737	0.103	0.450	0.944
Negative effect	408	0.264	0.078	0.112	0.483
Education	408	8.409	2.904	1.4	14.1
Population density	408	4.331	1.202	1.221	7.112
Physical health	408	0.638	0.059	0.483	0.749

Sample and Data Description Statistics

The panel data includes 51 countries from 2010 to 2017, which is based on the following reasons. Firstly, due to the limitation of $PM_{2.5}$ availability, the annual data of sample interval is from 2010 to 2017. Secondly, with the continuity of the survey data, the indicators to be used are the indicators with continuity since 2010; however, some countries miss some of indicators. Thirdly, in order to make the sample more representative, this paper selects the sample countries whose concentration of $PM_{2.5}$ is higher than the standard value (although the minimal risk to humans is lower than the standard value). Based on data availability of time dimension and data integrity of sample countries, 51 countries are finally selected as the research target. In order to eliminate the influence of heteroscedasticity, the logarithmic processing is carried out on partial data, including air pollution, per capita national income level and population density. The descriptive statistics of all data based on the full sample are shown in **Table 2**.

Stationary Test

The stationary tests on all index data are conducted using Levin-Lin-chu unit-root test and Fisher ADF unit-root test before

TABLE 3 | Results of the panel unit root test.

Variables	LLC test	Fisher-ADF test
Happiness	−18.497*** (0.000)	262.868*** (0.000)
Depression	−53.126*** (0.000)	173.128*** (0.000)
Anxiety	−44.688***	238.799*** (0.000)
Air pollution	−9.448*** (0.000)	194.574*** (0.000)
Income	−13.975*** (0.000)	255.679*** (0.000)
Unemployment	−17.672*** (0.000)	222.382*** (0.000)
Social support	−22.217*** (0.000)	260.392*** (0.000)
Generosity	−24.884*** (0.000)	228.32*** (0.000)
Positive effect	−18.372*** (0.000)	266.964*** (0.000)
Negative effect	−16.279*** (0.000)	247.585*** (0.000)

This table summarizes panel unit-root tests for all related variables in 51 countries. LLC, Levin-Lin-Chu unit-root test; Fisher-ADF, fisher ADF unit-root tests.
****,**,* Indicate significant at the 1, 5, and 10% levels, respectively.*
Standard errors are in parentheses. The sample period is from 2010 to 2017.

the regression model. This is to avoid the emergence of false regression problem. The priory test results are shown in **Table 3**.

Table 3 reports the unit root test results of happiness, depression, anxiety, air pollution, unemployment, social support, generosity, positive effect, and negative effect. Two test results for the null hypothesis contains unit roots. The first is the Levin-Lin-Chu unit root test, and the second is the Fisher augmented Dickey Fuller *t*-test. The criterion is: if the unit root test confirms that, it is 0 at the 5% significance level; thus, the variable is stationary. In both cases, the null hypothesis is rejected at the 1% significance level. Therefore, we can conclude that all variables are stationary.

RESULTS

The Heterogeneous Impact of Air Pollution on Different Types of Mental Health

The panel Tobit model (1) is used to empirically test the selected samples. Firstly, the maximum likelihood estimate (MLE) method is used to estimate the parameters of the Tobit random effect model by selecting happiness, depression and anxiety as explained variables. In order to test the robustness, control variables are added gradually to estimate the model for exploring the interference factors. The control variables are unemployment, social support, generosity, positive affect, negative affect, and income level. The regression results are shown in the following **Tables 4**–**6**.

Table 4 shows that the significance of the estimated value of regression coefficient of air pollution on happiness has changed from significant to insignificant in the process of gradually adding control variables under complete sample. Specifically, the regression coefficients of air pollution on happiness are significantly negative when control variables such as unemployment, social support, generosity, positive emotion, and negative emotion are gradually added; whereas, it is not significant after adding control variable of income level. Therefore, income level may influence the impact of air pollution on happiness through this empirical research. In other words, the significant impact of air pollution on happiness is related to income level.

Next, **Table 5** reports that the estimated value of regression coefficient of air pollution on depression is persistently significantly positive when a series of control variables such as unemployment, social support, generosity, positive affect, negative affect, and income level, are gradually added. This shows that air pollution significantly promotes the increase of depression.

Moreover, the results in **Table 6** are similar to **Table 4**. Under full sample, the significance of the estimated value of regression coefficient of air pollution on anxiety changed from significant to insignificant when it adds control variables gradually. Specifically, the regression coefficient of air pollution on anxiety is significantly positive when control variables such as unemployment, social support, generosity, positive emotion, and negative emotion are added; however, it becomes insignificant after adding one more control variables of income level. From the above, the empirical results show that the impact of air pollution on anxiety is related to income level.

In addition, the ordinary panel fixed effect model and ordinary panel random effect model are also used to test their robustness. The results of the robustness test in **Table 7** show that the estimation results of common panel fixed effect and random effect are consistent with the panel Tobit model, which means air pollution can increase the degree of depression. However, the impact of air pollution on happiness and anxiety is not significant when it takes income level into consideration. From the above, it proves that the effects of air pollution on different types of mental health are heterogeneous. Specifically, air pollution has a significant promoting role in depression; whereas the significant impact of air pollution on happiness and anxiety is related with income level.

The Heterogeneous Impact of Air Pollution on Mental Health Under Different Income Level

Data Grouping and Descriptive Statistics

Based on the above, the heterogeneity of the impact of air pollution on happiness under different income levels is further analyzed. According to the classification standard of the World Bank, the sample countries are divided into 29 high-income countries and 22 low-income countries. Specifically, based on its grouping standards, the high-income and upper middle-income countries are classified into the high-income group, and the low-income and lower middle-income countries are classified into the low-income group. The descriptive statistics data after grouping are shown in **Table 8**.

TABLE 4 | Regression results of air pollution on happiness under complete sample.

	(1) Happiness	(2) Happiness	(3) Happiness	(4) Happiness	(5) Happiness	(6) Happiness	(7) Happiness
Air	**−0.413*** **	**−0.394*** **	**−0.335*** **	**−0.345*** **	**−0.342*** **	**−0.344*** **	**−0.128**
	(0.115)	(0.115)	(0.109)	(0.108)	(0.107)	(0.109)	(0.097)
Unemp		−4.999***	−5.301***	−5.016***	−4.718***	−4.725***	−4.838***
		(1.423)	(1.376)	(1.377)	(1.385)	(1.386)	(1.183)
Soc			1.884***	1.906***	1.892***	1.907***	1.292***
			(0.422)	(0.419)	(0.418)	(0.437)	(0.424)
Gene				0.533**	0.517**	0.516**	0.559**
				(0.228)	(0.228)	(0.229)	(0.218)
Posi					0.596	0.601	0.721*
					(0.408)	(0.411)	(0.384)
Nega						0.0508	−0.293
						(0.425)	(0.411)
Income							**0.521*** **
							(0.0643)
_cons	6.886***	7.128***	5.406***	5.410***	4.954***	4.932***	0.363
	(0.391)	(0.396)	(0.537)	(0.533)	(0.616)	(0.643)	(0.822)
sigma_u	0.814***	0.833***	0.766***	0.764***	0.747***	0.746***	0.492***
	(0.0889)	(0.0923)	(0.0843)	(0.0838)	(0.0823)	(0.0829)	(0.0523)
sigma_e	0.320***	0.313***	0.308***	0.306***	0.306***	0.306***	0.303***
	(0.0121)	(0.0119)	(0.0117)	(0.0116)	(0.0116)	(0.0116)	(0.0114)
N	408	408	408	408	408	408	408
LR test (*p*-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000

happ, dep, anx, unemp, soc, gene, posi, nega represent happiness, depression, anxiety, unemployment, social support, generosity, positive effect, and negative effect, respectively. This is a regression with panel Tobit model for a balanced panel explaining the relationship between air pollution and happiness from 2010 to 2017.

****,**,*Indicate significant at the 1, 5, and 10% levels, respectively.*

Z or T-value is in parentheses. The sample period is from 2010 to 2017.

Table 8 demonstrates that the four variables of air pollution, happiness, the increment of depression and anxiety prevalence have heterogeneity under the groups of high-income and low-income. Specifically, in the high-income group, the average value of air pollution is 2.925, happiness is 6.117, the increment prevalence of depression is 0.00012, and anxiety is 6.41e-06, respectively; however, in the low-income group, the average value of air pollution is 3.678, happiness is 4.793, the increment prevalence of depression is 0.00014, and anxiety is 0.00011, respectively. Based on the above results, when compared with the high-income group, the low-income group has a higher level of air pollution, depression, and anxiety; whereas it has lower happiness.

Simultaneously, the heterogeneous impact of air pollution on different types of mental health under different income levels is further analyzed by drawing scatter diagrams for the explained variables and explanatory variables. The explained variables are happiness, depression and anxiety. The core explanatory variable is air quality, which is measured by $PM_{2.5}$ annual concentration. The correlation judgments are according to **Figures 1**–**3** as below.

From **Figures 1**–**3**, in high-income countries, $PM_{2.5}$ concentration is negatively related with the scatter of happiness; whereas it has no obvious relations with depression and anxiety. In low-income countries, there is no obvious rule between $PM_{2.5}$ concentration and happiness, but a positive correlation between $PM_{2.5}$ concentration and depression and anxiety, respectively.

Results of Heterogeneity Test of Income Level

By taking per capita national income as an index to measure income differences, the heterogeneous impact of air pollution on different types of mental health that are caused by income differences is examined. Tobit model (1) of benchmark panel by the MLE method is estimated in **Table 9** as below.

Table 9 shows the results of the benchmark regression model under the high-income and low-income sample groups. Column (1) to (6) list the results of the impact of air pollution on happiness, depression and anxiety. The regression coefficient of air pollution on happiness is −0.439, which is significant at the 1% significance level; whereas the regression coefficients of air pollution on depression and anxiety are not significant in the sample of high-income groups. However, in low-income countries, the regression coefficients of air pollution on anxiety and depression are 0.000047 and 0.000032, which are significant at the significance level of 10 and 5%, respectively; whereas the regression coefficient of air pollution on happiness is not significant. These results show that the impact of air pollution on mental health is heterogeneous under different income levels. Specifically, the impact of air pollution on happiness only has

TABLE 5 | Regression results of air pollution on depression under complete sample.

	(1) Depression	(2) Depression	(3) Depression	(4) Depression	(5) Depression	(6) Depression	(7) Depression
Air	**0.0000594*** **	**0.0000593*** **	**0.0000435***	**0.0000439****	**0.0000447****	**0.0000393***	**0.0000481****
	(0.0000215)	(0.0000215)	(0.0000223)	(0.0000223)	(0.0000223)	(0.0000224)	(0.0000245)
Unemp		−0.0000614	−0.00000143	−0.0000254	−0.00000899	−0.0000592	−0.0000829
		(0.000296)	(0.000294)	(0.000296)	(0.000297)	(0.000299)	(0.000300)
Soc			−0.000249**	−0.000250**	−0.000253**	−0.000185*	−0.000210**
			(0.0000984)	(0.0000984)	(0.0000986)	(0.000102)	(0.000105)
Gene				−0.0000343	−0.0000358	−0.0000411	−0.0000390
				(0.0000540)	(0.0000541)	(0.0000538)	(0.0000538)
Posi					0.0000431	0.0000546	0.0000534
					(0.0000969)	(0.0000961)	(0.0000960)
Nega						0.000248**	0.000231**
						(0.0001000)	(0.000102)
Income							0.0000148
							(0.0000167)
_cons	−0.0000674	−0.0000633	0.000190	0.000190	0.000157	0.0000474	−0.0000783
	(0.0000725)	(0.0000751)	(0.000125)	(0.000125)	(0.000145)	(0.000151)	(0.000207)
sigma_u	0.000133***	0.000132***	0.000130***	0.000130***	0.000129***	0.000133***	0.000131***
	(0.0000137)	(0.0000137)	(0.0000135)	(0.0000136)	(0.0000138)	(0.0000142)	(0.0000141)
sigma_e	0.0000755***	0.0000755***	0.0000751***	0.0000750***	0.0000751***	0.0000742***	0.0000742***
	(0.00000283)	(0.00000283)	(0.00000281)	(0.00000281)	(0.00000282)	(0.00000279)	(0.00000279)
N	408	408	408	408	408	408	408
LR test (*p*-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000

happ, dep, anx, unemp, soc, gene, posi, nega represent happiness, depression, anxiety, unemployment, social support, generosity, positive effect, and negative effect, respectively. This is a regression with panel Tobit model for a balanced panel explaining the relationship between air pollution and happiness from 2010 to 2017.

****,**,*Indicate significant at the 1, 5, and 10% levels, respectively.*

Z or T–value is in parentheses. The sample period is from 2010 to 2017.

a significant negative impact in high-income countries; whereas the effects of air pollution on depression and anxiety are significantly positive only in low-income countries.

Heterogeneity Test of Different Levels of Education and Population Density Under Different Income Levels

In order to fully consider the heterogeneous impact of air pollution on mental health under other subjective and objective factors of different income levels, the following analysis is carried out. First, education level and population density are selected as two variables. Then, samples are divided into two income level groups with significant effects of air pollution on various types of mental health based on section The Heterogeneous Impact of Air Pollution on Different Types of Mental Health. The values of education level (or population density) is in order from the smallest to largest for each income level group. Next, the groups with different income levels are further divided into upper and lower quantile groups by 50% quantile. The upper ones are the groups with high education level (or high population density); and the lower ones are the groups with low level education (or low population density).

From the above, the impact of air pollution on happiness is significant only in the high-income group, whereas its impact on depression and anxiety are significant only in the low-income group. Based on this, a further investigation reveals that the effects of air pollution on depression and anxiety are also verified in low-income countries regardless of education groups. Finally, in view of model (1), the estimating results of the panel Tobit random effect model by the MLE estimation method are shown in **Tables 10**, **11**.

Table 10 lists heterogeneity test results of education level under different incomes from Column (1) to Column (6). It shows that the estimated value of regression coefficient of air pollution on happiness is −0.569 in the sample of high income and high education level, which is significant at the 1% significance level; whereas the impact of air pollution on happiness is not significant under high income and low-level education sample. These manifest that in high-income countries, air pollution has a significant inhibitory effect on happiness in high-level educated samples; whereas it is not for the low educated one. In addition, in low-income countries, air pollution has no significant impact on depression and anxiety under different education levels; in other words, education level does not affect the impact of air pollution on depression and anxiety, which further indicates that income or economy may be the main causes for depression and anxiety.

Table 11 shows heterogeneity test of population density level under different incomes. The result shows that the estimated

TABLE 6 | Regression results of air pollution on anxiety under complete sample.

	(1) Anxiety	(2) Anxiety	(3) Anxiety	(4) Anxiety	(5) Anxiety	(6) Anxiety	(7) Anxiety
Air	**0.0000465*** **	**0.0000449*** **	**0.0000370** **	**0.0000364** **	**0.0000388** **	**0.0000402*** **	**0.0000206**
	(0.0000159)	(0.0000152)	(0.0000155)	(0.0000154)	(0.0000155)	(0.0000155)	(0.0000165)
Unemp		−0.00117***	−0.00113***	−0.00106***	−0.00102***	−0.00101***	−0.000921***
		(0.000207)	(0.000207)	(0.000208)	(0.000209)	(0.000210)	(0.000209)
Soc			−0.000129*	−0.000128*	−0.000134*	−0.000151**	−0.0000980
			(0.0000691)	(0.0000687)	(0.0000688)	(0.0000711)	(0.0000727)
Gene				0.0000850**	0.0000819**	0.0000832**	0.0000796**
				(0.0000376)	(0.0000376)	(0.0000376)	(0.0000372)
Posi					0.0000823	0.0000771	0.0000855
					(0.0000653)	(0.0000655)	(0.0000645)
Nega						−0.0000658	−0.0000288
						(0.0000693)	(0.0000695)
Income							−0.0000314***
							(0.0000107)
_cons	−0.0000999*	−0.0000236	0.000106	0.000104	0.0000378	0.0000680	0.000331**
	(0.0000535)	(0.0000532)	(0.0000869)	(0.0000864)	(0.000101)	(0.000106)	(0.000139)
sigma_u	0.0000945***	0.0000900***	0.0000882***	0.0000865***	0.0000856***	0.0000859***	0.0000806***
	(0.0000100)	(0.00000961)	(0.00000940)	(0.00000933)	(0.00000930)	(0.00000931)	(0.00000880)
sigma_e	0.0000549***	0.0000529***	0.0000528***	0.0000525***	0.0000525***	0.0000524***	0.0000523***
	(0.00000206)	(0.00000199)	(0.00000198)	(0.00000198)	(0.00000198)	(0.00000197)	(0.00000197)
N	408	408	408	408	408	408	408
LR test (*p*-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000

happ, dep, anx, unemp, soc, gene, posi, nega represent happiness, depression, anxiety, unemployment, social support, generosity, positive effect, and negative effect, respectively. This is a regression with panel Tobit model for a balanced panel explaining the relationship between air pollution and happiness from 2010 to 2017.

****,**,*Indicate significant at the 1, 5, and 10% levels, respectively.*

Z or T–value is in parentheses. The sample period is from 2010 to 2017.

TABLE 7 | Robustness test result of replacing estimation method.

	(1) Happiness	(2) Depression	(3) Anxiety
Air	−0.0175	0.0000625**	0.0000304
	(0.130)	(0.0000301)	(0.0000216)
Control variables	Yes	Yes	Yes
Constant	Yes	Yes	Yes
Time effect	Yes	Yes	Yes
Individual effect	Yes	Yes	Yes
N	408	408	408
R^2	0.128	0.181	0.185

This is a regression with ordinary panel regression model for a balanced panel explaining the relationship between air pollution and mental health from 2010 to 2017.

****,**,*Indicate significant at the 1, 5, and 10% levels, respectively.*

Z or T-value is in parentheses. The sample period is from 2010 to 2017.

value of regression coefficient of air pollution on happiness is −0.685 in the samples of high income and high population density, which is significant at the significance level of 1%. However, the impact is not significant under the condition of high income and low population density. These results indicate that air pollution has a significant inhibitory effect on happiness in high-income countries with high population density, whereas it is not for countries with low population density.

In samples with low income and low population density, the estimated value of regression coefficient of air pollution on depression is 0.000051, which is significant at the significance level of 5%; that is, air pollution has a significant aggravating effect on depression under the condition of low income and low population density. However, under the condition of low income and high population density, the effect of air pollution on depression is not significant.

Furthermore, in low-income countries, the estimated value of regression coefficients of air pollution on anxiety in high and low population density countries are 0.000059 and 0.000030, respectively, which are significant at 1 and 10% significance levels. This manifests that in low-income countries, air pollution has a significant positive impact on anxiety regardless of population density; however, the impact on high-density countries is greater than the lower ones.

Heterogeneous Mediating Effect Tests

The heterogeneity of the mediating effects of physical health on the effect of air pollution on happiness, depression and anxiety is tested by taking three strict steps mentioned in section Research

TABLE 8 | Descriptive statistics data of different income levels grouping.

Group	Variable	Obs	Mean	Std. Dev.	Min	Max
High–income group	Happiness	232	6.117	0.795	3.661	7.788
	Depression	232	0.00012	0.00017	−0.0007	0.0005
	Anxiety	232	6.41E−06	0.00011	−0.0006	0.0003
	Air pollution	232	2.925	0.396	2.227	4.067
	Income	232	9.33	0.812	7.92	11.069
	Social support	232	0.873	0.062	0.66	0.975
	Generosity	232	−0.037	0.164	−0.303	0.549
	Positive	232	0.76	0.106	0.45	0.944
	Negative	232	0.254	0.075	0.112	0.464
	Education	232	9.932	2.174	4.6	14.1
	Density	232	4.233	1.143	1.799	6.269
	Physical health	232	0.673	0.042	0.505	0.749
Low–income group	Happiness	176	4.793	0.745	2.903	6.74
	Depression	176	0.00014	0.000135	−0.00035	0.00044
	Anxiety	176	0.00011	0.000095	−0.00009	0.00033
	Air pollution	176	3.678	0.623	2.711	5.317
	Income	176	7.213	0.553	5.826	8.152
	Social support	176	0.757	0.097	0.51	0.914
	Generosity	176	0.016	0.117	−0.206	0.418
	Positive	176	0.708	0.091	0.513	0.876
	Negative	176	0.277	0.081	0.123	0.483
	Education	176	6.401	2.498	1.4	11.6
	Density	176	4.459	1.266	1.221	7.112
	Physical health	176	0.592	0.046	0.483	0.672

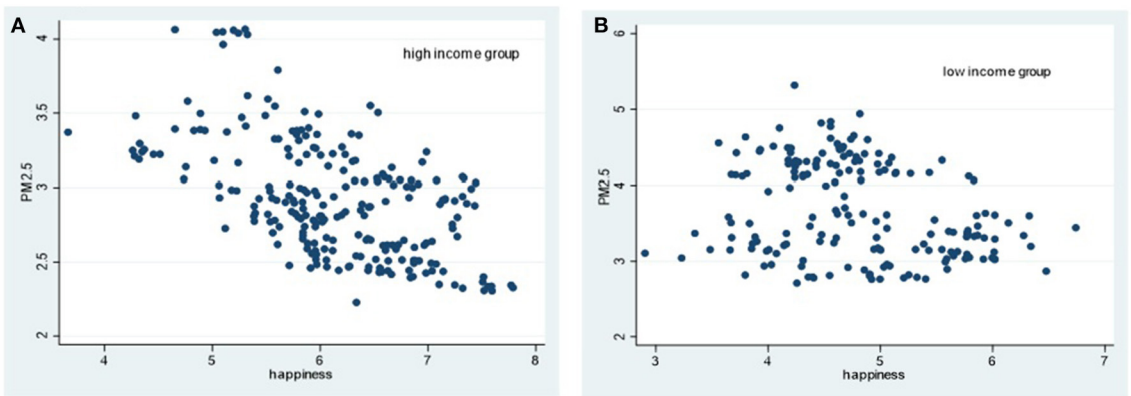


FIGURE 1 | Scatter diagram of relationship between PM2.5 concentration and happiness in different income groups. **(A)** High income group. **(B)** Low income group.

Methodology. The test uses MLE mediating effect model. First, based on the significant impact of air pollution on happiness only in high-income countries, hence only the sample of high-income countries is selected to test the intermediate effect of physical health. To test the intermediate effect of physical health on the effect of air pollution on depression and anxiety, the sample of low income countries is selected as early results show a significant influence on depression and anxiety in low-income countries. Then, by taking happiness, depression and anxiety as explanatory variables, and physical health as mediating variables, the results of the Tobit model (2), (3), and (4) are estimated, respectively in **Table 12**.

Firstly, in column (1), the estimated value of regression coefficient of air pollution on happiness is −0.439, which is significant at 1% significance level. This shows the first step of mediating effect test is passed. Secondly, the estimated value of the regression coefficient of air pollution on physical health is not significant in column (2). Therefore, the

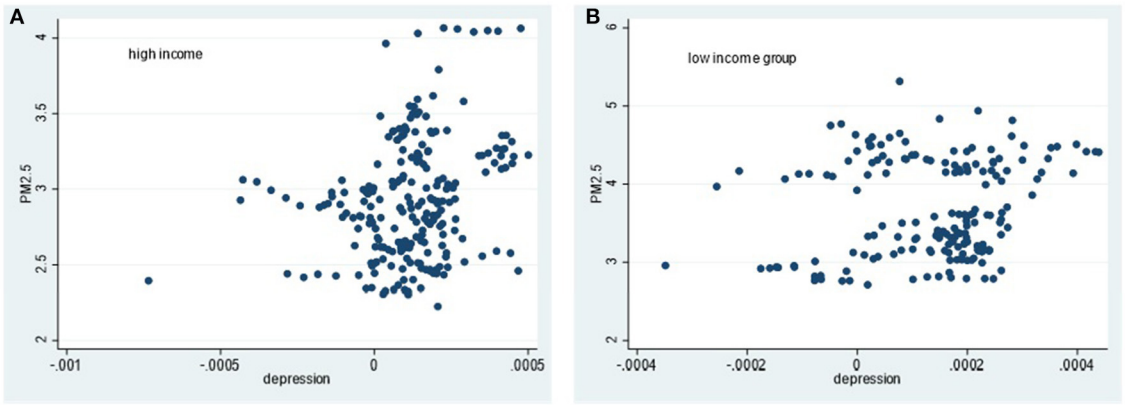


FIGURE 2 | Scatter diagram of relationship between PM2.5 concentration and depression in different income groups. **(A)** High income group. **(B)** Low income group.

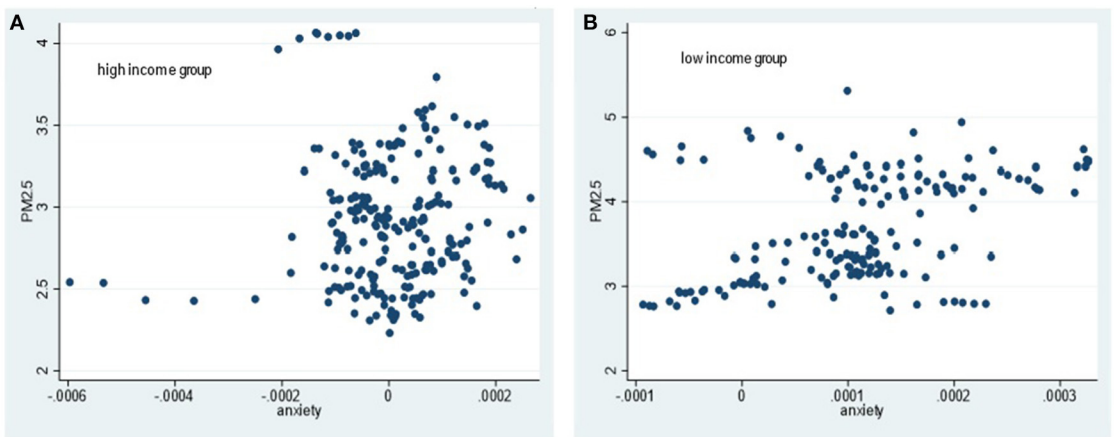


FIGURE 3 | Scatter diagram of relationship between PM2.5 concentration and anxiety in different income groups. **(A)** High income group. **(B)** Low income group.

TABLE 9 | Regression results of air pollution on mental health with different income levels.

	(1) High–income sample group Happiness	(2) Low-income sample group Happiness	(3) High-income sample group Depression	(4) Low-income sample group Depression	(5) High-income sample group Anxiety	(6) Low-income sample group Anxiety
Air	**−0.439*** **	0.0222	0.000044	**0.000047***	−0.000022	**0.000032****
	(0.145)	(0.132)	(0.00005)	(0.00003)	(0.00004)	(0.00001)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
sigma_u	0.449***	0.466***	0.00016***	0.000088***	0.000086***	0.000064***
	(0.0627)	(0.0770)	(0.000023)	(0.000015)	(0.000013)	(0.000011)
sigma_e	0.226***	0.374***	0.000074***	0.000071***	0.000063***	0.000031***
	(0.0113)	(0.0214)	(0.0000037)	(0.0000041)	(0.0000031)	(0.0000018)
N	232	176	232	176	232	176
LR test (*p*-value)	0.000	0.000	0.000	0.000	0.000	0.000

***, **, * *Indicate significant at the 1, 5, and 10% levels, respectively.*
Z or T-value is in parentheses. The sample period is from 2010 to 2017.

TABLE 10 | Heterogeneity test of education level under different incomes.

	(1) High-income and high-education sample group Happiness	(2) High-income and low-education sample group Happiness	(3) Low-income and high-education sample group Depression	(4) Low-income and low-education sample group Depression	(5) Low-income and high-education sample group Anxiety	(6) Low-income and low-education sample group Anxiety
Air	**−0.569*** **	−0.275	−0.000044	0.000032	0.000055	0.000022
	(0.215)	(0.205)	(0.000090)	(0.000027)	(0.000041)	(0.000014)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
sigma_u	0.396***	0.569***	0.0006***	0.000073***	0.000037**	0.000066***
	(0.0699)	(0.124)	(0.000056)	(0.000016)	(0.0000169)	(0.000012)
sigma_e	0.223***	0.208***	0.000041***	0.000075***	0.000019***	0.000032***
	(0.0142)	(0.0178)	(0.0000054)	(0.0000049)	(0.0000026)	(0.0000021)
N	149	83	35	141	35	141
LR test (*p*–value)	0.000	0.000	0.000	0.000	0.000	0.000

***, **, *Indicate significant at the 1, 5, and 10% levels, respectively.*
Z or T-value is in parentheses. The sample period is from 2010 to 2017.

TABLE 11 | Heterogeneity test of population density with different incomes.

	(1) High-income and high-density sample group Happiness	(2) High-income and low-density sample group Happiness	(3) Low-income and high-density sample group Depression	(4) Low-income and low-density sample group Depression	(5) Low-income and high-density sample group Anxiety	(6) Low-income and low-density sample group Anxiety
Air	**−0.685*** **	−0.323	0.000052	**0.000051****	**0.000059*****	**0.000030***
	(0.185)	(0.221)	(0.000042)	(0.000026)	(0.000019)	(0.000017)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
sigma_u	0.570***	0.302***	0.000099***	0.00011***	0.000044***	0.000063***
	(0.121)	(0.0717)	(0.000024)	(0.000027)	(0.000011)	(0.000014)
sigma_e	0.185***	0.245***	0.000078***	0.000043***	0.000029***	0.000029***
	(0.0134)	(0.0174)	(0.0000062)	(0.0000039)	(0.0000023)	(0.0000026)
N	112	120	100	76	100	76
LR test (*p*-value)	0.000	0.000	0.000	0.000	0.000	0.000

***, **, *Indicate significant at the 1, 5, and 10% levels, respectively.*
Z or T-value is in parentheses. The sample period is from 2010 to 2017.

significance of the estimated value of the regression coefficient of air pollution on physical health in model (3) should be further tested. Thirdly, in column (3), the estimated regression coefficient of air pollution on health is still not significant. From the above, it proves that there is no mediating effect of physical health on the impact of air pollution on happiness.

Next, the mediating effect of physical health on the impact of air pollution on depression is also tested. Specifically, first, in column (4), the estimated value of regression coefficient of air pollution on depression is −0.0000469, which is significant at the 10% significance level. This means it passes the first step of mediating effect test. Second, in column (5), the estimated value of the regression coefficient of air pollution on physical health is not significant. Therefore, the significance of the estimated value of the regression coefficient of air pollution on physical health in model (6) should be further tested. Third, in column (6), the estimated value of regression coefficient of air pollution on physical health is 0.00172, which is significant at the 1% significance level. From the above, the bootstrap method is continually used to further test the mediating effect of physical health. The results are shown in **Table 13**.

Table 13 shows that the mediating effect of physical health on the impact of air pollution on depression is −0.00017, which is significant under 5%. This shows that physical health plays a mediating role in the impact of air pollution on depression. In addition, the direct effect of air pollution on

TABLE 12 | Test of mediating effect of physical health on the effect of air pollution on mental health.

	(1) Happiness	(2) Physical	(3) Happiness	(4) Depression	(5) Physical	(6) Depression	(7) Anxiety	(8) Physical	(9) Anxiety
Air	−0.439***	**−0.000739**	−0.441***	0.0000469*	**0.00104**	0.0000590**	0.0000317**	**0.00104**	0.0000312**
	(0.145)	(0.00428)	(0.145)	(0.0000250)	(0.00251)	(0.0000251)	(0.0000131)	(0.00251)	(0.0000133)
Physical			**0.435**			**0.00172*** **			**0.00112*** **
			(2.087)			(0.000573)			(0.000348)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
sigma_u	0.449***	0.0312***	0.446***	0.000088***	0.0407***	0.000093***	0.000064***	0.0407***	0.000072***
	(0.0627)	(0.00468)	(0.0632)	(0.000015)	(0.0063)	(0.000018)	(0.000011)	(0.00632)	(0.000013)
sigma_e	0.226***	0.00568***	0.226***	0.000071***	0.00515***	0.000068***	0.000031***	0.0052***	0.000029***
	(0.0113)	(0.000288)	(0.0113)	(0.0000041)	(0.00029)	(0.0000040)	(0.0000018)	(0.00029)	(0.0000017)
N	232	232	232	176	176	176	176	176	176
LR test (*p*–value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

****, **, *Indicate significant at the 1, 5, and 10% levels, respectively.*

Z or T-value are in parentheses. The sample period is from 2010 to 2017. Column (1), (2), (3) are the estimated results based on high-income sample group, Column (4), (5), (6), (7), (8), (9) are the estimated results based on low-income sample group.

TABLE 13 | Bootstrap test of the mediating effect of physical health in the impact of air pollution on depression.

	Observed Coef.	Bootstrap Std. Err.	*Z*	*P > z*	Normal-based [95% Conf. Interval]	
Indirect effect	−0.00017	0.00008	−2.11	**0.034**	−0.00033	−0.00001
Direct effect	0.00080	0.00018	4.51	**0.000**	0.00045	0.00115

TABLE 14 | Bootstrap test of the mediating effect of body health in the impact of air pollution on anxiety.

	Observed Coef.	Bootstrap Std. Err.	*Z*	*P > z*	Normal-based [95% Conf. Interval]	
Indirect effect	−0.00022	0.00009	−2.42	**0.016**	−0.00039	−0.00004
Direct effect	0.00038	0.00015	2.52	**0.012**	0.00008	0.00067

depression is 0.0008, which is significant at 1% significance level. From the above, physical health has a partial mediating effect on the impact of air pollution on depression, and it may has other mediating effects on the impact of air pollution on depression.

The above process was repeated to test results of the mediating effect of physical health between air pollution and anxiety are also shown. The results are shown in **Table 14**. It can be seen that physical health has a partial mediating effect on the impact of air pollution on anxiety, and it may has other mediating effects on the impact of air pollution on anxiety.

In conclusion, the above results show that the mediating effect of physical health varies with the type of mental health. Specifically, physical health does not play a mediating role in the impact of air pollution on happiness; whereas it has a significant partial mediating effect on the impact of air pollution on depression and anxiety.

DISCUSSION

In this section, we mainly discuss the comparison between the research in this paper and existing literature, and the reasons behind some of the findings. In general, the conclusions of our study are similar to those of previous studies. Based on the above results, air pollution has no significant effect on happiness and anxiety but has a positive effect on depression when income levels are considered. This confirms the assertation of Zhang et al. that air pollution has increased the risk of depression of residents, but had no significant impact on long-term life satisfaction (24). In addition, the results are in line with Zu et al. They suggest that the heterogeneous impact of air pollution on the comprehensive value of mental health is decided by income (66), which add further insight. First, there is income heterogeneity in the impact of air pollution on happiness, which reaffirm by Maslow's Hierarchy of Needs Theory. Specifically, people with higher income generally have higher demand for environmental quality because their basic

material needs have been met. Therefore, air pollution will inhibit happiness significantly. However, this is contradictory to low-income countries where people usually pay more attention to material requirements rather than environmental problems; that is, their happiness can be improved with the improvement of the material living standard. Therefore, air pollution in low-income countries does not have a significant effect on happiness.

Second, the result on income heterogeneity in the impact of air pollution on depression and anxiety also advanced understanding. Studies have shown that developed countries with high-income have increased their defense expenditure against air pollution; whereas low-income countries have different investment willingness on the protective instruments production from private sector (67–69). The results in the study reenforce the notion that people are more prone to depression and anxiety. In other words, air pollution in low-income countries may significantly increase the prevalence of depression and anxiety.

Third, the result of education levels on the effects of air pollution on mental health is interesting to note. It appears that only in high-income countries, air pollution has a significant inhibitory effect on happiness for high educated groups, but not for low-educated ones. This may be explained that people with high-level education would have better ability to obtain information in high-income countries; besides, they would have deeper subjective feelings about air pollution with the increase of environmental knowledge (4). Therefore, air pollution in high-income countries with high education level has a significant negative impact on happiness. In addition, studies have shown that the origin of depression and anxiety are income and economy (20, 21). Therefore, in low-income countries, education levels do not have significant influence on depression and anxiety. Forth, under different income levels with different population densities, the effects of air pollution on mental health are also heterogeneous. First, in high-income countries, air pollution has a significant inhibitory effect on happiness in high-density samples, but not in low-density samples. This may be explained that countries with high density may lead to congestion and resource stress, thus accelerating its inhibiting effect of air pollution on happiness; whereas low density ones can dilute the influence of air pollution on happiness. Therefore, under the condition of high-income level with high population density, air pollution has a significant impact on happiness.

Fifth, the effect of air pollution on depression is significant in low-income with high-density countries, but surprisely not in low-income with low-density countries. This means low-density is critical on reducing the effect of air pollution related depression. Generally speaking, interpersonal communication can help people dispel disappointment, loneliness, and helplessness. Besides, low-income countries with high-density give people more advantages of frequently interpersonal communication; namely, they can get help easily when they are in trouble. For example, they can release some depression to some extent by talking with others when they face air pollution. However, in low-income countries with a low density population, people are living far away, and they may find it difficult to find someone to deal with the depression.

Sixth, the impact of air pollution on the occurrence of anxiety is greater in low-income countries with higher population density. This may be explained that people in low-income countries are more vulnerable to risk and face greater pressure to pay for out-of-pocket health care. When people are facing up to air pollution, they become worry too much about their family safety, as well as their future health. In addition, people may have stronger subjective concern about the harm of air pollution in countries with greater population density. Therefore, in low-income countries, the impact of air pollution on anxiety is significantly positive in different population density countries, as well as the impact in high population density countries is greater than lower ones.

The mediating effect of physical health on the effect of air pollution on different types of mental health is heterogeneous. There is no mediating effect of physical health on the impact of air pollution on happiness in high-income countries. However, physical health has a partial mediating effect of air pollution on depression and anxiety in low-income countries. This may be based on two aspects: on the one hand, high-income people are less likely to be exposed to environmental pollution (67), so the damage to health is not a concern. On the other hand, the health risks of high-income people exposed to air pollution are relatively low because their medical conditions are good (68).

CONCLUSIONS

This paper examined the heterogeneous effects of air pollution on mental health from income, education, indensity, and physical health perspectives. The key findings are summarized as below.

Firstly, there is a heterogeneous impact of air pollution on different types of mental health—happiness, depression, and anxiety. Air pollution has a positive effect on depression; however, the significant impact of air pollution on happiness, and anxiety is decided by income levels. Secondly, income levels pose heterogeneous impact of air pollution on different types of mental health. On one hand, the negative effect of air pollution on happiness is significant only in high-income countries; On the other hand, under different income levels, the heterogeneous impacts of air pollution on different types of mental health are mainly demonstrated in the two factors of education level and population density. Thirdly, the mediating role of physical health in the impact of air pollution on different types of mental health is heterogeneous. To be specific, the mediating role of physical health only significant in the impact of air pollution on the depression and anxiety of low-income groups. In summary, air polution has impact on different mental health, the impact is heterogenous according to primarily inome level, then education level, population density and physical health. The impacts of air pollution contributes to mental health, but the level of impact level differs in terms of happniess, depression, and anxiety. This suggests that a coordinated systemic approach is needed to take mental health issue with duly consideration of air polution and other specific context and conditions.

The results have several implication for policy making in order to to improve mental health. It must be recognized by

the relevant public health departments in various countries that air pulution has an impact on different types of mental health. Then, mental health issue should be mainstreamed into governmental and non-governmental policies and programs, parcicularly for low income and high population density countries, such as narrowing the gap among regions for investment of environmental pollution treatment and their regulation standards (69), effectively increasing the income of low-income residents through transferring payment and financial subsidies. Income is not the only factor contributing to mental health, hence economy development and financial support shall not be the only intenvening mechanism. To improve mental health, not only the health sector, but also other sectors, such as education, energy, transport, environment, housing, and welfare, etc., should coordinate to improve the critical conditions affecting mental health. Furthermore, the awareness of environmental protection and improvement should be gradually raised for low-income groups and residents in rural areas, and their enthusiasm of participating in environmental protection should also be increased, i.e., promoting and encouraging residents to buy environment-friendly products through energy-saving subsidies. Most importantly, governments need to encourage businesses to use green and renewable energy sources to reduce air pollution through energy-saving subsidies or providing finance support (70, 71).

Despite the effort to ensure the reliabilty and validity and the rigor of data analysis, this paper still has some limitations. First, the study is based on 51 countries that the findings may not applicable to other countries where the country profile is different. Secondly, categorizing the archieval data and defining the criteria from various data sources are subjective in nature, which may have unconcious bias. Thirdly, although the panel Tobit model is robust fo this type of analysis, it has its own limtations that need to be aware of.

This study can be taken further in the future by examining each specific factor—e.g., national economic variables, meteorological conditions, individual, and social demographic characteristics. Among them, national economic variables denote national investment in environmental governance, green space coverage, etc; regional meteorological conditions refer to factors such as sunshine duration, average wind speed, rainfall, relative humidity and average temperature; and the demographic characteristics of individuals and society are related with age, gender, and working status. Secondly, there may be spatial spillover effect in air pollution, but its spatial correlation is not mentioned in this paper. In fact, air is flowing, and air pollution in a country is easy to spill over the neighboring countries. Therefore, the spatial correlation elements can be added to empirical study in the future. Thirdly, the dynamic impact and its efficiency of air pollution on mental health are not taken into account. Future research can distinguish the effects of air pollution on mental health between long-term and short-term. Lastly, but not the least, a case based approach to examine the country specific policy and intervening mechanism effectiveness could provide useful practice or lessons to be learnt in improving air polution and mental health.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

QH and YF conceived and designed the study and supervised the study. MX provided guidance and approved the final manuscript. All authors contributed and discussed about the idea of the study and contributed to manuscript writing and editing.

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A Four-Component Framework Toward Patient-Centered, Integrated Mental Healthcare in Kenya

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Background: How can we fast-track the global agenda of integrated mental healthcare in low- and middle-income countries (LMICs) such as Kenya? This is a question that has become increasingly important for individuals with lived experiences, policymakers, mental health advocates and health care providers at the local and international levels.

Discussion: This narrative synthesis and perspective piece encompasses an overview of mental health care competencies, best practices and capacity building needed to fast track patient responsive services. In that vein we also review key policy developments like UHC to make a case for fast-tracking our four-step framework.

Results: While there is an increasingly global impetus for integrated mental healthcare, there is a lack of clarity around what patient-responsive mental healthcare services should look like and how to measure and improve provider readiness appropriately. Here, our collaborative team of local and international experts proposes a simple four-step approach to integrating responsive mental healthcare in Kenya. Our recommended framework prioritizes a clear understanding and demonstration of multidimensional skills by the provider. The four steps are (1) *provider sensitization*, (2) *continuous supervision*, (3) *continuous professional training*, and (4) *leadership empowerment*.

Conclusion: Our proposed framework can provide pointers to embracing patient-centered and provider empowerment focused quality of care improvements. Though elements of our proposed framework are well-known, it has not been sufficiently intertwined and therefore not been integrated. We think in the current times our integrated framework offers an opportunity to "building back better" mental health for all.

Keywords: mental health, patient-centered care, integrated care, Kenya, universal health care, primary health care

BACKGROUND

Integrated Mental Health Care in the Context of Low- and Middle-Income Countries

Recently, efforts to implement Universal health coverage (UHC) have recognized the need to integrate mental healthcare, a crucial component of UHC, within the broader health services (1–4). These efforts result from the apparent need to incorporate mental healthcare as a core component of health services, which is necessary to actualize UHC (5). Indeed, realizing the urgency and importance of making mental health a crucial component of UHC (6), the WHO recently adopted a Special Initiative for Mental Health with the vision that "all people achieve the highest standard of mental health and well-being" (7). This initiative acknowledged that since mental health problems were responsible for significant personal, communal, and societal suffering, it is impossible to realize the goals of UHC without quality mental healthcare (7). UHC proposes that "all individuals and communities receive the health services they need without suffering financial hardship. It includes the full spectrum of essential, quality health services, from health promotion to prevention, treatment, rehabilitation, and palliative care" (8). Furthermore, UHC must be—by definition—universal; it must cover all populations per the WHO constitution, including individuals with disabilities, refugees, and many other marginalized communities (6, 9–11) which are particularly vulnerable in mental health parlance. UHC is our collective belief that the highest attainable standard of physical and mental health is a fundamental human right and that everyone should have access to quality essential health services without financial constraints. This has in recent years become a critical priority for national governments, and many local and international organizations (8). The prioritization of UHC has come from the broader realization of the United Nations (UN) Sustainable Development Goals (SDGs) with this understanding that poverty reduction, equality and optimal quality of life cannot be attained without realizing this (9).

While the efforts to integrate mental healthcare within the UHC framework have been global, there has been undoubtedly an increased focus on low – and middle–income countries (LMICs) (2, 12–14). This is because LMICs, unlike their higher-income counterparts, have been shown to significantly bear the brunt of mental health problems (15–17) and represent overburdened and poorly invested health systems. These efforts have included attempts at actualizing UHC by international organizations—such as the UN—as well as by national governments and regional health and policy stakeholders. For example, the WHO recently launched a special initiative recognizing the burden of mental health problems in LMICs and commits to raising 60 million dollars. That budget will be used to advance a two-step approach that will involve both the advancement of health policy, advocacy, and human rights and the scaling up of interventions and services across general health settings and other community-based and specialist settings. The aim is to, by 2023, provide access to mental healthcare to 100 million people in 12 LMIC priority countries (7). At the national level, LMIC governments have increasingly made attempts to adopt policy frameworks and build infrastructure to integrate mental health into the UHC agenda. For example, Kenya has recently adopted a mental health policy that aims to set up the policy and infrastructure to advance mental health in the country's UHC agenda with the aim of attaining the highest standard of mental health by 2030 (18).

Regardless of the efforts mentioned above—which should be lauded and are an excellent first step toward integrating mental healthcare within the UHC agenda in LMICs—there is still a concerning need to incorporate mental healthcare as a core component of health services, a crucial and needed step if mental healthcare is to be firmly integrated within the UHC agenda (2, 13, 14, 19, 20). A recent review found that many of the efforts toward integrating mental healthcare in the UHC agenda—and achieving UHC more broadly—have had limited success in many sub-Saharan Africa (SSA) countries (19). This is because most SSA countries face challenges like a more significant proportion of the population living in extreme poverty unable to afford quality healthcare, an informal sector with many uninsured and under-insured people, and a poorly funded primary healthcare system hampering efforts to integrate mental healthcare on ground (19).

The above-mentioned challenges emphasize the need for a dedicated line of work to advance mental healthcare integration within the UHC agenda. Subsequent efforts should be made not only to address health emergencies but also to promote healthier populations in LMICs (21). To do this, three crucial targets should be prioritized with regards to actualizing UHC: (1), *who:* which concerns the inclusion of all people including the poorest and the most vulnerable, (2) *what*: which involves offering a full range of good quality essential services, and (3) *how:* which concerns reducing out of pocket expenses through cost-sharing (e.g., pre-payment and risk pooling). These tangents are reflected in the two broad areas of interventions when it comes to embedding mental healthcare into UHC: strengthening health care systems and workforce capacity to improve accessibility, affordability, and acceptability and expand the availability of services to the neediest.

In the past few years, several frameworks to guide mental healthcare integration within the UHC agenda in LMICs have been proposed. One such framework, by the WHO, postulated several levels at which integrated mental healthcare can be actualized at the grassroots level (6). One highlight of this report was their call for sensible local application of broad care principles, which should address the particular setting/context-relevant nuances while adhering to globally established agreements. This report's important recommendation was that mental healthcare integration should begin at the primary care level because that was the most viable way of closing the mental health treatment gap (6). Though the WHO report conceptualized integration as a cascade of care where different levels interact, they also pointed that integration could be conceptualized in many different ways. Besides the WHO, other financial aid and philanthropic organizations like Bill and

Melinda Gates Foundation, World Bank, African Development Bank have also played an essential role in integrated health services while also championing vulnerable populations' health rights and needs (6).

Many local organizations and government agencies also have advanced frameworks to expand UHC in LMICs. For example, the Government of Kenya has through its Vision 2030 Agenda offered a long-term development blueprint that is inspired by a collective aspiration for a better society by the year 2030, which aims to transform the country into a "globally competitive and prosperous country with a high quality of life" (22). Kenya has undertaken efforts to integrate mental healthcare broadly within the healthcare infrastructure. These efforts, conducted by the Ministry of Health and guided by the Kenya Mental Health Policy 2015–2030, have included an increased focus on mental healthcare through policy changes (18, 23). The policy frameworks have suggested action plans designed to improve mental healthcare access and quality care across the country. Similar efforts have also been undertaken at the county level in Kenya that include the recent integrated mental healthcare action plan by the Nairobi County Government for example and several other county mental health plans (24).

The efforts, as mentioned earlier, have been diluted by several factors. One such factor is the lack of progressive and wide-sweeping public policy and practice to sustain this momentum and provide guidance and resources to build these initiatives (2, 4, 13, 19, 20). A primary challenge has been how to connect top-level policy with on-the-ground implementation even where policy exists. Indeed, it is one thing to lay out a plan and a rational course of action that a plan prescribes, but it is another thing altogether to actualize these well-intended plans. This disconnect between policy and practice has resulted in the status quo, a lack of clarity as to how patient responsive mental healthcare should look like at the provider-level, the caregiver team level, and the facility level. One recent article highlighted that in the Kenyan context, this policy-practice disconnect, a lack of clear leadership and communication by government leaders and subsequent detachment by stakeholders at all levels, are the most significant barriers to realizing the UHC agenda (13). Unfortunately, there are many plans, policies, and frameworks, but grassroots-level players do not have the requisite guidance on how to execute these plans. Without clear vision and evaluation plans, it is difficult to measure the extent to which we are making progress toward integrated mental healthcare. For example, it is challenging to measure indices such as provider readiness which is a critical step in assessing integrated mental healthcare action plans.

BARRIERS TO INTEGRATING MENTAL HEALTH AND RESPONSIVE CARE

Why is the framework that we propose here needed in the first place? The answer lies in the several systemic barriers that have stood in the way of integrating mental healthcare and responsive care and reducing the disconnect between policy and practice. One recent review, for example, highlighted that even though Kenya had made significant progress toward UHC—the authors used a UHC index and found that Kenya's score on the index had increased from 43.9% in 2003 to 51.6% in 2013—significant barriers such as financial burdens of healthcare still prevented Kenya in its quest for UHC (2). Other barriers such as a lack of democratic prioritization of UHC action plans, differences in prioritizations of action plans by different stakeholders, and a lack of support for important stakeholders—primarily caregivers—have also been also identified (2, 13, 19, 20). The overall UHC agenda is also derailed by lack of a clear financing plan, dysfunctional healthcare system which has been exposed for example during the COVID pandemic with lack of clear coordination between counties and accountability, concerns on supply chains for medical supplies- seen with the challenges in accountability at the Kenya Medical Supplies Authority and frequent healthcare worker strikes and disgruntlement due to low and delayed pay (25). The lack of appropriate monitoring is not limited to mental health. Kenya has a challenge monitoring chronic illnesses and injuries, which limits her responsiveness to the population needs. Chronic conditions, including those related to mental health cause the largest Disability-Adjusted Life-years in LMICs (26).

These barriers can be imagined as occupying different levels. One such level is *patient-level barriers*, the social and cultural barriers that prevent patients from demanding and seeking integrated mental healthcare. This patient-level barrier may include a limited understanding and knowledge of mental health and mental illness—that is often compounded by a societal stigma around mental health help-seeking, patient-level factors such as chronicity of illness, comorbidities, and other adversities often render mental health a low prioritization (for a patient with a chronic infection sometimes mental healthcare can be seen as a luxury) (2, 27, 28). Another set of barriers are *provider-level barriers:* the professional challenges preventing professionals from integrating mental healthcare. This includes, but is not limited to, providers operating in silos, inadequate training and support on mental healthcare, provider stress and burnout, and limited resources (2, 13, 19). Sometimes other provider-level challenges like poor self-care, burnout, and poor mental health may also limit providers' integration of mental healthcare. The overall societal stigma and discrimination against mental health may also affect provider attitudes toward integrating mental healthcare into their services (29). Finally, another level of barriers is the *system-level barriers* that encompass the complex intersectoral policies that hamper implementation (6, 12). These barriers include limited collaboration by policymakers on the ground, an overlap of roles between different players (i.e., national/federal government and state/local governments), which limits responsibility, a lack of system-wide commitment toward integrated mental healthcare, and of course, the complex, and sometimes interpersonal, political dynamics (20). Another interesting system-level barrier is the focus on stigma and discrimination advocacy by policymakers at the expense of, rather than in support of expanding mental healthcare access (6, 12).

FROM RESPONSIVE, PATIENT-CENTERED TOWARDS INTEGRATED CARE

An unresponsive health care system would not catalyze the global development agenda including the realization of UHC. For health services to be responsive, health workers need to embed core mental health competencies into their practices. Therefore, it seems that to incorporate UHC policy and practice, a key next step is to introduce responsive care ethos in clinical practice.

If introducing responsive health services is a crucial step toward advancing the UHC agenda in Kenya as in other LMICs. A question that then arises is: *how do we integrate mental healthcare into patient care?* In answering this question, we must acknowledge that mental health programming needs vary for different contexts, including differences in patients, providers, and the facilities (30–34). Undoubtedly, the nature of mental healthcare often depends on a myriad of system level and socio-cultural factors. Unfortunately, this realization has often been construed as an excuse to provide mental healthcare without including mental healthcare experts in the process. Consider task-shifting, of course, the science on task-shifting (sometimes called task-sharing) suggests that lay-providers can effectively and cost-effectively deliver mental health interventions (35–38). But it is incorrect to use task-shifting as the primary, and sometimes only, means of mental healthcare. Can one genuinely claim to do integrated mental healthcare without the inclusion of expert mental health providers or professionals in the formal health delivery process? one of the arguments we make here is that the inclusion of expert mental health providers who can offer specific approaches for age, gender, disability, or cultures and who are also aligned with a patient's overall care is an essential element of integrated mental healthcare. Of course, these professionals can work alongside lay providers, but it must not be construed as a dichotomous either-or decision.

Besides including mental health professionals in clinical care and formal service delivery structures, another crucial element is the privileging of patient perspectives and needs. Patients should not be passive spectators but rather active participants in the caregiving process. This process of integrating patient perspectives and requirements into the service delivery process has been aided by the increasing number of user/patient-centric approaches, including human-centered and design perspectives borrowed from digital health technologies, that have advanced many patient-centered models and privileging of patients' perspectives. Taken together, approaches that involve mental health professionals in the service delivery process that consider and respond to patients' needs and perspectives, are fundamental in integrating mental healthcare into the UHC ethos.

Because of this, we propose a four-step approach that can improve responsive caregiving in Kenya—and other LMICs—and advance the integration of mental health in the UHC agenda. Our proposal is based on the belief that patient-responsive care requires: (a) compassion, empathy, clarity in communication, diligence in action, as well as competence in the specific role and task by the provider at an individual level, (b) good interpersonal communication and teamwork when thinking through care and referral as well as sound follow-up and clarity of roles and responsibilities at the collaborative care or team level, and (c) prompt feedback and communication—including positive support, mentorship and appreciation of the team and individual efforts—(d), follow up on referrals and leading decision-making and management of the team at the facility level. We propose that integrating responsive mental healthcare means using psychological tools to make decisions and empowering teams to be effective, resilient, and responsive. Furthermore, it means using evidence-based mental health interventions to provide care, relief, and psychosocial support to the patient. A framework, such as the one we propose, can help bridge the gap between policy, which in the Kenyan context already exists, and practice.

TOWARDS A FRAMEWORK FOR INTEGRATION

In this paper, we advocate for a framework for integration that circumvents some of the aforementioned challenges. our framework in its parts is well-articulated and backed by literature and advocacy however it has not been championed as an integrated, consolidated approach to mental health systems strengthening. We are guided by the belief that integration requires patients' perspectives and inputs to be put front and center, that mental health specialists be engaged in key care decisions, care teams be empowered to be effective, resilient, and responsive, and that evidence-based mental interventions be privileged in providing care, relief, and psychosocial support to patient populations.

How does this framework play out at the individual, team, and provider levels? Our framework calls for empathy, sound communication, diligence in action, and competence in the provider's specific roles and tasks at the individual level. At the care team level, it requires collaborative care that adopts good interpersonal communication, good teamwork in thinking through care and referral and sound follow, and clarity of roles and responsibilities by everyone in the team. Finally, at the facility level, it includes prompt feedback and communication, positive support, mentorship and appreciation of team and individual efforts, follow-up on referrals, and sound management of the team (see **Figure 1**).

Now we propose concrete on-the-ground steps that catalyze this framework:

(1) *Provider sensitization*: One of the reasons for the lack of clarity around the on-the-ground implementation of policy frameworks is that providers are often not adequately sensitized to the nuts and bolts of various policy plans and frameworks which the providers can implement them. Sensitizing providers is a crucial first step in implementing integrated mental healthcare. Suppose providers know that they have to embed mental healthcare in their caregiving approaches and are provided with the tools to do so, as we suggest below; In that case, there will be a lesser disconnect

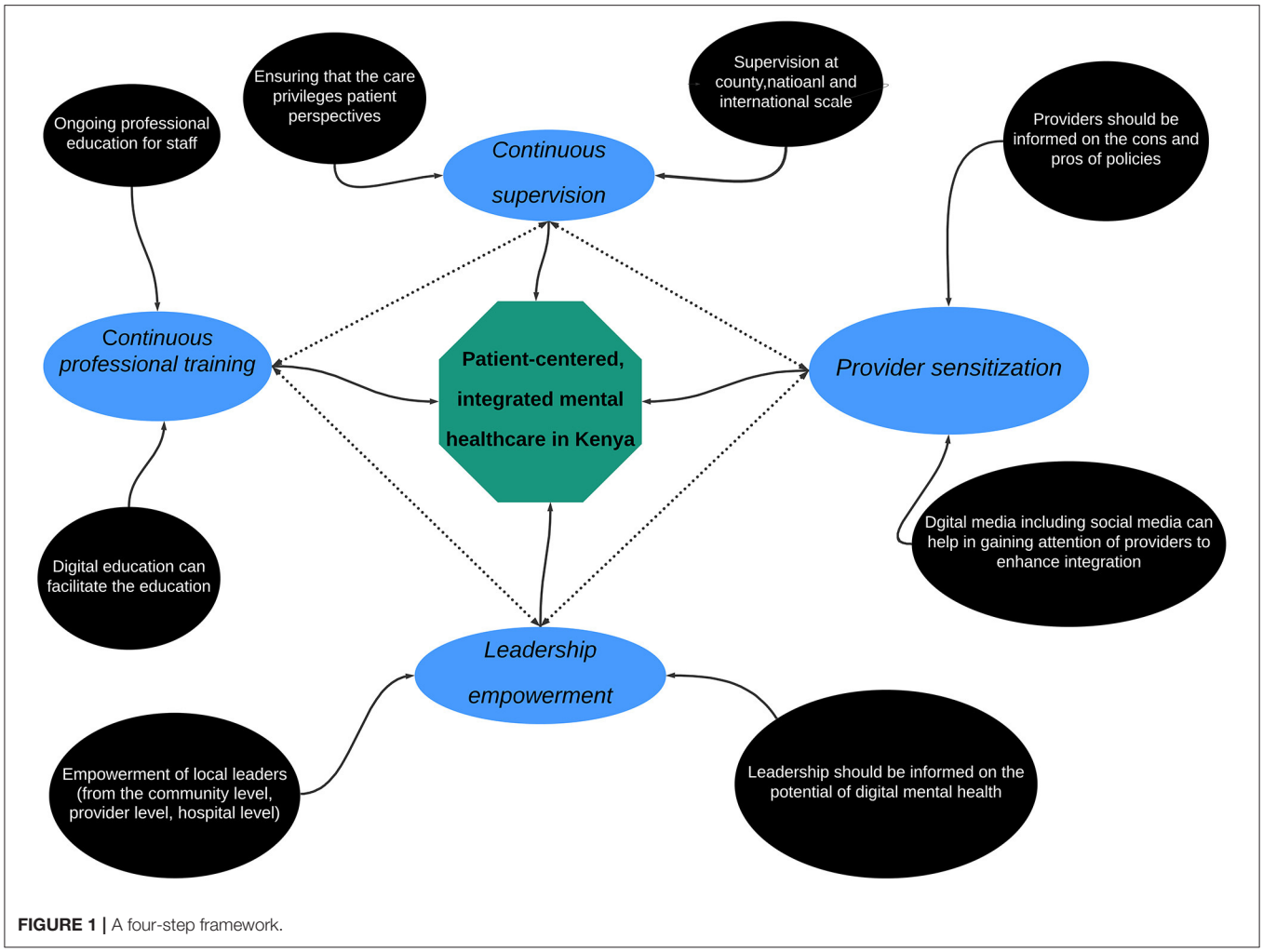


FIGURE 1 | A four-step framework.

between policy and practice. The current status quo, in which policy frameworks are left to the policymakers' domain, should be abandoned for an approach that emphasizes providers' sensitization on these policy frameworks such as efforts toward WHO QualityRights and Scale up of efforts combining NCDs to mental health, HIV and MNCH. There is precedence and experience from translating policy into practice in HIV care for adolescents, including locally managed training of the adolescent package of services and other HIV-related guidelines (39). Those who have used digital mental health applications to advance the UHC agenda in Kenya have concluded that there is a place for digital technologies because they can facilitate real-time communication, reduce costs, enhance the delivery of evidence-based care by primary health caregivers, promote training, supervision, and continuous support of plans toward the UHC agenda (system level and provider level barriers). Notably, digital mental health is an invaluable source for those avoid mental healthcare services due to stigma, discrimination or racial inequities (patient level barrier). The ongoing COVID-19 pandemic has only accelerated health delivery to Kenya's digital platforms and around the world (40, 41). Taken together, these examples illustrate that policymakers and providers should, to the extent possible, consider the use of digital technologies in mental health services.

(2) *Continuous monitoring loops*: Besides sensitization, there needs to be a framework to ensure that integrated mental healthcare that privileges patient perspectives at different caregiving levels is actually and continuously implemented on the ground. This can be done through continuous supervision by local government (i.e., county governments), national government (i.e., Ministry of Health), and even at the international level [i.e., WHO; see (42) for example]. These supervision efforts will help ensure that integrated mental healthcare does not become a one-time initiative but is embedded in health services and heath care institutions. Patient level monitoring helps identify symptoms associated with diseases or disease-driven disorders, which makes it an essential element of psychiatric diagnoses, clinical interventions, and rehabilitation treatments for severe disorders. Incorporating real time data monitoring of

the quality of services and patient-provider satisfaction, some through digital solutions, to feed into health service evaluation and creating iterative decision making loops would ultimately strengthen practice based research and quality of care at the same time.

(3) C*ontinuous professional training*: Because integrated healthcare requires holistic collaboration between different types of caregivers, there should be avenues for ongoing professional training for all players at all caregiving levels. From nurses and doctors to support staff and policymakers, governments and other entities should provide continued opportunities for professional training and development on integrated mental healthcare and UHC ethos. In 2021, Kenya has a 109% mobile penetration (many have more than one SIM card) and 43% internet penetration (far leading other East African countries) (43), there has been an increased report on the use of digital mental health applications in intervention delivery, training and capacity building, and supervision (44–47). Interventions delivered through digital apps have included the WHO Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST) and its linked brief intervention (BI) (44), brief single-session interventions for adolescent mental health (45), as well as the mobile-based mental health Global Action Global Action Programme Intervention Guide (mhGAP-IG) (48)—which was designed by WHO to help staff diagnose and manage high priority mental health issues in low resource environments (48). Digital trainings can enable the agenda of continuous professional development by offering alternative, enriched and flexible modalities that can be leveraged to enhance learning and supportive mentorship. It proves to be time efficacious as well when health care workers are offered alternatives to in-person trainings.

(4) *Leadership empowerment*: As is often the case, the extent to which initiatives succeed often depends on the extent to which the leadership is empowered to succeed. This is definitely the case with UHC. Because mental health problems and their treatments differ from culture to culture, context to context, it has been suggested by some observers that the empowerment of local leaders (from the community level, provider level, hospital level) is an essential step for the success of mental healthcare delivery. At every level, the leadership should be empowered to be able to make and execute context-specific decisions. To facilitate and enhance the use of digital mental health applications in implementing our proposed four-step approach and advancing the UHC agenda in Kenya, we recommend that policymakers and providers in Kenya consider the following considerations leveraging digital tools. (a) Developing proper legislation concerning digital mental health issues, especially around the issues of privacy, inclusivity, data access, sharing, security, and operability. With stringent health governance and stewardship planning, the Ministry of health should promote national intersectoral collaborations to leverage the capabilities of other stakeholders. Collaboration with international organizations such as WHO, UNICEF or other LMICs and best practices to integrate digital mental health in their PHCs successfully. (b) Designing educational platforms and curriculum for digital mental workers to train educators at both advanced and primary levels. The Ministry of Health should work toward increasing digital health literacy among the general population, who are the receivers of such services. Because of the progressive nature of this field, there should be regular sessions aimed at revising the digital health policies to diminish adverse effects and counteract threats.

SOME EXEMPLARS OF INTEGRATION

We will now illustrate how this framework can be implemented by highlighting recent efforts—at the national and county level—in Kenya. At the national level, the Ministry of Health (MOH) in Kenya (as part of Kenya Health Policy 2014–2030 aimed toward attaining the highest standard of health) has recently adopted the Kenya Mental Health Policy 2015–2030. One reason for this framework is the need to integrate mental health services with essential health programs in Kenya (known as the Kenya Essential Package for Health) and align the mental health agenda in Kenya with national and international efforts. The framework aims to address five key barriers, including (1) a lack of integration of mental health with primary care, (2) inadequate human resources for mental health, and (3) a lack of public mental health leadership. There are three key strategies that the MOH is presently actively pursuing to achieve these objectives. The first is integrating mental health in the Health Information System (HIS); HIS is the electronic medical records system used in Kenya. These efforts will promote the embedding of mental healthcare into primary care. The second is the continued investment in mental health through providing infrastructure and financing for leadership development, human resource capacity building, and providing health products and technologies that help further integrate mental healthcare into primary care. Finally, the MOH has developed and implemented an evaluation system to ensure that there is continued supervision and support at all caregiving levels.

Apart from these efforts at the national level, there have also been recent efforts at the county level to promote UHC. These efforts include those of Nairobi County, which through its County Integrated Development Plan (CIDP), seeks to integrate mental healthcare through its key objective of "halting and reversing the rising burden on non-communicable diseases." In the CIDP, the County government aims to achieve this objective through strategies such as improving the efficiency of service delivery, comprehensive leadership and governance on the health agenda, equitable distribution of human resources, and promoting universal access to essential health products and technologies. Further, the county is creating an enabling legal framework for the UHC agenda, mobilizing and appropriating adequate resources for the agenda's implementation, and providing training, support, and oversight at various caregiving levels. While it is still early days to know if these efforts

will be successful, we believe that as they combine provider sensitization, continuous supervision, professional training, and leadership empowerment, they are a promising step in the right direction.

The "how-to" gap is still enormous in mental health integration in the context of ongoing UHC mobilization. We want to underscore that each of these components gets studied and implemented on its own however our recommendation is to introduce these components at the same time altogether. We think that leveraging digital solutions offer an opportunity to speedily implement and test the impact of these components in real time. It has been suggested that monitoring universal health coverage (UHC) focuses on information on health intervention coverage and financial protection in general but this is also true for mental health field. Investment in provider sensitization, monitoring loops, their capacity building and leadership development is critical toward developing a mental health friendly system and service structure.

SUMMARY AND CONCLUSION

Here, we have shown a need to accelerate the efforts for integrated mental healthcare in LMIC contexts such as Kenya. We have highlighted worthwhile efforts aimed at this and pointed out that these efforts are weakened by a lack of clarity into how on-the-ground implementation should look like. To address this concern, we have proposed a four-component approach that can reduce the disconnect between policy and practice.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

MK: conception of the study, first draft generation and revisions of the paper, approval of the final draft, and overall oversight. TO, CM, and HA: revision of drafts, literature review and editing based on feedback from experts, and quality control. OW, WM, CW, CN, SS, SM, FG, and SN: manuscript revision, expert feedback from their fields of specializations, and approval of the final draft. All authors contributed to the article and approved the submitted version.

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Meditation: Evidence Map of Systematic Reviews

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Study Basis: This evidence map presents a summary of studies that addressed the effects of meditation on various clinical and health conditions. Meditation is a contemplative practice that has been used for the promotion of health, and the treatment of different conditions.

Method: The study is based on the search of four electronic databases for the period 1994-November 2019 and includes systematic reviews, meta-analyses, meta-syntheses, and integrative reviews. 3iE evidence gap map was the methodology of choice, and AMSTAR 2 was used for the analyses. Tableau was used to graphically display the confidence level, number of reviews, health outcomes, and intervention effects.

Results: This map encompasses 191 studies, with Mindfulness being the key word that retrieved the highest number of results. Several meditation techniques were evaluated in different contexts, and the confidence levels of 22 studies were high, 84 were moderate, and 82 were low. Two 2 meta-syntheses and 1 integrative review were also included. Most of the studies reported positive effects and a beneficial potential of the practice of meditation. Health outcomes were divided into five groups out of which mental health and vitality, and well-being and quality of life stood out with the largest number of studies.

Conclusions: Meditation has been applied in different areas. This Evidence Map intends to be an easy visual tool to access valuable evidence-based information on this complementary therapy for patients, health professionals, and managers.

Keywords: meditation, evidence map, systematic review, complementary and alternative medicine, mindfulness

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BACKGROUND

The World Health Organization (WHO) has encouraged and strengthened the inclusion, recognition, and use of Integrative and Complementary Health Practices (ICPs) in national health systems at all levels: Primary Care, Specialized Care, and Hospital Care, through the recommendations of the WHO Strategy on Traditional Medicine 2014–2023 (1).

Since 2018, meditation is one of the 29 practices that have been included in the Brazilian Unified Health System (2). Meditation is a contemplative practice, related to the development of human experiences and widely used in different traditions. It originated centuries ago and is currently studied for its effects on health. Meditation is a generic term that many practices fit into. Therefore,

some authors propose a general definition of meditation. Cardoso et al. (3) define it as: "Meditation is a procedure which should encompass a specific technique, clearly defined, involving muscle relaxation in some point of the process and "logic relaxation"; it is a self-induced state, using a self-focus skill (coined "anchor"). Within the various schools of meditation, Mindfulness has a prominent place due to the considerable number of works found on this map. Some authors define Mindfulness as: "paying attention in a particular way: on purpose, in the present moment, non-judgmentally" (4) or "mindfulness meditation involves the self-regulation of attention and involves adopting a particular orientation toward one's experiences in the present moment" (5). Given the considerable number of meditation schools, we chose to add studies that self-identified as meditation.

Due to the recent expansion of the National Policy for Integrative and Complementary Practices (PNPIC), the Brazilian Ministry of Health has signed a partnership with the Latin American and Caribbean Center for Health Sciences Information (BIREME-PAHO-WHO) and the Brazilian Academic Consortium for Integrative Health (CABSIN) to develop Evidence Maps on Integrative and Traditional Health Practices (6), including this one on meditation. The objective of this Evidence Map is to concisely describe different meditation interventions and their related health outcomes.

According to Johnson (7), meditation is a practice that may have arisen simultaneously with the domestication of fire. The author explains that the first meditative experiences may have taken place while our ancestors contemplated the fire flames. In the past, meditation was considered a practice within the spiritual realm; however, the recent increase in the number of practitioners may derive from its positive effects on health (8, 9).

The first robust evidence in the health field can be found in the late 60's. In 1970 (10), Wallace used EEG and other physiological measures to monitor the meditative state. The results of this study pointed to the surge of theta waves, a frequency decrease, and an increase in the amplitude of the alpha waves. Thus, the author characterized meditation as a hypo metabolic state with a predominant expression of the parasympathetic nervous system and a reduction of the sympathetic tonus.

Since then, the number and quality of studies on meditation has increased, becoming an integrative practice that has gained a growing interest among health professionals.

About 19% of the non-institutionalized adult population in the USA practices some kind of meditation (11). A higher rate of adoption has been observed among women, and the more educated and younger population, and people with chronic diseases as anxiety, depression, pain, and sleep problems. The high cost of conventional medical treatment is also one of the reasons for the adoption of this practice. The most vulnerable population, with worse health conditions, is less likely to practice meditation (12).

The interest in Complementary and Alternative Medicine, classified by WHO within a broader scope as Traditional, Complementary, and Integrative Medicines (MTCI), has grown not only within the general population, but also among health professionals. In general, about 80% of complementary therapies have been considered as an option of treatment during the patient-doctor discussions (13). Despite the moderate level of knowledge that doctors have about meditation, they find it beneficial and prescribe it as a form of treatment (14). This acceptance of the meditation practice may derive from the increasing number of courses on MTCI offered as part of the

TABLE 1 | Terms searched for the meditation evidence map.

Database	Searched words
BVS	((MH:Meditation OR ti:(Meditation OR Meditacao OR Meditacion OR Mindfulness OR "Atención Plena OR "Atenção Plena" OR "Consciência Plena" OR "Terapia de relaxamento")) AND (therap* OR medicinal OR medical OR terap* OR treatment* OR tratamento* OR eficacia OR efficacy OR clinic* OR effect* OR MH:"/uso terapeutico" OR MH:"/terapia" OR "uso clinic" OR "uso terapeutico" OR "Therapeutic use" OR "Clinical use" OR "aplicação clínica" OR "aplicación clinica" OR "aplicação terapêutica")) andnot "MEDLINE"
PUBMED	((((MH:Meditation OR TI:Meditation OR TI:Meditação OR TI:Meditacion OR TI:Mindfulness OR Cogitat* OR Pranayam* OR kapalabhati OR TI:zen OR TI:transcendental OR "M-Sidhi" OR mahayana OR hiniyana OR theravada* OR vajrayana OR vipassana OR vipashyana OR dhyana OR dyana OR dharana OR zazen OR kinemantra OR TI:KM OR mantra OR mantras OR samadhi OR samatha OR pratyahara OR purusha OR prakruti OR Hesychasm OR "lectio divina" OR bonadona OR "Anapana Sati" OR anapanasati OR "kabat-zinn" OR "sudarshan kriya" OR TI:raja OR ratha) OR (("Atención Plena" OR "Atenção Plena" OR "Consciência Plena" OR "Terapia de relaxamento" OR "mind-body and relaxation techniques" OR "mindbody relations" OR "open awareness" OR "focused awareness" OR "relaxation response" OR "progressive muscle relaxation" OR "progressive relaxation" OR "forced nostril breathing" OR "Uninostril breathing" OR "unilateral breathing") AND NOT (qigong OR "qi gong" OR "ch'i kung" OR "Tae Eul Ju" OR "tai ji" OR "tai chi" OR "tai ji" OR "Taijiquan" OR Khundalini OR Kundalini OR TI:yoga))) AND (therap* OR medicinal OR medical OR terap* OR treatment* OR tratamento* OR eficacia OR efficacy OR clinic* OR effect* OR MH:"/usoterapeutico" OR MH:"/terapia" OR "usoclinico" OR "usoterapeutico" OR "Therapeutic use" OR "Clinical use" OR "aplicaçãoclinica" OR "application clinica" OR "aplicaçãoterapeutica")) AND NOT DB:"MEDLINE")
EMBASE	#38 AND #39 AND ('therapeutic use' OR 'clinical use' OR 'clinical') AND [embase]/lim NOT ([embase]/lim AND [medline]/lim) AND ('meta-analysis': de OR 'systematic review':de) #38 AND #39 #39 #36 OR #37 #38 therap*:ti OR medicinal:ti OR medical:ti OR treatment*:ti OR efficacy:ti OR clinic*:ti OR effect*:ti OR 'therapy'/exp OR 'therapeutic use' OR 'clinical use' #37 'meditation'/mj OR mindfulness:ti OR meditation:ti OR cogitat* OR pranayam* OR kapalabhati OR zen:ti OR transcendental:ti OR 'm sidhi' OR mahayana OR hiniyana OR theravada* OR vajrayana OR vipassana OR vipashyana OR dhyana OR dyana OR dharana OR zazen OR kinemantra OR km:ti OR mantra OR mantras OR samadhi OR samatha OR pratyahara OR purusha OR prakruti OR hesychasm OR 'lectio divina' OR bonadona OR 'anapana sati' OR anapanasati OR 'kabat-zinn' OR 'sudarshan kriya' OR raja:ti OR ratha #36 ('mind-body and relaxation techniques' OR 'mindbody relations' OR 'open awareness' OR 'focused awareness' OR 'relaxation response' OR 'progressive muscle relaxation' OR 'progressive relaxation' OR 'forced nostril breathing' OR 'uninostril breathing' OR 'unilateral breathing') NOT (qigong OR 'tai chi' OR 'tai ji' OR 'taijiquan' OR khundalini OR kundalini OR yoga:ti OR 'yoga'/mj)

medical curriculum; however, little scientific evidence is offered on this regard (15).

To bridge this gap, this study intends to systematize research results on the prescription and adoption of meditation in a clear and concise map to boost confidence and inform decisions taken by health professionals and public administrators.

METHOD

This Evidence Map includes integrative and systematic reviews, meta-analysis, and meta-synthesis, and summarizes meditation related health interventions and outcomes. Systematic reviews were performed to obtain a reliable summary of the best evidence available in this area. The analysis was carried out following the PRISMA guidelines (16) and the International Initiative for Impact Evaluation (3iE) Evidence Gap Map methodology (17). An advisory panel of librarians, practitioners, policy makers, content experts, and researchers contributed to the production of this evidence map.

DATA SOURCES

Papers published in English, Spanish, and Portuguese were selected in searches conducted on PUBMED, BVS, and EMBASE databases from 1994 to November 2019. Experts on the topic were consulted and the search strategy was jointly developed with BIREME.

List of the words used in the search in **Table 1** terms searched for the meditation evidence map.

Inclusion Criteria

Systematic reviews/meta-analysis, and meta-syntheses on meditation with adequate description of health outcomes were eligible for inclusion in the Evidence Map. An integrative review study was considered as highly relevant and was also included. The selection of systematic reviews, meta-analysis, meta-synthesis, and integrative reviews was done based on the studies that self-identified as such. Participants of all ages, regardless of their health condition, were also eligible for inclusion as well as interventions of any kind, follow-up, and duration. Studies that did not focus on meditation and/or related health outcomes were excluded.

Procedures

Screening and blinding procedures were carried out by two independent reviewers using Rayyan software (18). Citations deemed as potentially relevant by at least one reviewer and unclear citations were verified in their full text. Full-text publications were selected according to the inclusion criteria agreed by the two independent reviewers; disagreements were

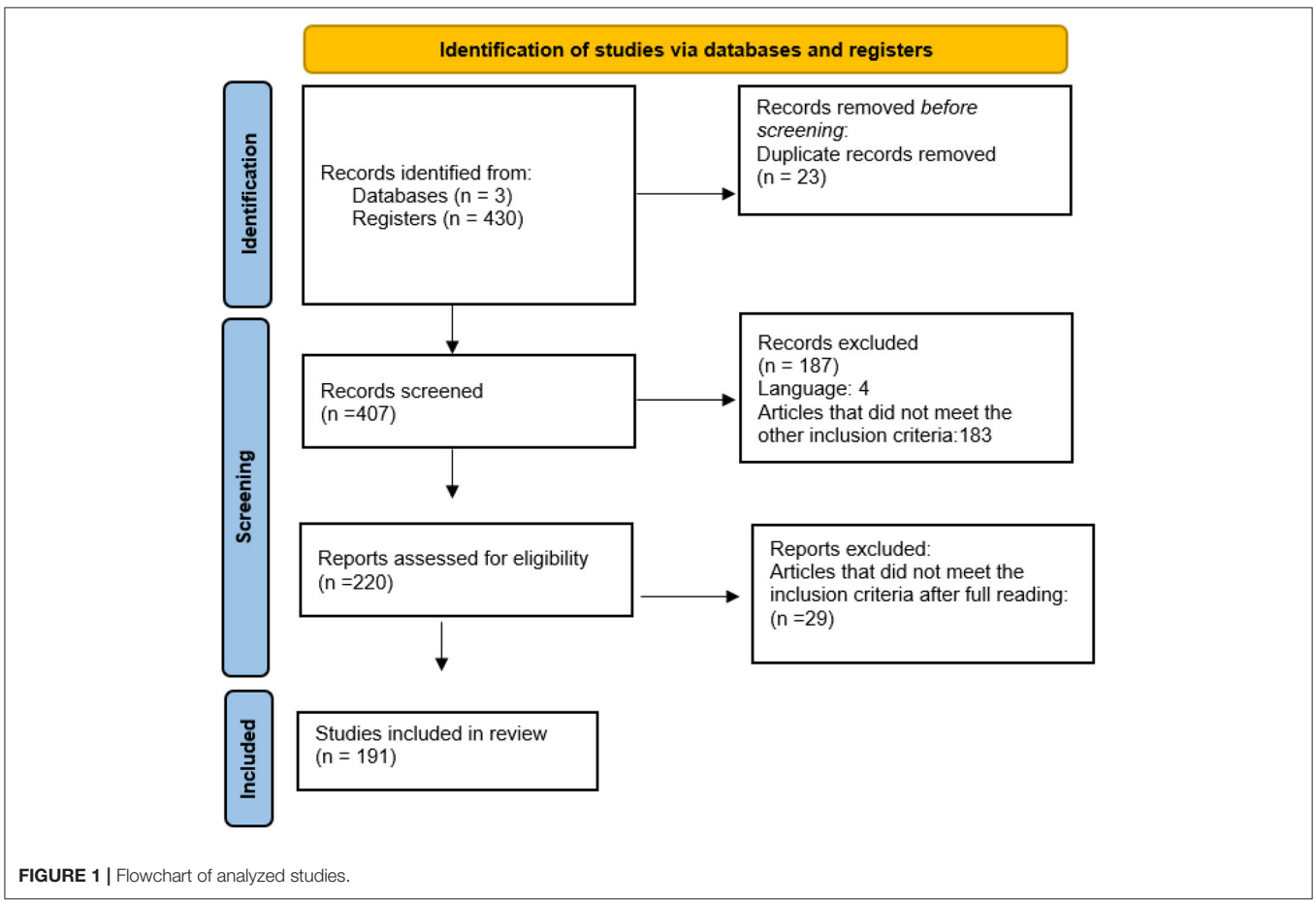


FIGURE 1 | Flowchart of analyzed studies.

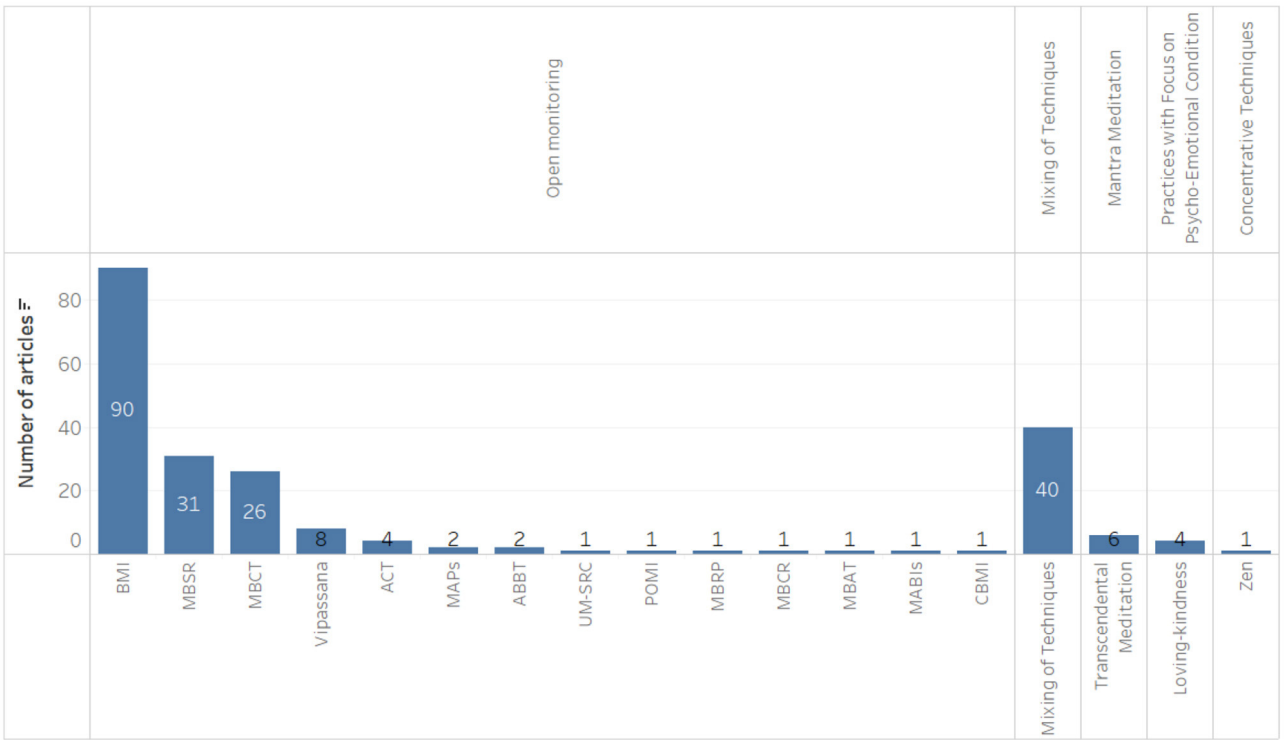


FIGURE 2 | Types of meditation practices identified.

resolved by discussion (**Figure 1**). AMSTAR 2 (19) (**Figure 2**) was used to analyze the quality and methodological rigor of the studies included.

Synthesis of the Data

A spreadsheet with various descriptors was developed to synthesize the findings. This matrix included: Full text citation; Interventions; Outcomes group; Outcomes; Effect; Population; Database ID; Country of focus; Country of publication; Year of publication; Type of review; Review design; Study design; Confidence level. The Evidence Map was organized considering the outcomes, effects, and confidence level of the studies included.

RESULTS

Of 407 citations identified, 191 studies met the inclusion criteria. A total of 507 different outcomes were identified, with it being possible to find more than one per study, i.e., a single article may have information related to two outcome groups, several types of meditation, and different populations. One hundred and ten systematic reviews with meta-analysis, 78 systematic reviews, two meta-syntheses, and one integrative review were included. Meditation types based on open state practices accounted for the highest number of results (390 results), followed by mixture of techniques (93 results), mantra-focused practices (15 results), state-focused practices (8 results), and focused mindfulness practices (1 result). According to AMSTAR2 classification, most studies showed a moderate level of confidence ($n = 84$ studies), 82 studies had a low confidence level, and 22 studies had a high confidence level. The two meta-syntheses and the integrative review could not be evaluated by this tool (19).

Population

Most of the studies found in the search addressed outcomes in the adult population with some diagnosed conditions, with 114 on patients with mental disorders, 45 on patients with cancer, and 36 on patients with chronic pain. The search also identified 36 studies conducted exclusively with children or adolescents, and 35 that only included women.

Countries

The United States was the country of focus where the highest number of studies were carried out (61 studies), followed by Canada (30 studies), United Kingdom (28 studies), and Australia (23 studies). One hundred and twenty one studies did not report the country of focus.

Outcomes and Effects

It was observed that meditation has been used as an intervention in diverse health conditions. Within the 191 studies retrieved, effects were classified into five categories of health outcomes and considered as: negative (no results); positive (246 results); potentially positive (174 results); inconclusive/mixed (74 results); and no effect (13 results), reaching a total of 507 diverse effects, as

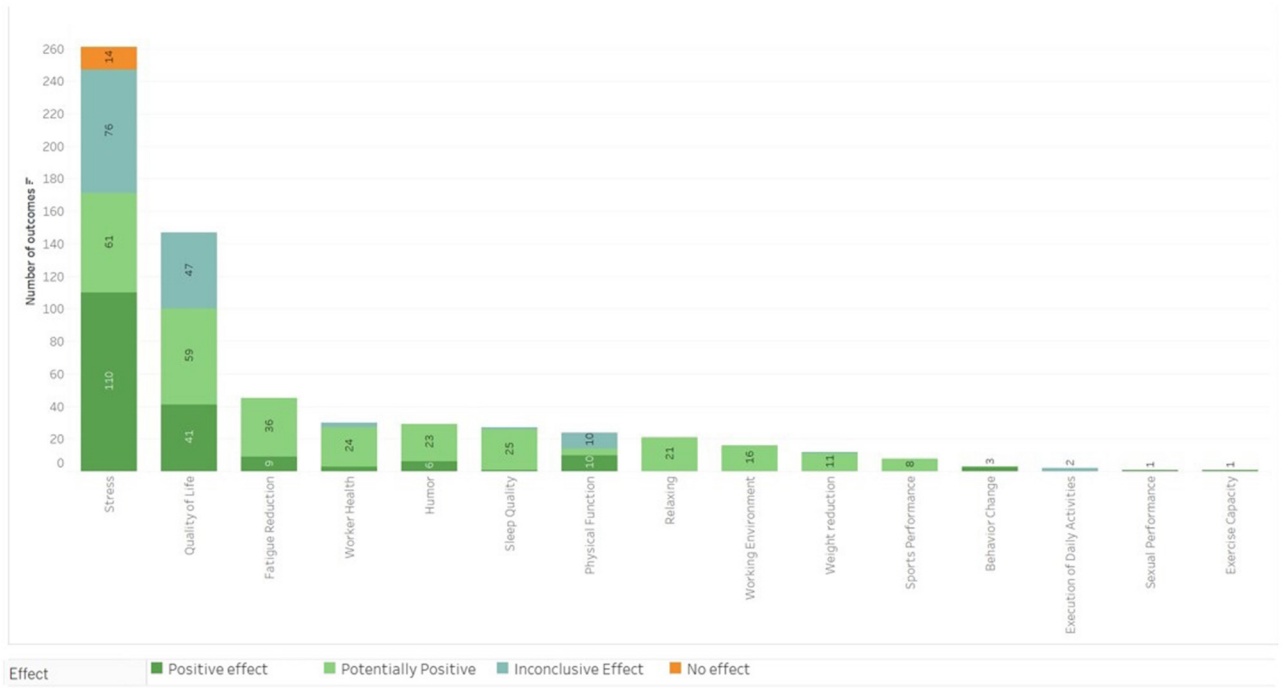


FIGURE 3 | Main outcomes categorized by results and confidence level.

shown in **Figure 3**. **Figure 4** depicts the results, which are divided into five major groups.

Mental Health

The Mental Health category included 270 results involving the practice of meditation (**Figure 5**) among which 138 reported positive effects, 88 reported potentially positive effects, 38 reported inconclusive/mixed effects, and 6 did not describe the effects. The highest number of results was found in the treatment of anxiety, depression, and stress, followed by those pointing out the improvement in levels of mindfulness (**Figure 5**). Regarding the population, in 97 results the inclusion criterion was patients with some diagnosis of mental disorder, 24 results referred to the effect of meditation practices exclusively in children and adolescents, and in 20 results the inclusion criterion was cancer patients. Results whose inclusion criterion was exclusively women had 18 occurrences. Open State practices were the most prevalent, represented in the treatment of 34 different categories among which Mindfulness-Based Interventions were the most common, followed by Mixed Techniques, adopted in 16 categories, mantra-focused practices, adopted in six categories and focused attention adopted for the treatment of four different categories.

Physical and Metabolic Effects

The group including Physical and Metabolic outcomes presents a total of 87 results. The effect of meditation was positive in 41 results, potentially positive in 29 results, inconclusive in 15 results, and with no effects in two results. The most

Effects	Mental Health	Vitality, Well-Being and Quality of Life	Physical and Metabolic Effects	Socio-environmental and Spiritual	Other
Positive	138	47	37	5	
Positive Potential	88	37	27	13	
Inconclusive/Mixed	38	20	12		1
No effect	6	2	2	3	

FIGURE 4 | Results of meditation effects by category in the research included in the Evidence Map.

common outcomes were improvements regarding high blood pressure, general cancer symptoms, and chronic pain (**Figure 6**). Regarding the population, the inclusion criteria for cancer patients showed effects in 16 outcome categories, cardiovascular/vascular disease 15, and chronic pain 14. Mindfulness-Based Interventions were applied in 20 categories, Mix of Techniques in 11, and Mindfulness-Based Stress Reduction in 14 outcome categories. Most of the studies in this group were classified as having a moderate level of confidence.

Vitality, Well-Being, and Quality of Life

The vitality, well-being and quality of life group obtained 106 results for the practice of meditation as can be seen in **Figure 7**, out of which 47 were positive, 37 potentially positive, 20

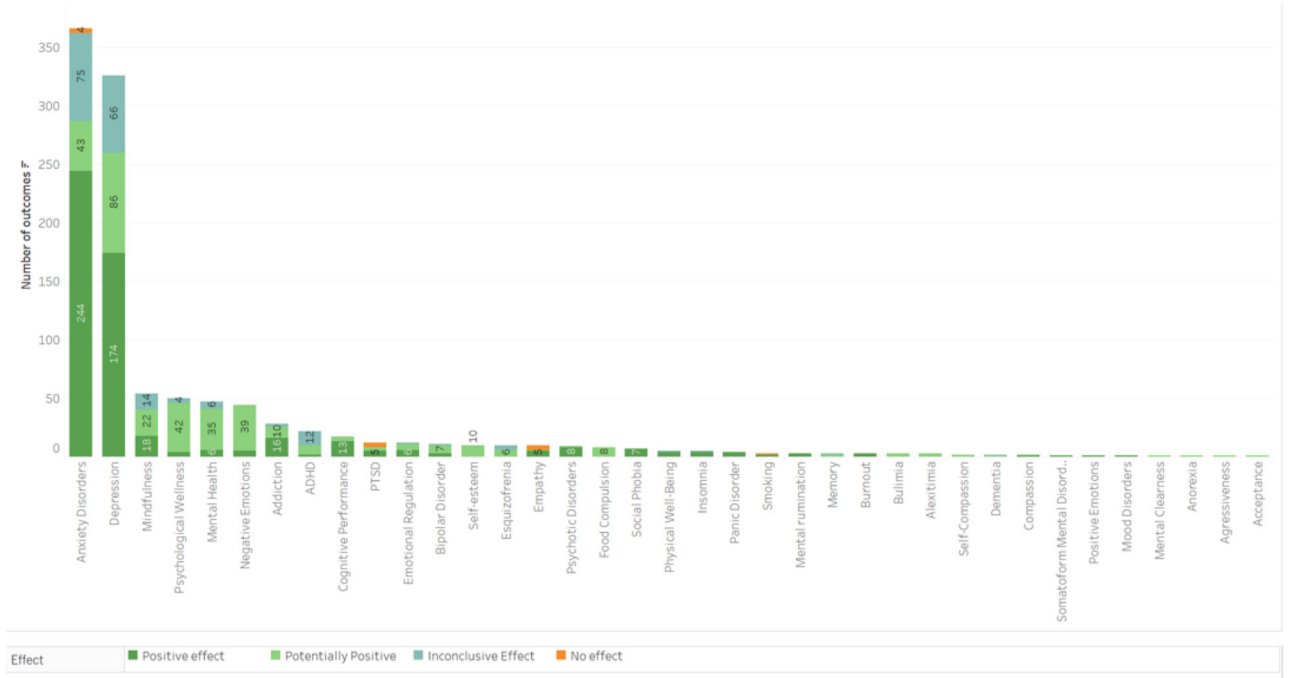


FIGURE 5 | Main outcomes in the Mental Health category.

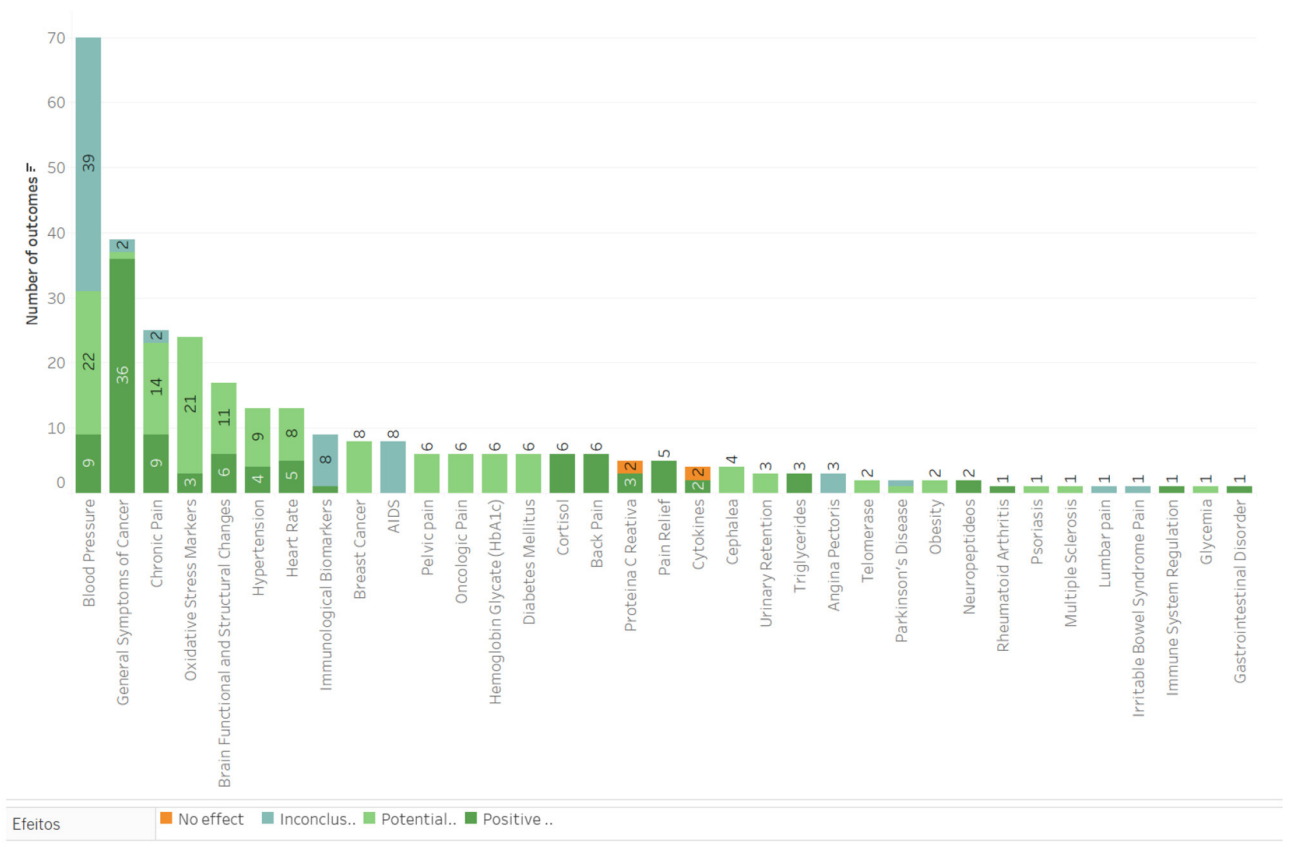


FIGURE 6 | Main outcomes in the category of Physical and metabolic effects.

inconclusive and two results with no effects. The most common outcomes were decreasing stress, higher quality of life and better worker health with 39, 24, and 4 results, respectively. Most of the results obtained in this group (62 results) included a population with some health disorder diagnosed, plus 11 results were obtained using the criteria of workers.

DISCUSSION

The number of meditation practitioners has grown in recent years. One of the main reasons is the acknowledgment of the positive effects that meditation exerts on health in general (8, 9). However, healthcare courses themselves offer few disciplines and little scientific evidence on the MTCI (15, 20), that is why studies of this nature are necessary, such as systematic reviews, meta-analyses, and evidence mapping.

A survey carried out by Andrade et al. (21), found out that ∼30% of the population in a large city like São Paulo suffer some sort of mental disorder, the most prevalent being depression and anxiety. Our survey mostly researched population with some mental disorder. The high prevalence of psychiatric disorders around the world is one of the reasons why a large number of studies on meditation were carried out within the Mental Health outcome group. Within a US sample, anxiety, stress, and depression were the health issues most associated with the search for meditation. Most respondents recognized that meditation improves mental health (22).

In the map, depression, and anxiety were the disorders with the highest number of results, with 71 and 67 results, respectively. On depression, there were 11 reviews with a high confidence level of which only one effect was inconclusive, one potential positive and 9 had positive effects related to meditation. All articles with a high confidence level were systematic review studies with meta-analysis (23, 24) reporting positive effects for reducing depressive symptoms in patients with mental disorders.

Goldberg et al. (24) also conclude that meditation has similar results to some standard treatments such as psychotherapy. Another study showed that a meditation program reduced relapse in patients with depression (25), that is, since recurrent depression is more difficult to be treated and causes high costs for society (26, 27), the MBCT program can be considered an efficient treatment, as observed in NHS experiences in England (28) and confirmed by several studies present in this map (29–31).

Mental health costs in China increased more than 3-fold from 2005 to 2013 and could have reached much higher values if all patients with mental illness received adequate professional treatment. Anxiety is the most prevalent mental disorder, affecting up to a third of the population at some point in life (21, 32, 33) with a high economic and social impact (34). Of all the studies included in this map, most have addressed anxiety. Of the 67 results for Anxiety Disorders, the vast majority, 56 results, were positive or potentially positive, that is, meditation can be used as one of the forms of integrative and complementary treatment for anxiety disorders, as shown in Montero-Marin et al. (35). In other studies, anxiety was assessed in patients with other comorbidities, such as cancer (36–39). The prevalence of anxiety in cancer patients is high (40, 41) and meditation can help patients to reduce anxiety symptoms as stated in the meta-analysis carried out by Zhang et al. (42) which included RCT studies of patients diagnosed with cancer.

In the dimension of health promotion and vitality, 7 moderate quality reviews highlight relevant effects on quality of life (37, 39, 43–48) obtained through Mindfulness interventions. These practices can even be done online (49). The fact that meditation is a potentially self-applicable practice that can be taught from a distance is especially important in periods of social isolation such as the one imposed by the covid-19 (50) pandemic.

The use of meditation as a health promotion resource is growing, with positive outcomes in terms of cognitive performance (51–53) and sexual performance (54), for example. Also noteworthy is the development of mindfulness skills (39, 48, 55–57), compassion (58), empathy (58), and positive emotions (59).

Integrative resources have been increasingly used in the context of health promotion (60). Sarris et al. emphasize the importance of incorporating practices that support lifestyle change based on scientific evidence to support health protocols and policies (60).

Along the same lines, other authors propose broad intervention programs involving lifestyle changes based on meditation (61). Thus, the interdependence between psychological, physical, and human development factors for an approach involving meditation has become relevant (62).

Among the interventions of the Complementary and Integrative Traditional Medicines (MTCI), meditation is the most comprehensive in terms of results and variety of effects. Among the systematic review studies included in the evidence maps presented in the BVS/MTCI, the meditation map is the largest of them, indirectly showing the substantial number of studies published on the subject in recent decades. Meditation techniques can be used by children and adolescents (63), pregnant women (64), the elderly (65), health professionals, and caregivers (66, 67), in addition to people with chronic diseases (68), having a great potential from the point of view of public health, given its impact on physical and metabolic health conditions (63). In cancer patients, it is possible to highlight the increase in variables such as physical well-being (69, 70) and psychological well-being through meditation.

On the physical and metabolic effects of meditation, the literature has described several relevant factors. The ability to promote neural plasticity of meditation techniques is very relevant and has important physical and metabolic impacts (71). Black and Slavich describe possible effects of meditation to improve the immune system (72). The literature also speaks of inflammatory and metabolic markers (73) that are altered with meditative practice.

In this perspective, perhaps interventions such as meditation are part of a plausible solution to deal with the challenges related to quaternary prevention in collective health (74, 75) mainly due to the need to deal with chronic diseases in a preventive

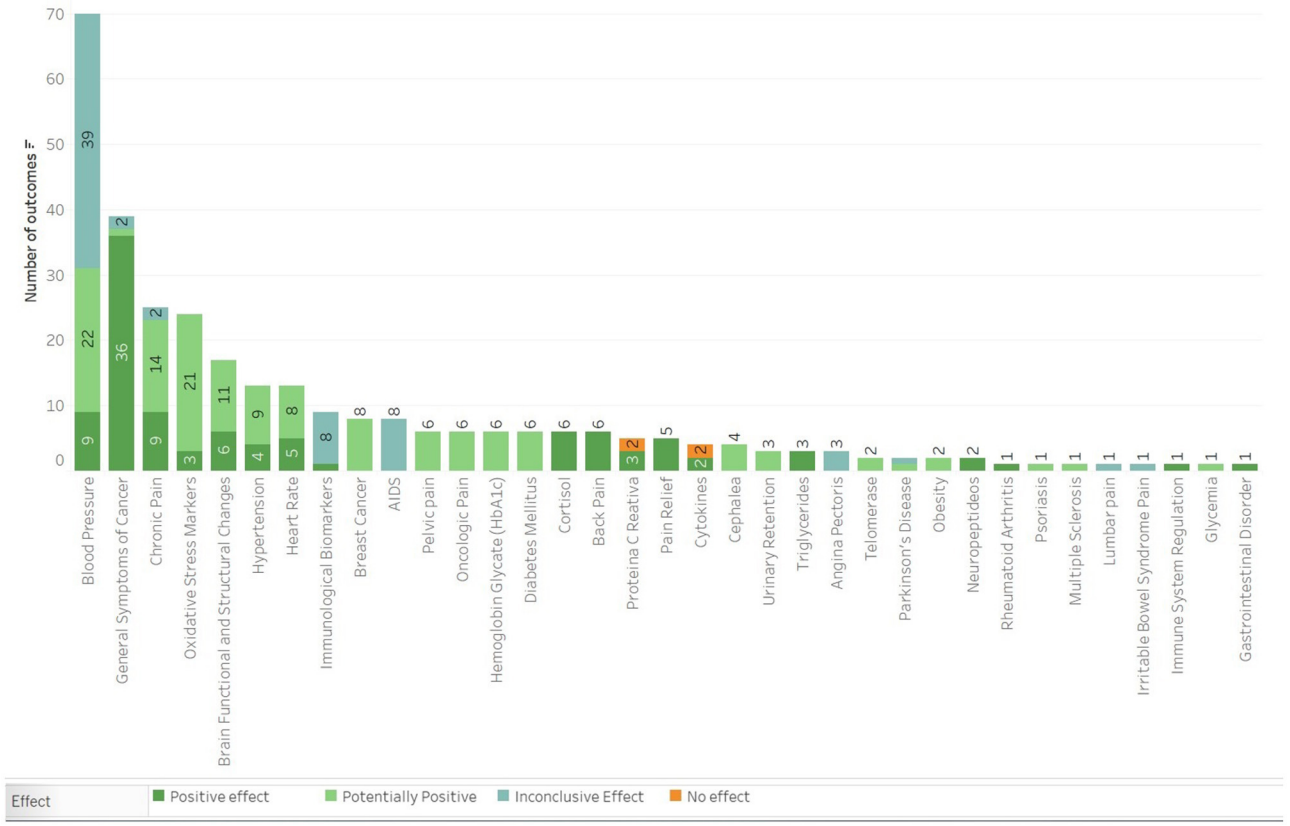


FIGURE 7 | Main outcomes in the Vitality, well-being, and quality of life category.

and comprehensive approach, considering lifestyle changes in addition to symptom-focused attention.

The creation and publication of evidence maps consists of graphically representing the best evidence found, analyzed and categorized, with the corresponding bibliographic records and full texts (when available) of the studies, in order to facilitate access to information for all interested parties (50).

As it is not the objective of an evidence map, the calculation of the effect sizes of a meta-analysis was not performed, nor was the risk of bias assessments performed, but we tried to overcome these limitations by assessing the quality of the included systematic reviews by applying AMSTAR 2.

The outcomes and effects information presented in this Meditation Evidence Map will further advance the evidence-based knowledge of MTCI as proposed by PNPIC in Brazil and promoted by WHO 2014–2024 and BIREME.

CONCLUSIONS

Meditation practices can be developed by healthy individuals or individuals who have different health conditions, from chronic diseases to different mental health disorders, with positive and potentially positive effects on various low-risk health outcomes.

The practice of meditation can be a safe and effective strategy for implementing programs in the field of collective health. The possibility of applying it in groups facilitates access and reduces costs in relation to drug interventions, for example in mild cases of depression and anxiety, being a potential resource to avoid chronicity and the negative impact of stress on health.

DATA AVAILABILITY STATEMENT

Publicly available datasets were analyzed in this study. This data can be found here: https://mtci.bvsalud.org/pt/mapas-de-evidencia-2/.

AUTHOR CONTRIBUTIONS

CS and RA did the selection of articles and quality assessment, analysis of results, and writing of the discussion. VA designed the search strategies and accompanied the filtering of results by reviewers on the RAYYAN platform, collaborated in the data analysis, methodological design of the evidence maps, and writing of the manuscript. MS and RG collaborated in the methodological design of the evidence maps, data analysis, and writing of the manuscript and conclusions. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2021.742715/full#supplementary-material

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Humanized Care From the Nurse–Patient Perspective in a Hospital Setting: A Systematic Review of Experiences Disclosed in Spanish and Portuguese Scientific Articles

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Nowadays, humanized care is an essential component in the field of health because the professional work of nursing seeks to provide quality services to patients who are suffering and fear illness or the dying process. Nurses recognize the need to incorporate humanized care into their daily work, as supported by Jean Watson, who states that caring entails establishing an adequate nurse–patient therapeutic relationship, where health education is a tool that promotes self-care in the patient, family, and community. The main objective of this work was to find scientific evidence on humanized care from the perspectives of nurses and hospitalized patients. To meet those research objectives, an exploratory systematic review of articles published in high-quality scientific journals from 2016 to 2020 using the PRISMA methodology in the Scopus and Scielo databases was conducted, yielding 26 studies that were analyzed. The findings show that nurses and patients perceive the need to remove the barriers that limit the advancement of humanized care in hospital institutions because they urgently demand that health professionals in all settings, especially critical ones, strengthen their humanizing role by sharing cordial, empathetic health experiences, and respecting their customs and beliefs during the hospitalization process. As a conclusion of the findings, the nurse–patient professionals agree that health personnel training is critical to providing humanized attention with quality in the hospital context, emphasizing that professional training should develop in practice soft skills, communication, safety environment, and human values.

Keywords: humanized care, nurse, patient, perspective, hospital, systematic review

INTRODUCTION

The humanization of care is an essential element to achieve the promotion of well-being during the processes of care within health systems because the hospital environment is immersed in an imbalance of emotions resulting from the suffering and anxiety endured by the sick person and the family (1, 2).

Promoting humanized care during the daily work of health professionals implies promoting the universality of the right to health as an essential element and where there should be no distinction of any kind (3). This should be developed as an integral formation of every nursing student in the university classrooms (4, 5).

The humanization of health services seeks to raise the quality of care at the administrative and assistance levels, for comprehensive care and without financial difficulties throughout the life of the patient (6–8).

The essence of nursing care is founded on Jean Watson's (9–12) theory, which states that care necessitates a way of being able to interact and connect with the patient and the family, with the goal of providing an environment of excellence, comfort, and safety, with high competencies, skills, and conditions to achieve holistic care (13).

Some authors agree that the conceptualization of care, the essential art of nursing, is to care for the most primitive act that a human being performs to effectively become, this being, a being in relation to another who invokes it in an ethical and philosophical foundation (14–19). Humanized care represents an enlightening guide and support to the practice for its benefit in cultivating a conscience of care and the establishment of a strong and sustainable therapeutic relationship. Therefore, care represents the work of nursing, based on humanistic values in order to meet the needs of patients and improve their quality of life (20, 21).

Care, as the essence of professional nursing practice, necessitates that professionals know how to act with ethical commitment, foster relationships of understanding, empathy, and respect, and prioritize actions to provide timely responses to difficulties, because humanized care, to be meaningful, must be based on the reciprocity of professionals in the face of health problems (22–24). However, no one is unaware that health services are seen as stressful and overcrowded places for patients, which causes emotional exhaustion in professionals as a result of work overload and lack of resources, which makes care management a current challenge for health professionals, especially for nurses (25, 26).

On the other hand, the dynamics of action of nursing professionals is to provide comprehensive care from the practice of learned scientific knowledge and their own experience, with the objective that the patient achieves physical, psychosocial, and spiritual well-being (27); since care has ethical bases, originates autonomy, and creates confidence and security (28).

In reference to the problematic reality, it can still be seen that nurses still govern their work in a technical–scientific and somewhat mechanized manner, often disregarding the human aspect, which alienates the patient and damages interpersonal relationships (29). In this regard, the humanized care approach conceives that "the other human being" in front of us, expects humanized care, being necessary that professionals have the appropriate qualities, which should be generated during academic training (30).

There are some studies that sought to systematize the evidence of the perception of humanized care received by patients or delivered by nurses throughout the world. Some cases can be reviewed in (31–33).

A systematic review was carried out in Chile on humanized care in patients with limited therapeutic effort focused on adults in intensive care in Ibero-America. The authors found 23 articles from the databases PubMed, Epistemonikos, Web of Science, Scielo, Elsevier, and added information from other electronic sources such as End-of-Life Journal and Journal of Medical Ethics. The main conclusion of the study was the determination that the nursing professional is aware of the diversity of roles he or she fulfills when attending to a patient, but when applying humanized care, the relationship between patient, family, and medical team is evidenced, communication being a priority agent for the knowledge of the needs of the patient (34).

Likewise, a systematic review on humanized care in children was carried out in Italy, analyzing scientific evidence published in the PubMed and Scopus databases. Only 28 records met the inclusion criteria, and it was concluded that humanized care is elementary for pediatric hospital global management, being necessary to continue research to strengthen child-centered research (31).

In Spain, the results of a systematic review on the humanized care of the neonate and the family were disclosed. The search was done in PubMed, Cochrane, CINHAL, Scopus, and Google Scholar databases. Thirteen peer-reviewed scientific articles were found that met the inclusion criteria, whose conclusions suggest the promotion of family participation through the modification of health policies such as the daily and permanent attention of the nurse and their constant communication (33).

Currently, health institutions show an urgent need to strengthen the right and guarantee accessibility to health services with a human face. Thus, humanized care is a way to raise the quality of health services provided by health professionals, especially nurses, who must create a safe environment, with dignified treatment for the patient, family, and community. The satisfaction experienced by patients and families in health institutions is important to strengthen trust, quality of services in a safe environment to ensure holistic care in each individual, taking into account a moral commitment, through values of respect for the dignity of life, contributing to improve the quality of life of people (13).

To complement the findings identified by the authors previously developed, it was deemed convenient to carry out a systematic review on humanized care in hospitalized patients, compiling evidence published in Spanish in the Scopus and Scielo databases.

TABLE 1 | Searches.

Code	Database	Search	Language
A1	Scopus	"Cuidado humanizado" AND "hospitalización"	Spanish
A2	Scopus	"Cuidados humanizados" AND "hospitalização"	Portuguese
B1	Scopus	"Paciente hospitalizado" AND "hospitalización"	Spanish
B2	Scopus	"Paciente hospitalizado" AND "Hospitalização"	Portuguese
C1	Scielo	"Cuidado humanizado" AND "hospitalización"	Spanish
C2	Scielo	"Cuidados humanizados" AND "hospitalização"	Portuguese
D1	Scielo	"Paciente hospitalizado" AND "hospitalización"	Spanish
D2	Scielo	"Paciente hospitalizado" AND "Hospitalização"	Portuguese

MATERIALS AND METHODS

The study was an exploratory systematic review (35). We searched for evidence seeking to meet the research objectives in the Scopus and Scielo databases published in the years 2016–2020 in Spanish and Portuguese. The searches detailed in **Table 1** were performed.

The initial search of the Scopus and Scielo databases yielded 74 records. During their exploration, 32 articles were identified that were neither downloadable nor visible, which were withdrawn from the study, resulting in a subtotal of 42 accessible records. The application of filters according to the inclusion and exclusion criteria resulted in 30 eligible records, of which four records were removed due to duplicity. The final result included 26 records. Having all the information collected, we proceeded according to the research question: What is the scientific evidence on humanized care from the point of view of nurse–patients in a hospital context?

To meet the objectives, the database was exhaustively reviewed and to categorize them, the titles, abstracts, and contents of each document were evaluated, extracting the data from the preselected and selected studies, to finally present the conclusions after analyzing and interpreting them. That said, the preferred reporting items for systematic review and meta-analyses (PRISMA) flow chart (36) was used for its presentation, which is detailed in **Figure 1**.

RESULTS

The 26 reorder identified were carefully reviewed and systematized and are shown in **Table 2**.

A more detailed analysis by the authors identified relevant data for each of the records, such as the country where the study was carried out, the methodology applied, the results, and the conclusions reached. This is detailed in **Table 3**.

DISCUSSION

Articles pertaining to humanized care from the point of view of nurses–patients in a hospital context were found in the two databases. The articles were selected according to the objectives of the search, obtaining a total of 26 articles from six countries (Spain, Chile, Mexico, Cuba, Ecuador, and Colombia), which were quantitative (6), qualitative (9), mixed (1), and systematic review (10), which were critically analyzed to meet the objectives of the study.

Humanized nursing care is a unique way of caring within the health system, where the patient is offered a safe environment and protection of their human dignity, which sustains the care over time, educates to promote health and harmony in body, mind, and soul, based on a relationship of trust. Likewise, humanized nursing care attends to the human and therapeutic needs of the patient in his or her health–disease condition (13, 54).

The evidence suggests that from the perception of nurses–patients, the topic leads to discussing and reflecting on the complexity that humanized care implies, from dignified treatment to the application of institutional policies, for which the commitment of all social actors is required to assist in humanizing health institutions. Expressions that are perceived by nurse–patients in the hospital context are detailed.

Elimination of the Constraints of the Delivery of Humanized Care

Prieto Martínez et al. (42) state that patients and family members perceive limitations in humanized care related to the technified language that causes distance and distrust, and in health personnel they perceive a greater interest in technological equipment, diagnoses, and disease evolution, which brings with it a feeling of disinterest in the person and a lack of compassion in front of the suffering, and pain experienced by the person and the family.

Also, Ospina Vanegas et al. (43) point out that health professionals show a lack of soft and social skills, which makes it difficult for them to achieve adequate interpersonal relationships, especially in critical situations experienced by patients (21, 24). In fact, the health problems faced by patients lead to strict changes in their lifestyle, which generates emotional and even existential crises, with some physical limitations to carrying out their daily activities.

In this sense, health professionals assume critical behavior due to the same health situation experienced by patients, and the strict pressures to comply with medical indications generates insecurity, fear, and apprehension, resulting in distancing for interpersonal relationships and even little freedom to express doubts about emerging health scenarios, turning them into simple listeners, which hinders the achievement of joint goals designed by the nursing staff.

In relation to the infrastructure of health services, in some cases these do not meet the needs of patients as they do not protect privacy, do not provide comfort, and there is no waiting room for family members, among others. In addition, the lack of institutional policies does not allow promoting behavioral change of professionals within health institutions, who continue to label the patient with a bed number, a diagnosis, name of the disease, among others; who currently demand health services based on the right, with the freedom to make complaints or complaints in the institutions for mistreatment, misinformation, lack of medicines or disinterest in the health situation, among others.

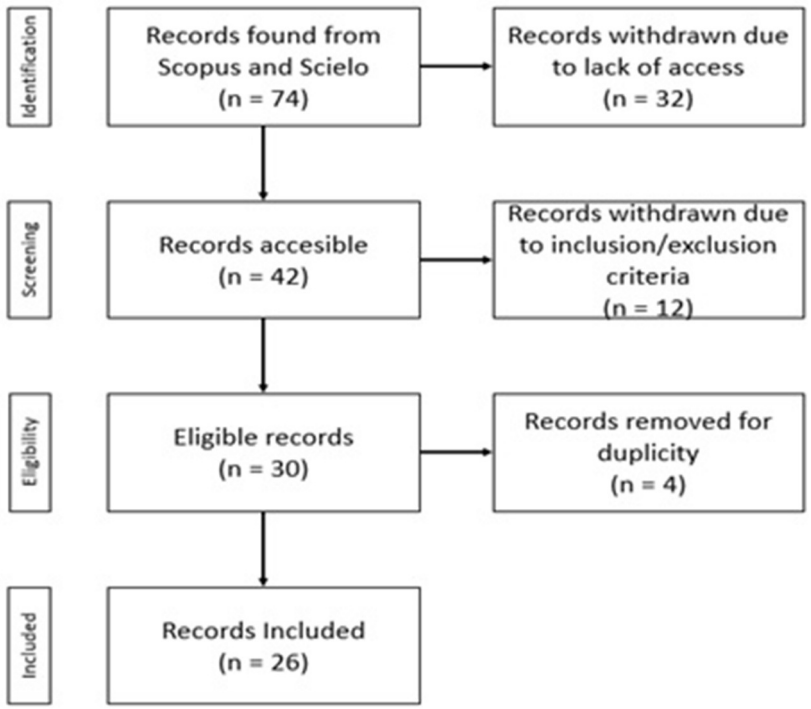


FIGURE 1 | PRISMA flow chart.

Cruz C. argues that the hegemony of the medical paradigm wields a vertical-unidirectional relationship between the professional and the patient, where decision making is an obstacle to the joint work between health professionals–patient and family. However, the management of hospital services from a patient-centered vision favors the quality of health services with a sense of accessibility, social inclusion, and health for all from a humanizing vision (42). Likewise, Diaz Rodríguez et al. (39) report that deficiencies in professional training limit the competencies and soft skills of professionals, who are unable to deal with situations of emotional imbalance experienced by the patient during the care process.

In short, the various limitations in hospital systems affect management, block the expectations of patients and relatives, and the continuity of health care with the various phenomena experienced by the sick person and which are linked to suffering due to the disease itself and to treatment-care, because care is a service that requires faith, hope, and love. Considering that caring is an art and a science, it turns the service into a moment of transcendent gratitude.

Humanizing Nursing Role in Hospital Services, Especially in Critical Areas

According to international studies, participation and leadership of nurses in care actions are critical to supporting quality standards because of their role in defending the rights of the patient and acting as communication agents of care (46). According to Oviedo et al. (37), humanizing behavior creates a calm and confident environment for the health scenario that is being experienced, an affirmation that can be validated when patients yearn within the care attention process to establish affective bonds of trust with details of cordiality, kind treatment, active listening, empathy, solidarity, and respect for customs and beliefs (37, 48, 51).

According to Silva et al. (40), nursing professionals have to deal with highly complex services, most of whom respect human dignity by providing humanized care on a daily basis. However, these critical areas necessitate a high level of specialization and emotional skills from professionals to respond to the needs of the patient and family who live in a state of uncertainty due to the same situation or health condition of the patient. So professionals must be trained to deal with such situations from the standpoint of ethical knowledge of care (40).

In this regard, it is necessary to implement and strengthen professional and technical competencies and soft skills in nurses of critical services: emergency, post-operative, intensive care unit, pediatrics, maternity, oncology, among others, to provide holistic care focusing on the physical, psychological, and spiritual dimensions, among others (41, 45, 55, 56).

On the other hand, in the case of maternity services, women express the various emotions they experience in adapting to a new way of life. It should be noted that the process of childbirth is important for a woman, but it requires humanized care, where the health personnel can identify her needs, offer her cordial

TABLE 2 | Records identified.

Code	Author	Tittle	Journal
1	Oviedo, A. Delgado, I., and Licona, J. (2020) (37)	Habilidades sociales de comunicación en el cuidado humanizado de enfermería: Un diagnóstico para una intervención socioeducativa.	Escola Anna Nery
2	Cruz, C. (2020) (38)	La naturaleza del cuidado humanizado. Enfermería	Enfermería: Cuidados Humanizados
3	Díaz-Rodríguez, M., Alcántara, L., Aguilar, D., Puertas, E., and Cano, M. (2020) (39)	Orientaciones formativas para un cuidado humanizado en enfermería: una revisión integrativa de la literatura.	Enfermería Global
4	Silva, A., Pantoja, F., Millón, Y., Hidalgo, V., Stojanova, J., Arancibia, M., and Campos, M. (2020) (40)	Percepción de actores involucrados acerca del parto humanizado y la violencia obstétrica en Chile: una revisión panorámica.	Medwave
5	Correa-Pérez, L. and Chavarro, G. (2020) (41)	Integralidad en la atención del paciente crítico: buscando un camino para humanizar la UCI.	Acta Colombiana de Cuidado Intensivo.
6	Martínez, P., Suárez, N., Gómez, L., Bolívar, Y., and Rodríguez, É. (42)	Percepciones de dignidad y respeto en Unidades de Cuidado Intensivo.	Acta Colombiana de Cuidado Intensivo.
7	Ospina, D., Cristancho, S., Lafaurie, M., and Rubio, D. (2020) (43)	Humanización de los servicios reproductivos desde las experiencias de las mujeres: aportes para la reflexión.	Revista Cuidarte
8	Monje P., Miranda P., Oyarzün J., Seguel F., and Flores E. (2020) (44)	Percepción de cuidado humanizado de enfermería desde la perspectiva de usuarios hospitalizados	Ciencia Enfermería.
9	Campiño-Valederrama S., Duque P., and Cardozo-Arias V. (2020) (45)	Percepción del paciente hospitalizado sobre el cuidado brindado por estudiantes de enfermería.	Universidad y Salud.
10	Escobar-Castellanos B. and Cid-Henriquez P. (2018) (46)	El cuidado de enfermería y la ética derivados del avance tecnológico en salud.	Acta bioethica.
11	Yáñez-Dabdoub M and Vargas-Celis I. (2018) (47)	Cuidado humanizado en pacientes con limitación del esfuerzo terapéutico en cuidados intensivos: desafíos para enfermería.	Persona y Bioética.
12	Joven Z. (2019) (48)	Percepción del paciente crítico sobre los comportamientos de cuidado humanizado de enfermería.	Avances de Enfermería
13	Hernández L., Díaz A., Martínez J., and Gaytán D. (2018) (49)	Educación de enfermería en el cuidado humanizado.	Escola Anna Nery
14	Acosta-Romo, M., Cabrera-Bravo, N., Basante-Castro, Y., and Jurado, D. (2017) (50)	Sentimientos que experimentan los padres en el difícil camino de la hospitalización de sus hijos prematuros. Un aporte al cuidado humanizado.	Universidad y Salud
15	Beltran-Salazar, Ó. (2015) (51)	Atención al detalle, un requisito para el cuidado humanizado.	Index Enferm
16	Lopera B. (2016) (52)	Cuidado humanizado de enfermería al final de la vida: el proceso humanizado de muerte.	Revista Colombiana Enfermería
17	Mejía M., Faneyra F., Molina B., and Arango U. (2018) (53)	La deshumanización en el parto: significados y vivencias de las mujeres asistidas en la red pública de Medellín.	Investigación educación enfermería
18	Ramírez P. (2016) (54)	Fenomenología hermenéutica y sus implicaciones en enfermería.	Index Enfermería
19	Rojas V. (2019) (55)	Humanización de los cuidados intensivos humanization of intensive care.	Revista Médica Clínica las Condes.
20	García-Salido, A., La Calle, G. H., and González, A. S. (2019) (56)	Revisión narrativa sobre humanización en cuidados intensivos pediátricos: ¿'dónde estamos?	Medicina Intensiva
21	Vialart N., Medina I., and Gavilondo X. 2018 (57)	La cultura profesional del docente de enfermería: Preparación ante las tecnologías informáticas.	Revista Cubana Enfermería.
22	Camero, Y., Meléndez, I., Álvarez, A., and Apuntes, Y. (2019) (58)	Cuidado Humanizado en el Postoperatorio Inmediato de Pacientes Histerectomizadas.	Cultura de los Cuidados.
23	Borges L., Sixto A., and Sánchez R. (2018) (59)	Comprehensive Perspective about Humanized Care to Women during Labor and Delivery.	Revista Cubana Enfermería
24	Castañeda C., Orozco M., and Rincón G. (2015) (60)	"Empoderamiento," una utopía posible para reconstruir la humanización en Unidades de Cuidado Crítico.	Hacia promoción salud.
25	Pabón-Ortiz E., Mora-Cruz J., Buitrago-Buitrago C., and Castiblanco-Montañez R. (2021) (61)	Estrategias para fortalecer la humanización de los servicios en salud en urgencias	Revista ciencia cuidad.
26	Valenzuela, M., Sanjuan-Qui, Á., Ríos-Risquez, M., Valenzuela-Anguita, M. Juliá-Sanchis, and R. Montejano-Lozoya, R. (2019) (62)	Humanización de la asistencia en urgencias: un análisis cualitativo basado en las experiencias de las enfermeras.	Revista de Enfermagem Referência.

TABLE 3 | Details of the studies.

Code	Country	Methodology	Results and conclusions
1	Mexico	Quantitative, descriptive and cross-sectional study.	In relation to empathy and communication, patients perceived humanized care in the majority of nursing professionals at a high level. When evaluating respect and kindness, they wish to be understood and cared for. It is concluded that nursing professionals need to strengthen social skills and effective communication.
2	Chile	Literature review	During the processes of care, patients perceive a vertical—unidirectional relationship of professional-patient. The categories for the practice of humanized care are: the human being, professional-patient relationship, subject of care, communication and holistic approach.
3	Spain	Integrative bibliographic review	The need is expressed to incorporate training programs in emotional and communication competencies in nursing in order to strengthen humanized care.
4	Chile	Systematic review	The analysis carried out by nursing professionals identifies areas of conflict and consensus, as diverse interacting dimensions that should be addressed with the development of comprehensive and effective health policies, because they hinder the advancement of hospital humanization.
5	Colombia	Literature review	In the healthcare field, there are efforts to raise the psychoemotional aspects directed to the patient—family, of the intensive care areas. It is concluded that the ABCDEF care rates are a way to humanize the care of the patient in critical condition.
6	Colombia	Mixed quantitative-qualitative approach.	It is concluded that the technified language leads to a distance between patient-health personnel, since technology dehumanizes the work of health personnel, the doctor-patient relationship, now: doctor-machine-patient, where the machine seems to legitimize the patient's discourse.
7	Colombia	Qualitative approach.	The factors related to the lack of humanization are: lack of training, lack of competencies, compassion, mindfulness and soft skills; added to the lack of information in the area of specialization and the increase of the nurse-patient ratio. It is concluded that the strategies improve empathy, communication and skills for successful care, reduce work overload in the area.
8	Chile	Quantitative approach, correlational study, with a sample of 171 hospitalized patients.	Humanized care exhibits categories in doing, identifies the patient's needs, maintains a cordial treatment, availability and educates. It is concluded that nursing professionals in a high complexity hospital respect human dignity and provide daily humanized care.
9	Colombia	Quantitative, descriptive, cross-sectional, quantitative approach study, conducted with 356 patients.	Patients perceive humanized care in the attention, highlighting the identification of physical, psychological and spiritual needs that achieved low scores. It is concluded that humanized care is a phenomenon of interest for the discipline, by identifying strengths and weaknesses in care.
10	Chile	Literature review	The nursing professional should demonstrate humanized care in all the actions he/she performs, applying ethical knowledge, attitudes and values to the person to be cared for.
11	Chile	Qualitative approach study.	It is concluded that in humanized care, the roles of nurses as defenders of the patient's interests and communicating agents stand out.
12	Colombia	Quantitative, descriptive, descriptive approach study. It was applied to 55 patients admitted to the ICU.	It is concluded that the actions of humanized care are globally perceived as good, in the category Prioritizing the subject of care for patient satisfaction.
13	Mexico	Pre-experimental, quantitative approach study with 37 nurses.	It is concluded that the educational intervention increased the knowledge on the good use of the dignified treatment indicator.
14	Colombia	Qualitative approach study with eight parents between 17 and 35 years of age.	The results show that feelings and affective bonding are expressions of parental love and of the process of interaction with health personnel.
15	Colombia	Qualitative, phenomenological approach study with 16 participants.	It is concluded that humanized care includes details that favor nurse-patient interaction.
16	Colombia	Qualitative, ethnographic approach study.	The results show the attributes of a humanized death as a dignified death: the person keeps his/her rights; calm death: when he/she keeps his/her preferences; good or peaceful death: when it is accepted; and beautiful death: when death occurs at home. It is concluded that humanized death requires the participation and leadership of the nurse with caring actions.
17	Colombia	Qualitative approach study	The results show that the meaning of the experiences of the birthing process are not consistent with a transcendent human experience.

(Continued)

TABLE 3 | Continued

Code	Country	Methodology	Results and conclusions
18	Colombia	Qualitative approach study	It is concluded that individualized care from the perspective of the unitary being humanizes the practice of care.
19	Chile	Literature review	The technological progress achieved in the diagnosis and treatment of diseases has not gone hand in hand with advances in the development of non-technical skills in the health team, the latter demanded and suffered by patients and relatives, who yearn for comprehensive care, in a context of crisis in ICU hospitalization.
20	España	Literature review	Humanization should be the subject of debate, without calling into question the humanity displayed by professionals. In this study, the strategic lines on which the humanized care of the critically ill patient revolves were analyzed and referred to, adapting them to the pediatric setting.
21	Cuba	Bibliographic and documentary review	Informatics should be seen as an instrument that facilitates the management of humanized care from the interaction of professionals and care actors. Its application should be valued to provide care and promote health with quality and ethics, which does not exclude its realization with humanity and respect.
22	Ecuador	Quantitative, descriptive approach.	Humanized care is a complex and indispensable process for post-operative care in hysterectomies. In the health institution approached, the care is developed in a fragmented way, since there is an opening in the nursing professionals for humanization.
23	Cuba	Systematic literature review	The relevance of the humanized care provided to women during labor is based on the fact that it leads to the satisfaction of physical, emotional and spiritual needs.
24	Colombia	Mixed study Integrative review of scientific and qualitative literature: descriptive-phenomenological.	Empowerment as a disciplinary tool allows facing the difficulties of professional role identity and adherence to Watson's Theory of Human Care, in juxtaposition with the Nursing Diagnosis Taxonomy-NANDA, as a proposal that allows transcending the barriers of care in Critical Care Units.
25	Colombia	Integrative review	The strategies identified as effective and that have an impact on low humanization are: lack of training, competence and soft skills, compassion and mindfulness; added to the lack of information in expert areas and a decrease in the nurse-patient relationship. It is concluded that the strategies mentioned improve empathy, raise awareness of the present, favor communication and facilitate practices for the success of care and reduce work overload.
26	Spain	Qualitative approach study	Strengthen initiatives to implement integrated health care models. The implementation of holistic, patient- and family-centered care is essential to ensure the humanization of health care in the emergency department.

treatment, be available, and educate her so that she can deal with her own self-care and in the management of the integral care of her child (53).

In relation to areas where there is a high mortality rate, health professionals should generally have the appropriate competencies to address bereavement situations and care for a dignified death (52). Likewise, Correa-Pérez and Chavarro (41) state that nurses should make great efforts to train themselves in addressing the psychoemotional aspects of patients so that they can achieve relationships of trust that allow them to raise the quality of the services provided by the nurse.

Indicators That Favor the Implementation of Humanized Care

Humanized care includes the nurse–patient–family relationship, which strengthens the work performance and productivity levels of nurses who perform not only procedural activities, but also provide information and emotional, spiritual, and educational support, which raises the quality indicators in the care processes, safe environment, promotion of self-care, health education, and reduction of operating costs during the health care process, thus ensuring the sustainability of health care over time. Continuous training of care actors should promote the use of the dignified treatment indicator (49, 57).

Strategy and Innovation for a Path of Humanization

It is necessary to identify and prioritize health needs to assume the practice of human care for patients, considering the different human dimensions: physical, psychological, spiritual, among others; with the purpose of maintaining a predisposition to provide continuous care, promote dignified and cordial treatment, and motivate a safe environment that favors the process of care based on values (45). Caring requires the development of skills and the meeting of knowledge because it requires the capacity for active listening, kind response, and constant training to achieve the path to humanization.

During the outcome of care practice, nurses adhere to the Jean Watson theory to transcend in their work and achieve a balance of theoretical and practical approach that generates

confidence during the health care process. Strengthening the soft skills of health professionals enables them to adequately increase interpersonal relationships that will support the psychological emotional aspects of patients, as well as maintain education and ongoing training of the patient and family (39, 41, 50).

Finally, humanized care is a way of life that the nursing professional assumes in order to identify the needs, expectations, and health demands of patients and family members who require professional nursing care. As a result, it is critical that the patient perceives highly qualified personnel with whom he or she can maintain trust bonds throughout the health-disease process, taking into account the patient's disposition, commitment, cordiality, kindness, simple language, and availability of care. However, it is necessary that institutional policies are applied to generate spaces for analysis to achieve quality indicators, according to international standards that consider humanized care as an essential right in the hospital context (58–62).

CONCLUSION

This systematic review evidences the knowledge gap regarding the development and/or construction of care models on humanized care in public and private institutions worldwide, a limitation that should become a worldwide challenge for the application of humanizing policies and models for practice and that should be linked to the professional practice of health personnel, especially nursing professionals, highlighting the prioritization of the basic needs of patients who should receive humanizing care that responds to social changes.

Since nursing professionals lack competencies and soft and social skills, patients are put in danger because they are not cared for in a comprehensive, quality, and warm manner.

It should be noted that care should reinforce the sense of trust to respond to their basic therapeutic needs based on an authentic safe care approach to the production of assistive care, which is an art that requires a willingness to care and share feelings and emotions during the interpersonal and transpersonal relationship between the caregiver and the patient.

DATA AVAILABILITY STATEMENT

The systematic review was carried out using scientific articles available in the open access databases Redalyc and Scielo.

AUTHOR CONTRIBUTIONS

All authors listed have equally contributed to the work and approved it for publication.

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From Burnout to Occupational Depression: Recent Developments in Research on Job-Related Distress and Occupational Health

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Job-related distress has been a focal concern in occupational health science. Job-related distress has a well-documented health-damaging and life-threatening character, not to mention its economic cost. In this article, we review recent developments in research on job-related distress and examine ongoing changes in how job-related distress is conceptualized and assessed. By adopting an approach that is theoretically, empirically, and clinically informed, we demonstrate how the construct of burnout and its measures, long favored in research on job-related distress, have proved to be problematic. We underline a new recommendation for addressing job-related distress within the long-established framework of depression research. In so doing, we present the Occupational Depression Inventory, a recently developed instrument devised to assess depressive symptoms that individuals specifically attribute to their work. We close our paper by laying out the advantages of a paradigm shift from burnout to occupational depression.

Keywords: depression, anxiety, occupational depression inventory, work stress and burnout, job-related distress, occupational health science, Maslach Burnout Inventory

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INTRODUCTION

Job-related distress, a focal concern of occupational health science, has well-documented health-damaging and life-threatening effects, not to mention economic costs. Burnout and depression have constituted two key indicators in research on job-related distress over the last decades.

Considerable evidence has accumulated to show that chronic exposure to adverse working conditions contributes to the emergence of depressive symptoms and disorders (1–3). Depression can culminate in suicide, including workplace suicide (4). Burnout is thought to reflect the personal impact of chronic exposure to adverse working conditions. Given the common origins of burnout and job-related depressive symptoms and disorders, it is important to examine the evidence bearing on their conceptualization.

In theory, burnout is a gauge of job-related distress. It consists of three symptom dimensions, the core dimension being (emotional) exhaustion (5). Maslach et al. (6) wrote that "[f]or use in applied settings, a prudent approach when deciding to take action on the basis of burnout scores is to give the most weight to Emotional Exhaustion [EE] scores as they are the most reliable" (p. 3), underlining the dimension's central position in burnout. EE refers to feeling emotionally drained—the result of the worker's chronic exposure to adverse job conditions. Burnout's two other dimensions are depersonalization/cynicism (DP) and a reduced sense of personal accomplishment

(rPA), also known as professional inefficacy (6). DP refers to the worker being socially distant, disengaged, and possessing a cynical attitude toward coworkers and the people the worker is supposed to serve (e.g., patients, students, customers); rPA refers to the worker feeling that he or she fails to accomplish worthwhile job-related goals. Many researchers have advanced the view that burnout is distinct from depression (5, 7).

This paper has a twofold aim. First, we examine sets of research findings and observations that bear on the conceptualization of job-related distress in the context of the burnout–depression relationship, approached both dimensionally and categorically. Second, we provide a recommendation for assessing job-related distress by way of a new measure that may help occupational health specialists support individuals and organizations more effectively.

BURNOUT AND DEPRESSION

Burnout has been conceptualized as a set of symptoms, largely fatigue-related, that are caused by adverse working conditions. An exemplary item from the most frequently used burnout measure, the Maslach Burnout Inventory (MBI), demonstrates that idea: "I feel emotionally drained from my work" (6). The symptom in question is explicitly attributed to the individual's job. Burnout scales like the MBI have been linked to prominent occupational risk factors such as excessive workloads and reduced control over job tasks (8, 9). From a methodological standpoint, given that burnout items reference both the dependent variable (the symptoms) and independent variable (workplace stressors), it is no surprise that burnout scales are related to perceived workplace stressors, particularly when cross-sectional designs are used [see (10)].

Depression involves a cluster of affective, cognitive, behavioral, and somatic symptoms (e.g., dysphoric mood and anhedonia). Though depression is nosologically and diagnostically defined, there is robust evidence that depression is better conceived of as a dimensional phenomenon—a continuum—with only individuals at the highest end of the continuum meeting criteria for formal diagnoses of depression (11–13). Depressive symptom scales differ from burnout scales in an important way. Except for the recently developed Occupational Depression Inventory (14), described later, depressive symptom scales are "cause-neutral." This is not to say that depressive symptoms and disorders are void of causes, only that assessment instruments tend to focus on symptom severity rather than symptom causes. Situations involving unresolvable stress, in which individuals feel helpless and trapped in the face of negative events perceived as uncontrollable and impossible to surmount, have long been identified as crucial depressogenic factors (15, 16).

OBSERVATIONS BEARING ON BURNOUT'S RELATION TO DEPRESSION

We now examine six sets of observations that bear on the problematic nature of the burnout construct, particularly regarding its relation to depression. First, although multiple factors can give rise to depression, abundant evidence from well-controlled longitudinal studies indicates that workplace stressors are related to increased levels of depressive symptoms (measured by cause-neutral symptom scales) and elevated risk of depressive disorders (2, 3, 17, 18). It is unlikely that job stressors increase the risk of burnout without commensurately increasing the risk of depressive symptoms and disorders (19, 20).

Second, burnout's core dimension, exhaustion, is highly related to depressive symptoms. Although some meta-analytic evidence suggests an average burnout/exhaustion–depression correlation in the 0.50 s (21, 22), other meta-analytic research (11, 23) indicates that the burnout/exhaustion–depression correlation can reach 0.70–0.80 and higher, particularly when measurement error is controlled. Meier and Kim (22) observed that a correlation of 0.50 has been used to advance the view that (a) burnout and depression *do not* overlap and (b) burnout and depression *do* overlap. Correlation coefficients should be understood in context. The research of Wurm et al. (24) provides some of that context. These authors obtained a burnout–depression correlation of 0.52 in a sample of 5,897 physicians, and observed that, compared to an almost-symptom-free reference group, as burnout symptoms increased stepwise from mild to moderate to severe to extremely high levels, the odds ratio for major depression increased dramatically, from 2.99 to 10.14 to 46.84 to 92.78.

Because fatigue and sleep problems are symptoms of depression (25), fatigue-related items are commonly found in depression symptom scales. Maslach and Leiter (7) argued that, because depression scales include fatigue-related symptom items, a high burnout–depression correlation may be a methodological artifact. However, empirical research in which fatigue-related items were stripped out of depressive symptom scales barely changed the correlation (23, 26).

Exploratory structural equation modeling bifactor analyses extract a general factor on which all items can, theoretically, load and specific factors (bifactors) on which items are allowed to cross-load. In several studies (11, 27, 28), depression and exhaustion items primarily loaded on the general factor. The DP and rPA items tended to load more highly on their respective specific factors than on the general factor with exemplary exceptions. For example, the rPA item "I feel very energetic," which, understandably, reflects the opposite of exhaustion, has a strong negative loading on the general factor and a much weaker loading on the rPA-specific factor.

What construct do depression and burnout's exhaustion (sub)scales measure? Schonfeld et al. (23, 27) advanced the view that the construct is a dimension of psychopathology that can be labeled psychological distress/dysphoria. More than 40 years ago, Dohrenwend et al. (29) found that measures of dread, sadness, anxiety, helplessness/hopelessness, and poor self-esteem correlated about as highly as the scales' reliabilities permitted, suggesting that the scales reflect the same underlying construct. The investigators labeled the construct psychological distress. More recent research on psychopathology has provided evidence for a distress or internalizing dimension reflecting depressive and related (e.g., anxiety) symptoms (12, 27, 30, 31). Structural

equation modeling (SEM) evidence indicates that one cohesive distress factor underlies depressive, anxiety, and exhaustion symptom items (27).

Some have argued that burnout (or depression) may mediate the impact of job stressors on depression (or burnout). However, that the discriminant validity of burnout vis-à-vis depression has not been clearly demonstrated undermines the argument. Moreover, such an argument is difficult to articulate when approaching both burnout and depression dimensionally (i.e., as continua).

Third, if burnout is a syndrome comprising EE, DP, and rPA—as indicated by Maslach and colleagues (5, 6)—one would expect the EE, DP, and rPA subscales of the MBI to be more highly correlated with each other than with non-burnout scales. Meta-analytic and SEM evidence (11, 23), however, indicates that EE is more highly related to depressive symptoms than to DP and rPA, undermining the idea that burnout is a (distinct) syndrome (11, 23). In other words, if exhaustion is part of a syndrome, it is part of a depressive syndrome (10, 11).

Interestingly, several methodological factors work *against* finding the magnitude of the EE–depression correlation to be stronger than the correlations among the MBI's subscales, suggesting that the EE–depression link is sturdy. First, the abovementioned "energetic" item on the rPA subscale of the MBI likely increases the magnitude of the EE–rPA correlation. Second, depression symptom items cover the previous 1 or 2 weeks whereas MBI items cover the previous year. Third, the wording of the items in the MBI subscales are substantially similar, each item referencing work, but depression items cover diverse symptoms without a common causal reference. Despite the influence of these methodological factors, the magnitude of the EE–depression correlation is greater than that of the correlations among the MBI subscales.

How are the MBI's other dimensions, DP and rPA, related to depression? They have non-zero correlations with depressive symptoms. DP supposedly reflects a strategy for coping with EE (5, 32). It is reflective of "not caring anymore," a feature associated with depression (25). rPA is likely to be a long-term consequence of exhaustion (5, 33). It parallels the negative evaluations of one's worth associated with depression (25).

Fourth, there are no clear or consensual diagnostic criteria for burnout. Maslach et al. (6) indicated that the MBI is not a diagnostic tool. That admonition has not stopped researchers from treating burnout diagnostically. Rotenstein et al. (34) found 142 unique definitions of burnout in the literature on physicians. When attempting to treat burnout diagnostically, researchers generally define a case arbitrarily, as an individual with a score above a predetermined cutoff on a burnout (sub)scale. Bianchi, Schonfeld, and colleagues (35, 36) observed that many researchers identify individuals as cases of burnout based on surprisingly low scale scores. Such case-identification procedures fail to distinguish an individual experiencing pervasive distress from an individual confronting a day in which job stress increased but was still within the "normal range." When Bianchi et al. (37) used an MBI cutoff corresponding to burnout symptoms experienced at least a few times a week (a frequency assumed to represent pervasive distress), they found that 90% of the individuals in the burnout group met criteria for a provisional diagnosis of depression. Schonfeld and Bianchi (20) obtained similar findings using the Shirom-Melamed Burnout Measure. Such findings suggest that if "clinical burnout" (i.e., burnout as a medical diagnosis) were to be defined someday, its differential diagnosis vis-à-vis clinical depression would be impossible, undermining burnout's clinical validity and usefulness (38).

A related set of findings indicates that as burnout symptoms increase, the risk of meeting criteria for a diagnosis of depression increases. This pattern has been replicated across occupational groups, including physician (24), teacher (20, 37), and dentist (39) samples. Ahola et al. (19) went on to observe that "burnout could be used as an equivalent to depressive symptoms in work life" (p. 35).

Fifth, "[o]ften insomnia or fatigue is the presenting complaint" when a depressed individual seeks help from a clinician [(25); p. 162]. An experienced clinician recognizes the disorder. Freudenberger (40), the first investigator to write about burnout in a research journal, observed that the burned-out individual "looks, acts and seems depressed" (p. 161). Exhaustion complaints can mask broader depressive syndromes, especially in male and younger patients. Exhaustion then acts as a metonym for depression.

Sixth, the nomological networks of burnout's exhaustion core and depression parallel each other. Research has, inter alia, identified parallels in burnout/exhaustion's and depression's relationship to the following: cognitive style [e.g., attentional, interpretational, and memory biases, rumination, pessimistic attributions; (41–43)]; anxiety, workplace support, and exposure to nonwork stressful life events and job-related adversity (20, 27); and job satisfaction, illegitimate work tasks, and work-nonwork interference (44).

In this disquisition on burnout and depression, we do *not* advance the view that the burnout construct is identical to the construct of work-related depression. Extensive findings show that burnout's exhaustion core and fatigue-related symptoms are important symptoms of work-related depression, but *not the only* symptoms of work-related depression. The burnout construct captures a depressive phenomenon, but in a truncated manner.

Some depressed workers may represent themselves as "burned out" to reduce stigma. However, the sparse comparative literature on the issue suggests that both conditions are similarly stigmatizing (45). Moreover, the stigma recruiters attach to burnout is a barrier to employment and promotion (46).

We summarize the reasons for identifying burnout symptoms as depressive symptoms. First, job stressors elicit both burnout and depressive symptoms. Second, burnout's core dimension, exhaustion, correlates highly with depressive symptoms. Third, exhaustion correlates more highly with depressive symptoms than with burnout's other putative burnout dimensions, DP and rPA. Fourth, as burnout symptoms increase, the risk of a depressive diagnosis increases. Fifth, often with depression, the presenting complaint is exhaustion, the core symptom of burnout. Sixth, the nomological networks of burnout's exhaustion core and depression closely parallel each other.

Finally, we assert that the symptoms burnout scales assess are *some* of the symptoms that characterize depression, but not all the symptoms that characterize depression. Kasl (47) already observed that a famous burnout scale that "reflects exhaustion (physical, mental, and emotional) … can be seen as a major component of depression" (p. 396). Burnout scales miss important depressive symptoms, such as suicidal thoughts. We, next, report on a new instrument that better fills the role that burnout scales occupy in identifying workers adversely affected by their jobs.

THE OCCUPATIONAL DEPRESSION INVENTORY

Depression contributes heavily to the worldwide burden of disease (48). Unresolvable stress is a primary depressogenic factor. Intractable stressors are often encountered at work. In view of the problem of job-related stressors evoking depressive symptoms in workers, we recently developed the Occupational Depression Inventory [ODI; (14, 49, 50)]. The ODI references the nine symptoms of major depression (25) and incorporates causal attributions to work. From a psychometric and structural standpoint, the ODI is stronger than burnout scales (14, 49, 50). In addition, the ODI assesses crucial symptoms such as suicidal ideation, a risk factor for work-related suicide. The construct of depression, which is deeply anchored in the ODI, has been and continues to be highly researched. A diagnosis of depression has consensual criteria, such as the widely employed criteria in the DSM-5, which contrasts sharply with Rotenstein et al.'s (34) finding that researchers have employed 142 different unique categorizations of burnout.

In contrast to other depressive symptom scales (e.g., the CES-D), the ODI explicitly asks respondents whether they attribute each depressive symptom to their job (e.g., "My experience at work made me feel like a failure"). The instrument has a protocol to help rule out symptoms attributed to nonwork sources (e.g., a conflictual spousal relationship) or a source the respondent cannot identify. The ODI can be used in two different ways. First, it can quantify work-related depressive symptoms along a continuum of severity. Second, the instrument produces provisional diagnoses of work-related depression. The ODI is currently available in English, French, and Spanish (see the **Supplemental Material**).

Because the ODI can help identify workers with clinically significant job-related distress, occupational health specialists (e.g., physicians, psychologists) can direct affected workers to treatment. We also recommend that specialists investigate workplace stressors that contribute to distress and take steps to ameliorate the stressful working conditions. The ODI can also help epidemiologists estimate the prevalence of job-related depression in organizations and occupational sectors. Because the instrument is brief, it reduces the burden on the respondent completing it. Unlike the MBI, the ODI is available at no cost.

Compared to the ODI, MBI items manifest redundancy (e.g., "Working with people all day is really a strain for me;" "Working with people directly puts too much stress on me)", artificially inflating the instrument's reliability. The ODI does not exhibit this limitation because each of its nine items focuses on a specific DSM-5 symptom of major depression. Item wording shows no explicit redundancy—yet the ODI has optimal reliability.

Because the ODI deliberately assesses symptoms the individual attributes to perceived job stress, we recommend *against* using the instrument in cross-sectional research linking the ODI to perceived job-stressor measures. We recommend research that employs longitudinal designs or that links objective measures of job adversity to the ODI.

We created the ODI for two practical purposes: (1) to help occupational health specialists identify suffering workers and take the appropriate steps to remediate the problem and (2) to aid epidemiologists in estimating the prevalence of job-related depression such that appropriate public health policies can be established. A corollary to those two practical purposes is that the ODI can help specialists identify depressogenic organizations. For example, if within a given economic sector, the prevalence of occupational depression is, say, 2.5% but in one organization the prevalence is 25%, problematic working conditions are likely to plague that organization. The ODI would be the sentinel that signals occupational health specialists to take action to help troubled workers and improve workplaces.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

ISS wrote the initial draft of the paper. RB edited the draft and added to it. The draft went back and forth between ISS and RB several times during which the two authors iteratively shaped the paper and settled on its final form. Both authors contributed to the article and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2021.796401/full#supplementary-material

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Associations Between Symptoms of Depression and Air Pollutant Exposure Among Older Adults: Results From the Taiwan Longitudinal Study on Aging (TLSA)

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Background: Little epidemiological research has investigated the associations of air pollutant exposure over various time windows with older adults' symptoms of depression. This study aimed to analyze the relationships of long- and short-term ambient air pollution exposure (to coarse particulate matter, O_3, SO_2, CO, and NO_x) with depressive symptoms in a sample of community-dwelling older adults.

Methods: A sample of older adults (n = 1,956) was recruited from a nationally representative multiple-wave study (Taiwan Longitudinal Study on Aging). Between 1996 and 2007, four waves of surveys investigated depressive symptoms by using the 10-item Center for Epidemiologic Studies Depression questionnaire. We approximated air pollutant concentrations from 1995 to 2007 by using daily concentration data for five air pollutants at air quality monitoring stations in the administrative zone of participants' residences. after adjusting for covariates, we applied generalized linear mixed models to analyze associations for different exposure windows (7-, 14-, 21-, 30-, 60-, 90-, and 180-day and 1-year moving averages).

Results: In a one-pollutant model, long- and short-term exposure to CO and NO_x was associated with heightened risks of depressive symptoms; the odds ratio and corresponding 95% confidence interval for each interquartile range (IQR) increment in CO at 7-, 14-, 21-, 30-, 60-, 90-, and 180-day and 1-year moving averages were 1.232 (1.116, 1.361), 1.237 (1.136, 1.348), 1.216 (1.128, 1.311), 1.231 (1.133, 1.338), 1.224 (1.124, 1.332), 1.192 (1.106, 1.285), 1.228 (1.122, 1.344), and 1.180 (1.102, 1.265), respectively. Those for each IQR increment in NO_x were 1.312 (1.158, 1.488), 1.274 (1.162, 1.398), 1.295 (1.178, 1.432), 1.310 (1.186, 1.447), 1.345 (1.209, 1.496), 1.348 (1.210, 1.501), 1.324 (1.192, 1.471), and 1.219 (1.130, 1.314), respectively. The exposure to PM_{10}, O_3, and SO_2 over various windows were not significant. In the two-pollutant model, only the associations of NO_x exposure with depressive symptoms remained robust after adjustment for any other pollutant.

Conclusions: Exposure to traffic-associated air pollutants could increase depression risks among older adults.

Keywords: depressive symptoms, older adults, air pollution, repeated-measures study, cohort study

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INTRODUCTION

Depression, a common mental health issue, is among the key causes of disability. Worldwide, approximately 264 million individuals have depression (1). Among all nonfatal diseases worldwide, depressive disorder has the third highest burden (1). Negative health effects associated with depression include poor social function, reduced quality of life, and heightened cancer mortality risks (2, 3). Depression is a major public health challenge worldwide, and risk factor management is crucial for its prevention.

Air pollution, both ambient and indoor, considerably affects environments worldwide. According to one report, in 2017, air pollution caused 4.90 million deaths and was associated with the loss of 1.47 billion disability-adjusted life years (4). The deleterious effect that air pollution exerts on depression and various other mental health disorders has recently gained attention worldwide, especially in public health-care research (5–7).

Depression is among the commonest mental health disorders affecting the older adult population (8). Epidemiological investigations have examined associations of air pollution exposure with depression in older adult populations (9–16), but results have been limited and inconsistent. Whether air pollution over different exposure windows (e.g., short-term vs. long-term) is linked to depression remains unclear, as does whether specific air pollutants are related to depression in older adults. Furthermore, epidemiological research regarding the joint effects of cognitive function and air pollution over various exposure windows on depression in the older population is scarce. To make up for these deficiencies, our aims were to explore the relationship between air pollution over various exposure windows and depressive symptoms by conducting repeated measurements in Taiwanese older adults; additionally, we examined the joint effects of long- or short-term exposure to air pollution and cognitive decline on depressive symptoms.

METHODS

Participants

The Taiwan Longitudinal Study on Aging (TLSA), a survey with national representativeness, was initiated in 1989 by the Health Promotion Administration of Taiwan's Ministry of Health and Welfare (17). In the TLSA, equal-probability sampling was implemented in three stages to select 4,049 older adults (≥60 years); in the initial survey year, a 92% response rate was achieved (17). Follow-up surveys were conducted in 1993, 1996, 1999, 2003, and 2007. Individuals who participated in the survey provided only verbal consent before 2007; however, in 2007, signed consent forms were provided by each participant prior to enrolment by the Health Promotion Administration.

In the current study, data for the years 1996–2007 were used. In total, 1,956 older adults (≥65 years) were included in the 1996 survey after the exclusion of participants with a stroke history in 1993, those with a Short Portable Mental Status Questionnaire (SPMSQ) score of <3 in 1993, those with incomplete information, and those who had moved residence during the study period (**Figure 1**). A total of 1,956 participants were included in 1996. During *1996–1999,* there were 31 participants lost to follow-up, and 226 participants moved during follow-up. Follow by *2003, 2*72 participants were lost to follow-up, and 179 participants moved during follow-up. Till *2007, 2*99 participants were lost to follow-up, and 76 participants moved during follow-up. During 1996 to 2007, total of 5776 number of observations were presented in the present study. Each participant had about 3 follow-up times. The percentage of loss to follow-up and moving out was 7.7 and 6.1% in this study, respectively.

Approval for this study was granted by the Tri-Service General Hospital Institutional Review Board (No.: 2-104-05-153).

Depressive Symptom Measurement

Symptoms of depression were assessed with the 10-item version of the Center for Epidemiological Studies Depression (CES-D-10) questionnaire. The CES-D-10 achieves similar precision to that of the 20-item CES-D (18). The Cronbach α for internal consistency is 0.78–0.87 for the TLSA sample (19). The CES-D-10 requires participants to respond to *ten* items (see **Supplementary Table S1**) and indicate how often in the preceding week they experienced the feeling described, from 0 (rarely or never) to 3 (most of or almost all of the time). The score range is 0–30; more severe symptoms of depression are indicated by higher scores. Following Chang and Weng (20), we considered participants with a CES-D-10 score of ≥10 to have moderate-to-severe depressive symptoms.

Exposure Assessment

Hourly data on particulate matter (PM) with a diameter of <10 μm (PM_{10}), O_3, CO, SO_2, NO, NO_2, and NOx concentrations were obtained from monitoring stations (*N* = 75) established by Taiwan's Environmental Protection Administration (TEPA) (21), all of which are located on the main island of Taiwan (see **Supplementary Figure S1**); these 75 stations provided continual measurements from 1995 to 2007. Stringent and independent quality assurance and control procedures were implemented to ensure the quality of the meteorological data: with TEPA authorization, a private company conducted yearly audits and routine inspection of the performance of the monitoring instruments. Average daily measurements of seven air pollutants at each station were employed in later analyses. For a day to be included in calculation, ≥75% of the hourly values must be available. The pollutant concentrations measured at monitoring stations within the city or county of a TLSA participant were assigned to that participant, as described elsewhere (22). Along with 1-year moving averages, 7-, 14-, 21-, 30-, 60-, 90-, and 180-day moving averages prior to each participant's survey date were calculated.

Covariates

Data pertaining to related covariates were gathered using structured interviews. Demographics (e.g., educational attainment, age, marital and economic status) and information on the participants' lifestyle (e.g., physical activity, smoking status, and alcohol intake) were obtained. The instrumental

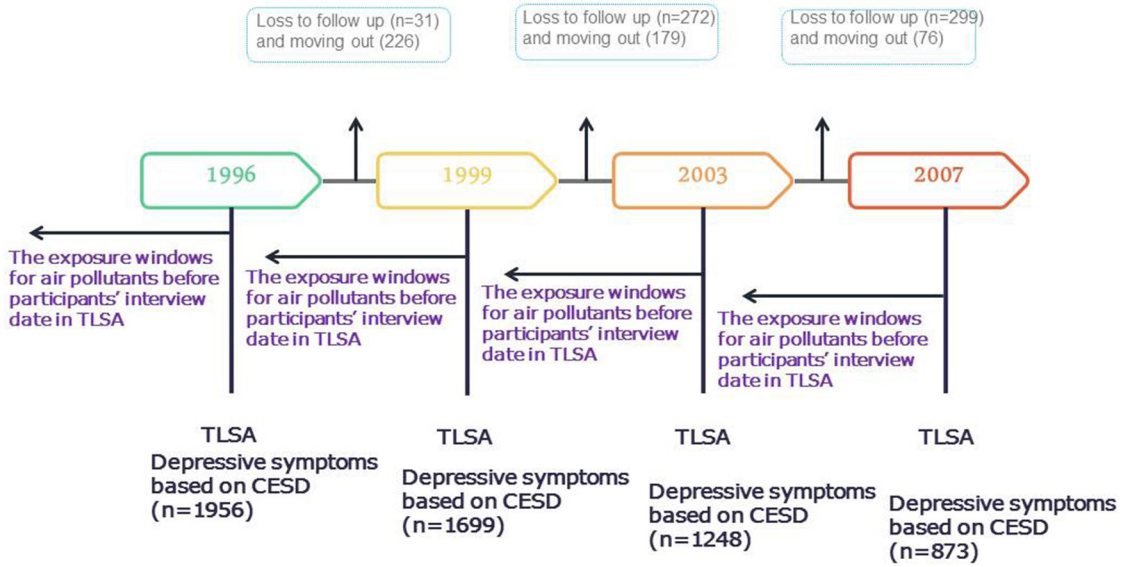


FIGURE 1 | Sample selection flowchart.

activities of daily living (IADLs) score was determined to reflect the participants' physical function. IADLs include telephone use, financial management, independent public transport use, strenuous housework, and light housework. The overall score range is 0–18, with low physical function denoted by a higher score. We examined cognitive function using a 5-item SPMSQ (SPMSQ-5), which was validated using a version of the Mini-Mental State Examination in Chinese (23). The SPMSQ-5 was applied to measure cognitive function in the Asset and Health Dynamics Among the Oldest Old study (24, 25). Correct answers are worth 1 point, with the overall scores ranging from 0 to 5. An SPMSQ-5 score of <3 indicates moderate-to-severe cognitive impairment (26). In this study, participants self-reported chronic diseases, such has heart disease, diabetes, and hypertension, and these were verified with a physician's diagnosis.

Statistical Analysis

Because repeated measures and a prospective design were used, we employed a generalized linear mixed model–based procedure (PROC GLIMMIX) to examine the relationship of depression symptoms with exposure to ambient PM_{10}, O_3, CO, SO_2, NO, NO_2, and NOx, while accounting for the random effects of repeated measurements. We modeled moderate-to-severe depressive symptoms as a binary outcome indicated by a CES-D-10 score of $\geq$10. We investigated the PM_{10}, O_3, CO, SO_2, NO, NO_2, and NOx exposure by using window averages from 7 days up to 1 year before each interview date to evaluate the effect of long- and short-term air pollutant exposure on depressive symptoms. To address non-linear relationships, we categorized the exposures into quartiles to examine the associations. Furthermore, we applied the residual regression models due to the high correlation between different air pollutants in two-pollutant models (27).

Variables related to outcomes or exposure, rather than intermediate variables between exposure and outcomes were selected as confounders (28). Additional confounders were selected on the basis of a 10% change-in-estimate criterion (29); adjusted confounders were sex, age, marital situation, financial situation, educational attainment, alcohol intake, physical activity level, heart disease status, IADL score, season of study visit, and SPMSQ-5 score. To investigate the joint effect of cognitive function with pollutant exposure on depressive symptoms, air pollutant–cognitive function interaction terms were included in these models. We performed all analyses adjusted confounders included by using SAS 9.3 (SAS Institute Inc., Cary, NC, USA) with a significance threshold of $p < 0.05$.

RESULTS

Demographics

The demographics of the participants surveyed from 1996 to 2007 are presented in **Table 1**. The mean participant age was 73.4 years at baseline, and approximately 60% of the participants were men. More than 63% of the participants had a spouse. Approximately half of the participants had a primary and secondary degree, and 43% self-evaluated their financial status as fair. Large proportions of the participants engaged in physical activity on a regular basis, did not consume alcohol, did not smoke, and did not have hypertension or diabetes mellitus. The diabetes mellitus and hypertension rates in 2007 were above those in 1996. There were 4.90% of the study group had an SPMSQ score of <3 and 1.81 was the mean IADL score in 1996. There were 18.1% of participants

TABLE 1 | TLSA participant data for each study year.

Variable	Year 1996 (n = 1,956)	Year 1999 (n = 1,699)	Year 2003 (n = 1,248)	Year 2007 (n = 873)
Male, *n* (%)	1172 (59.9)	997 (58.7)	727 (58.3)	462 (52.9)
Age, y, mean ± SD	73.44 ± 4.90	76.10 ± 4.68	78.64 ± 4.04	82.28 ± 3.75
Spouse, yes	1,233 (63.0)	1,006 (59.2)	673 (53.9)	403 (46.2)
Personal education, *n* (%)				
Illiterate	664 (33.9)	555 (32.6)	379 (30.4)	284 (32.5)
Primary and secondary school	1,047 (53.5)	927 (54.6)	689 (55.2)	459 (52.6)
High school and above	245 (12.5)	217 (12.8)	180 (14.4)	130 (14.8)
Self-reported financial status, *n* (%)				
Very satisfied	163 (8.30)	125 (7.40)	71 (5.70)	47 (5.38)
Satisfied	655 (33.5)	561 (33.0)	515 (41.3)	365 (41.7)
Fair	843 (43.1)	678 (39.9)	427 (34.2)	309 (35.4)
Dissatisfied	243 (12.4)	250 (14.7)	180 (14.4)	115 (13.2)
Very dissatisfied	52 (2.70)	85 (5.00)	55 (4.40)	37 (4.24)
Physical activity, *n* (%)	1,164 (59.5)	1,099 (64.7)	844 (67.6)	589 (67.5)
Smoking status	542 (27.7)	400 (23.5)	231 (18.5)	107 (12.3)
Alcohol-drinking	381 (19.5)	380 (22.4)	265 (21.2)	170 (19.5)
Season of study visit				
Spring	1,190 (60.8)	1,493 (87.9)	–	352 (40.3)
Summer	714 (36.5)	173 (10.2)	–	511 (58.5)
Fall	52 (2.7)	31 (1.8)	1,142 (91.5)	10 (1.15)
Winter	–	2 (0.1)	106 (8.5)	–
Hypertension	512 (26.2)	633 (37.5)	540 (43.3)	406 (46.5)
Diabetes	192 (9.80)	254 (14.9)	203 (16.3)	121 (13.9)
Heart disease	308 (15.7)	393 (23.1)	332 (26.6)	223 (25.5)
SPMSQ (0–5)				
≥3	1,861 (95.1)	1606 (94.5)	1,155 (92.5)	715 (81.9)
<3	95 (4.90)	93 (5.50)	93 (7.50)	158 (18.1)
IADL (0–18), mean ± SD	1.81 ± 3.48	2.27 ± 3.91	3.10 ± 4.42	4.13 ± 5.03

TLSA, taiwan longitudinal study on aging; SPMSQ, short portable mental status questionnaire; IADL, instrumental activities of daily living.

had an SPMSQ score of <3 and 4.13 was the mean IADL score in 2007.

Distribution of Depressive Symptoms and Exposure to Air Pollutants for Different Exposure Windows by Survey Year

Participants with a CES-D-10 score of ≥10 were around 20.5% to 25.8% in four survey years. The concentrations of air pollutants for different exposure windows by survey year. We discovered that the PM_{10}, CO, SO_2, NO, NO_2, and NOx levels in the 1-year and 7-day exposure windows declined from 1995 to 2007 (p for trend: < 0.001) (**Table 2**). The levels of air pollutants (PM_{10}, CO, SO_2, NO, NO_2, and NOx) for other exposure windows (14-, 21-, 30-, 60-, 90-, and 180-day) were also declined from 1995 to 2007 (**Supplementary Table S2**). However, the O3 levels for the 1-year and 21-, 30-, 60-, 90-, and 180-day exposure windows gradually increased from 1996 to 2007 (p for trend: < 0.001). During the study period, the levels of O3 for the 7- and 14-day exposure windows declined (p for trend: < 0.001). The percentile 25th, 50th, 75th, and interquartile range (IQR) were presented in **Supplementary Table S3**. We observed that the correlations between short-and long-term averages for the same pollutant were ranged from 0.7 to 0.9 except O_3 (**Supplementary Table S4**). We also found that the correlations between CO and NOx for the different exposure window were ranged from 0.8 to 0.9 and the other pollutants presented the low to moderate correlations (**Supplementary Table S5**).

Individual Pollutants and Depressive Symptoms

In the single-pollutant model, after covariates were adjusted for, we discovered associations of long- and short-term exposure to CO, NO_2, NO, and NOx with a heightened risk of depressive symptoms. The odds ratio (OR) and corresponding 95% confidence interval (CI) for each IQR increase in CO in the 7-, 14-, 21-, 30-, 60-, 90-, and 180-day and 1-year moving averages were 1.232 (1.116, 1.361), 1.237 (1.136, 1.348), 1.216 (1.128, 1.311), 1.231 (1.133, 1.338), 1.224 (1.124, 1.332), 1.192 (1.106, 1.285), 1.228 (1.122, 1.344), and 1.180 (1.102, 1.265), respectively. The ORs and 95% CIs for each IQR increment in NOx over the same exposure windows were 1.312 (1.158, 1.488), 1.274 (1.162, 1.398), 1.295 (1.178, 1.423), 1.310 (1.186, 1.447), 1.345

TABLE 2 | Distribution of depressive score and air pollutant concentrations over various exposure windows for each survey year.

Variable	Year 1996 (n = 1,956)	Year 1999 (n = 1,699)	Year 2003 (n = 1,248)	Year 2007(n = 873)	P for trend
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
CES-D (0–30)					
<10, n (%)	1468 (75.1)	1277 (75.2)	992 (79.5)	650 (74.2)	–
≥10, n (%)	488 (24.9)	422 (24.8)	256 (20.5)	226 (25.8)	–
7-day					
PM_{10} ($\mu g/m^3$)	61.50 ± 15.47	69.95 ± 25.32	53.79 ± 19.94	48.62 ± 20.86	<0.001
O_3 (ppb)	34.05 ± 4.05	32.38 ± 5.72	31.61 ± 7.68	29.99 ± 10.62	<0.001
CO (ppm)	0.757 ± 0.242	0.687 ± 0.180	0.643 ± 0.141	0.474 ± 0.177	<0.001
SO_2 (ppb)	6.40 ± 3.92	4.99 ± 2.90	2.99 ± 1.64	4.01 ± 1.31	<0.001
NO (ppb)	9.76 ± 8.45	8.37 ± 6.87	6.33 ± 5.12	6.35 ± 5.19	<0.001
NO_2 (ppb)	24.18 ± 6.12	24.73 ± 5.47	19.84 ± 5.67	15.72 ± 6.86	<0.001
NOx (ppb)	33.93 ± 12.84	32.96 ± 10.89	26.13 ± 9.43	22.08 ± 11.17	<0.001
1-year					
PM_{10} ($\mu g/m^3$)	65.76 ± 15.69	56.26 ± 13.74	53.41 ± 10.22	54.86 ± 7.25	<0.001
O_3 (ppb)	22.79 ± 2.31	23.27 ± 2.92	27.79 ± 2.52	28.66 ± 1.69	<0.001
CO (ppm)	0.779 ± 0.285	0.734 ± 0.251	0.678 ± 0.159	0.627 ± 0.068	<0.001
SO_2 (ppb)	7.63 ± 4.65	4.52 ± 2.20	3.25 ± 1.56	4.54 ± 0.87	<0.001
NO (ppb)	11.65 ± 9.50	10.96 ± 8.45	7.77 ± 5.85	10.34 ± 2.92	<0.001
NO_2 (ppb)	22.35 ± 4.91	21.24 ± 5.30	19.03 ± 4.72	20.40 ± 2.68	<0.001
NOx (ppb)	33.87 ± 13.46	32.19 ± 12.96	26.79 ± 9.94	30.74 ± 5.27	<0.001

CES-D, center for epidemiological studies depression.

(1.209, 1.496), 1.348 (1.210, 1.501), 1.324 (1.192, 1.471), and 1.219 (1.130, 1.314), respectively. For each IQR increment in NO and NO_2 over the same exposure windows, the ORs ranged between 1.180 and 1.346 ($p < 0.001$). Long- and short-term exposure to PM_{10}, O_3, and SO_2 had no significant association with depressive symptoms (**Figure 2** and **Supplementary Table S6**).

We have categorized the exposures into quartiles to examine the possible non-linear relationships. For example, compared to the Q1 in NOx for 7-day and 1-year exposure window, the Q4 in NOx had the more risk of depressive symptoms (OR = 1.524, 95% CI: 1.215, 1.911 for 7-day exposure window; OR = 1.435, 95% CI: 1.161, 1.773 for 1-year exposure window). Similarly, the Q4 in CO had the more risk of depressive symptoms as compared to the Q1 in CO for 7-day and 1-year exposure window (OR = 1.215, 95% CI: 0.970, 1.522 for 7-day exposure window; OR = 1.348, 95% CI: 1.096, 1.658 for 1-year exposure window) (**Supplementary Tables S10–S17**).

Two-Pollutant Exposure Model

In the two-pollutant model, we adjusted for the same covariates as we did in the single-pollutant model and added one air pollutant at a time. We discovered associations of long- and short-term exposure to NOx with an increased risk of depressive symptoms after further control for PM_{10}, O_3, or SO_2 exposure. A significant association was discovered between exposure to NOx (1-year and 30-, 60-, 90-, and 180-day exposure windows) and depressive symptoms after further control for CO exposure (**Figure 3A** and **Supplementary Table S7**). Furthermore, the associations of long- and short-term CO exposure with a heightened risk of depressive symptom development after adjusted same covariates and PM_{10}, O_3, or SO_2 exposure, however, no significant association were found after control for NOx (**Figure 3B** and **Supplementary Table S8**).

Residual Regression Models

In the residual method, the CO exposure was regressed with the NOx exposure. We added the CO residual to the model as the independent variable and adjusted for NOx exposure. We found that CO residuals for the different exposure windows were not associated with the odds of depressive symptoms but Nox for the different exposure windows were positive associated with the odds of symptoms of depression (**Supplementary Table S9**).

Joint Effect Analysis

Participants whose cognitive impairment was moderate to severe had higher risks of depressive symptoms with associated with PM_{10} and SO_2 exposure over various exposure windows ($p < 0.001$; **Table 3**). However, according to this study, no other air pollutants exerted interaction effects (data not shown).

DISCUSSION

In one-pollutant models, ambient NOx and CO exposure over various exposure windows had a positive association with the development of symptoms of depression by older adults. In two-pollutant and residual regression models, medium- and long-term exposure to ambient NOx still had a significant effect after simultaneous exposure to CO was controlled for. Furthermore, PM_{10} and SO_2 exposure among older adults with

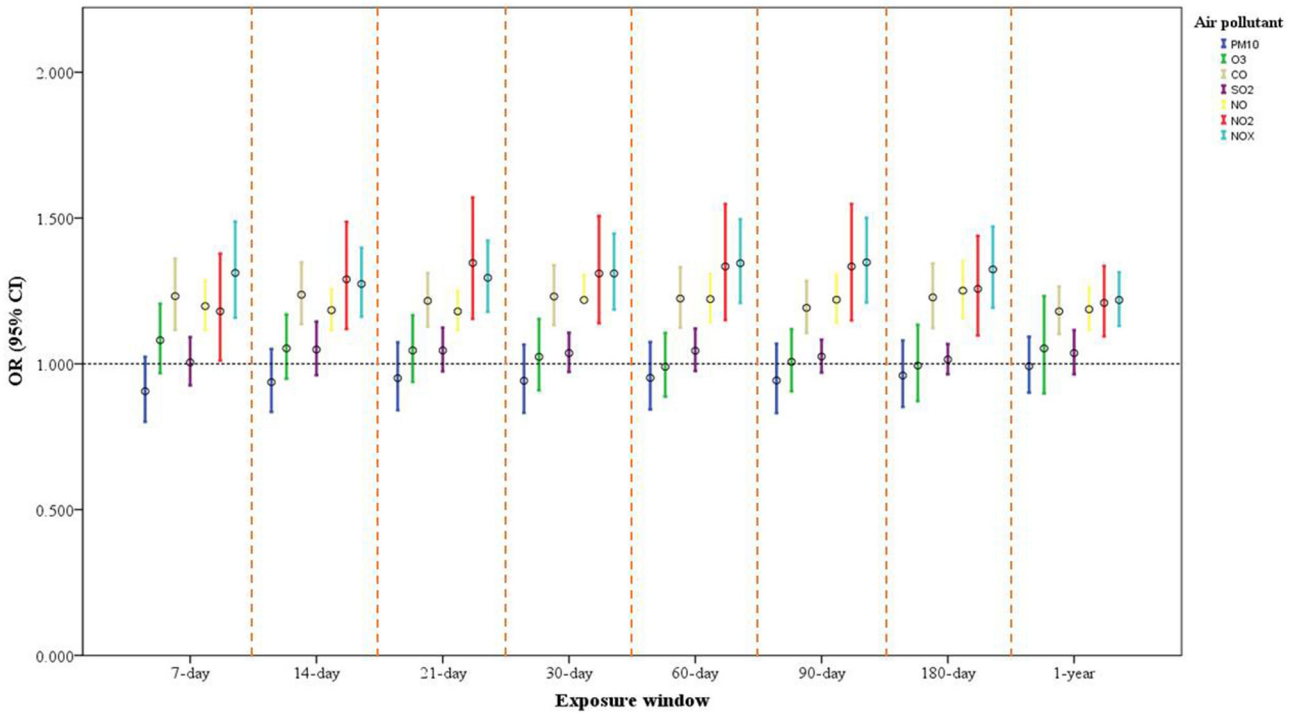


FIGURE 2 | One-pollutant model of air pollution exposure and its association with depressive symptoms in older adults. Model adjusted for sex, age, marital status, educational attainment, financial status (self-reported), physical activity, alcohol intake, heart disease, IADL score, season of study visit, and SPMSQ score. The ORs and 95% CIs for each increase of interquartile range (IQR) in PM_{10}, O_3, CO, SO_2, NO, NO_2, and NOx are expressed.

cognitive decline carried a greater risk of depression symptoms than did no cognitive decline. These results demonstrate that long- and short-term air pollutant exposure can increase older adults' risk of depression symptoms, and cognitive decline could render such individuals exposed to air pollution more susceptible to depression.

In a German study, long-term NOx exposure was positively related to depressive symptoms in 821 older women (9). Using repeated measures from 537 South Korean older adults, another study reported an association of short-term NO_2 exposure with a heightened risk of depressive symptoms (11). The Korean Community Health Survey from 2013 revealed a relationship of long-term NO_2 and CO exposure with heightened depression risk among individuals aged over 65 years (30). Another study discovered a positive association of long-term NO_2 exposure with the prescription of antidepressants by using single-exposure regression models based on a large-scale Dutch health survey (31). A study with a nested case–control design revealed relationships of long- and short-term CO exposure with heightened depression risks (32). These studies had similar results to our study. Furthermore, a meta-analysis associated short-term NO_2 exposure with a heightened depression risk (7). However, unlike the aforementioned studies, we did not identify associations of any other air pollutants (e.g., PM, SO_2, and O_3) with the risk of depression in one-pollutant models. These discrepancies could have resulted from differences in exposure profiles, the demographic characteristics of the study population, the exposure assessments used, the outcome assessment scales used, the study design, or our adjustment for confounding factors. Besides, the differences on the effects for the short vs. long term exposures could be due to the different correlations between the same pollutant of the different exposure windows or between the different pollutants of the same exposure window.

Using two-pollutant and residual models, we revealed that medium- and long-term NOx exposure had associations with increased risks of depressive symptoms, after adjustment for simultaneous exposure to CO. However, associations between exposure to CO and depression did not remain significant. This result may be attributable to the strong correlation between NOx and CO ($r = 0.8$ to 0.9) in our study. Similarly, long-term NOx exposure was positively associated with psychopathological symptoms, including internalizing, externalizing, and thought disorder symptoms, after adjustment for simultaneous exposure to $PM_{2.5}$ (33); however, significant associations of $PM_{2.5}$ exposure with psychopathology were not identified in co-pollutant models of NOx and $PM_{2.5}$, because of the high correlation discovered between the two pollutants ($r = 0.83$). One study indicated that ambient gas concentrations can be used as proxies for $PM_{2.5}$ exposure (34). A review revealed that depression and long-term $PM_{2.5}$ exposure were positively associated (5). Taken together, the study results indicate that traffic-related air pollutants could play crucial roles in the development of mental illnesses.

Our results demonstrate cognition-dependent associations of exposure to some air pollutants (e.g., SO_2 and PM_{10}) in the long and short terms with symptoms of depression among older adults. Only one study reported that women

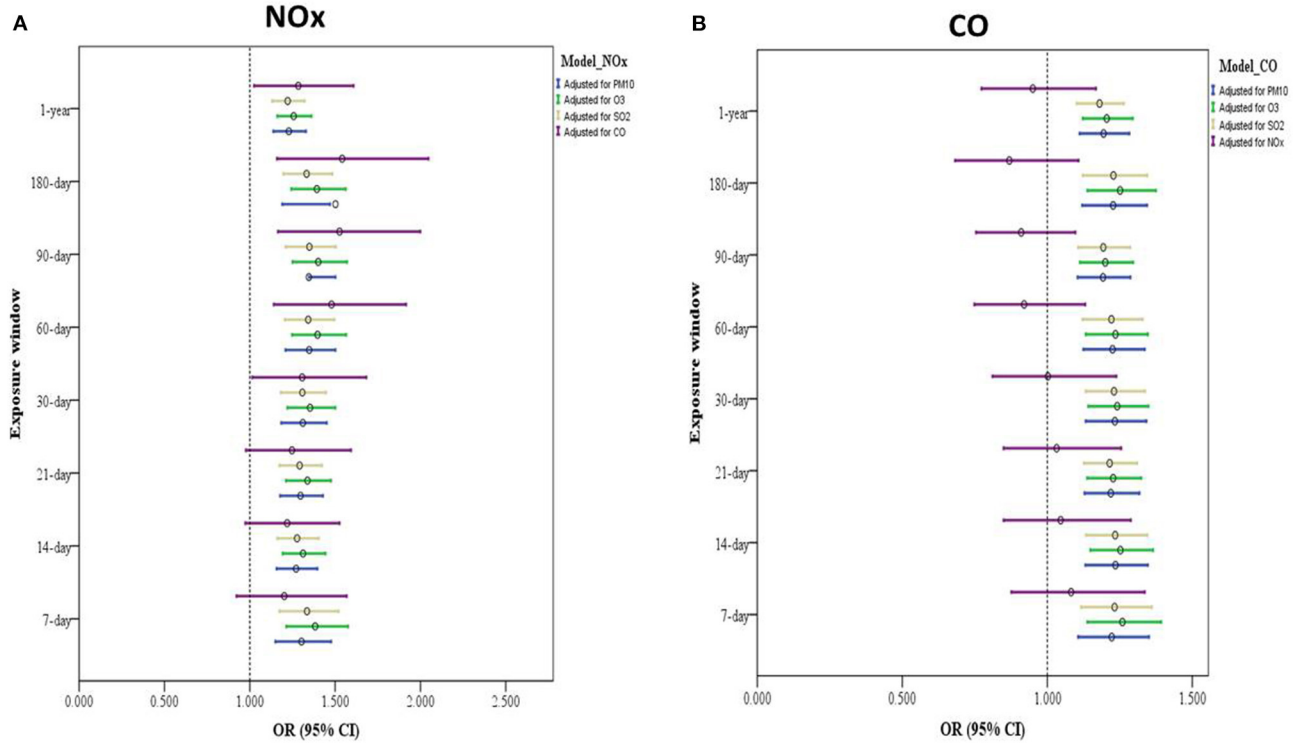


FIGURE 3 | Two-pollutant model of air pollution exposure and its association with depressive symptoms among older adults. **(A)** Model with adjustments for sex, age, educational attainment, marital status, financial status (self-reported), physical activity, alcohol intake, heart disease, IADL score, season of study visit, SPMSQ score, and exposure to other air pollutants (such as PM_{10}, O_3, CO, and SO_2). **(B)** Model adjusted for sex, marital status, age, educational attainment, financial status (self-reported), physical activity, alcohol intake, heart disease, IADL score, season of study visit, SPMSQ score, and exposure other air pollutants (e.g., NOx, PM_{10}, O_3, and SO_2).

with low cognitive ability and exposure to high pollutant (e.g., PM_{10}, $PM_{2.5}$, and NOx) concentrations had higher risks of developing depressive symptoms (9). Reports in this field are limited; thus, large-scale investigations are warranted to confirm such findings.

The biological mechanisms of the depression–air pollution association remain unclarified. However, researchers have proposed multiple pathways. First, exposure to ambient air pollution could induce a systemic inflammatory response (35, 36). Systemic inflammation can affect the brain via an induced cytokine response, resulting in neurotoxicity and neuroinflammation (35). Second, air pollutant exposure could increase the levels of hippocampal proinflammatory cytokines and affect hippocampal dendrites, increasing depression-like behavior in animals (37). Third, exposure to air pollutants could cause oxidative stress in the brain (38). Oxidative stress has deleterious effects on dopaminergic neurons, and dopamine depletion in the nervous system is probably related to the neuropathology of depression (39, 40). Fourth, air pollution can negatively affect microvascular endothelial viability in humans and reduce tight junction protein levels, damaging the blood–brain barrier (35). Fifth, ambient air pollutant exposure could disrupt the hypothalamic–pituitary–adrenal axis. This axis regulates stress responses by producing certain hormones (e.g., cortisol). Disruption of this axis is a potential etiological factor of anxiety and depression (41, 42).

The current study was not without limitations. First, the CES-D is not a clinical diagnostic instrument, and it was not designed to assess individuals with chronic mental disorders. However, this screening tool is widely used to evaluate the severity of depressive symptoms, including in populations with somatic or psychiatric disorders (43); it provides cutoffs indicating potential clinical relevance and has high internal consistency, specificity, and sensitivity (20, 44). Second, all participants' residential addresses were not collected, and this may cause measurement errors and result in non-differential misclassification of exposure assessment to attenuated the observed effects. In addition, $PM_{2.5}$ may be strongly correlated with NOx exposure (33); however, we did not assess the effects of $PM_{2.5}$, because it was not measured. Third, unmeasured covariates such as traffic noise and surrounding green areas could have influenced the estimated effects, but related studies have revealed no clear associations of these factors with depression (9, 45).

The nationally representative cohort comprising community-dwelling older adults in Taiwan was a key strength. Our study had robust statistical power for the detection of meaningful

TABLE 3 | Association of interaction of air pollution (selected air pollutants) and cognitive function with depressive symptoms.

Interaction term	Depressive symptoms <10 vs. ≥10		*p*-value
	OR	(95%CI)	
PM_{10} * SPMSQ[a]			
7-day			
PM_{10} * SPMSQ≥3	Ref.		
PM_{10} * SPMSQ<3	1.018	(1.004, 1.032)	0.007
14-day			
PM_{10} * SPMSQ≥3	Ref.		
PM_{10} * SPMSQ<3	1.024	(1.009, 1.039)	0.001
21-day			
PM_{10} * SPMSQ≥3	Ref.		
PM_{10} * SPMSQ<3	1.027	(1.012, 1.042)	<0.001
30-day			
PM_{10} * SPMSQ≥3	Ref.		
PM_{10} * SPMSQ<3	1.026	(1.011, 1.040)	<0.001
60-day			
PM_{10} * SPMSQ≥3	Ref.		
PM_{10} * SPMSQ<3	1.025	(1.012, 1.039)	<0.001
90-day			
PM_{10} * SPMSQ≥3	Ref.		
PM_{10} * SPMSQ<3	1.023	(1.011, 1.036)	<0.001
180-day			
PM_{10} * SPMSQ≥3	Ref.		
PM_{10} * SPMSQ<3	1.021	(1.010, 1.033)	<0.001
1-year			
PM_{10} * SPMSQ≥3	Ref.		
PM_{10} * SPMSQ<3	1.037	(1.014, 1.059)	0.001
SO_2 * SPMSQ[b]			
7-day			
SO_2 * SPMSQ≥3	Ref.		
SO_2 * SPMSQ<3	1.122	(1.021, 1.233)	0.016
14-day			
SO_2 * SPMSQ≥3	Ref.		
SO_2 * SPMSQ<3	1.131	(1.024, 1.249)	0.014
21 day			
SO_2 * SPMSQ≥3	Ref.		
SO_2 * SPMSQ<3	1.126	(1.025, 1.236)	0.012
30-day			
SO_2 * SPMSQ≥3	Ref.		
SO_2 * SPMSQ<3	1.132	(1.029, 1.245)	0.010
60-day			
SO_2 * SPMSQ≥3	Ref.		
SO_2 * SPMSQ<3	1.135	(1.036, 1.243)	0.006
90-day			
SO_2 * SPMSQ≥3	Ref.		
SO_2 * SPMSQ<3	1.116	(1.029, 1.211)	0.007
180-day			
SO_2 * SPMSQ≥3	Ref.		
SO_2 * SPMSQ<3	1.095	(1.019, 1.176)	0.012
1-year			
SO_2 * SPMSQ≥3	Ref.		
SO_2 * SPMSQ<3	1.089	(0.992, 1.196)	0.073

[a]*Adjusted for sex, age, marital status, educational attainment, financial status (self-reported), physical activity, alcohol intake, heart disease, IADL score, season of study visit, PM_{10}, and SPMSQ score.*

[b]*Adjusted for sex, age, marital status, educational attainment, financial status (self-reported), physical activity, alcohol intake, heart disease, IADL score, season of study visit, SO_2, and SPMSQ score.*

SPMSQ, short portable mental status questionnaire.

associations, and we adjusted for potential confounding factors. Furthermore, the repeated-measures study design enabled the identification of time-dependent associations of exposure with outcomes and helped to minimize the influence of the genetic backgrounds of participants.

In summary, our results indicate that long- and short-term exposure to traffic-associated air pollutants is associated with increased risks of older adults developing depressive symptoms, and air pollution may exacerbate depressive symptoms in older adults with cognitive decline.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Tri-Service General Hospital Institutional Review Board (No.: 2-104-05-153). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

H-BH: conceived and designed the experiments. K-CW, Y-TL, and H-BH: analyzed the data and wrote the paper. Y-TL, C-CL, Y-YJ, and H-BH: contributed to critical revision of the manuscript. All authors have read and approved the final manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2021.779192/full#supplementary-material

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SYSTEMATIC REVIEW
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People Who Die by Suicide Without Receiving Mental Health Services: A Systematic Review

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Introduction: The majority of people who die by suicide have never seen a mental health professional or been diagnosed with a mental illness. To date, this majority group has largely been ignored, with most existing research focusing on predictors of suicide such as past suicide attempts. Identifying the characteristics of people who die by suicide without receiving services, often with a fatal first attempt, is crucial to reduce suicide rates through guiding improvements to service pathways and "just in time" interventions.

Methods: In this systematic review, PsycInfo, PubMed, CINAHL, and Web of Science were searched for peer-reviewed articles published from 1980 to 1st March 2021. Included studies examined predictors of non-receipt of formal mental health services among people who died by suicide. Data were extracted from published reports and the quality of included studies was assessed using a modified version of the Joanna Briggs Institute Checklist for Analytical Cross Sectional Studies. This review was registered with PROSPERO, CRD 42021226543.

Results: Sixty-seven studies met inclusion criteria, with sample sizes ranging from 39 to 193,152 individuals. Male sex, younger or older age, and rural location were consistently associated with non-receipt of mental health services. People not receiving mental health services were also less likely to have a psychiatric diagnosis, past suicidal behavior or contact with general health services, and more likely to use violent means of suicide. There was some evidence that minority ethnicity and psychosocial stressors were associated with service non-receipt.

Conclusion: People who die by suicide without receiving mental health services are likely to have diverse profiles, indicating the need for multifaceted approaches to effectively support people at risk of suicide. Identifying the needs and preferences of individuals who are at risk of suicide is crucial in developing new support pathways and services, and improving the quality of existing services.

Systematic Review Registration: http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42021226543.

Keywords: suicide, systematic review, healthcare utilization, coronial data, mental health services

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INTRODUCTION

Suicide is the leading cause of death for Australians aged 15–49 (1). Notably, over two-thirds of individuals who die from suicide do not receive professional mental health support (2). Research has focused on understanding suicide risk factors [for reviews, see (3–5)], but not on identifying factors specifically for those who did not receive mental health services prior to suicide. Although it is not possible to obtain first-hand reports from people who have died by suicide, coronial data can provide insights into the characteristics of this population and guide opportunities for suicide prevention efforts by policymakers, researchers, and service providers.

The current systematic review provides a comprehensive overview of predictors of non-receipt of formal mental health services among people who died by suicide, consolidating work in existing reviews on predictors of service utilization among those with common mental health issues (6, 7). To our knowledge, only two other systematic reviews have examined predictors of service use in a suicidal population. A systematic review by Han et al. (8), which examined predictors of help-seeking across different levels of suicidality, found that help-seeking for suicidality was associated with female gender, older age, non-minority ethnicity, presence of mental health issues, and greater severity of suicidality. However, this review did not have a primary focus on people who died by suicide. Furthermore, a systematic review by Hom et al. (9) examined barriers and facilitators of help-seeking for suicidality, but this review did not examine other factors associated with help-seeking, such as demographic and diagnostic characteristics.

We recognize that people may not use formal services for variety of reasons, including service inaccessibility or unaffordability, stigma, poor mental health literacy, preference for informal support, or negative past healthcare experiences. Identifying the characteristics associated with non-use of services within this population is critical to address these barriers, develop alternative pathways into services, re-design current services, and inform the development of novel interventions or more appropriate "care" models.

We focused on non-receipt of formal mental health services, rather than informal support as the primary outcome, given the focus of available literature, and since formal service use data is more easily verifiable by administrative health records linkage. Additionally, formal services are more likely to deliver evidence-based treatments compared to informal supports. One complexity in the literature is that studies consider a range of timeframes of mental health service use, ranging from non-use at time of death to non-use across an individual's lifetime. Shorter timeframe studies that classify decedents as "not in services" based on data from the weeks before death may miss service use in the months before death. Longer timeframe studies that classify decedents as "in services" based on lifetime use may inaccurately reflect service use in response to direct precipitants of suicide. In this review, we did not set limits on the timeframe examined; rather, this information was extracted from included studies. A second complexity is that studies vary in the data source used to ascertain service utilization and predictors of non-receipt of services. Studies that use psychological autopsies to acquire data through interviewing bereaved family, friends, or health professionals may yield unreliable reports (10). Studies that use coronial and/or health administrative data are also subject to methodological limitations (e.g., missing data) and are limited to examining risk factors that can be ascertained after death. To increase the comprehensiveness of the review, we included service use data and data on predictors of non-receipt of services from all aforementioned sources.

The aims of the review were to: (1) determine robust risk factors for non-receipt of formal mental health services among people who died by suicide, regardless of age; and (2) examine whether these risk factors are stable across different timeframes and types of services (e.g., inpatient vs. outpatient services).

MATERIALS AND METHODS

Search Strategy and Selection Criteria

This systematic review adhered to PRISMA guidelines (11) and was prospectively registered with PROSPERO (CRD 42021226543). The research team included individuals with lived experience of suicidality, who helped to shape the inclusion criteria and interpretation of findings for this review. Four electronic databases (PsycInfo, PubMed, CINAHL, and Web of Science) were searched from 1st January 1980 to 1st March 2021, with no language restrictions. The search strategy included a combination of three key blocks of terms related to: (i) suicide, (ii) health service utilization, and (iii) dying by suicide (see **Supplementary Materials**). Reference lists of included papers were examined to identify any additional papers.

Eligible studies were observational studies published in a peer-reviewed journal that examined one or more predictors of non-receipt of formal mental health services amongst people who died by suicide. Predictors specific to certain populations or regions (e.g., military rank, number of deployments, US census region, years spent living in a specific country) were excluded. Formal mental health services use was defined as seeing a general practitioner (GP), psychologist, psychiatrist, or other mental health professional in an emergency department (ED), inpatient or outpatient setting for mental health or substance use problems, or receiving a prescription for psychotropic medication. Studies that did not distinguish between mental health and non-mental health services, or formal and informal supports were excluded. No restrictions were placed on timeframe of service use, but the timeframe needed to be ascertainable from the article or through secondary sources (e.g., public information on the database). Studies that examined "past" or "previous" service contact were assumed to be examining lifetime service use.

Following removal of duplicates, all titles and abstracts were screened for suitability by ST, and a subset of 20% was screened by NR, with high interrater reliability ($\kappa = 0.96$). Both authors then independently screened full-text articles for inclusion ($\kappa = 0.85$).

TABLE 1 | Description of strength of evidence ratings.

Level of evidence	Description
Consistent evidence	>50% of observations find a significant association in one direction, with no substantial significant findings in the opposite direction for variable is examined by ≥3 studies
Some evidence	30–50% of observations find a significant association in one direction, with no substantial significant findings in the opposite direction for variables examined by ≥3 studies
Unlikely association	<30% of observations found a significant association in one direction for variables examined by ≥3 studies
Insufficient studies	Variables examined by <3 studies

Any disagreements were resolved through discussion with a third author (HC). At the full-text screening stage, three non-English articles were translated into English using Google Translate. One article, in French, and another, in German, were manually cross-checked by AJM. The third article, in Norwegian, was corrected by checking unclear expressions using alternative translators or by exploring where unclear terms were used in other contexts.

Data Analysis

ST and NR extracted data into a custom spreadsheet, recording: article, authors, year of publication, region/country, sample characteristics (size, age, and time period of death), data source(s), type of mental health service use (any, specialist, inpatient/ED, or mental health-related primary care), timeframe of mental health service use (within 1 month of death, within 1 year of death, or over 1 year prior to death/lifetime), predictors assessed, and main findings. Specialized mental health services include services provided within a particular setting (e.g., only outpatient, only a specified clinic/hospital) or by a particular type of mental health professional (e.g., only psychiatrists or psychologists).

A narrative synthesis approach was undertaken because significant variability in the designs, analyses and variables examined in included studies (see **Supplementary Table 1**) precluded a meta-analytic approach. Given the number and breadth of risk factors examined across studies, the below findings are reported by strength of evidence for an association with non-receipt of care, with variables with "consistent evidence" described first, followed by variables with "some evidence" and "unlikely association" for ease of interpretation of the results. See **Table 1** for definitions.

Quality Assessment

Study quality was assessed using a modified version of the Joanna Briggs Institute Checklists for Cohort and Analytical Cross-Sectional Studies (12) (see **Supplementary Table 2**). Studies were rated "adequate," "partial," "poor," or "unclear" on each item by two independent reviewers (ST and AA), with consensus achieved through discussion.

RESULTS

A total of 7,240 articles were identified. After removing duplicates and excluding studies based on abstracts, full text, or overlapping samples, 67 were eligible for inclusion (see **Figure 1**). The majority of included studies were from the United States (n = 19), the United Kingdom (n = 11), Canada (n = 8), Australia (n = 7), or Taiwan (n = 5). Most studies included a broad age range, though some exclusively examined adults over 50 (n = 8), or young people under 25 (n = 10). The type of services was highly varied, with "any" and "specialist outpatient" being most common. Timeframe of service use was also varied with lifetime, and within 1 year of death being most common (see **Supplementary Table 1**). **Supplementary Table 3** presents characteristics of included studies. **Table 2** presents a summary of the results for each risk factor. We examined findings across different timeframes and types of services and found little difference in the pattern of results, except for financial stressors where the association between experiencing a stressor and non-use of services was only seen for short timeframes of care (described below). As such, our results collapse across timeframe and type of mental health service use.

Consistent Evidence of Association With Non-receipt of Services

There was consistent evidence of an association between non-receipt of services and a number of demographic, diagnostic, and suicide-related variables. Most studies indicated that males were less likely to receive services compared to females (13–31). A number of studies found that male sex was only associated with non-receipt of services in certain subgroups [e.g., non-Indigenous Australians (32), young adults (33)] or under certain circumstances (34–36) [e.g., inpatient, not outpatient services (37), within 1 year of death, but not 1 month of death (34, 35)]. Although some studies found no relationship (24, 38–42), no study found that females were less likely to access services compared to males.

Age also predicted non-receipt of services in most studies. Some studies using general population samples (13, 21, 28, 43) and US military samples (24, 35) found that non-receipt of services was associated with younger age. In contrast, a number of studies of the general population found that non-receipt of services was associated with older age (18, 22, 30, 39). Almost all significant findings compared age groups using diverse age categories. Samples exclusively of young people under 25 (33), and of older adults over 65 had mixed findings (17, 44). While these findings may appear to be inconsistent, both young age and old age are likely risk factors for non-receipt of services. In line with this interpretation, two studies found that service use within 1 year of death was less pronounced among both younger *and* older decedents (20, 26). Six studies found no association (19, 38, 40, 45–47), which, when taken in the context of the other findings, may implicate a bimodal pattern of risk for both younger and older people, given that these studies included a broad age range and continuous age measures.

Regarding location, four studies found that decedents residing in rural locations were less likely to have received any mental

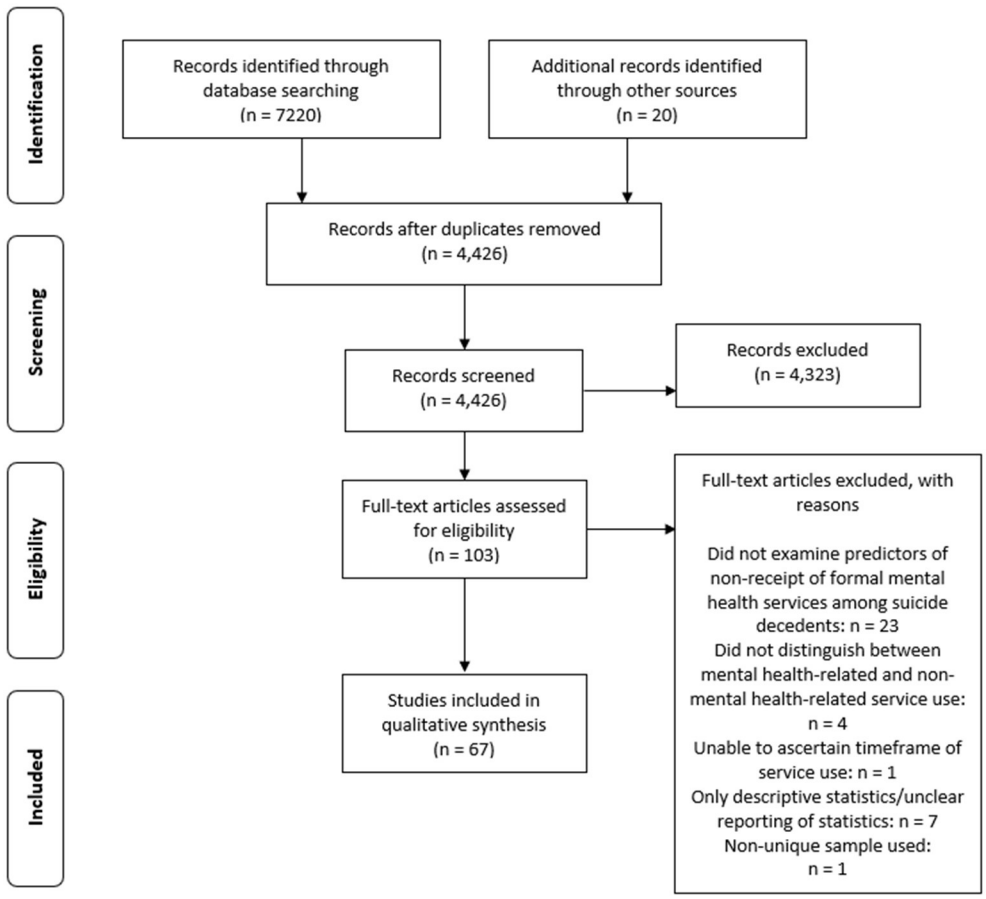


FIGURE 1 | PRISMA flow diagram.

health services compared to those residing in urban locations (27, 48–50). An Australian study found that non-receipt of mental health services was predicted by rural location only among Indigenous Australians (32). Three studies found no association (39, 44, 51).

Regarding diagnostic variables, studies consistently found that the absence of any mental health diagnosis predicted non-receipt of services across different timeframes and service types (38, 45, 46, 52–55). Specific diagnostic categories that were consistently associated with a greater likelihood of receiving services were mood disorders or symptoms, including depression and bipolar disorder (20, 26, 38, 44, 46, 56, 57), and schizophrenia and related disorders (37, 47, 58). There was also consistent evidence to suggest that non-receipt of services was associated with the absence of alcohol and/or substance abuse in general samples (37, 38, 50) and in certain subgroups [e.g., non-Indigenous Australians (32)]. An additional study found that non-receipt of services was associated with presence of blood alcohol at the time of death (59). However, four studies found no association for alcohol and/or substance abuse (44–46, 53).

Regarding suicide-related variables, the majority of studies found that non-receipt of mental health services was associated with more violent methods of suicide (e.g., firearm or hanging) compared to less violent methods (e.g., drug overdose) (13, 14, 20, 22, 25, 26, 39, 42, 50, 60–62). One study found that males, but not females, who were not receiving services were less likely to die by drug overdose compared to those receiving services (31). Two studies found that suicide by carbon monoxide poisoning was associated with not receiving services (50, 63). A minority of studies found no association (37, 38, 44, 45, 47, 64). All but two studies (47, 50) found that the absence of past suicidal behavior also consistently predicted non-receipt of services (14, 20, 25, 26, 31, 32, 37, 38, 42, 44–46, 64, 65). That is, decedents who had made a previous suicide attempt were more likely to have received services. Studies also consistently found that those not receiving non-mental health services, such as physical healthcare services and social services were also less likely to receive mental health services in the period before suicide (25, 31, 32, 45, 46, 49).

Some Evidence of Association With Non-receipt of Services

There was some evidence of an association between non-receipt of services, and ethnicity and employment status. Several studies

TABLE 2 | Summary of variables assessed, including strength of evidence for the relationship between each variable and non-receipt of mental health services.

Variable	Total # of studies	Total # of observations	Direction (variable associated with non-receipt of mental health services)	Total # of observations in this direction	Summary of evidence for risk factors for non-receipt of mental health services
Demographic					
Sex	31	50	**Male**	**31**	**Consistent evidence for male sex**
			Null	19	
Age	23	30	**Older age**	**10**	**Evidence for both younger and older age***
			Younger age	**8**	
			Middle age	1	
			Bimodal (older and younger age)	2	
			Null	9	
Location	8	14	**Rural location**	**8**	**Consistent evidence for rural location**
			Null	6	
Ethnicity	13	15	Non-White ethnicity	5	Some evidence for ethnic minority status
			Indigenous	2	
			Null	8	
Employment status	7	10	Being employed	4	Some evidence for being employed
			Being retired	1	
			Null	5	
Marital status	11	15	Being married	2	Unlikely association for marital status
			Never having been married	1	
			Being widowed	2	
			Null	10	
Living situation	6	7	Living alone	2	Unlikely association for living situation
			Null	5	
Education level	4	5	Low neighborhood education	2	Unlikely association for individual education level; insufficient evidence for neighborhood education level
			Null	3	
Occupation	7	9	Farm laborer (compared to farm manager)	1	Insufficient studies (given heterogeneity among studies)
			Non-farming/agriculture occupation among those living rurally	1	
			Marine Corp (compared to Army)	1	
			Null	6	
Income level	2	3	High income	2	Insufficient studies
			Low neighborhood income	1	
Religion	2	2	Null	2	Insufficient studies
Sexual orientation	1	2	Null	2	Insufficient studies
Parental status	1	2	No children	2	Insufficient studies
Perinatal status	1	5	Suicide death during perinatal period	1	Insufficient studies
			Null	4	
Political views	1	1	Being socially conservative	1	Insufficient studies
Diagnostic					
Any MH diagnosis	8	10	**Absence of any MH diagnosis**	**10**	**Consistent evidence for absence of any MH diagnosis**
Mood disorder/ depressed mood	10	15	**Absence of mood disorder/depressed mood**	**12**	**Consistent evidence for absence of mood disorder/depressed mood**
			Null	3	

(Continued)

TABLE 2 | Continued

Variable	Total # of studies	Total # of observations	Direction (variable associated with non-receipt of mental health services)	Total # of observations in this direction	Summary of evidence for risk factors for non-receipt of mental health services
Schizophrenia and related disorders	6	13*	**Absence of schizophrenia and related disorders**	**11**	**Consistent evidence for absence of schizophrenia and related disorders**
			Null	2	
Alcohol/substance abuse	10	15	**Absence of alcohol/substance abuse**	**8**	**Consistent evidence for absence of alcohol/substance use**
			Null	7	
Family history of mental illness/suicidality	4	6	Absence of family history of mental illness	1	Unlikely association for family history of mental illness/suicidality
Anxiety	2	3	Absence of anxiety disorder	2	Insufficient studies
			Null	1	
Personality disorder	2	2	Null	2	Insufficient studies
Adjustment disorder	1	2	Absence of adjustment disorder	2	Insufficient studies
Problem gambling	1	3	Absence of problem gambling	3	Insufficient studies
Suicide-related					
Method of suicide	20	24	**Violent methods**	**15**	**Consistent evidence for violent methods of suicide**
			Carbon monoxide	2	
			Null	7	
Past suicidal behavior	16	20	**Absence of past suicidal behavior**	**18**	**Consistent evidence for absence of past suicide attempts**
			Null	2	
Disclosure of suicide intent to others	7	9	Absence of disclosure	4	Some evidence for the absence of disclosure
			Null	5	
Location/time of death	4	4	Null	4	Unlikely association for location/time of death
Suicide note	7	7	No suicide note	2	Unlikely association for no suicide note
			Null	5	
Time from initial onset of suicidal behavior	1	2	Short time period between initial onset of suicidal behavior and death	2	Insufficient studies
Perceived suicide risk	2	2	Low perceived risk	1	Insufficient evidence
			Null	1	
Psychosocial stressors/precipitating events					
Any stressor	4	4	Presence of any recent stressor	2	Some evidence for presence of any stressor
			Null	2	
Financial/job problems	9	13	Presence of financial/job problems	4	Some evidence for presence of financial/job problems
			Null	9	
Criminal/legal problems	5	6	Presence of criminal/legal problems	2	Some evidence for experiencing criminal/legal problems
Physical health problems	10	11	Absence of physical health problems	1	Unlikely association for physical health problems
			Presence of physical health problems	3	
			Null	7	
Family or relationship or interpersonal problems	6	8	Presence of family/relationship/interpersonal problems	1	Unlikely association for experiencing family or relationship or interpersonal problems
			Null	7	
Recent loss (incl. suicide or other death of close person)	6	7	Null	7	Unlikely association for experiencing recent loss

(Continued)

TABLE 2 | Continued

Variable	Total # of studies	Total # of observations	Direction (variable associated with non-receipt of mental health services)	Total # of observations in this direction	Summary of evidence for risk factors for non-receipt of mental health services
Housing problems/homelessness	2	2	Being homeless	1	Insufficient studies
			Null	1	
Immigration	1	1	Null	1	Insufficient studies
Life events in childhood	1	1	Null	1	Insufficient studies
Perpetuating violence	1	1	Perpetrator of violence	1	Insufficient studies
Victim of violence	1	1	Null	1	Insufficient studies
Other variables					
Contact with other services (e.g., GP, social services)	6	10	**Absence of contact with other services**	**8**	**Consistent evidence for absence of contact with other services**
			Null	2	
Family history of psychiatric contact	1	2	Absence of family history of psychiatric contact	1	Insufficient studies
			Null	1	
Social problem-solving	1	1	Null	1	Insufficient studies
Impulsivity	1	1	Null	1	Insufficient studies
Academic performance	1	1	Null	1	Insufficient studies

The results reported in this table were based on the most adjusted analyses provided. Observations refer to distinct instances of a result for different types/timeframes of mental health service use, or non-overlapping samples or predictors.

**See Results text for clarification.*

The bold values represent variables that consistently predict non-receipt of mental health services.

found that non-White compared to White (14, 20, 30, 35, 66), and Indigenous compared to non-Indigenous decedents (14, 20, 30, 66) were less likely to have received services. No studies found that ethnic minority groups were more likely to receive services, but a number found no association (19, 32). Among studies examining employment status, two found that non-receipt of mental health services was associated with being employed (47, 64), and one found that non-receipt of inpatient, but not outpatient services, was associated with being employed (37). In contrast, another study found that being retired, but not being employed, predicted lower odds of service use (39). Three studies found no association (42, 45, 46).

Regarding suicide-related variables, there was some evidence for an association between non-disclosure of suicidal intentions/ideation to others and non-receipt of mental health services. Some studies found that non-receipt of services was associated with the absence of disclosure in general samples (39, 67) and among certain subgroups (e.g., non-Indigenous Australians only) (32) and circumstances (e.g., for inpatient, but not outpatient service use) (37). However, three other studies found no relationship (45, 46, 50).

Regarding psychosocial stressors, some studies explored whether non-receipt of services was associated with experiencing any recent stressors. Two studies found that people who had not received services were more likely to have experienced a stressor prior to their deaths (26, 42), but another two found no such association (46, 64). Other studies examined the relationship between service use and a specific stressor, with some finding that non-receipt of mental health services in the year before death was associated with experiencing financial problems (20, 44, 47, 68), but not job problems (20, 44) at the time of death. Lifetime service use on the other hand, was not associated with financial or job problems (26, 45, 50, 69). This pattern suggests that recent experiences of financial problems may be a risk factor for dying by suicide without having received mental health services. Additionally, there was some, albeit limited, evidence to suggest that non-receipt of services was associated with experiencing criminal/legal problems prior to suicide (20, 26, 38, 44, 64).

Unlikely Evidence of Association With Non-receipt of Services

The evidence suggested that there was an unlikely association between mental health service use and the following variables: marital status (50, 70, 71), individual education level (45, 47, 64), having a family history of mental illness/suicidality (25, 26, 35, 38, 39, 44–47, 50, 64), location or time of death (13, 45, 47, 64), the presence of a suicide note (37, 42, 45, 64), experiencing physical health problems (24, 44, 60, 72–75), family/relationship problems (25, 26, 39, 45), and experiencing a recent loss (14, 26, 37, 42, 45, 50). Most studies found no association between non-receipt of services and living situation (20, 26, 38, 44, 50, 64), although one study found that elderly

decedents not receiving services were more likely to be living alone (25), which might suggest living alone confers a risk in older populations.

Insufficient Evidence of Association With Non-receipt of Services

There was an insufficient number of studies examining all remaining variables (see **Table 2**). Although occupation was examined in a number of studies, these studies were highly heterogenous in the occupations examined and no specific occupation was examined by more than two studies (24, 44, 60, 72–75).

Quality of Included Studies

Study quality assessment and ratings are presented in **Supplementary Table 4**. Most studies were adequate on Items 1 and 2, while close to half of studies were rated as partial for item 3 and poor for item 4. Only eight studies scored less than adequate on >50% of the items (31, 36, 53, 54, 56, 68, 73, 76). Excluding these studies did not meaningfully alter the results.

DISCUSSION

Key factors associated with non-receipt of formal mental health services before suicide death identified in this review were male sex, younger or older age, and rural location. These findings are largely consistent with previous reviews of service use among people with mental health issues (6, 7). People not receiving services were less likely to have a psychiatric diagnosis, or contact with non-mental health services. They were also less likely to have past suicidal behavior and more likely to use violent means of suicide, which might suggest their first suicide attempt tends to be fatal. Mood and schizophrenia spectrum disorders were associated with greater likelihood of service receipt compared to other diagnoses. There was some evidence to suggest that people who died by suicide without having received services were more likely to be from an ethnic minority background, and have experienced stressors, such as financial problems.

Consistent with previous research showing that men are less likely to use all types of health services (77), we found that males were less likely than females to have received formal mental health services prior to suicide. This disparity may be due to men's higher levels of stigma toward mental illness and help-seeking (78–82) and/or lack of services that align with men's preferences (83). There is also evidence of lower levels of mental health literacy among men, meaning they may be less likely to recognize symptoms, and less aware of where or how to access help (82). Findings related to the association between non-receipt of services and more violent means of death and the absence of suicide attempt may also be mediated by sex, in that women are more likely to attempt suicide compared to men (84), while men are more likely to use more violent suicide means (85). The use of less violent methods among women may result in higher survival rates for attempts, and subsequent linkage to healthcare services. Lower rates of mental health service utilization among men may, at least partly, contribute to higher global suicide rates in men relative to women (86), indicating that future research should focus on developing and evaluating service pathways tailored to men's needs.

The association between rural location and non-receipt of clinical services may be due to a number of factors, including geographic and structural barriers to accessing services (87), a culture of self-reliance among those living rurally (88), and threats to livelihood like physical injury and drought (89). There was also some evidence that experiencing financial problems and ethnic minority status were associated with reduced likelihood of service use. Each of these variables are associated with increased risk of suicide (90–93) and highlight the impact of cultural factors and social determinants of health on service use (94).

Decedents with a psychiatric diagnosis were more likely to have received services compared to those without a diagnosis, which likely reflects that acquiring a formal diagnosis necessarily requires contact with a professional. In contrast, suicide among people without diagnoses might be more likely to have been precipitated by acute stressors, rather than enduring mental health issues, providing little opportunity for intervention. Indeed, we found some, albeit mixed, evidence to suggest that those experiencing acute stressors, such as financial difficulties, prior to suicide were less likely to have received services compared to those not experiencing such stressors.

It is possible that there are distinct profiles among those not receiving mental health services. For instance, we found evidence that both younger and older age were associated with non-receipt of services, potentially reflecting different subgroups. Younger individuals are more likely to report financial concerns and fear of psychotherapy as barriers to help-seeking, whereas elderly people may be less likely to receive formal mental health services due to difficulties with transportation and/or a tendency to normalize distress (95). We also found some inconsistent evidence for the relationship between service use, and ethnicity and employment status, which might further indicate that people who die by suicide without having received services have diverse profiles. One limitation of the current review was that all included studies were conducted in high-income countries, meaning the findings may not apply to low and middle-income countries, where 75.5% of global suicides occur (96). Included studies also varied in the range of covariates accounted for, which may impact the significance and comparability of results. Furthermore, we assessed the reliability and validity, but not the comprehensiveness of the service utilization data. Studies varied in the breadth of healthcare utilization data that they captured, with many studies effectively capturing public but not private mental health service utilization. Although accessing data on all possible sources of mental health service use may not be practicable in many cases, mental health service use is likely to be underreported within databases, impacting the accuracy with which studies could determine service use. However, despite variation in the quality of included studies, key findings in relation to demographic, diagnostic, suicide-related, and service contact variables were

largely consistent across studies. Additionally, the use of coronial and similar data also limited the type of predictors that could be examined. Few studies examined such variables as sexual orientation and personality characteristics, while no studies examined the presence of adverse childhood experiences (ACEs), despite the well-established association between ACEs, and both suicidality and self-harm (97, 98). Further, given the current focus on individuals who died by suicide, we were unable to gain insight into service preferences and barriers to service use in this population. Future research should examine these characteristics among individuals at risk of suicide to help guide clinical practice and inform the development of alternative service pathways.

The current review was also unable to distinguish between people who chose not to seek help and people who attempted to access help without successfully receiving it. These subgroups are likely to have different needs and barriers to service access, highlighting an important avenue for future research. Moreover, this review only examined predictors of non-receipt of *formal* mental health services. These services may not always meet users' needs and may vary in quality (99). Receiving formal services also does not guarantee that individuals were recognized as suicidal or treated for suicidality. The quality of services received within the formal mental health system also varies considerably and may not always meet the individual needs of those within this system (99). Furthermore, those at risk of suicide—particularly those in younger age groups—also often rely on informal sources of support, such as support from family and friends, and crisis lines or internet forums. The latter sources remove additional barriers to help-seeking such as cost and confidentiality (100, 101). These informal supports may be helpful, or indeed sufficient, for some people at risk of suicide (102). For example, calls to suicide crisis lines are a form of help-seeking not captured in this review that may be effective in alleviating short-term distress for some people (102). Understanding the characteristics of suicidal individuals who do not receive either formal or informal sources of support is necessary to identify those least likely to receive any form of help.

Further work is needed to understand the trajectories and antecedents to suicide, and barriers to using mental health services to aid the development of appropriate interventions. Epidemiological studies provide broad data on risk factors. However, within-group patterns and individual trajectories may be more clearly elucidated through surveys of those "at risk" outside of services and qualitative interviews with people in our target group that have made a non-fatal attempt, as well as families and friends bereaved by suicide. By providing insight into the individual stories and needs of people at risk of suicide, these approaches will facilitate the development of tailored and preference-based service pathways (103).

Our conclusion from this review is that people who die by suicide without receiving formal mental health services are likely to have diverse characteristics. It is likely that a multi-faceted approach may increase engagement. Clearly, services that are currently on offer do not attract or reach this group. New pathways, such as alternatives to the ED (e.g., peer support services, safe havens), and outreach activities, potentially integrated in non-health settings such as workplaces, welfare and housing agencies, and educational institutions, are needed (see **Box 1** for research implications). Online interventions, which have been shown to reduce suicidal ideation and reduce barriers such as high out-of-pocket expenses, physical distance and stigma, may also offer a route into services (104). However, we do not know whether the above avenues will work, and more investigation is needed. Furthermore, significant reform is likely needed to provide timely support to those experiencing an acute stressor given that existing services are subject to long waitlists, and ED responses are often perceived as unsatisfactory (105). Further, people experiencing suicidal distress may not recognize the role of mental health support in managing acute distress. Our findings on the relationship between social determinants of mental health and mental health service use among people who die by suicide suggest that equity issues and broader policy reform in relation to such issues as social welfare, employment, education, and housing should be considered.

BOX 1 | Implications of research findings.

Reaching people who are "under the radar" before they die by suicide may require:

- Reducing inequity of access to existing services including financial and locational barriers
- Trialing outreach approaches and interventions that are designed to reach people in the short interval between experiencing a life stressor (e.g., financial adversity) and suicide
- Providing alternative pathways into services including capitalizing on existing government service touchpoints (e.g., income support, social housing, transition periods)
- Implementing and evaluating alternative forms of support including safe havens, respite services, and the peer support workforce
- Offering and evaluating online support and referral services for suicidality

Due to diversity among people who die by suicide without receiving services, there are likely several avenues for increasing the service use for those experiencing suicidality, including improving access, quality, and delivery of existing services and the development of new support pathways. Further research exploring reasons underlying non-use of existing services is critical to better meet the needs of people at risk of suicide.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

ST, NR, PB, AC, GC, AM, and HC designed the study. ST and NR conducted the literature search, screened titles, abstracts, and full-texts for eligibility for inclusion into the review, and extracted

data from the manuscripts. ST and AA performed quality assessments. AM translated non-English articles to English. ST, NR, and AA wrote the first draft of the manuscript. All authors contributed to the interpretation and subsequent edits of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2021.736948/full#supplementary-material

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SYSTEMATIC REVIEW
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Digital Media Use and Adolescents' Mental Health During the Covid-19 Pandemic: A Systematic Review and Meta-Analysis

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The Covid-19 physical distancing measures had a detrimental effect on adolescents' mental health. Adolescents worldwide alleviated the negative experiences of social distancing by spending more time on digital devices. Through a systematic literature search in eight academic databases (including Eric, Proquest Sociology, Communication & Mass Media Complete, Psychology and Behavioral Sciences Collection, PsycINFO, CINAHL, Pubmed, and Web of Science), the present systematic review and meta-analysis first summarized the existing evidence from 30 studies, published up to September 2021, on the link between mental health and digital media use in adolescents during Covid-19. Digital media use measures included social media, screen time, and digital media addiction. Mental health measures were grouped into conceptually similar dimensions, such as well-being, ill-being, social well-being, lifestyle habits, and Covid-19-related stress. Results showed that, although most studies reported a positive association between ill-being and social media use ($r = 0.171$, $p = 0.011$) and ill-being and media addiction ($r = 0.434$, $p = 0.024$), not all types of digital media use had adverse consequences on adolescents' mental health. In particular, one-to-one communication, self-disclosure in the context of mutual online friendship, as well as positive and funny online experiences mitigated feelings of loneliness and stress. Hence, these positive aspects of online activities should be promoted. At the same time, awareness of the detrimental effects of addictive digital media use should be raised: That would include making adolescents more aware of adverse mechanisms such as social comparison, fear of missing out, and exposure to negative contents, which were more likely to happen during social isolation and confinement due to the pandemic.

Keywords: adolescence, social media, mental health, media addiction, well-being, review, Covid-19 pandemic

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INTRODUCTION

The Covid-19 pandemic and its related containment measures unavoidably affected mental health, which can be defined as "a state of well-being in which an individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community" (1). Mental health is most affected during adolescence, when individuals

enlarge their social sphere, establish a sense of autonomy, and make crucial decisions to achieve long-term goals (2). The concomitant maturation of social and cognitive control areas of the brain supports the progress of these skills, together with the exposure to and experience of appropriate contextual and social stimuli (3). Indeed, for adolescents, the social environment is important for developing essential brain functions, self-concept, and mental health in general (4). Hence, physical distancing measures introduced during the Covid-19 pandemic may have had a detrimental effect on youth development. Several studies already showed that adolescent age is a risk factor for diverse mental health problems, especially during epidemic outbreaks [e.g., (4–10)]. Particularly, social deprivation during a developmental period characterized by a high need for peer interaction likely augments negative consequences on mental health.

During the early months of the pandemic, many countries worldwide went into complete lockdown. Mental health of youth was threatened due to the shift toward distant learning, the closure of leisure environments, the decrease in outdoor activities, the impossibility to organize social events, and the increase of distress related to the pandemic. As measures were taken across the globe, their long-term effects on adolescents' mental health were unknown. To date, several reviews have summarized the immediate impact of the Covid-19 pandemic on the younger population. According to a review of ten studies (11), school closure contributed to anxiety, loneliness, stress, depressive symptoms, frustration in young people, together with higher indiscipline and hyperactive conduct. Similarly, also an increase in Body Mass Index and overweight was reported. A rapid narrative review of 15 articles (12) highlighted that pandemic and lockdown measures impacted young persons' mental health in particular, leading to a general decrease in psychological well-being followed by changes in sleep habits. Stressors were mainly linked to academic, economic, and social issues. Another review of six studies reported a general decrement in adolescents' quality of life during Covid-19, including the perception of physical, psychological, and social well-being (8). Overall, these reviews showed that young people were more vulnerable to psychological distress, highlighting the need for targeted interventions and psychological support.

Adolescents around the world alleviated the negative experiences of social distancing by spending more time online. A general increment in the use of digital technologies has been reported, especially of social media (13), with applications such as TikTok, Pinterest, Reddit, Facebook, Snapchat, Instagram, LinkedIn, and Twitter showing growth in active users ranging from 8 to 38% (14). Notably, teens reported staying connected with others via text messages (83%), phone calls (72%), social media and video chats (66%), instant messaging apps (48%), and, to a lesser extent, e-mails (37%) (15).

In line with this increment, a study on 5114 high school students from five countries (16) showed that more than 40% increased their social media time to stay connected with others since they could not meet in person. Similarly, Munasinghe et al. (17) reported augmented screen time – including social media, Internet, and smartphone use – together with diminished time for physical activity, decreased happiness, and more fast-food consumption. Focusing on the use of digital technology in 1,860 adolescents aged 12–18 years, Salzano et al. (18) reported that participants spent more than six hours a day on screens for educational purposes and from four-to-six hours a day for recreational activities. To note, adolescents reported that, on average, they sent and received over 100 messages per day. Not surprisingly, more frequent symptoms of smartphone dependency have been observed, especially among young females (19). The augmented time spent on digital technologies, particularly social media, might have alleviated feelings of loneliness and enhanced social connection. However, social media platforms also provided an overload of Covid-19 related information, where one-third of Covid-19 updates have been classified as fake (20), thus adding additional stress to the already worrisome situation. Accordingly, social media use has been identified as both a protective and risk factor for mental well-being during Covid-19 (21). This evidence should be interpreted in a larger, pre-pandemic context, where past reviews concluded that screen media use has negative but small effects on adolescents' health [e.g., (22, 23)] through various mechanisms such as upward social comparison and time displaced for other activities. This poses the question of whether the augmented use of screen media due to the pandemic may have exacerbated adverse outcomes by increasing social comparison and envy, displacing time for health-promoting activities such as sleep and exercising, and fostering cognitive distraction. Yet, screen media use could have also acted as a buffer, e.g., by initiating and maintaining social connections in times of limited face-to-face interactions or providing a way to get entertained. Additionally, adolescents may have used digital media as a coping tool to deal with the stress generated by the Covid-19 confinement by self-regulating their emotions using, for example, social media to escape ongoing worries and boost their mood (24).

To the best of our knowledge, no systematic synthesis on the link between digital media use, including social media and smartphone use, and adolescents' mental health during Covid-19 exists. Hence, the present systematic review and meta-analysis aims to fill this gap by focusing on the adolescent age, mental health, and digital media use during the Covid-19 pandemic.

METHODS

Literature Search

On 16th April 2021, a systematic search was carried out in the titles and abstracts of scientific publications listed in eight academic databases, including Eric and Proquest Sociology (via Proquest), Communication & Mass Media Complete, Psychology and Behavioral Sciences Collection, PsycINFO, and CINAHL (via Ebscohost), Pubmed (via Medline and Proquest), Web of Science (via Clarivate Analytics). Key terms covered the population (e.g., "adolescent*", "teen*", "young*"), intervention/activity (e.g., "social media*, "screen time*"), outcome (e.g., "well-being*", "psych*", "mental*"), and context (e.g., "covid*"). They were combined using Boolean operators. The complete list of keywords and their combination is reported in **Table 1**.

TABLE 1 | Complete list of keywords according to the PICO criteria.

Population:	adolescent* OR teen* OR tween* OR young* OR youth* OR child* student* OR adult*
	AND
Intervention/activity:	social network* OR social networking OR social media OR Facebook OR instagram OR snapchat OR SNS* OR screen time OR screen-time OR digital OR smartphone* OR Internet use*
	AND
Outcome:	well being* OR well-being* OR mood* OR anx* OR distress* OR stress* OR affect* OR life satisfaction* OR psychopatolog* OR psych* OR feeling* OR dependence* OR self-esteem* OR self-worth OR sleep* OR irritab* OR attention* OR inattent* OR fear* OR worry* OR insomnia* OR distract* OR panic* OR mental* OR health* OR behav* OR academic* OR school*
	AND
Context:	covid* OR covid-19* OR corona* OR pandemic* OR quarantine*

TABLE 2 | Adapted STROBE checklist.

	Dimension	Description
Introduction	Background/ rationale	Explain the scientific background and rationale for the investigation being reported
	Objectives	State specific objectives, including all the hypotheses
Methods	Setting	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
	Participants	Give the eligibility criteria, and the sources and methods of selection of participants
	Variables	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
	Data sources/ measurement	For each variable of interest, give sources of data and details of methods of assessment (measurement)
	Statistical methods	Describe all statistical methods. Explain how missing data were addressed
Results	Descriptive results	Give characteristics of study participants (e.g., demographic, clinical, social)
	Outcome data	Report numbers of outcome events or summary measures
Discussion	Key results	Summarise key results with reference to study objectives
	Limitations	Discuss limitations of the study, taking into account sources of potential bias or imprecision.
	Total	Total score

To exclude any duplicates, all entries were imported in Zotero, a reference management software. After duplicates were excluded, the remaining titles and abstracts were screened by two coders according to the predefined eligibility criteria. Cohen's kappa statistic (25) was calculated and used to measure inter-coder reliability. Discrepancies that emerged after full-text screening were resolved through a consensus meeting. Two additional hand searches were carried out on 15th June 2021 and 15th September 2021 to update the initial search due to the rapid rate of published works on the topic.

Study Selection

According to the PICO [Population, Intervention, Comparison, and Outcome; (26)] definition of pre-specified eligibility criteria, we included articles with original data on a population aged 10 to 24 years (P) (27), including measures of (problematic) digital media as intervention (I), and mental health as the outcome (O), in the context of the Covid-19 pandemic. We did not include any comparison. Additionally, only studies published in peer-reviewed journals, written in English, and using a quantitative methodology with a cross-sectional or a longitudinal design were retained.

Articles were excluded if they were book chapters, pre-prints, conference papers, experimental studies, intervention studies, qualitative studies, studies focusing on gaming or cyberbullying, studies with no reference to Covid-19, as well as studies focusing on education, information-seeking behaviors, contact tracing, and clinical populations. Publications were also excluded if they reported only descriptive information of digital media use and mental health without linking the two concepts.

Data Extraction

The following information was collected for each study: First author, year, and title of the paper, the country where the research was conducted, study design (cross-sectional or longitudinal), sample size, type of recruitment (online vs. other), type of sampling (random vs. convenience), % of male participants, age of participants, theoretical background, construct and measure of digital media use, construct and measure of mental health (including its different facets as *well*-being and *ill*-being), a brief description of the results, and raw data convertible into effect sizes.

Quality Assessment of the Included Studies

The quality assessment of the included studies was carried out using the Strobe-checklist (28). In particular, for each study, we evaluated the quality of the information regarding the background/rationale, objectives, setting, participants, included variables, data sources/measurement, statistical methods, descriptive results, outcome data, key results, and limitations. The assessment of each study resulted in a total score from 0 to 11. A summary of the studies' quality can be found in **Tables 2**, **3**. We also considered if the included studies used reliable measures for digital media use and well-being.

TABLE 3 | Quality assessment of the included studies.

	Introduction		Methods					Results		Discussion		
Study ID	**Background/ rationale**	**Objectives**	**Settings**	**Participants**	**Variables**	**Data sources/ Measurement**	**Statistical methods**	**Descriptives data**	**Outcome data**	**Key results**	**Limitations**	**Total**
1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
7	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
9	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	10
11	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
12	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
13	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
14	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
15	✓	✓	✓	✓	✓	X	✓	✓	✓	✓	✓	10
16	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
17	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
18	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
19	✓	✓	✓	✓	✓	X	✓	✓	✓	✓	✓	10
20	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
21	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
22	✓	✓	✓	✓	✓	X	✓	✓	✓	✓	✓	10
23	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
24	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
25	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
26	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
27	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
28	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11
29	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	10
30	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11

✓ = *present; X = absent.*

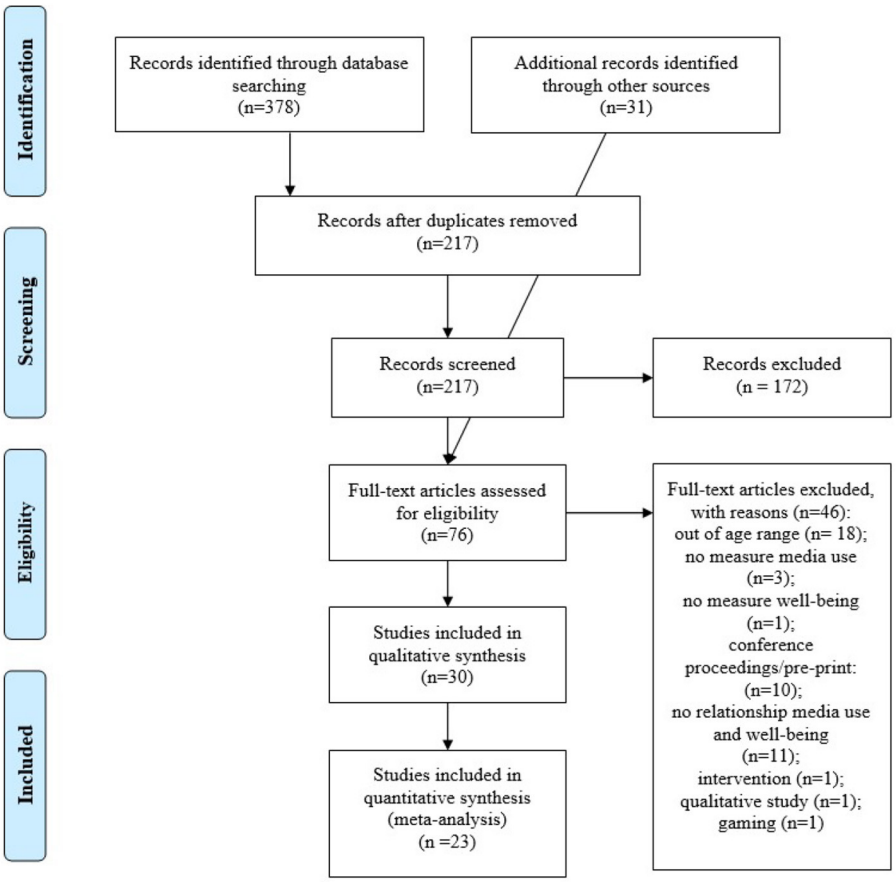


FIGURE 1 | PRISMA flowchart.

Meta-Analytic Procedure

Due to the high heterogeneity of the included studies, meta-analytic syntheses were carried out only for studies including raw data convertible into effects sizes and similar investigated concepts. The "meta" (29) package in R statistical software was used for the meta-analysis. A Fisher's r-to-z transformation was calculated as a measure of effect size, and results were converted back to *r* correlation coefficients for interpretation. Conversion formulas (30, 31) were used when necessary to convert raw data to correlations. Several meta-analyses were carried out linking (i) social media use, (ii) screen-time, and (iii) media addiction to diverse mental health outcomes grouped into comparable categories. We interpreted pooled effect sizes of $r = 0.10$, $r = 0.30$, and $r = 0.50$ as small, medium, and large, respectively (32). An inverse-variance method with a random-effects model and Hartung-Knapp-Sidik-Jonkman adjustment (33) was used to adjust for study variability in sample sizes. Heterogeneity of results was calculated with the between-study-variance τ^2, the restricted maximum-likelihood estimator (REML), and reported as I^2 statistic (31, 34, 35). When possible ($k = 10$), additional meta-regression analyses were carried out to investigate the role of moderators, such as the age and gender of participants.

RESULTS

General Overview

From the initial database search, 378 records were obtained. After duplicates removal, the title and abstract of 217 records were screened independently by two coders based on the predefined eligibility criteria. Cohen's kappa as a measure of intercoder reliability was 0.80, indicating substantial agreement. After title and abstract screening, 45 articles were retained. Another 31 articles were identified through the two additional hand searches, adding up to 76 articles for full-text screening. Of these, 30 articles were retained in the systematic review and a subset of 23 in the meta-analysis (see PRISMA flowchart in **Figure 1**).

The included studies were mainly conducted in Asia ($n = 12$) and Europe ($n = 11$). Few were conducted in Oceania ($n = 3$), America ($n = 2$), and Middle East ($n = 1$). One study (36) collected data from Italy, Argentina, and United Kingdom. Six studies adopted a longitudinal design, ranging from 14 days (37) to twelve months (38). In all the studies, data were collected through online questionnaires, and three studies made use of a random sampling procedure. The median sample size was 760, ranging from 102 to 13,525, with one longitudinal study including 1,64,101 participants at the first time point of data

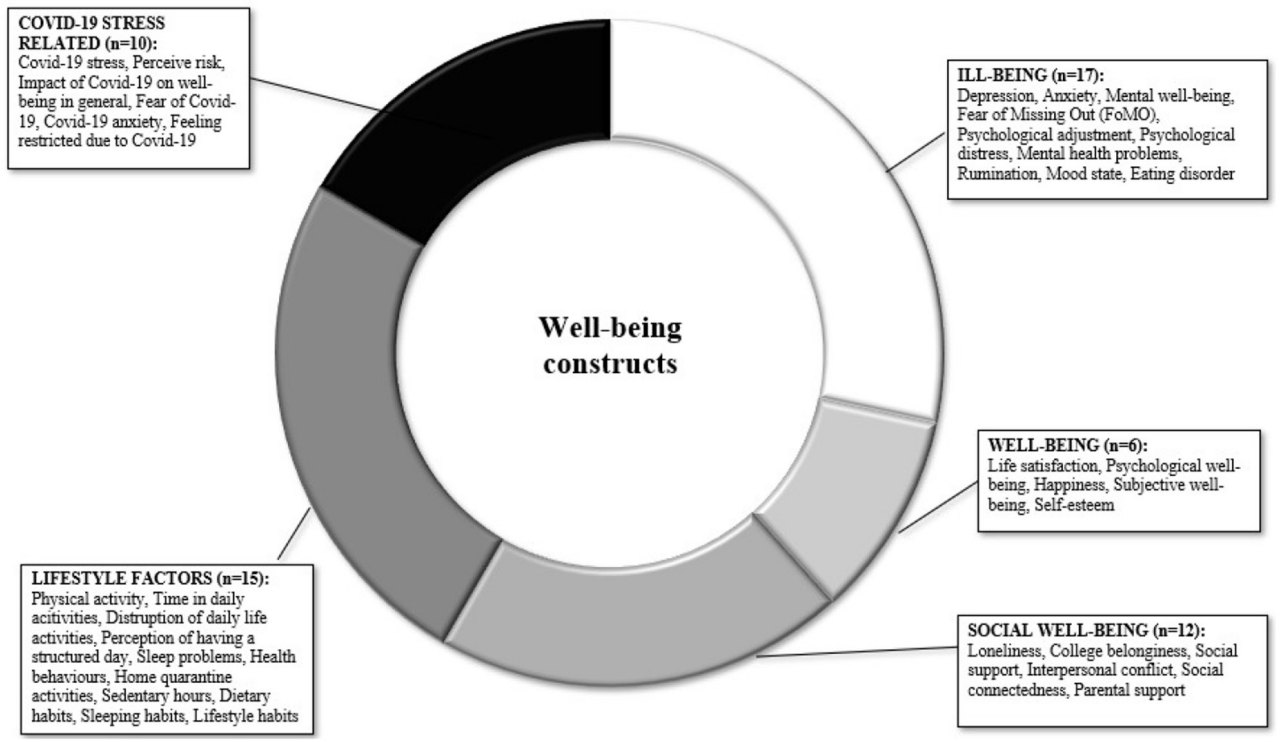


FIGURE 2 | Graphic representation of well-being investigated constructs.

collection (39). In general, females were slightly over-represented (mean = 60%). Participants' mean age was 17.75 years (ranging from 9.50 to 25.5).

Included studies mainly assessed social media use ($n = 16$), screen time ($n = 10$; including time spent on different devices, change in screen time, and type of usage), and media addiction ($n = 9$; including measures of Internet and social media addiction). Mental health was measured in terms of *ill*-being ($n = 17$, i.e., psychopathological problems such as symptoms of depression, anxiety, mood disorder, ruminative thoughts), *well*-being ($n = 6$, including life satisfaction, optimism, happiness), social well-being ($n = 12$, covering the quality of social relationships, social support, interpersonal conflict, and loneliness), lifestyle habits ($n = 15$, including physical activity, sleep, smoking, nutrition, and everyday health routines), and Covid-19-related stress ($n = 10$, covering distress, fear, and worries due to the Covid-19 pandemic). For a summary of the investigated concepts, see **Figures 2**, **3**.

A summary of the study characteristics can be found in **Tables 4**–**6**. Applying the Strobe checklist, all studies were of very good quality, except for three studies lacking detailed information on data sources and measurement (55, 58, 66) and two studies with insufficient recognition of their study limitations (48, 64).

In the following subchapters, the studies are summarized qualitatively and - when possible - quantitatively by grouping them according to the type of media use and its association with mental health, i.e. social media use and mental health, screen time (excluding social media use) and mental health, and media addiction and mental health. A separate subchapter focuses on longitudinal studies investigating the different types of media use and their causal relationships with mental health outcomes.

Social Media Use and Mental Health During Covid-19

In general, studies reported that social media use increased during the Covid-19 pandemic (36, 47, 56, 60, 62), including the usage of a variety of social media platforms (e.g., Instagram, Snapchat, TikTok). In particular, three studies reported that about one-third of the participants used social media for more than 5 h per day (40, 50, 56), with some participants reporting time spent on social platforms up to 10 h per day (40).

Overall, meta-analytic results showed that time spent on social media was positively correlated with ill-being (k = 11, $r = 0.171$, 95%CI [0.050–0.286], $p = 0.011$, $I^2 = 96\%$, **Figure 4**), indicating that using social platforms was related to higher psychopatological symptoms. To note, meta-regression analyses showed that the strength of correlation slightly augmented with age ($\beta = 0.008$, $p = 0.027$) and percentage of males in the sample ($\beta = 0.333$, $p = 0.034$). No significant association was found for measures of well-being (k = 6, $r = -0.051$, 95%CI [−0.194–0.0947], $p = 0.411$, $I^2 = 89\%$).

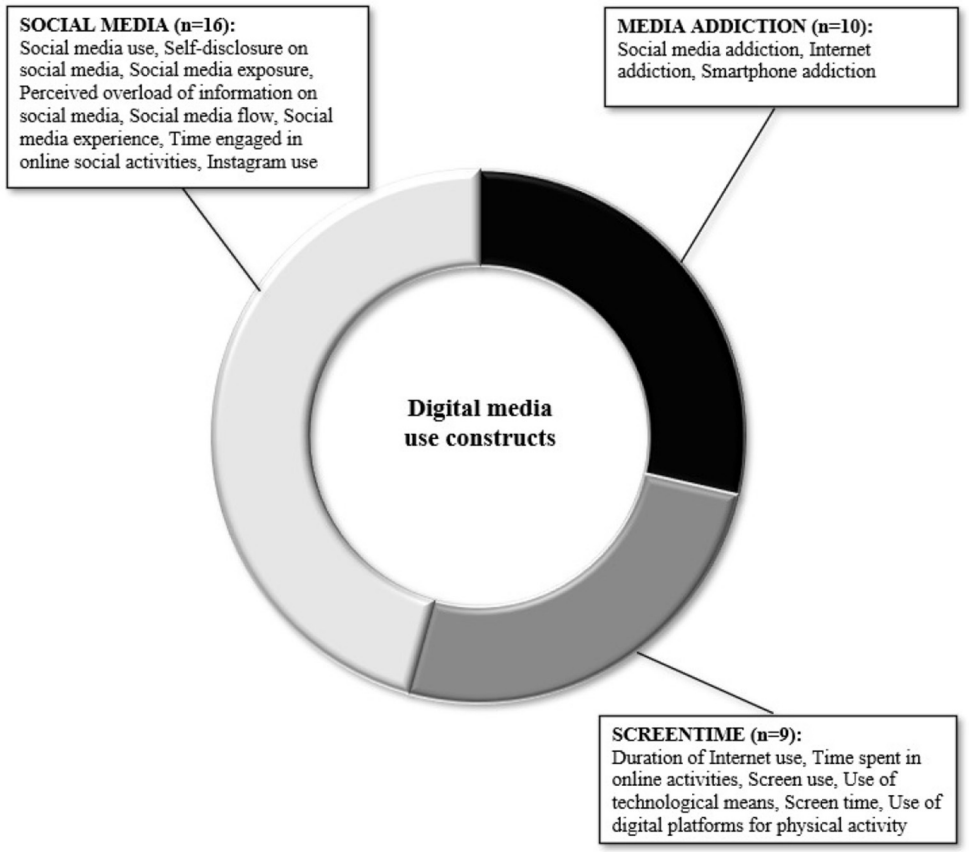


FIGURE 3 | Graphic representation of digital media use investigated constructs.

Looking at single studies examining ill-being, social media use was associated with higher levels of depression, anxiety, mental health problems in general, and lower self-esteem, especially among girls (38). Furthermore, girls reported having had negative online experiences more often (55). One study found that exposure to Covid-19 information likely increased levels of anxiety and depression, especially when participants had already reported psychopathological symptoms before the pandemic (50). Also, adolescents who - under normal circumstances - did not use social media so often reported a steeper increment in mental problems: Indeed, a three-fold increase in distress was reported in young people who augmented social media time up to 3 hours more than before the pandemic (56). Symptoms were also exacerbated through the mediating role of rumination - which refers to the persistent act of thinking about something bad, hurtful, or uncertain for an extended period (67). That was probably due to the greater exposure to Covid-19 related information online, although mindfulness skills buffered this adverse effect (49). A lack of cognitive control over the time spent on social media platforms likely exacerbated psychopathological symptoms and augmented a sense of isolation from social reality, fueling an obsessive cycle of social media usage patterns (59). Conversely, anxious participants reported using social media more often as a strategy to adapt to the current emergency and – to a lower extent – as a way to keep in touch with family and friends (60). Interestingly, individuals who reported more frequent experiences of Fear of Missing Out (FoMO) tended to use social media more frequently to seek and share information, thus fueling a vicious cycle and leading to an even higher engagement with these platforms (64). The higher engagement in social media content was carried out also if the information received were perceived as overwhelming (42). Furthermore, the use of Instagram and, in particular, following appearance-focused accounts was related to higher body dissatisfaction, drive for thinness and lower self-esteem in female adolescents. However, the effect sizes were small (47).

To note, conflicting results were found when social media use was considered in relation to social well-being ($k = 5$, $r = -0.002$, 95%CI [−0.181–0.176], $p = 0.972$, $I^2 = 94\%$), since studies reported both positive and negative associations. In particular, although depressive symptoms augmented – social media use mitigated the feeling of loneliness (40). However, the way through which this positive effect acted is complex. For example, disclosing oneself to a small group of people, i.e. reciprocal online friendship, was found to relieve stress more than one-to-many online communication (45). Similarly,

a study found that messaging and the use of VoIP apps (e.g., Skype, Viber, WhatsApp) were associated with lower levels of loneliness. In contrast, general social media use increased feelings of loneliness via the mediating role of FoMO (36). A study of thirteen-year-old participants found that positive online experiences (e.g., feeling valued, receiving advice) decreased loneliness, whereas negative experiences (e.g., being cut-off and mistreated) augmented it (55). At the same time, one study showed that lonely participants were more inclined to use social media as a coping tool, but social media did not influence their happiness feelings (60). However, in the same study, humorous coping - e.g., watching or sharing funny videos - was positively related to feelings of happiness, although it was not influenced by loneliness or anxiety. These results underlined the positive associations between social media use and mental health in a developmental period during which connecting with peers is crucial for social well-being and showed that the *quality* and the *quantity* of social connections play a pivotal role.

Social media use was positively associated with Covid-19 related stress (k = 6, $r = 0.253$, 95%CI [0.049–0.437], $p = 0.025$, $I^2 = 93\%$). In particular, Covid-19 information shared through social platforms have been perceived as excessively complex and overwhelming, thus augmenting both social media fatigue and fear of Covid-19 (42), with the risk to further bias information-processing capacities for the assessment of Covid-19 information. Conversely, young people reporting more Covid-19-related stress fostered active use of social media as a coping tool [e.g., (40, 43)].

Lifestyle behaviors closely linked to mental health were also associated with time spent on social media. More precisely, higher levels of social media use were associated with lower levels of physical activity, more frequent sleep problems, as well as higher levels of substance use. In the meta-analysis, including two studies (40, 41), a non-significant relationship between lifestyle behaviors and social media use during the pandemic was found.

Screen Time and Mental Health During Covid-19

Screen time included any screen-based media use except for video gaming and social media use (excluded, unless studied alongside other screen-based activities). The majority of the included studies looking at screen time found that it augmented during the pandemic, especially for online leisure activities, watching television, news consumption, and overall Internet usage through smartphones, computers, and tablets (37, 46, 50, 51, 54, 62, 65). In one study, participants reported spending up to 11 h and more per day in front of screens (65). Also, young people living in urban areas reported an additional increase in their time spent in front of screens compared to those living in the countryside (51).

Two studies reported comparable effect sizes for screen time and well-being, the latter measured as general well-being and happiness (41, 54). The meta-analytic results revealed a negative yet marginally significant pooled correlation (k = 2, $r = -0.196$, 95%CI [−0.429–0.061], $p = 0.065$). The same studies also reported comparable effect sizes on screen time and ill-being. However, meta-analytic results were not significant.

Looking at the individual studies, the frequency and duration of recreational screen media use, as well as nighttime use, augmented, and this increment was related to increased psychopathology (46). Particularly, leisure screen time was negatively associated with mood problems, even after considering covariates such as physical activity and body mass index (57). In addition, young people showed less increment in Internet-related activities and lower psychological distress when involved in structured activities (37) or spent more time reading, studying or exercising (62).

Screen time that was not used for social interactions was negatively related to social well-being (k = 2, $r = -0.115$, 95%CI [−0.178–−0.051], $p = 0.028$). Meta-analytic results linking screen time and lifestyle behaviors were not significant. However, increased sitting and screen time was followed by a precipitous decline in physical activity, which led to lower mood levels (57). To note, the increment in screen and sedentary time was reported irrespectively of the initial time dedicated to both activities (51). Participants with previous mental health problems were also at higher risk of an unhealthy lifestyle, including lower levels of physical activity, higher levels of screen time, and poorer sleep quality (41). On the contrary, when adolescents used digital platforms promoting physical activities, they were more likely to meet the recommended movement guidelines (53). Also, lower television and mobile phone use levels were related to greater adherence to a Mediterranean diet, which was, in turn, related to less perceived adversity and more happiness and quality of life during the lockdown (54).

Finally, although a meta-analysis was not possible due to the paucity of studies, participants reported that increased screen time, including news consumption, helped them stay up-to-date and cope with Covid-19 uncertainty, although news consumption also augmented fear of infection (37).

Media Addiction and Mental Health During Covid-19

Across the studies included in this review, prevalence rates of media addiction ranged from about 20 to 70% (44, 48, 52, 63, 65). Two studies revealed that media addiction levels grew during the pandemic (46, 48). A study found that media addiction was more prevalent among youth who had difficulties organizing their daily schedules (59).

During the Covid-19 pandemic, media addiction showed a medium-to-large positive relation to ill-being (k = 6, $r = 0.434$. 95% CI [0.092–0.685], $p = 0.024$, $I^2 = 98\%$, **Figure 5**) including internalizing and externalizing problems [e.g., (65)]. Looking at the different types of addiction, Fung et al. (63) found a positive association between social media addiction and ill-being, likely caused by rumors and alarming news on Covid-19 circulating on social media platforms. Nevertheless, the same authors reported a decrease in the strength of the association between depression and anxiety with smartphone addiction over time, possibly due to the recently designed mental health apps (63). Also, according to Siste et al. (65),

TABLE 4 | Summary of the included studies.

ID	Author and Year	Title	Country	Study design	Duration	Data collection	N	Sampling	Males	Age	Theory
1	Arend et al. (37)	Increased screen use on days with increased perceived COVID-19-related confinements - a day level ecological momentary assessment study	Germany, Austria	L	14 days	online	102	R	18.6%	25.5	–
2	Ellis et al. (40)	Physically isolated but socially connected: psychological adjustment and stress among adolescents during the intial COVID-19 crisis	Canada	C		online	1,054	C	21.9%	16.68	–
3	Li et al. (41)	The impact of COVID-19 on the loves and mental health of Australian adolescents	Australia	C		online	760	C	19%	14.8	–
4	Liu et al. (42)	COVID-19 information overload and generation Z's social media discontinuance intention during the pandemic lockdown	United Kingdom	C		online	322	C	38.80%	18-25	Stimulus-organism-response (S-O-R) model
5	Zhao et al. (43)	COVID-19 stress and addictive social media use (SMU): mediating role of active use and social median flow	China	C		online	512	C	37.5%	22.12	Addictive social media use, Theory of basic psychological needs
6	Arslan et al. (44)	Coronavirus Anxiety and Psychological Asjustment in College Students: Exploring the Role of College Belongingness and Social media Addiction	Turkey	C		online	315	C	23%	21.65	–
7	Zhen et al. (45)	College students coping with COVID-19: stress-buffering effects of self-discolsure on social media and parental support	United States	C		online	215	C	21%	20.5	Stressful life events, Social penetration theory
8	Dong et al. (46)	Internet Addiction and Related Psychological Factors Among Children and Adolescents in China During the Coronavirus Disease 2019 (COVID-19) Epidemic	China	C		online	2,050	C	52%	12.34	–
9	Vall-Roqué et al. (47)	The impact of COVID-19 lockdown on social network sites use, body image disturbance and self-esteem among adolescent and young women	Spain	C		online	1,620	C	0%	14-24	–

(Continued)

TABLE 4 | Continued

ID	Author and Year	Title	Country	Study design	Duration	Data collection	N	Sampling	Males	Age	Theory
10	Sheoran et al. (48)	Prevalence of psychological distress among adolescents in relation to internet addiction during COVID-19 times	India	C		online	300	C	50%	15.57	–
11	Hong et al. (49)	Social media exposure and college students' mental health during the outbreak of covid-19: the emdiating role of rumination and the moderating role of mindfulness	China	C		online	439	C	58.10%	20.37	Health belief model, Integrated model of ruminative response style, Diathesis-stress model
12	Magson et al. (38)	Risk and protective factors for prospective changes in adoelscent mental health during the COVID-19 pandemic	Australia	L	12 months	online	248	C	50%	14.4	–
13	Li et al. (50)	Mental health among college students during the COVID-19 pandemic in China: a 2-wave longitudinal survey	China	L	2.5 months	online	T1: 164 101; T2: 68 658	C	37.40%	college year (freshman, sophomore, junior, senior, and graduate)	–
14	Chambonn -iere et al. (51)	Effect of the covid-19 lockdown on physical activity and sedentary behvaiors in french children and adolescents: new results from the ONAPS national survey	France	C		online	6,491	C	38.80%	6-17	–
15	Islam et al. (52)	Problematic internet use among yound and adult population in Bangladesh: Correlates with lifestyle and online activities during the COVID-19 pandemic	Bangladesh	C		online	13,525	C	61.30%	23.7	–
16	Parker et al. (53)	The use of digital platforms for adult's and adolescents' physical activity during the COVID-19 pandemic (our life at home): survey study	Australia	C		online	963	R	28.90%	16.2	–
17	Dragun et al. (54)	Have lifestyle habits and psychilogical well-being changed among adolescents and medical students due to COVID-19 lockdown in Croatia?	Croatia	C		offline/online	T1: 1326; T2: 531	C	40%	18	–
18	Fumagalli et al. (36)	Centennials, FOMO, and loneliness: an investigation of the impact of social networking and messaging/VoIP apps usage during the initial stage of the coronavirus pandemic	Italy, Argentina, United Kingdom	L	1 month	online	334	C	30.20%	21.5	Evolutionay theory of loneliness

(Continued)

TABLE 4 | Continued

ID	Author and Year	Title	Country	Study design	Duration	Data collection	N	Sampling	Males	Age	Theory
19	Magis-Weinberg et al. (55)	Positive and Negative Online Experiences and Loneliness in Peruvian Adolescents During the COVID-19 Lockdown	Latin America	L	3 months	online	735	C	38.80%	13.25	–
20	Rens et al. (56)	Mental distress and its contributing factors among young people during the first wave of COVID-19: a belgian survey study	Belgium	C		online	2,008	R	21.91%	22.27	–
21	Xiao et al. (57)	Physical activity, screen time and mood disturbance among chinese adolescents during COVID-19	China	C		online	1,680	C	51.30%	7-12	–
22	Nomura et al. (58)	Cross-sectional survey of depressive symptoms and suicide-related ideation at a japanese national unviersity during the COVID-19 stay-home order	Japan	C		online	2,449	C	58%	20	–
23	Hudimova et al. (59)	The impact of social media on young web user's psychological well-being during the COVID-19 pandemic progression	Ukraine	C		online	254	C	NA	16-21	–
24	Cauberghe et al. (60)	How adolescents use social media to cope with feelings of loneliness and anxiety during COVID-19 lockdown	Belgio	C		online	2,165	C	34.4%	15.51	Mood management theory
25	Pigaiani et al. (61)	Adolescent lifestyle behaviors, coping strategies and subjective wellbeing during the COVID-19 pandemic: an online student survey	Italy	C		online	306	C	72.90%	18.1	–
26	Islam et al. (52)	Problematic Smartphone and Social Media Use Among Bangladeshi College and University Students Amid COVID-19: The Role of Psychological Well-Being and Pandemic Related Factors	Bangladesh	C		Online	5,511	C	58.90%	21.2 (1.7)	–
27	Chen et al. (62)	Internet-Related Behaviors and Psychological Distress Among Schoolchildren During the COVID-19 School Hiatus	China	C		Online	2,026	C	50.10%	10.71 (1.07)	Interaction of Person- Affect-Cognition-Execution (I-PACE) model

(Continued)

TABLE 4 | Continued

ID	Author and Year	Title	Country	Study design	Duration	Data collection	N	Sampling	Males	Age	Theory
28	Fung et al. (63)	Problematic Use of Internet-Related Activities and Perceived Weight Stigma in Schoolchildren: A Longitudinal Study Across Different Epidemic Periods of COVID-19 in China	China	L	6 months	Online	T1: 550; T2: 543; T3: 489	C	51%	11.60 (.74)	Components model of addiction
29	Hayran et al. (64)	Well-Being and Fear of Missing Out (FOMO) on Digital Content in the Time of COVID-19: A Correlational Analysis among University Students	Europe	C		online	178	C	62	21.35 (1.82)	–
30	Siste et al. (65)	Implications of COVID-19 and Lockdown on Internet Addiction Among Adolescents: Data From a Developing Country	Indonesia	C		online	2,932	C	21,3%	17.38 (2.24)	–

Study design (C, correlational; L, longitudinal): Duration If longitudinal duration in months (between first and last wave); N, analytical sample size; Sampling (Type of sampling procedure) (R, random; C, convenient; other, specify); Age (Mean, Standard deviation or Range, if Longitudinal, M and SD at T1 are reported).

adolescents were more susceptible to Internet addiction than young adults during Covid-19. The authors explained these findings with the fact that adolescents' cognitive control system is still underdeveloped. On top of that, the pandemic has limited physical peer contacts essential for adolescents' growth and social connection, pushing adolescents to alternative, online means to stay in contact with peers and friends. Media addiction also deteriorated psychological adjustment via college belongingness: Students with higher levels of college belongingness reported better psychological adjustment. However, when social media addiction was high, it likely interfered with the sense of belonging to the school (44).

Concerning the association between media addiction and lifestyle behaviors, the former was related to irregular physical exercise or physical inactivity, lower engagement with studying, ignoring earning activities and household chores, poor or heavy sleep, and alcohol or cigarettes consumption (52, 66). Yet, the meta-analytic results based on the comparable effect sizes of the two studies were not significant.

Longitudinal Studies

Six studies included in this review used a longitudinal design (36–38, 50, 55, 63), thus providing insights into the causal mechanisms between (addictive) media use and mental health. In particular, using Ecological Momentary Assessments (EMAs) for 14 days, Arend et al. (37) found that more than 40% of participants augmented daily time spent watching TV and using social media. Participants who reported frequent experiences of structured daily activities also engaged in less intense sessions of screen-based activities, like video gaming, Internet surfing, and television watching. Fumagalli et al. (36) obtained screen-time usage data for a 4-week period from diverse countries. They found that only social media use augmented at the beginning of the lockdown in spring 2020. Furthermore, higher levels of social media use predicted higher levels of loneliness through the mediating role of FoMO. On the contrary, messaging and VoIP apps usage reduced loneliness and was not influenced by individuals' FoMO levels. Also, VoIP apps consumption varied greatly among countries, but time spent using these apps was still lower with respect to time spent using social media apps. Magis-Weinberg et al. (55) studied levels of loneliness and reported that they remained unchanged between weeks 6 and 11 of the lockdown in Spring 2020 in Perù. Yet, loneliness was consistently more prevalent among females. Social media use, including positive experiences, such as feeling valued and receiving advice, predicted lower levels of loneliness over three months, whereas negative experiences on social media as well as overall screen time predicted the opposite. Furthermore, one study (38) reported an increment in depressive and anxiety symptoms and a decrease in life satisfaction from the pre-pandemic to the intra-pandemic period. However, exposure to Covid-19 information on social media did not significantly affect these changes in mental health. Fung et al. (63) collected data from 11-years-old participants during the pre-, ongoing-, and post- Covid-19 lockdown, finding that the positive association between smartphone addiction and ill-being decreased across the three waves. The opposite happened for social media addiction, for which the association with depression and anxiety increased across the three waves. Finally, the study by Li et al. (50),

TABLE 5 | Digital media and well-being constructs investigated.

ID	Author and Year	Media	Media construct	Measures	Reliability	Media in the model	Mental health	Mental health construct	Measures	Reliability	Mental health in the model
1	Arend et al. (37)	SCREEN	Screen time	Watching TV, Social media use, News consumption, Video games, Internet use	5 items	O	COVID/ LIFESTYLE	1) Feeling restricted due to the pandemic; 2) Perception of having a structured day	1) Socially and in the work environment; 2) Very/lowly structured day	Nr	P, MOD
2	Ellis et al. (40)	SOCIAL	Social media use	How many hours per day you spent on social media 6 months before and during the pandemic	2 items	P	COVID, LIFESTYLE, ILLBEING, SOCIAL	1) COVID-19 stress; 2) Time in daily activities; 3) Depression; 4) Loneliness; 5) Physical activity	1) Fear of the spread of the Covid, Swine Flu Anxiety scale; 2) How have your days gone in the last 3 weeks since the pandemic, how much time spent in the single activities; 3) Brief Symptom Inventory; 4) UCLA Loneliness Scale; 5) Godin Leisure-time Exercise Questionnaire	1) 8 items, Swine Flu Anxiety Scale: Cronbach's alpha = 0.60; 2) Nr; 3) 6 items, Cronbach's alpha = 0.88; 4) 8 items, Cronbach's alpha = 0.81; 5) Si	O
3	Li et al. (41)	SCREEN	Use of technological means	Screen time (not including time for online teaching), How much time used for exchanges with friends and family, How technology use has changed since the pandemic	3 items	P	COVID, LIFESTYLE, WELLBEING, ILLBEING	1) Covid exposure, perceived risk, and changes in behavior; 2) Impact of Covid on physical and mental well-being, school/education, and relationships; 3) Lifestyle; 4) Mental well-being and well being	1) Covid exposure, perceived risk, changes in behavior (social distance, hygiene,.); 2) Physical and mental well-being, school and education, relationships with others, family functioning; 3) Exercise, insomnia severity index, UCLA Loneliness Scale, uncertainty about the future; 4) Kessler-6, seven-item Warwick Edinburgh Mental Well-being Scale, Body Preoccupation Scale of the Illness Attitude Scales	1) 9 items; 2) 2 items for family functioning, 3) 7 items for sleep, Si for loneliness, Si for uncertainty about the future; 4) Nr, K6, 7 items SWEMWS, 3 items BPSIAS	O

(Continued)

TABLE 5 | Continued

ID	Author and Year	Media	Media construct	Measures	Reliability	Media in the model	Mental health	Mental health construct	Measures	Reliability	Mental health in the model
4	Liu et al. (42)	SOCIAL	1) Perceived COVID-19 information overload on social media as environmental stimulus; 2) Social media fatigue; 3) Social media discontinuance intention	Ad hoc items	1) 3 items, Cronbach's alpha =0.834; 2) 3 items, Cronbach's alpha =0.871; 3) 4 items, Cronbach's alpha =0.813	P, MED	COVID, SOCIAL	1) Fear of missing out; 2) Fear of Covid-19	Items used by another study	1) 3 items, Cronbach's alpha =0.884; 2) 4 items, Cronbach's alpha =0.904	O, MOD, MED
5	Zhao et al. (43)	ADDICTION, SOCIAL	1) Addiction to social media use; 2) Active social media use; 3) Social media flow; 4) Hours of social media use	1) Brief version of Bergen Facebook Addiction Scale; 2) 4 items adapted from the assessment tool developed by Brailovskaia and Margraf; 3) Modified version of "Facebook flow" developed by Brailovskaia et al.; 4) Method of Lin et al.	1) 6 items, Cronbach's alpha = 0.84; 2) 4 items, Cronbach's alpha = 0.78; 3) 11 items, Cronbach's alpha = 0.82, 4) 1 item	O, MED	COVID	Covid-19 stress	SARS-related stress by Main et al.	10 items	P
6	Arslan et al. (44)	ADDICTION	Social media addiction	Bergen Social Media Addiction Scale	6 items	MED	COVID, SOCIAL, ILLBEING	1) Coronavirus anxiety; 2) College belongingness; 3) Psychological Adjustment	1) Coronavirus Anxiety Scale; 2) College Belongningness Questionnaire; 3) Brief Adjustment Scale-6	1) 5 item; 2) 10 item; 3) 6 item	O, MED, P
7	Zhen et al. (45)	SOCIAL	1) Peripheral disclosure on social media; 2) Core disclosure on social media	1) Degree to which participant willing to share general information on social media; 2) Degree to which participant willing to share private information and with whom on social media	1) 5 items, Cronbach's alpha = 0.71; 2) 2 items, Cronbach's alpha = 0.82	P	COVID, SOCIAL, LIFESTYLE	1) Disruption of daily life due to the pandemic; 2) Self-revelation; 3) Support from parents; 4) Perceived stress due to Covid	1) 7-point Likert scale; 2) 7 items from Osatuyi et al. 2018; 3) shortened version of MOS Social Support Survey; 4) Perceived Stress Scale	1) 5 items, Cronbach's alpha = 0.71; 2) 34 items; 3) 10 items, Cronbach's alpha = 0.94; 4) 10 items, Cronbach's alpha = 0.88	O

(Continued)

TABLE 5 | Continued

ID	Author and Year	Media	Media construct	Measures	Reliability	Media in the model	Mental health	Mental health construct	Measures	Reliability	Mental health in the model
8	Dong et al. (46)	SCREEN, ADDICTION	1) Screen time; 2) Internet use; 3) Internet addiction	1) Primary electronic devices used; 2) recreational use, nightime use; 3) Chinese version of Young's Internet Addiction Test (IAT)	1) Multi item; 2) 20 items, Cronbach's alpha > 0.82	P	ILLBEING	1) Depression, Anxiety, Stress	Chinese version of Depression, Anxiety, and Stress Scale (DASS-21)	21 items	O
9	Vall-Roqué et al. (47)	SOCIAL	Social media use	Frequency of instagram, youtube, tiktok, twitter, and facebook usage before and during the lockdown, What profiles the participant follows on instagram before and during the lockdown	4 items	P	ILLBEING, WELLBEING	1) Eating disorder and drive for thinness; 2) Self-esteem	1) The drive for thinnes and body dissatisfaction subscales of the Eating Disorders Inventory, latter subscale; 2) Rosenberg Self-esteem Scale	1) 7 items, 10 items, drive for thinness Cronbach's alpha = 0.92 e body dissatifscation Cronbach's alpha = 0.90; 2) 10 item, Cronbach's alpha = 0.85	O
10	Sheoran et al. (48)	ADDICTION	Internet addiction	Internet addiction test	20 items, Cronbach's alpha between 0.54 and 0.82	O, P	ILLBEING	Psychological distress	Psychological distress subscale of mental health inventory	38 items, Cronbach's alpha = 0.94	O, P
11	Hong et al. (49)	SOCIAL	Social media exposure	How much participants are exposed to information regarding covid on the 6 most used social media in China	6 items, Cronbach's alpha =0.67	P	WELLBEING, ILLBEING	1) Mindfulness; 2) Rumination; 3) Psychological distress	1) Chinese version of the Child and Adolescent Mindfulness Measure; 2) event- related rumination inventory; 3) Kessler Psychological Distress Scale	1) 10 items, Cronbach's alpha # =0.90; 2) 10 items, Cronbach's alpha =0.93; 3) 10 items, Cronbach's alpha =0.94	O, ME

(Continued)

TABLE 5 | Continued

ID	Author and Year	Media	Media construct	Measures	Reliability	Media in the model	Mental health	Mental health construct	Measures	Reliability	Mental health in the model
12	Magson et al. (38)	SOCIAL	Social media exposure	Social media exposure	2 items	P, MO	ILLBEING, COVID, SOCIAL	1) General anxiety; 2) Depressive symptoms; 3) Life satisfaction; 4) Covid-19 related distress; 5) Disruption to schooling; 6) Interpersonal conflict; 7) Media exposure; 8) Social connectedness; 9) Adherence to Covid-19 Australian government stay-at-home directive	1) Generalized anxiety subscale of the Spence Children's Anxiety Scale; 2) Short Mood and Feelings Questionnaire-child version; 3) Student's Life Satisfaction Scale; 4) How much perceived stress due to Covid; 5) Perception of homeschooling and distance learning; 6) Conflicts with parents and siblings; 7) Social Connectedness Scale; 8) How often left home	1) Cronbach's alpha = T1- 0.86, T2- 0.87; 2) 13 items, Cronbach's alpha = T1- 0.91,T2- 0.93, 3) 9 items; Cronbach's alpha = T1- 0.91, T2- 0.92, 4) 18 items; Cronbach's alpha = T2- 0.91; 5) Nr; 6) Cronbach's alpha = 0.91; 7) 1 item	O
13	Li et al. (50)	SOCIAL	Social media exposure	Hours exposed to info regarding covid the previous week on social media	3 items	P	ILLBEING, COVID, SOCIAL, LIFESTYLE	1) Health behavior; 2) Mental health problems; 3) Exposure to Covid-19 epidemic and related factors; 4) Psychosocial factors	1) Lifetime cigarette smoking, alcohol use and daily physical activity; 2) Impact of Event Scale-6, Patient Health Questionnaire, Chinese version of the Generalized Anxiety Disorder Scale; 3) Whether participants became sick with Covid or were suspected sick in their vicinity, severity of the pandemic in their region, exposure to social media; 4) Scale of Perceived Social Support, role of family	1) Nr, 2) Acute stress symptoms: 6 items, Cronbach's alpha = 0.80 and 0.82, Depressive symptoms: Cronbach's alpha =0.88 and 0.91, Anxiety symptoms: 7 items, Cronbach's alpha = 0.92 and 0.93	O
14	Chambonniere et al. (51)	SCREEN	Screen time	Media hours spent before and during the lockdown	Nr	O,P	LIFESTYLE	1) Physical activity; 2) Sedentary hours	1) Hours of physical activity before and during lockdown; 2) Sedentary activities before and during the lockdown, what they did before the lockdown	Nr	O,P

(Continued)

TABLE 5 | Continued

ID	Author and Year	Media	Media construct	Measures	Reliability	Media in the model	Mental health	Mental health construct	Measures	Reliability	Mental health in the model
15	Islam et al. (52)	ADDICTION, SCREEN	1) Duration of internet use; 2) Problematic internet use	1) Average hours spent on the internet; 2) What participants did on the internet, IDS9-SF	9 items, Cronbach's alpha: 0.85	O	LIFESTYLE	Lifestyle-related behaviors	Smoking status, Sleeping hours, Physical exercise, Doing household chores	4 items	P
16	Parker et al. (53)	SCREEN	Use of digital platforms for physical activity	Frequency and duration of use of digital physical activity platforms, What type of online platform	Nr	P	LIFESTYLE	Compliance with recommendations regarding physical activity	How many days per week in the past month, for 30/60 min, whether at home or in the gym before the pandemic	Nr	O
17	Dragun et al. (54)	SCREEN	Screen time	Computer/tablet/cell phone/TV hours usage per day	3 items	P	LIFESTYLE, WELLBEING, ILLBEING	1) Dietary habits; 2) Sleeping habits; 3) Sedentary activity; 4) Psychological well-being; 5) Lifestyle habits	1) Mediterranean diet adherence, consumption of sweet drinks and processed meat/fish, frequency of breakfast consumption, snacking habits while studying/TV; 2) Wake up time and when you go to bed, how you feel after waking up; 3) Sedentary activities and frequency of physical activity; 4) Perceived Stress Scale, happiness, anxiety and optimism about the future; 5) Consumption of fruits and vegetables, body weight,...	1) 3 items; 2) 4 items; 3) Si; 4) 6 items; 5) 7 items	O
18	Fumagalli et al. (36)	SOCIAL	1) Screen time; 2) Social media use	Trace data of total time spent on the smartphone, time using apps of various categories, time spent on a single installed application, set a limit for a certain app or not	Nr	P	SOCIAL	1) FOMO; 2) Loneliness; 3) Personality characteristics	1) 3-item measure; 2) UCLA Loneliness Scale; 3) 7-point scale	1) 3 items, Cronbach's alpha =0.39; 2) 8 items, Cronbach's alpha = 0.82; 3) 10 items	O

(Continued)

TABLE 5 | Continued

ID	Author and Year	Media	Media construct	Measures	Reliability	Media in the model	Mental health	Mental health construct	Measures	Reliability	Mental health in the model
19	Magis-Weinberg et al. (55)	SOCIAL, SCREEN	1) Social media experience; 2) Screen time	1) Online social experience measure; 2) Hours spent from 0 to 8 with video games, watching TV, pc or cell phone	1) 11 items, Cronbach's alpha pos = 0.85, Cronbach's alpha =0.79; 2) 1 item	P	SOCIAL	1) Loneliness; 2) Perceived family support	1) UCLA Loneliness Scale; 2) Multidimensional Scale of Perceived Social Support	1) Cronbach's alpha =0.79; 2) 12 items, Cronbach's alpha = 0.88,0.90,0.86,0.90	O
20	Rens et al. (56)	SOCIAL	Social media use	Daily social media usage in hours	2 items	P	SOCIAL, COVID, LIFESTYLE	1) Mental distress; 2) Social support; 3) Exposure to Covid-19; 4) Home activities; 5) Change in everyday life; 6) Experiencing loneliness	1) General Health Questionnaire; 2) Oslo Social Support Scale, 3) Have/had Covid, has/had a relative with Covid; 4) Change in time spent at home before and during the pandemic; 5) Visiting friends and relatives, going out to drink and eat, physical activity, hobbies and activities at home; 6) UCLA 3-item Loneliness Scale	1) 12 items; 2) 3 items; 3) Si; 4) Nr; 5) 5 items; 6) 3 items	O
21	Xiao et al. (57)	SCREEN	Screen time	Hours spent online for school and other reasons	2 items	P	SOCIAL, ILLBEING, LIFESTYLE	1) Mood state; 2) Physical activity; 3) Conflicts with parents	1) Chinese version of the Mood Profile, Total Mood Disorder; 2) Questions about leisure exercise; 3) Number of conflicts with parents	1) Nr; 2) Nr; 3) Si	O
22	Nomura et al. (58)	SOCIAL	1) Social media use; 2) Social media disorder	Communication through text, audio and video on various social networks	Si	P	SOCIAL, LIFESTYLE, ILLBEING	1) Social support; 2) Exercise; 3) Depressive symptoms	1) Presence of someone to talk to about your concerns; 2) Measurement of the intensity of physical activity performed, how long in minutes,...; 3) Japanese version of PHQ-9	1) 2 items; 2) Si; 3) 9 items	O
23	Hudimova et al. (59)	SOCIAL, ADDICTION	Social media use	Social media disorder scale, Experience using social media, Time spent on social media per day, Social media disorder scale, Number of profiles	Cronbach's alpha = 0.82	P	WELLBEING, LIFESTYLE, ILL-BEING	Psychological well-being	Sleep changes, worry, tolerance, feeling connected during quarantine, avoidance behaviors, conflict, loneliness, Warwick-Edinburgh Mental Wellbeing Scale	Nr	O

(Continued)

TABLE 5 | Continued

ID	Author and Year	Media	Media construct	Measures	Reliability	Media in the model	Mental health	Mental health construct	Measures	Reliability	Mental health in the model
24	Cauberghe et al. (60)	SOCIAL	Social media use	Brief-coping scales, How social media used to manage crisis, Coping strategies to manage lack of social relationships and manage mood	14 items, Cronbach's alpha = 0.722, 0.765	MED	WELL-BEING, ILLBEING, SOCIAL	1) Happiness; 2) Anxiety; 3) Loneliness; 4) Happiness/depression	1) Three items of the Center for Epidemiological Studies Depression Scale; 2) General Anxiety Disorder Scale, 3) 6-item scale (RULS-6); 4) Feelings of sadness/happiness	1) 3 items; 2) 7 items, Cronbach's alpha = 0.868; 3) 6 items, Cronbach's alpha = 0.768; 4) 3 items, Cronbach's alpha =0.811	O, P
25	Pigaiani et al. (61)	SOCIAL	1) Video games; 2) Social media use	1) Playing video games; 2) Using social networks to stay in touch with family, acquiring new skills through social networks	Si	P	WELLBEING, LIFESTYLE	1) Subjective well-being; 2) Lifestyle and coping skills	1) Difficulty staying at home, impact of the pandemic experience on the person, changes in psychological well being, anxiety about the situation, sleep abstinence; 2) organization of the day, activities performed and how they have changed, relationship with family, distance learning	Nr	O
26	Islam et al. (52)	ADDICTION	1) Problematic social media use; 2) Problematic smartphone use	1) Bergen Social Media Addiction Scale (BSMAS); 2) Smartphone Application Based Addiction Scale (SABAS)	1) 6 items, Cronbach's alpha = 0.80; 2) 6 items, Cronbach's alpha =0.85	O	ILLBEING, LIFESTYLE	1) Depressive symptoms; 2) Anxiety symptoms; 3) Lifestyle Measures; 4) Home Quarantine Activities Measures during Covid-19	1) Patient Health Questionnaire (PHQ-9); 2) Generalized Anxiety Disorder (GAD-7); 3) Items measuring sleep, physical exercising, smoking cigarettes, and alcohol consumption; 4) Items on the engagement in frequent activities during the pandemic, including home quarantine regular/frequent activities (i.e., academic/other studies, social-media use, watching television, household chores, and professional activities).	1) 9 item, Cronbach's alpha =0.89; 2) 7 item, Cronbach's alpha =0.91; 3) Nr; 4) Nr	O

(Continued)

TABLE 5 | Continued

ID	Author and Year	Media	Media construct	Measures	Reliability	Media in the model	Mental health	Mental health construct	Measures	Reliability	Mental health in the model
27	Chen et al. (62)	ADDICTION, SCREEN	1) Social media addiction; 2) Smartphone addiction; 3) Gaming addiction; 4) Time spent in online activities	1) Bergen Social Media Addiction Scale (BSMAS); 2) Smartphone Application-Based Addiction Scale (SABAS); 3) Internet Gaming Disorder Scale-Short Form (IGDS-SF9); 4) Ad hoc questions	1) 6 items, Cronbach's alpha =0.875; 2) 6 items, Cronbach's alpha =0.882; 3) 9 items, Cronbach's alpha =0.922; 4) si	O, MED	ILLBEING	Psychological distress (symptoms of anxiety, depression, and stress)	Depression, Anxiety, Stress Scale-21 (DASS-21)	21 item, Cronbach's alpha =0.820, 0.778, 0.813	P
28	Fung et al. (63)	ADDICTION	1) Social media addiction; 2) Smartphone addiction	1) Bergen Social Media Addiction Scale (BSMAS); 2) Smartphone Application-Based Addiction Scale (SABAS)	1) 6 items, Cronbach's alpha =0.83, 0.88, 0.89; 2) 6 items, Cronbach's alpha =0.78, 0.90, 0.88	P	ILLBEING	Psychological distress (symptoms of anxiety, depression, and stress)	Depression, Anxiety, Stress Scale-21 (DASS-21)	21 items, Cronbach's alpha =0.93, 0.91, 0.93	O
29	Hayran et al. (64)	SOCIAL	1) Time they engaged in online social activities (such as virtual gatherings with family and friends, watching real-time Instagram concerts or interviews) since the beginning of the pandemic; 2) Whether the time they spent on social media increased during the pandemic	Ad-hoc scales	10 items, 2 items, 2 items, 4 items	P	ILLBEING	FOMO	State and trait FOMO	10 items, Cronbach's alpha =0.82	O
30	Siste et al. (65)	ADDICTION	1) Internet addiction	Internet Addiction Diagnostic Questionnaire	44 items, Cronbach's alpha =0.979	O	ILLBEING	1) Psychopatological problems; 2) Sleep problems	1) Strengths and Difficulties Questionnaire; 2) Pittsburgh Sleep Quality Index	1) 25 items, Cronbach's alpha =0.773; 2) 24 items, Cronbach's alpha =0.79	P

Media (SCREEN, screen time in general; ADDICTION, Internet, social media, smartphone addiction; SOCIAL, social media use); Reliability (number of items/inter-item correlation/Cronbach's alpha; nr, not reported; si, single item scale); Media and Mental health in the model (P, Predictor, Med, Mediator, Mod, Moderator, O, Outcome); Mental health (WELLBEING, in a positive sense such as self-esteem, life satisfaction; ILLBEING, anxiety, depression, other symptoms; COVID, stress related to Covid-19; SOCIAL, social well-being; LIFESTYLE, physical activity, food, sleep, etc.).

TABLE 6 | Description of results.

ID	Author and Year	Brief description of results
1	Arend et al. (37)	Results showed that participants reported increased screen use during leisure time, mostly social media and television watching, followed by news consumption, other internet usage, and gaming. Experienced work confinements were positively associated with social media usage. Further, work confinements were positively associated with gaming in males and with news consumption, especially in individuals living alone. Social confinements were positively associated with watching television especially in younger participants and with social media consumption in younger participants. Higher experienced day structure was related to less television watching, gaming, and internet surfing but more news consumption.
2	Ellis et al. (40)	Frequency of social media use increased during the pandemic and physical activity decreased. Social media use increased, with 48% of participants using social media for more than 5 hours. Although social media use is nearly universal among youth (95% of teens reported at least 30 min per day), results showed a substantial increase in the time spent using a variety of social media platforms (e.g., Instagram, Snapchat, TikTok,) during the initial call to stay at home. Shockingly, over 12% of adolescents reported using social media more than 10 hrs a day. Analyses showed virtual time with friends related to higher depression but lower loneliness, beyond reported COVID-19 stress.
3	Li et al. (41)	Most youth reported: worsening family stress, decreased/maintained physical activity, higher technology use. 93% say they have some level of worry about the future and 40.1% show clinical symptoms of illness anxiety. Participants with previously diagnosed anxiety or depression showed lower levels of physical activity, higher technology use, worse sleep quality, higher levels of loneliness and uncertainty, lower levels of psychological stress, lower levels of mental well-being, and anxiety about health. Use of technology to feel with other people is associated with better overall well-being and lower levels of loneliness.
4	Liu et al. (42)	The results indicate that the perceived COVID-19 information overload on social media increased social media fatigue and fear of COVID-19.The enormous amounts of complex information related to COVID-19 exceeded the information-processing capacity of the members of Gen Z and further hindered their ability to develop an unbiased assessment of COVID-19, which led to a higher level of fear of the coronavirus pandemic. Results suggest that fear of missing out acts as a moderator that weakens the associations between the inner psychological states of Gen Z social media users (i.e., social media fatigue and fear of COVID-19) and their social media discontinuance intention. Users who are high in FoMO tend to derive more benefits from social media use, particularly during the time of lockdown.
5	Zhao et al. (43)	The results showed that COVID-19 stress was positively associated with tendencies toward addictive SMU. Path analyses revealed that this relationship was significantly serially mediated by active use and social media flow, with SMU time being controlled. Our findings suggest that individuals who experience more COVID-19 stress are at increased risk of addictive SMU that may be fostered by active use and flow experience. Therefore, the significant indirect path from COVID-19 stress to addictive SMU via active use implies that excessive active use acts as a maladaptive coping strategy in the time of the COVID-19 crisis.
6	Arslan et al. (44)	Higher experience of coronavirus anxiety was associated with lower college belongingness and higher psychological adjustment problems. Adjustment via college belongingness only occurred when social media addiction was low and moderate. Unsurprisingly, the moderating effect of social media addiction did not occur when it was high. When they are highly engaged in social media, they may find an opportunity to meet their sense of belongingness with their peers in the virtual environment.
7	Zhen et al. (45)	The results demonstrated a complicated relationship between online self-disclosure and perceived stress. Specifically, we found a positive relationship between the levels of disclosing oneself to a small group of people and the levels of perceived stress. This positive relationship potentially indicates that college students are more likely to turn to their online friends through social media channels during stressful times. We also found that the willingness to disclose personal information to a selected group of people on social media moderates the negative impact of life disruptions such as schedule changes, moving, and selfisolating. However, the results did not show that peripheral selfdisclosure, such as updating SNS casually, helps relieve the stress.
8	Dong et al. (46)	In the present study, 2.68% and 33.37% of the participants were classified as addicted and possibly addicted to the Internet. The results also showed that IA grew with age. This study discovered that the frequency and duration of recreational electronic devices use, the frequency of electronic devices use after midnight, and the self-score of addiction to electronic products were all significantly higher than those before the epidemic in all the groups. Our data showed that a number of participants experienced significant depression, anxiety, and stress during the outbreak. In this particular period, due to the suspension of schools, the closure of living environments, the reduction of outdoor activities, and the increase of epidemic pressure, the mental health of school-age children and adolescents were threatened.
9	Vall-Roqué et al. (47)	The frequency of use of Instagram was positively associated with body dissatisfaction, drive for thinness and low self-esteem. However, effect sizes were very small, hence these results should be interpreted with caution. Following appearance-focused accounts on Instagram was found to be associated with drive for thinness in both age groups, and the effect size in this case was stronger, even though still small. Taking into consideration the lockdown's associated changes in SNS use stated above, these results might have significant implications, as they might indicate that the detrimental effects of SNS could have been exacerbated during the pandemic, and COVID-19 might be linked to increased drive for thinness and risk for eating disorder behaviors relative to media effects.
10	Sheoran et al. (48)	The total number of uncontrolled users of internet (moderately and severely addicted combined) constitute about two thirds (66.7%) of the sample population. There were, however, no significant gender differences in Internet Addiction among the male and female adolescents. In case of Psychological Distress, more than one third of the sample population (35.3%), was in moderate range and another 36.3 % population was found to be in the severe range. The female adolescents seem to be at a higher risk of Psychological Distress as compared to male adolescents though the differences with respect to gender are not statistically significant. The current study established significant positive correlation between Psychological Distress and Internet Addiction among adolescents.

(Continued)

TABLE 6 | Continued

ID	Author and Year	Brief description of results
11	Hong et al. (49)	EMS and covid info do not directly predict psychological distress. When college students read massive amounts of stressful news from various media platforms (e.g., WeChat), increased perceptions of COVID-19 as a severe health threat may lead to fear, anxiety, and depression. Thus, college students who are frequently exposed to COVID-19 information on social media are likely to report increased levels of anxiety and depression. Second, SME was positively associated with rumination, which in turn was positively associated with psychological distress in these college students, supporting the integrated model of ruminative response style. During this pandemic, exposure to COVID-19 information serves as a stressor, which may activate cognitive processes and increase ruminative thoughts. Mindfulness significantly moderated the first stage of the mediating process in these college students. Specifically, SME was positively associated with rumination among students who reported low levels of mindfulness, whereas this association was not significant among students who reported high levels of mindfulness.
12	Magson et al. (38)	The pre-pandemic to intra-pandemic increase in depressive symptoms and anxiety, and decrease in life satisfaction. The finding that girls are experiencing greater declines in mental health than boys during the COVID-19 crisis. The present results also showed that feeling socially disconnected during the pandemic was associated with higher levels of anxiety and depressive symptoms and lower levels of life satisfaction.
13	Li et al. (50)	Acute stress levels decreased over time while levels of possible depression and anxiety significantly increased. During second survey fewer participants said they use social media often and worry about their family or that they might get sick. Probability of developing symptoms related to acute stress increased in students with higher levels of depression and anxiety during initial spread of covid, higher exposure to social media, and anxiety about getting sick from covid.
14	Chambonniere et al. (51)	68.9% of adolescents reported an increased screen time. A higher proportion of children and adolescents who complied with the recommendations before lockdown reported an increase in their screen time (65.0% and 78.7% respectively) compared to those who exceeded the 2h/day of screen time before the lockdown (respectively 47.8% and 64.8%). A higher proportion of adolescents who had a sitting time > 6h/day before the lockdown declared an increase of their screen time during lockdown (70.3%) compared to those who showed a sitting time < 6h/day before the lockdown (57.6%) ($p < 0.001$). All declared an increase in their screen time during the lock- down but the higher proportion of children and adolescents who lived in urban areas reported an increase in their time spent in front of screen (respectively 66.4% and 70.6%) compared 56.7% and 67.4% of those who lived in the countryside respectively. Higher proportions of children and adolescents who had not access to an outdoor before the lockdown admitted to increasing their screen time. A total of 64.2% of initially inactive adolescents before the lockdown reported an increase of their screen time during lockdown against 75.8% of the initially active participants ($p < 0.001$).
15	Islam et al. (52)	Problematic Internet use was significantly associated with being younger in age, having a bachelor degree level of education, being unmarried, being a member of a nuclear family, having middle-income socioeconomic status, living in an urban area, being a cigarette smoker, being a heavier sleeper, being physically inactive, not engaging in household chores, and having higher engagement with online activities (e.g., playing video games, social media use, and online recreational activities).
16	Parker et al. (53)	Among adolescents, just 7% met guidelines for moderate-to-vigorous physical activity (MVPA), which was slightly lower than the Australian average of 10% of 15- to 17-year-olds. Using platforms that promote physical activity determined that on average participants who used it added movement recommendations more often. 26.5% (255/963) of adolescents reported using digital platforms for physical activity. Adolescents'MVPA (OR 2.4, 95% CI 1.3-4.3), MSE (OR 3.1, 95% CI 2.1-4.4), and combined (OR 4.3, 95% CI 2.1-9.0) guideline adherence were also higher among users of digital platforms relative to nonusers.
17	Dragun et al. (54)	We found no substantial differences in dietary pattern between pre-lockdown and lockdown periods, including the overall Mediterranean diet (MD) adherence. MD adherence was positively correlated with QoL and study time, and negatively with TV and mobile phone use in pre-lockdown period (all $p < 0.001$). Interestingly, higher MD adherence was correlated with less perceived hardship and greater happiness and QoL during lockdown. The most prominent difference in sedentary activity corresponded to the time spent on computer/tablet. This kind of activity was reported to average three hours per day during COVID-19 lockdown, which is two hours more than before due to the online learning ($p < 0.001$). As many as 78.4% of secondary school students increased their computer time during lockdown period. subjective health rating was negatively correlated with daily sitting time, stress score, and anxiousness, while it showed a positive correlation with the MD adherence, sleep duration, quality of life, happiness and optimism during both study periods.
18	Fumagalli et al. (36)	Results showed that only social network usage increased in the initial stage of confinement as a function of lockdown initiation. Additionally, social network app usage was associated with increased feelings of loneliness, and this relation was mediated by fear of missing out (FOMO). In contrast, messaging app usage was associated with decreased feelings of loneliness, and was unrelated to FOMO. These results suggest that technology may be useful for mitigating the impact of loneliness during social isolation but that it is necessary to promote usage of messaging and VoIP apps, rather than social networking apps, because they are directly associated with decreases in loneliness without increasing FOMO.
19	Magis-Weinberg et al. (55)	Positive and negative online experiences were more frequent for older students, and females experienced more negative online experiences than males. Greater positive online experiences related to lower loneliness, with the reverse pattern for negative online experiences. Our results suggest that positive online experiences may mitigate loneliness during physical isolation. Lower loneliness was associated with lower negative experiences and also higher positive experiences.
20	Rens et al. (56)	The results indicate that about two thirds (65.49%) experienced mental distress. In the multivariable regression model, significant ($p < 0.01$) predictors of mental distress were female gender (OR = 1.78), low social support (OR = 2.17), loneliness (OR = 5.17), a small (OR = 1.63), or large (OR = 3.08) increase in social media use, a small (OR = 1.63) or large (OR = 2.17) decrease in going out for drinks or food, and a decrease in doing home activities (OR = 2.72).

(Continued)

TABLE 6 | Continued

ID	Author and Year	Brief description of results
21	Xiao et al. (57)	Physical activity, particularly of at least 150 minutes' duration each week, significantly decreased the likelihood of negative mood among adolescents during lockdown. Screen time, specifically other than that spent on online study, had a negative association with mood, after controlling for the relevant variables (i.e., physical activity and body mass index). Less screen time and accumulating 150 minutes of physical activity were associated with fewer conflicts with parents. An additional 1 hour of screen time that was not online study was associated with an increase of 1.6 to 1.8 points in participants' mood disturbance scores.
22	Nomura et al. (58)	Multivariable logistic regression analyses showed that risk factors for depression included being a woman, smoking, alcohol consumption, and social network communication using either video or voice. For suicide-related ideation, alcohol consumption was the only risk factor. Exercise and having someone to consult about worries were associated with decreased risk of both depressive symptoms and suicide-related ideation. Conclusions: Negative lifestyles of smoking and drinking, and being a woman, may be important risk factors for depressive symptoms, whereas exercise and having someone to consult about worries may be protective factors.
23	Hudimova et al. (59)	The study proves that young people spend almost all day online due to the obsessive pattern of social media involvement and/or procrastination, which often provokes withdrawal syndrome upon the attempt to distract from them. The lack of controlled time spending on social media during self-isolation provokes an exacerbation of anxiety, apathy, depressed mood, and a sense of isolation from social reality.
24	Cauberghe et al. (60)	Participants who were feeling lonely were more inclined to use social media to cope with lacking social contact. However, this coping strategy was not significantly related to their happiness feelings. Humorous coping was positively related with feelings of happiness, but not influenced by loneliness or anxiety. An analysis of the indirect effects showed that the effect of anxiety on happiness is positively mediated by social media (active) coping. A higher feeling of loneliness among the participants predicted social media use to keep in touch with peers and family, but it was not associated with happiness. Anxious participants indicated to use social media more often to actively seek for a manner to adapt to the current situation, and to a lesser extent as a way to keep in touch with friends and family. The indirect effect of anxiety on happiness through active coping was significantly positive
25	Pigaiani et al. (61)	When assessing the impact of adolescents' lifestyle behaviors and coping strategies on their psychological wellbeing, a number of variables predicted a significant change. "Active" and planning" adaptive coping strategies associated with a significant change in wellbeing included doing physical activity and engaging in different activities than before, including media use.
26	Islam et al. (52)	Problematic social media sue (PSMU) was positively associated with irregular physical exercise, poor engagement with academic studies, social media use, watching television, ignoring earning activities, anxiety, and depression. Similarly, PSMU was positively associated with lower age, poor sleep, alcohol consumption, social media use, anxiety, and depression. Moreover, according to the hierarchical regression analyses conducted, individuals with irregular physical activity were found to exhibit higher levels of PSPU than physically active individuals. The present study found that PSPU was significantly associated with poor study engagement. Moreover, the results of this study found that depression, and anxiety were positively associated with PSPU. In the hierarchical regression analysis conducted, reporting with less sleep (<7 h/day) were more prone to PSMU. Another important finding was that alcohol consumption and PSMU were positively associated.
27	Chen et al. (62)	In the present study, the problematic use of gaming, social media, and smartphones showed mediating effects in the associations between psychological distress (including depression, anxiety, and stress) and screen time use among Chinese primary schoolchildren during their school hiatus due to the COVID-19 outbreak. However, the fear of being infected by COVID-19 did not impact on any noticeable changes concerning increased time or problematic gaming, problematic social media use, and problematic smartphone use given the weak significant correlations with small effect sizes. In contrast, children who increased their time reading/studying or exercising showed less problematic use of Internet-related activities and less psychological distress during school hiatus.
28	Fung et al. (63)	We found that problematic smartphone use (PSU) was significantly higher during the COVID- 19 outbreak, However, there was no significant difference in PSMU across the three waves. we found positive associations between PSU/PSMU and psychological distress. However, their associations changed direction across the three waves. Specifically, the association between PSU and depression/anxiety decreased from before, during, to post-lockdown; however, association between PSMU and depression/anxiety increased from before, during, to post-lockdown. The diminished associations between PSU and depression/anxiety may be due to the recently designed mental health apps. Although we did not ask whether our participants used such apps, it could be possible that participants used apps to cope with their depression and anxiety. The exacerbated associations between PSMU and depression/anxiety may be due to the rumors and frightening news or information on COVID-19 in the social media.
29	Hayran et al. (64)	With two studies conducted at the beginning and towards the end of the pandemic, we tried to uncover the triggers and the accompanying well-being effects of university students' FOMO experiences resulting from this digital overuse. Our results reveal that during the pandemic, even when socially distancing at home, individuals continued to experience FOMO. During this time, there has been a major shift in the type and amount of digital information individuals consumed. Our findings show that FOMO has been commonly experienced due to the difficulty of catching up with real-time social media content, others' posts and videos, newly released movies and series on videostreaming platforms such asNetflix, and virtual gatheringswith family and friends. Especially individuals who are more prone to FOMO as a personality characteristic reported feeling it more intensely about digital content. We find that like a vicious cycle, higher involvement in virtual activities feeds into experiencing higher levels of FOMO, which then leads to increased engagement with social media.
30	Siste et al. (65)	This study observed a point prevalence of 19.3% for suspected Internet addiction among Indonesian adolescents during the COVID-19 outbreak. Our findings showed that internalization and externalization problems were correlated to higher KDAI scores. This finding corresponded with other studies about this issue on adolescents

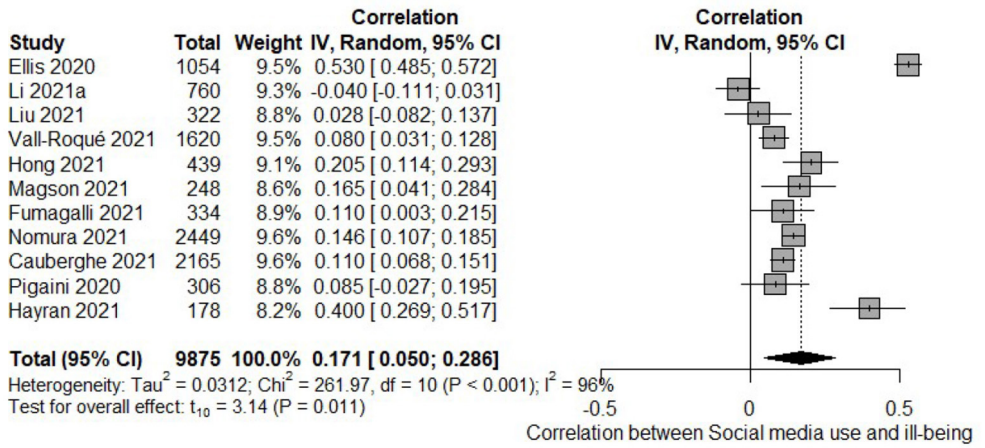


FIGURE 4 | Forest plot of the meta-analysis of social media use and ill-being.

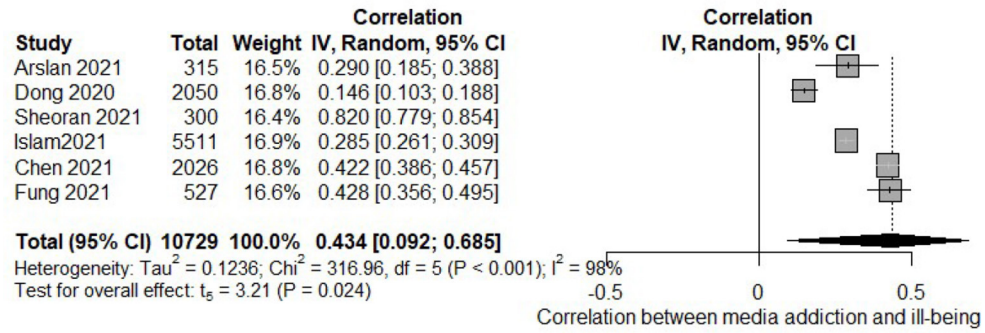


FIGURE 5 | Forest plot of the meta-analysis of media addiction and ill-being.

including 1,64,101 Chinese college students at the onset of the Covid-19 in February 2020 and 68,685 participants at the follow-up assessment - about 2.5 months later - highlighted that acute stress diminished. However, depressive and anxiety symptoms augmented, and social media exposure was a risk factor, especially when participants spent more than 3 h per day with these platforms.

DISCUSSION

During the Covid-19 pandemic, especially during the lockdown, social distancing measures and the associated disruption of everyday activities and social contacts threatened the mental health of adolescents (6, 68). To alleviate the negative experiences of social distancing measures, young people spent more time online. Lockdown and distancing measures began not long ago, but researchers have studied whether and how the time spent in front of screens affected mental health. However, a comprehensive synthesis of the literature published so far was still missing. Based on a systematic search and screening process, the present review qualitatively and quantitively summarized the existing evidence on the association between (addictive) screen media use and mental health in adolescents during the Covid-19 pandemic.

The key message of the present review is that *not all uses of digital media had negative consequences* on adolescents' mental health during the pandemic. In particular, our results suggested that social media use was helpful in mitigating the feeling of loneliness during Covid-19, but only when a one-to-one or one-to-few communication (e.g., use of VoIP apps), rather than a general social media use, was promoted. Likewise, online disclosure in the context of reciprocal friendship was found to relieve stress rather than a one-to-all peripheral disclosure on social media. In addition, good online experiences like receiving positive feedback augmented social connection and reduced loneliness during the lockdown, and using social media as a humorous coping tool (i.e., using humor to cope with the pandemic) increased happiness. These findings align with the Theory of Compensatory Internet Use, according to which "negative life situations can give rise to a motivation to go online to alleviate negative feelings" [(69), p. 352], although time online can have both positive and negative outcomes. In the present

review, positive outcomes included better self-reported (social) well-being and less ill-being in terms of loneliness and stress.

Although some studies underlined the positive side of social media use, the majority reported that digital media use was associated with diminished well-being. Firstly, detrimental effects of social media may derive from the overload of Covid-19-related information, which was frequently negatively valenced and included much misinformation augmenting feelings of worry, fear of the pandemic, and FoMO, thus diminishing well-being [e.g., (42)]. It is likely that, when dealing with high levels of stress and uncertainty, online communication and posts' sharing among adolescents fostered rumination on negative feelings and involuntarily intensified these concerns. Not surprisingly, older participants, who better understood the pandemic's severity, were more affected by the negative consequences of social media contents' exposure.

Secondly, young people used social media as a coping tool to disconnect from negativity, avoid boredom, displace time for homework, get entertained and follow social media content without getting directly involved. However, as reported by previous literature reviews, passive and compensatory social media use led to increased ill-being (59), including feelings of depression, anxiety, loneliness, and low self-esteem due to social comparison as well as body-related concerns (47). The latter result is in line with a general risk of increased eating disorders during the pandemic (70). Although many of the studies included in this review used a correlational design, the results indicated a detrimental effect of social media use during the Covid-19 pandemic, especially in adolescents who were less involved in online activities and those who already experienced mental health problems before the pandemic.

While mechanisms such as social comparison, FoMO or exposure to negative Covid-19-related information are one possible explanation for the detrimental effect of social media, another mechanism is that social media, and screen time in general, replaced lifestyle activities promoting mental health. For example, more time in front of screens was associated with sleep problems, leading to even more screen time during night hours and determining irritability and anxiety. Likewise, physical activity was reduced, and a more sedentary lifestyle was adopted, including a poorer diet and greater use of substances like alcohol and cigarettes, which were subsequently associated with more screen time [e.g. (54)] and a more frequent engagement in alcohol-related social media usage [e.g., (66)].

Additionally, youth who spent more time in front of screens to deal with Covid-19 stressful situations also tended to fall into "an immersed pleasant state through repeated use", which eventually led to the development of media addiction symptoms (43). Yet, the prevalence of these addictive symptoms varied considerably across the included studies, ranging from 20 to 70 per cent. In particular, during home quarantine, social media use was the only way to meet and socialize, thus contributing to longer time spent online and more frequently reported symptoms of social media addiction, especially when adolescents experienced FoMO, thus diminishing well-being (64) - in particular, FoMO proneness was higher at the early stage of the pandemic (64). Given that adolescents' self-control skills are still underdeveloped due to the immaturity of the prefrontal cortex, younger age groups were even more at risk of developing symptoms of media addiction during the pandemic, which was further facilitated by the instantaneous and easy-to-access gratifying contents that (social) media platforms convey (65, 71). According to the Interaction of Person-Affect-Cognition-Execution Model (72), the experience of psychological distress, such as the one created by the Covid-19 lockdown, likely contributed to the development of addictive Internet use. As previously stated, social media, and screen media in general, could be used as a coping tool for self-regulating negative emotions deriving from stress, fear, uncertainty, and lifestyle changes due to the pandemic. That would end up in the experience of negative emotions due to the loss of control over online activities and the search for more frequent gratifications online (62). This would explain the sizeable meta-analytic correlation found between media addiction measures and ill-being.

To conclude, although overall digital media use was related to lower adolescents' well-being during Covid-19, some kind of social media use (i.e., one-to-one communication and online mutual relationships, the experience of funny and positive contents) improved social and mental well-being and helped adolescents to deal with the lack of in-person social experiences during the pandemic. That said, our findings contribute to a growing body of evidence highlighting that the *quality* rather than the *quantity* of online interactions and experiences are crucial in determining potential influences on young people's mental health. Thus, the positive aspects of online activities should be promoted. At the same time, awareness should be raised about the detrimental effects of addictive media use and adverse mechanisms such as social comparison, FoMO, and the exposure to negative content during online activities, which can happen more frequently in times of pandemic, social isolation, and confinement.

LIMITATIONS AND FUTURE DIRECTIONS

This review does not come without limitations. We included only peer-reviewed articles; hence, pre-prints and gray literature were left out, which may have introduced some biases. Also, in some cases, we did not have enough effect sizes to conduct a meta-analysis on all of the associations of interest or to run meta-regression and sub-group analyses. Additionally, heterogeneity levels of the effect sizes varied largely, suggesting a significant variance that other factors should likely explain. Also, more studies are needed to conclude on more reliable results. Eventually, the findings of our systematic review may be biased because the included studies looked mainly at detrimental effects of screen time and social media use, including addictive use, with only a few focusing on a positive conceptualization of mental well-being. Likewise, causality claims, i.e., whether screen time and social media use impact mental health or whether the latter is a driver of certain usage behaviors, could only be made with caution since most reviewed studies relied on a cross-sectional design.

We encourage researchers to focus on the positive side of mental health for future research, including *hedonic* and *eudaimonic* well-being measures. Furthermore, given the strong focus and predominance of studies measuring the *quantity* of (social) media use in terms of duration and frequency, future studies should move beyond these holistic measures and disentangle the type and *quality* of (social) media use. Furthermore, researchers should invest time and effort in longitudinal studies, although we are confident that more longitudinal findings will be published in the upcoming months. Researchers should include longer time ranges when conducting longitudinal studies and use a rigorous statistical procedure to differentiate between- and between-person effects.

CONCLUSIONS

To conclude, the present systematic review and meta-analysis first summarizes the existing evidence from 30 studies on the link between mental health and digital media use in adolescents during Covid-19. Results showed that adolescents augmented their social media use, including general screen time. Also, higher levels of digital media addiction were reported during the pandemic. In general, higher social media use and media addiction were related to higher ill-being. Hence, adolescents are particularly at risk of experiencing mental health problems due to the augmented exposure to screen time and social media during the pandemic. However, not all types of digital media use had a negative consequence. In particular, one-to-one communication, mutual online friendship, and positive and funny online experiences mitigated feelings of loneliness and stress during Covid-19. These positive aspects of online activities should be promoted. Youth's access to psychological support services to provide measures for and promote healthy coping mechanisms during the ongoing Covid-19 pandemic should be facilitated (68).

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

LM and MO contributed to developing the main research question, carrying out the literature search, collecting the included studies' information, and describing the results. LM performed the meta-analysis and wrote the first draft of the manuscript. A-LC contributed to developing the main research question and revised the manuscript. PS revised the manuscript. All authors contributed to the article and approved the submitted version.

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