Mental health in primary health care

Edited by
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Mental health in primary health care

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Editorial: Mental health in primary health care

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Editorial on the Research Topic
Mental health in primary health care

Globally, mental health disorders are on the rise, particularly during the COVID-19 pandemic. According to some studies, 25–35% of patients utilizing Primary Care (PC) services have a psychiatric condition, with more than 80% of these patients presenting depression or anxiety disorders. Many of these conditions are influenced by socioeconomic factors. General Practitioners (GPs) refer ∼5–10% of psychiatric patients detected in PC to Mental Health Services, highlighting that the majority of mental disorders are diagnosed and managed in PC. Furthermore, PC rarely conducts screening and action on social determinants of health (SDH). As a result, the underlying cause of mental health issues remains unaddressed.

Given the current global situation and the available resources in PC, there is a need to investigate new approaches. Experimenting with new technologies (e.g., treatments and diagnosis) and primary prevention through a novel SDH approach that necessitates collaboration across multiple sectors and levels outside of the health system are examples of these.

The Research Topic investigated the management and prevention of mental health issues in PC. The following topics were taken into account:

- Depression and anxiety in Primary Health Care.
- Interventions and management.
- New technologies, both for treatment, and instruments for the diagnosis.
- Social determinants of mental health.
- Social DH approach to prevention and management.
- Moral injury.
- Burnout in health.

This Research Topic focused on Mental Health in Primary Health Care. The topic was published in July 2021, call for papers was published until April 2022. Scholars and practitioners were invited to submit research articles and brief reports on Mental Health in Primary Care to the journal Frontiers in Psychology. Many academics and practitioners responded to this call for papers by submitting their research. Out of a total of 24, thirteen submissions were accepted and published under this theme.

In particular, and within the topic of Depression and anxiety in Primary Health Care, we have an article that explores the factors that influence having better mental health. More specifically, Tao et al. explored whether individuals with a growth mindset might have better mental health and life event outcomes than those with a fixed mindset. Data was collected from 2,505 freshmen at a Chinese university using the Growth Mindset Scale, Adolescent Self-rating Life Events Checklist, and The Symptom Checklist-90-Revised Scale. Their findings suggested that individuals with a growth mindset are less prone to mental health problems than individuals with a fixed mindset.

On the other hand, the influence that some personality traits have on suicidal behavior has also been explored. To be more precise, Chen G. et al. aimed to test a model in which the quality of life (QOL) and suicide relationship was mediated by hopelessness and moderated by impulsivity. They used psychological autopsy data to confirm the negative association between QOL and suicide, and they demonstrated the role of hopelessness in mediating the QOL-suicide relationship, which is further modified by impulsiveness.

The relationship between mental health and cognitive impairment has also been taken into account since Zhou et al. aimed to investigate the longitudinal associations between changes in depressive symptoms and cognitive decline and mild cognitive impairment (MCI) incidence among Chinese rural elderly individuals. They concluded that among Chinese rural residents, increased depressive symptoms were associated with more cognitive decline and a higher risk of incident MCI. Along the same vein, Wang et al. identified correlates of the incidence of cognitive impairment among older Chinese populations through the use of logistic regression analysis-based decision tree approaches. They concluded that combining logistic regression and decision tree analyses can reduce predicted risk scores, allowing for the subdivision of populations with different characteristics and providing intuitive and specific insight into the effects of individual variables on predictive analyses.

Following the same topic, the use of healthcare resources and the use of psychiatric medication have been analyzed. Specifically, Lear-Claveras et al. determined the changes in pharmacological variables and variables related to the use of healthcare resources, in a population undergoing active treatment for depression or anxiety. The results indicated that anxiolytic drug use increased in comparison to the 6 months preceding the lockdown. Antidepressant use, on the other hand, was found to be decreasing. Six months after the lockdown ended, the use of health resources remained below pre-pandemic levels. The increase in drug use, particularly benzodiazepines, may indicate a worsening of symptoms during the lockdown and in the months following.

Furthermore, the psychological wellbeing of individuals can also be analyzed according to the chronic illnesses that a person suffers from. Thus, Aldossari et al. compared the psychological wellbeing of individuals who are prediabetic, diabetic, or non-diabetic. Their research showed that diabetic or prediabetic people have significantly lower psychological wellbeing than non-diabetic people. In this same line of chronic diseases, Chen H. et al. aimed to establish a nomogram prediction model to assess the occurrence of depression in patients with Systemic lupus erythematosus (SLE). Their developed nomogram provides a highly predictive assessment of depression in SLE patients, allowing for more comprehensive depression evaluation in standard clinical care. Likewise, Napalai et al. assessed the influence of COVID-19-related knowledge on mental health, healthcare behaviors, and quality of life among the elderly with non-communicable diseases (NCDs) in Northern Thailand. Their findings highlighted the significance of COVID-19-related knowledge in improving self-care behaviors and quality of life in the elderly population with NCDs during the pandemic, particularly given the high rate of stress and mental health problems in their sample.

Regarding the topic of interventions on mental health, Li et al. aimed to provide a comprehensive understanding of the trajectory, key themes, and prospects in acceptance and commitment therapy (ACT) research. Their review was the first of its kind, attempting to systematically examine the knowledge structure and map the evidence of ACT research. It expands on existing research, suggests new research directions, and makes recommendations for future ACT research.

Also, information about new instruments for the diagnosis has been added, as are the articles by Garrote-Cámara et al. and Wei et al. On the one hand, Garrote-Cámara et al. evaluated the psychometric properties of the Spanish version of the Corrigan Agitated Behavior Scale (ABS), in a sample of patients with severe mental disorders. Their results suggested that the reliability and validity of the three dimensions were acceptable. In their study, the three domains aim to explain 64.1% of the total variance of the scale, which exceeds the 50% found in the original version. On the other hand, Wei et al. aimed to test the reliability and validity of the Chinese version of the Life-threatening Illness-Family Carer Version (QOLLTI-F-CV). They concluded that the three-domain QOLLTI-F-CV questionnaire is a valid and reliable tool for identifying Quality of Life concerns among family caregivers of advanced cancer patients in China. The refactoring structure is well suited to Chinese culture and value system.

Regarding Social Determinants of Mental Health, Chela-Alvarez et al. assessed the evolution of the concern about employment status, anxiety, and depression of hotel housekeepers (HHs). They concluded that, in HHs, the COVID-19 pandemic has caused significant concern about employment status and symptoms of depression and anxiety. In the pandemic's uncertainty, variables that confer stability, such as internal locus of control, perception of social support, and a stable job, benefit mental wellbeing. Longitudinal findings indicate that the COVID-19 pandemic has long-term effects on mental health. To adequately address the anticipated influx of needs, additional resources in primary care must be allocated.

Continuing with the theme of the influence of Social Determinants of Health, Bentué-Martínez et al. explained the behavior of depression in a Mediterranean region of Northeastern Spain from an ecological and diachronic perspective. They concluded that epidemiological studies could provide useful guidelines for proactive decision-making when viewed through a territorial lens. When developing policies for creating healthier environments and directing health services with more specific resources to where they may be needed, the integration of data on diseases and territory must be considered.

All the authors developed novel research approaches and methodologies that aided theory and practice in this critical research domain of Mental Health in Primary Health Care.

Regarding the topics "Moral injury and Burnout in health" also considered, no article was received or accepted. These issues remain pending work in future Research Topics.

Author contributions

AA-L: concept, design, and drafting of the manuscript. BO-B, AP-E, RM-B, and MS-R: critical revision of the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

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Psychometric Characteristics and Sociodemographic Adaptation of the Corrigan Agitated Behavior Scale in Patients With Severe Mental Disorders

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Background: Severe mental disorder (SMD) is understood in a first approximation as a disorder of thought, emotion, or behavior of long duration, which entails a variable degree of disability and social dysfunction. One of the most widely used assessment scales for agitated behavior, in its English version, is the Corrigan Agitated Behavior Scale (ABS); several studies have demonstrated solid psychometric properties of the English version, with adequate internal consistency.

Objective: The objective of this study was to evaluate the psychometric properties of the Spanish version of the ABS Corrigan scale, in a sample of patients with severe mental disorders. The psychometric analyses of the Spanish version of the ABS Corrigan included tests of the reliability and validity of its internal structure.

Results: The structure of the factorial loads of the analyzed elements is consistent with the hypothesized three-dimensional construction referred to in the original ABS. The results suggest that the reliability and validity of the three dimensions are acceptable (First 0.8, Second 0.8, and Third 0.7). The internal consistency of the Spanish version of the complete ABS and of each of the three domains that compose it is high, with values very close to those found in the original version, with approximate figures of 0.9.

Conclusion: In our study, the three domains aim to explain 64.1% of the total variance of the scale, which exceeds the 50% found in the original version.

Keywords: nursing, psychometrics, mental health, psychiatry, psychomotor agitation

INTRODUCTION

Severe mental disorder (SMD) is understood in a first approximation as a disorder of thought, emotion, or behavior of long duration, which entails a variable degree of disability and social dysfunction (Vila et al., 2007). In the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), specifically, it is "a syndrome characterized by a clinically significant alteration of the cognitive state, emotional regulation or behavior of an individual, which reflects a dysfunction of psychological processes, biological or developmental that underlie their mental function" (American Psychiatric Association, 2013). According to the National Institute of Mental Health, SMD patients face a limitation in being able to carry out important activities in their daily lives (National Institute of Mental Health, 2019). There are very diverse pathologies that can be included in the concept of serious mental disorder, and they are usually classified according to the symptoms, evolution, chronicity and level of disability they cause in the lives of patients (World Health Organization, 2018). Patients with SMD experience a significant deterioration, which limits the development of their daily activities (Hazelden Foundation, 2016; Padilla et al., 2018). At present, the two most used taxonomies for the diagnosis of SMD are the Classification of Mental and Behavioral Disorders (ICD-11) of the World Health Organization (2018) and the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) of the American Psychiatric Association (2013). The main groups of diagnoses that give rise to the appearance of situations valued as a severe mental disorder are as follows: schizophrenia and a group of psychotic disorders; depressive disorder, manic disorder and bipolar disorder; anxiety disorders; and personality disorders (Pichot et al., 1995; Gobierno de Navarra, 2005). In Spain, the results of the 2017 National Health Survey (Ministry of Health, Consumer Affaris and Social Welfare, 2017) indicate that 10.8% of adults reported having been diagnosed with a mental health problem; women report a mental health problem more frequently than men, 14.1% versus 7.2%. Furthermore, 6.7% of adults report chronic anxiety, 9.1% of women and 4.3% of men. Depression is declared in the same proportion as anxiety (6.7%), and it is more than double in women (9.2%) than in men (4%).

All the diagnoses described above present a series of common characteristics, such as greater vulnerability to stress, difficulties in coping with the demands of the environment, problems in managing frustration, deficits in their abilities to manage autonomously, difficulties in social interaction and high dependence on other people and health and/or social services (Vila et al., 2007; Hazelden Foundation, 2016; Padilla et al., 2018). Symptoms of the disease and difficulties in interacting with the environment develop complications, such as psychomotor agitation, more prevalent in people suffering from a serious mental disorder. The prevalence of psychomotor agitation is high, up to 10% of patients seen in general emergency services (Pacciardi et al., 2013) and between 20 and 50% if we specifically consider psychiatric emergencies (Allen and Currier, 2004; Marco and Vaughan, 2005). Different studies relate psychomotor agitation with the suffering of a severe mental disorder (Bogner et al., 1999; Huber et al., 2016; Ostinelli et al., 2019), diverse

psychiatric conditions, as well as some medical disorders (Galián Muñoz et al., 2011). Agitation of psychiatric origin is seen more frequently in patients with psychotic disorders, such as schizophrenia, schizoaffective disorder and the manic phase of bipolar disorder, as well as in some personality disorders (Feldman et al., 2001; Buckley et al., 2003; Battaglia, 2005; Serretti and Olgiati, 2005; Wittchen et al., 2011). In a manic episode, psychomotor agitation comes from the same phenomenology of the condition, where it is described as part of the symptom complex of mania with excessive motor and cognitive activity (Soutullo et al., 2011). In Spain, it is estimated that 25% of patients with schizophrenia and 15% of patients with bipolar disorder could suffer from at least one episode of agitation each year, with an average of two episodes per patient (Viñado et al., 2015).

Psychomotor agitation is characterized as a non-specific syndrome, of multifactorial etiology, which entails an alteration of motor behavior, consisting of a disproportionate and disorganized increase in motor functions and which may be accompanied by vegetative activation (profuse sweating, tachycardia, and mydriasis), severe anxiety, aggressiveness, panic, behavior lability, disinhibition or other intense emotional states (Allen and Currier, 2004; Pacciardi et al., 2013). The patient's state of mind can manifest itself as nervous, euphoric and choleric, and laughter, crying and uncontrollable screaming are frequent, which can lead to verbal and/or physical aggressions, and therefore, pose a serious risk to both the patient themself (self-harm), as well as family members, healthcare personnel and the environment in general (hetero-harm) (Marco and Vaughan, 2005). On many occasions, the management of agitation presents difficulties, since they are usually people who are difficult to collaborate and who can present aggressive behaviors, disinhibition, which greatly hinders the assistance work, treatment and care of the patient.

Psychomotor agitation corresponds to one of the most important hospital emergencies in the care of severe mental disorder since it requires immediate professional assistance, and the safety of the patient is seriously compromised (Bogner et al., 2001; Buckley et al., 2003; Nott et al., 2006; Galián Muñoz et al., 2011; Ostinelli et al., 2019).

A large proportion of older people with mental disorders live at home and are cared for by their relatives, which requires the involvement of primary care physicians and rapid intervention (Adriaenssens et al., 2019). Whenever possible and when required by the patient, the patient should be assessed and cared for in their own environment, limiting trips to health centers for emergencies or seriousness, or for special tests (Snowdon, 2007). Home assessment should involve primary care professionals and should always take into account socio-demographic, somatic, functional and social aspects (Olivera et al., 2011). The assessment should result in the formulation of a care plan with clear objectives and defined responsibilities for members of the multidisciplinary team and the primary care team (Hoedemakers et al., 2019).

The evaluation of psychomotor agitation, as well as its management, constitutes a challenge for health professionals since this syndrome usually overwhelms their management skills. One of the most widely used assessment scales for agitated behavior, in its English version, is the Corrigan Agitated Behavior

Scale (ABS; Corrigan, 1989). This scale provides both quantitative and qualitative data, determining the level of agitation and its characteristics at the level of lability, disinhibition and aggressiveness associated with the agitation episode (Corrigan, 1989; Corrigan and Bogner, 1994). It was designed by Corrigan (1989) to evaluate agitation in the context of patients in a period of post-encephalic trauma; however, since its design, it has been widely used in the evaluation of agitation in patients with severe mental disorders (Bogner et al., 1999; García et al., 2002; García - Ribera, 2014).

Given the importance of psychomotor agitation among the population suffering from a severe mental disorder and Spanish being the second most spoken language in the world (Instituto Cervantes, 2020), it is necessary to have a tool with which to assess agitation in these patients. The objective of this study was to evaluate the psychometric properties of the Spanish version of the ABS Corrigan scale in a sample of patients with severe mental disorder.

MATERIALS AND METHODS

Translation, Adaptation and Modeling

Before testing its psychometric properties, the Corrigan ABS scale was translated and culturally adapted from its original English version into Spanish. We follow the guidelines published by Beaton et al. (2000) who divided the process into the following six steps: (1) translation, (2) synthesis, (3) back-translation, (4) back-translation synthesis, (5) review by the expert committee of the translated version, and (6) preliminary tests.

The original ABS Corrigan scale was translated into Spanish by two independent translators, an expert in medical translation and a researcher familiar with the instrument and its characteristics (forward translation). The translators were instructed to use simple sentences and avoid metaphors, colloquial terminology, passive sentences, and hypothetical statements. In a meeting of the expert committee, made up of the authors and the translators, the differences between the two translations were discussed, and the initial translation was unified (reconciliation). This first Spanish translation was blindly re-translated into English (back-translation). Subsequently, the expert committee compared and contrasted the original and retro-translated versions, in order to achieve the most precise adaptation possible to the original language of the Spanish version and agreed, by consensus, on the final Spanish version of the ABS Corrigan to be used in the sample.

Finally, as it is a hetero-applied administration instrument, cognitive interviews were completed in a sample of 20 nursing professionals (cognitive debriefing) that confirmed the legibility of the elements as they were written.

Procedures

This study was conducted in the north region of Spain (La Rioja) using a cross-sectional design. We enrolled a sample of $n = 140$ participants admitted to the Mental Health of Albelda de Iregua (La Rioja) who met the following inclusion criteria: (1) being diagnosed severe mental disorder, (2) be admitted to

psychiatric hospitalization units at the Rioja Health Service, (3) present an episode of psychomotor agitation between 2015 and 2020, and (4) being 18 years or older. According to Norman and Streiner (1996) we enrolled 140 participants at least five patients for item of the scale. All data were collected by qualified nurses, who had been specifically trained for this purpose, during the patients' admission.

The sample size was estimated according to the criteria to perform a factor analysis that contemplated a minimum of 10 subjects for each item (De Vet et al., 2005). The Corrigan Agitated Behavior Scale is a hetero-applied administration instrument, where the interviewer must evaluate 14 items, which are quantified with a Likert-type scale according to the observation of the professional (Bogner et al., 1999; García et al., 2002; García - Ribera, 2014). The scale was completed by trained nursing professionals; the psychomotor agitation data of patients with severe mental disorders, who developed an episode of psychomotor agitation during their admission to the psychiatric hospitalization units of the Rioja Health Service, were collected. The inclusion criteria were patients diagnosed with a severe mental disorder, of both sexes, older than 16 years, admitted to the psychiatric hospitalization units of the Rioja Health Service, and who developed an episode of psychomotor agitation between 2015 and 2020.

The scale includes 14 items that are grouped in the original English version into three factors: disinhibition, items 1, 2, 6, 7, 8, 9, and 10; aggressiveness, items 3, 4, 5, and 14; lability, items 11, 12, and 13 (Corrigan, 1989). There are 14 items that assess the ability to sustain attention: impulsiveness, pain tolerance and frustration management; cooperation and demand; violence and threats; explosiveness, anger and unpredictability; self-stimulating behaviors; pull objects or ties from the bed; roams the treatment areas; restlessness and excessive movement; repetitive behaviors; excessive, fast and loud language; sudden mood change; excessive facility for crying and/or laughing; self-injurious behaviors. The professional must score according to a Likert-type scale of 4 degrees of intensity, from 1 (absence) to 4 (extreme degree). The sum of the scores of the 14 items determines the severity of the agitation; the higher the score, the greater the severity. The score in each of the three factors determines if the episode is characterized more by its lability, disinhibition, or aggressiveness (Corrigan, 1989; Teri et al., 1992; Corrigan and Bogner, 1994; Spanish Society of Emergency and Emergency Nursing, 2009). In addition to the score for each item, socio-demographic data and the main diagnosis that led to admission were collected.

Statistical Analysis

Sociodemographic and clinical variables were analyzed using descriptive statistics as the mean and standard deviation in the case of quantitative variables and frequencies in the case of categorical variables. In addition, other parametric techniques, including the mean, standard deviation, skewness, and kurtosis, were used to describe responses to items and summarize the total scale score. The psychometric analyses of the Spanish version of the ABS Corrigan included tests of reliability and validity of its internal structure. We evaluated the reliability of the scale

by exploring internal consistency, and we calculated Cronbach's alpha coefficient of the global scale and each of the theoretical dimensions, accepting significance values of 0.70 or higher as an indicator of good internal consistency (Argimon, 2012).

We evaluated the underlying factor structure of the ABS scale in Spanish using factor analysis. To assess the relevance of performing an exploratory factor analysis on the sample, the Kaiser–Meyer–Olkin (KMO) sample adequacy statistic and the Bartlett sphericity statistic were previously calculated. The suitability of the analysis was determined with a KMO greater than 0.6, and in the case of Bartlett's test of sphericity, a rejection of the null hypothesis of sphericity of $p < 0.05$ to ensure that the use of the factorial model was adequate. An exploratory factor analysis (EFA) was performed using principal component analysis with a Varimax rotation to determine the number of latent constructs and the underlying factorial structure of domains on the ABS scale in its Spanish version. The number of factors on the scale was estimated, considering two complementary criteria: (1) the Kaiser–Guttman or latent root criterion and (2) the drop contrast criterion (Hair et al., 2005; Martínez et al., 2006; Tabachnick et al., 2007). The statistical software used was SPSS (IBM SPSS Statistics for Windows, Version 23.0, IBM Corp., Armonk, NY, United States).

Ethical Considerations

The data collection was anonymous and did not collect personal data or devices that could identify the informant. The information was treated confidentially and anonymously since they had dissociated data, following the Data Protection Regulation (EU) 2016/679 of the European Parliament and the Spanish Organic Law 3/2018. The study was approved by the Ethics Committee of the Rioja Biomedical Research Center (CIBIR) (reference CEImLar P.I. 467) (Biomedical Research Center of La Rioja, 2021). The researchers do not declare any type of ethical, moral or legal conflict, nor do they claim to have received financial compensation of any other kind. The participants did not receive any type of compensation for answering the questionnaire, as it was voluntary.

RESULTS

Table 1 illustrates the main sociodemographic characteristics of the sample. The mean age of the sample was 45.61 years. In total, 52.9% of the sample were men, and 47.1% were women. Regarding the underlying pathology, 60.7% of the sample presented schizophrenia and other psychotic disorders, of which 60% were men and 40% were women; 9.3% presented a depressive episode, of which 30.8% were men and 69.2% were women; 2.1% presented a manic episode, all of which were women; 8.6% presented a bipolar episode, of which 33.3% were men and 66.7% were women; 10.7% presented a personality disorder, of which 40% were men and 60% were women; 8.6% presented other pathologies, of which 75% were men and 25% were women.

The mean, standard deviation (SD), asymmetry and kurtosis values for each of the items of the Spanish version of the scale of psychomotor agitation, ABS Corrigan, are indicated in Table 2.

TABLE 1 | Main sociodemographic characteristics of the sample ($n = 140$).

Variables	n	%
Age		
<18	1	0.7
18–30	21	15
31–50	69	49.3
51–65	28	20
66–79	17	12.1
>80	4	2.9
Sex		
Women	66	47.1
Men	74	52.9
Mental illness		
Schizophrenia and other psychotic disorders	85	60.7
Depressive episode	13	9.3
Manic episode	3	2.1
Bipolar episode	12	8.6
Personality disorder	15	10.7
Others	12	8.6

Most of the items are distributed normally, without excessive asymmetry and kurtosis. The items with the highest scores are item 2 "Impulsive, impatient, tolerates pain or frustration poorly" and item 3 "Uncooperative, does not let them take care of him, demanding." The lowest scores were recorded by item 7 "Pulls the tubes or ties on the bed" and item 13 "Cries or laughs easily and excessively."

In terms of reliability, the internal consistency of the Spanish version of the ABS Corrigan scale and its domains is excellent (Alexandre et al., 2013; Coluci et al., 2015; Cunha et al., 2016). Cronbach's alpha for the total scale is 0.9, and for each of the scale dimensions, disinhibition is 0.8, aggressiveness is 0.8 and lability is 0.7 (see Table 3).

The adequacy tests, before performing the exploratory factor analysis, resulted in a Kaiser–Meyer–Olkin (KMO) value of 0.9. Bartlett's test of sphericity is significant ($p < 0.01$) both in the analysis of each of the domains and in the global analysis of the scale. Sampling suitability is high in the exploratory factor analysis.

The Kaiser–Guttman or latent root criterion identified three factors with eigenvalues greater than 1, as shown in Table 4, which would explain 64.1% of the total variance of the items. The second criterion, fall contrast or screen test, also showed through the sedimentation graph the presence of three factors, as reflected in Figure 1.

The exploratory factor analysis (EFA) was developed using principal component analysis with a Varimax rotation, considering the following criteria: factor load >0.30, the number of items per factor according to the original version, the interpretability of the results and the theory that supports the ABS Corrigan scale. According to these criteria, the best solution was to identify three dimensions of grouping the items as in the original version; see Table 5. The dimension "disinhibition" included items 1, 2, 6, 7, 8, 9, and 10; the "aggressiveness" dimension included items 3, 4, 5, and 14; the dimension "lability"

TABLE 2 | Descriptive statistics of the items of the Spanish version of the ABS Corrigan scale.

Items	Mean	SD±	Asymmetry	Kurtosis
1. Poor attention paid, easily distracted, inability to concentrate	2.8	± 0.8	−0.3	−0.3
2. Impulsiveness, impatience, poor tolerance for pain and frustration	3.2	± 0.8	−1	0.4
3. Little cooperation, does not allow to be taken care of, demanding	3.1	± 0.8	−0.6	−0.2
4. It is violent, threatens people and property	2.9	± 1	−0.5	−0.8
5. Explosive or unpredictable outbursts of anger	2.9	± 0.9	−0.6	−0.6
6. Rocks, rubs, groans, or exhibits other self-stimulating behavior	2.2	± 1.1	0.3	−1.2
7. Pulls objects or ties from the bed	1.7	± 1	1	−0.4
8. Roams through treatment areas	2.5	± 1.1	−0.1	−1.3
9. Restlessness, it comes and goes, it moves excessively	2.8	± 0.9	−0.5	−0.5
10. Repetitive, motor, or verbal behaviors	2.7	± 0.9	−0.3	−0.8
11. Speak fast, loud, or excessively	2.9	± 1	−0.5	−0.9
12. Sudden mood changes	2.8	± 1	−0.6	−0.7
13. Cries or laughs easily and excessively	2	± 1	0.6	−0.8
14. It hurts or insults	2.7	± 1	−0.3	−1.1

items 11, 12, and 13. In the matrix of the rotated component (Varimax) of **Table 5**, it is observed that the elements load significantly in the three previous factors.

The results of the exploratory factor analysis (EFA) suggest that the three dimensions determined in the ABS Corrigan evaluation scale originally validated in the US, "disinhibition," "aggressiveness," and "lability," are applicable for this version in Spanish. The structure of the factorial loads of the analyzed elements is consistent with the hypothesized three-dimensional construction referred to in the original ABS. The results suggest that the reliability and validity of the three dimensions is acceptable. The results are largely consistent with the initial hypothesis.

DISCUSSION

The adaptation and cross-cultural validation into Spanish of the Agitated Behavior Scale (ABS Corrigan) was carried out, thus obtaining a culturally equivalent instrument that allows

TABLE 3 | Cronbach's Alpha – ABS Corrigan. Scale dimensions.

Dimension	Cronbach's Alpha
Disinhibition	0.8
Aggressiveness	0.8
Lability	0.7
Total	**0.9**

Cronbach's alpha for the total scale is 0.9.

TABLE 4 | Total explained variance – ABS Corrigan. Sum of rotation of charges square.

Component	Total	% Variance	% Accumulated
1	3.9	27.9	27.9
2	3.5	25.3	53.2
3	1.5	10.9	64.1

the evaluation of psychomotor agitation in patients with severe mental disorder, obtaining levels of severity of agitation, such as the exploration of three related domains, disinhibition, lability, and aggressiveness. The results of this study indicate that these three domains are applicable in patients with severe mental disorder, and the reliability and validity measures are satisfactory for their use in Spanish.

During the cross-cultural adaptation process, there were no language difficulties; only some expressions were slightly modified to ensure their cultural equivalence. The nursing professionals who participated in the study did not show any difficulties in filling in the scale after attending to and observing the patient's psychomotor agitation. As it is a hetero-applied administration instrument, the patients do not need to understand the scale.

Several studies have demonstrated the solid psychometric properties of the English version, with an adequate internal consistency, Cronbach's alpha between 0.801 and 0.921 (Corrigan, 1989; Corrigan and Bogner, 1994; Bogner et al., 1999; Vilibiæ et al., 2014; Hellweg and Schuster-Amft, 2016). The internal consistency of the Spanish version of the complete Corrigan Agitated Behavior Scale and of each of the three domains that compose it is high, with values very close to those found in the original version, with approximate figures of 0.9. Similar to the original English version, and the German version of the scale, Cronbach's alpha of the aggression, disinhibition and lability subscales is lower than that of the total scale score, indicating that the total score remains the best overall measure of agitation (Corrigan, 1989; Corrigan and Bogner, 1994; Hellweg and Schuster-Amft, 2016). In our study, the three adopted domains explain 64.1% of the total variance of the scale, which exceeds the 50% found in the original version (Corrigan, 1989).

The exploratory factor analysis of this study supports the maintenance of the same three domains adopted in the original version and confirmed in the validated version in German (Corrigan, 1989; Corrigan and Bogner, 1994; Hellweg and Schuster-Amft, 2016). Although adequate correlations were
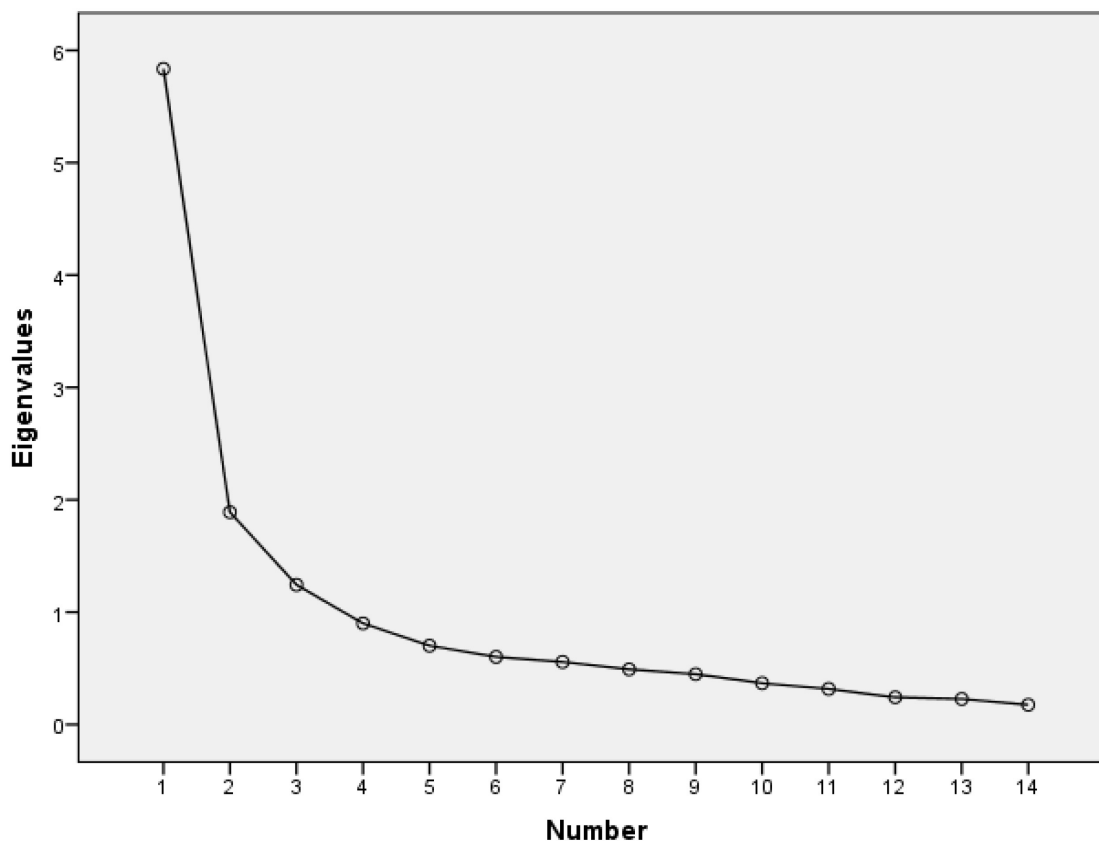
FIGURE 1 | Sedimentation chart of the Spanish version of the ABS Corrigan.

observed in the German version, the correlations were lower than those in the original English version and in this study, in which we analyzed a Spanish version. This may be due to the fact that the German study was multidisciplinary compared to the Spanish version, which is monodisciplinary. The nursing professional knows the patient, is responsible for the patient's health care,

knows the signs and symptoms of the disease and is the first line of care for episodes of psychomotor agitation. The fact that these professionals assess the agitation episodes through the 14 items of the ABS Corrigan improve the adequacy of the results of the scale (Santolalla et al., 2015; Caqueo-Urízar et al., 2016; Hellweg and Schuster-Amft, 2016).

In the exploratory factor analysis, it is observed, for example, that there are items related to the aggressiveness dimension, such as item 4 "is violent, threatens person or property," item 5 "explosive or with unpredictable anger attacks" and item 14 "harm or insult," which highly identified with the dimension, as also observed in the study of the German version (Hellweg and Schuster-Amft, 2016). The aggressiveness dimension is perhaps one of the most related to psychomotor agitation in patients with severe mental disorder, especially regarding the diagnostic group of schizophrenia and other psychotic disorders, which helps healthcare professionals to evaluate the items related to this dimension (Lehman et al., 2004). In fact, psychomotor agitation is particularly prevalent among the population with schizophrenia and bipolar disorder (Witt et al., 2013; Zhou et al., 2015; Vieta and Garriga, 2016; Wu et al., 2018). In Spain, a recent report indicated that 25% of patients with schizophrenia and 15% of those with bipolar disorder could be expected to experience at least one episode of psychomotor agitation each year (Vieta et al., 2017). On the other

TABLE 5 | Rotated component matrix. Principal component analysis (Varimax).

Item	Factor 1	Factor 2	Factor 3
Item 1	0.8		
Item 2	0.5		
Item 3		0.4	
Item 4		0.9	
Item 5		0.9	
Item 6	0.7		
Item 7	0.6		
Item 8	0.5		
Item 9	0.7		
Item 10	0.8		
Item 11			0.3
Item 12			0.4
Item 13			0.8
Item 14		0.7	

hand, the lower load of item 3 "Uncooperative, does not let them take care of him, demanding" on the aggressiveness dimension can be related to cultural and translation factors, as the demand or little collaboration is not significantly related in our country with aggressiveness, so the nursing professional could score this item in a more random way (Real Academia Española, 2021).

In this line, item 8 "wanders through the treatment areas," item 11 "speaks fast, loud, or excessively," and item 12 "changes of mood suddenly," with lower loads on its dimensions, can be more difficult to identify with its domain due to cultural factors or translation difficulties. Describing these items further could improve the response from professionals. These notes do not substantially change the use of the scale in its Spanish version, but they do inform us about the importance of not only the linguistic but also the cultural validation of the tools for measuring concepts as complex as agitation.

Psychomotor agitation is characterized by an interruption in the relationship or collaboration of the health professional and the patient, severely interfering with the evaluation, treatment, health care and prognosis of the underlying pathology. The management and care of the agitated patient constitute a first level health care demand. The safety of the patient, health care personnel and third parties; reducing the progression of the condition by acting on prodromal phases; and limiting complications during crises by their early discovery and management, must be guaranteed. The availability of a psychomotor agitation assessment scale, adapted to the language and culture of our country, with adequate psychometric properties, offers greater possibilities for prevention, adequate diagnosis, research, treatment and effective care, improving the prognosis and quality of life of affected patients (Santolalla et al., 2015; Caqueo-Urízar et al., 2016).

LIMITATIONS

The sample used for data validation is sufficiently large to guarantee an adequate representation of patients with severe mental disorder. However, most of the sample for this study presents schizophrenia, in this sense it is recommended to focus the analysis only on these patients, since the rest of the sample is too stratified in other pathologies.

CONCLUSION

The results of this translation and validation study into the Spanish version of the Agitated Behavior Scale (ABS

Corrigan) suggest that the reliability and validity of the three dimensions is acceptable, with data similar to the original English version and better fit than the German version (Corrigan, 1989; Hellweg and Schuster-Amft, 2016). The total scale score remains the best overall measure of agitation. The results are largely compatible with the initial hypothesis, which makes them useful for clinical and research use in our country.

RELEVANCE FOR CLINICAL PRACTICE

The use of validated instruments means providing health professionals with reliable and valid tools. Different studies have demonstrated the solid properties of the Corrigan Agitated Behavior Scale in its English version. However, no studies have validated this scale in the Spanish language. With this study, we reveal psychometric characteristics and sociodemographic adaptation of the Corrigan Agitated Behavior Scale in patients with various mental disorders to one of the most widely spoken language in the world.

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.

ETHICS STATEMENT

The study was approved by the Ethics Committee of the Rioja Biomedical Research Center (CIBIR) (reference CEImLar P.I. 467) (Centro de Investigación Biomédica, 2021). Written informed consent from the patients/participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

REFERENCES

Adriaenssens, J., Benahmed, N., and Ricour, C. (2019). Improving mental healthcare for the elderly in Belgium. *Int. J. Health Plann. Manage.* 34, e1948–e1960. doi: 10.1002/hpm.2858

Alexandre, N. M. C., Gallasch, C. H., Lima, M. H. M., and Rodrigues, R. C. M. (2013). Reliability in the development and evaluation of measurement instruments in the health field. *Eletr. Nurs. J.* 15, 802–809. doi: 10.5216/ree.v15i3.20776

Allen, M. H., and Currier, G. W. (2004). Use of restraints and pharmacotherapy in academic psychiatric emergency services. *Gen. Hosp. Psychiatry* 26, 42–49. doi: 10.1016/j.genhosppsych.2003.08.002

American Psychiatric Association (2013). *Diagnostic and Statistical Manual of Mental Disorders: (DSM-5)* Washington, DC: American Psychiatric Association 10.

Argimon, J. M. (2012). *Métodos de Investigación Clínica y Epidemiológica.* 4rd Edn. Amsterdam: Elsevier.

Battaglia, J. (2005). Pharmacological management of acute agitation. *Drugs* 65, 1207–1222.

Beaton, D., Bombardier, C., Guillemin, F., and Ferraz, M. B. (2000). *Recommendations for the Cross-cultural Adaptation of Health Status Measures.* New York, NY: American Academy of Orthopaedic Surgeons 1–9.

Bogner, J. A., Corrigan, J. D., Fugate, L., Mysiw, W. J., and Clinchot, D. (2001). Role of agitation in prediction of outcomes after traumatic brain injury. *Am. J. Phys. Med. Rehabil.* 80, 636–644. doi: 10.1097/00002060-200109000-00002

Bogner, J. A., Corrigan, J. D., Stange, M., and Rabold, D. (1999). Reliability of the agitated behavior scale. *J. Head Trauma Rehabil.* 14, 91–96.

Buckley, P. F., Noffsinger, S. G., Smith, D. A., Hrouda, D. R., and Knoll, J. L. (2003). Treatment of the psychotic patient who is violent. *Psychiatr. Clin. North Am.* 26, 231–272.

Caqueo-Urízar, A., Fond, G., Urzúa, A., Boyert, L., and Willians, D. (2016). Violent behavior and aggression in schizophrenia: prevalence and risk factors. a multicentric study from three latin-America countries. *Schizophr. Res.* 178, 23-28. doi: 10.1016/j.schres.2016.09.005

Centro de Investigación Biomédica (2021). *Comité de Ética de la Investigación con Medicamentos.* Madrid: Centro de Investigación Biomédica.

Coluci, M. Z. O., Alexandre, N. M. C., and Milani, D. (2015). Construction of measurement instruments in the area of health. *Cien. Saude Colet.* 20, 925-936. doi: 10.1590/1413-81232015205.04332013

Corrigan, J. D. (1989). Development of a scale for assessment of agitation following traumatic brain injury. *J. Clin. Exp. Neuropsychol.* 11, 261–277. doi: 10.1080/01688638908400888

Corrigan, J. D., and Bogner, J. A. (1994). Factor structure of the agitated behavior scale. *J. Clin. Exp. Neuropsychol.* 16, 386–392. doi: 10.1080/01688639408402649

Cunha, C. M., Almeida Neto, O. P., and Stackfleth, R. (2016). Main psychometric evaluation methods of measuring instruments reliability. *Rev Atenção Saúde* 14, 98–103.

De Vet, H. C., Adèr, H. J., Terwee, C. B., and Pouwer, F. (2005). Are factor analytical techniques used appropriately in the validation of health status questionnaires? A systematic review on the quality of factor analysis of the SF-36. *Qual. Life Res.*14, 1203–1218. doi: 10.1007/s11136-004-5742-3

Galián Muñoz, I., Bernal Torres, J., Díaz Sánchez, C., and Martínez Serrano, J. (2011). *Protocolo de Atención a Pacientes con Agitación y/o Heteroagresividad.* Murcia: Hospital Psiquiátrico Román Alberca.

García, J. B., Portilla, M. P. G., Fernández, M. T. B., Martínez, P. A. S., and García, M. B. (2002). *Banco de Instrumentos Básicos Para la Práctica de la Psiquiatría Clínica.* Madrid: Ars Médica.

García - Ribera, C. (2014). *Clínica y Psiquiatría, Clips en Agitación.* Barcelona.

Gobierno de Navarra (2005). *Programa de Atención a Personas con Trastorno Mental Grave.* Available online at: https://www.navarra.es/NR/rdonlyres/B66BCCE6-6744-4560-83E7-7729EE54C2D1/152344/PROGRAMATMG1.pdf (accessed September 2, 2021).

Feldman, H., Gauthier, S., Hecker, J., Vellas, B., Subbiah, P., and Whalen, E. (2001). A 24-week, randomized, double-blind study of donepezil in moderate to severe Alzheimer's disease. *Neurology* 57, 613–620.

Hair, J., Black, W., Babin, B., Anderson, R., and Tatham, R. (2005). *Multivariate Data Analysis,* 6th Edn. New Jersey: Prentice Hall.

Hazelden Foundation (2016). *Severe Mental Illness Defined by Duration and Disability.* Available online at: http://www.bhevolution.org/public/severe_mental_illness.page (accessed July 17, 2021).

Hellweg, S., and Schuster-Amft, C. (2016). German version, inter- and intrarater reliability and internal consistency of the "Agitated Behavior Scale" (ABS-G) in patients with moderate to severe traumatic brain injury. *Health Qual. Life Outcomes* 14:106. doi: 10.1186/s12955-016-0511-x.

Hoedemakers, M., Marie Leijten, F. R., Looman, W., Czypionka, T., Kraus, M., Donkers, H., et al. (2019). Atención integrada para ancianos frágiles: un estudio cualitativo de un enfoque prometedor en los Países Bajos. *Revista internacional de atención integrada* 19:16. doi: 10.5334/ijic.4626

Huber, C. G., Hochstrasser, L., Meister, K., Schimmelmann, B. G., and Lambert, M. (2016). Evidence for an agitated-aggressive syndrome in early-onset psychosis correlated with antisocial personality disorder, forensic history, and substance use disorder. *Schizophr. Res.* 175, 198–203. doi: 10.1016/j.schres.2016.04.027

Instituto Cervantes (2020). *CVC. Anuario 2020. Informe 2020. El español en cifras.* Available online at: https://cvc.cervantes.es/lengua/anuario/anuario_20/informes_ic/p01.htm (accessed June 26, 2021).

Lehman, A. F., Lieberman, J. A., Dixon, L. B., McGlashan, T. H., Miller, A. L., Perkins, D. O., et al. (2004). Practice guideline for the treatment of partients with schizophrenia. *Am. J. Psychiatry* 161(2 Suppl.), 1–56.

Marco, C. A., and Vaughan, J. (2005). Emergency management of agitation in schizophrenia. *Am. J. Emerg. Med.* 23, 767–776. doi: 10.1016/j.ajem.2005.02.050

Martínez, M. R., Hernández, M. J., and Hernández, M. V. (2006). *Psicometría.* Madrid: Alianza Editorial.

Ministry of Health, Consumer Affaris and Social Welfare (2017). *National Health Survey ENSE, Spain 2017.* Madrid: Ministry Of Health, Consumer Affairs and Social Welfare.

National Institute of Mental Health (2019). *Mental Illness.* https://www.nimh.nih.gov/health/statistics/mental-illness (accessed June 15, 2021).

Norman, G. R., and Streiner, D. L. (1996). *Bioestadística.* Madri: Mosby-Doyma Libros, 129–142.

Nott, M. T., Chapparo, C., and Baguley, I. J. (2006). Agitation following traumatic brain injury: an Australian sample. *Brain Inj.* 20, 1175–1182. doi: 10.1080/02699050601049114

Olivera, J., Benabarre, S., Lorente, T., Rodriguez, M., Barros, A., Quintana, C., et al. (2011). Detecting psychogeriatric problems in primary care: factors related to psychiatric symptoms in older community patients. *Ment. Health Fam. Med.* 8, 11–19.

Ostinelli, E. G., D'Agostino, A., Shokraneh, F., Salanti, G., and Furukawa, T. A. (2019). Acute interventions for aggression and agitation in psychosis: study protocol for a systematic review and network meta-analysis. *BMJ open* 9:e032726. doi: 10.1136/bmjopen-2019-032726

Pacciardi, B., Mauri, M., Cargioli, C., Belli, S., Cutugno, B., Di Paolo, L., et al. (2013). Issues in the management of acute agitation: how much current guidelines consider safety? *Front. Psychiatry* 4:26. doi: 10.3389/fpsyt.2013.00026

Padilla, E. M., Posada, D. O., and Medina, P. S. (2018). La adherencia familiar en el trastorno mental grave. *Atención Primaria* 50, 519–526. doi: 10.1016/j.aprim.2017.06.010

Pichot, P., López-ibor Aliño, J. J., and Valdés Miyar, M. (1995). *DSM-IV. Manual diagnóstico y estadístico de los Trastornos Mentales.* Barcelona.

Real Academia Española (2021). *Diccionario de la Lengua Española.* 23.ª Edn. Madrid: Real Academia Española.

Santolalla, I., Losa, M., and Silva, T. (2015). *Impact of Drug Use on Psychomotor Agitation in Hospitalized Patients With Severe Mental Disorder,* (*Doctoral Thesis*), España: King Juan Carlos University.

Serretti, A., and Olgiati, P. (2005). Profiles of "manic" symptoms in bipolar I, bipolar II and major depressive disorders. *J. Affect Disord.* 84, 159–166.

Snowdon, J. (2007). Psychogeriatric services in the community and in long-term care facilities: needs and developments. *Curr. Opin. Psychiatry* 20, 533–538. doi: 10.1097/YCO.0b013e3282c8c85e

Spanish Society of Emergency and Emergency Nursing (2009). *El Paciente agitado.* Madrid: Sociedad Española De Enfermería De Urgencias Y Emergencias.

Soutullo, C., Quintana, F., Vicario, M., and De Castro, P. (2011). Enfermedad bipolaro maníaco-depresiva. *Mood dis. psych.* 48, 5684-5692.

Tabachnick, B. G., Fidell, L. S., and Ullman, J. B. (2007). *Using Multivariate Statistics.* Boston, MA: Pearson, 481–498.

Teri, L., Rabins, P., Whitehouse, P., Berg, L., Reisberg, B., Sunderland, T., et al. (1992). Management of behavior disturbance in Alzheimer disease: current knowledge and future directions. *Alzheimer Dis. Assoc. Disord.* 6, 77-88.

Vieta, E., and Garriga, M. (2016). Adjunctive antidepressants in bipolar depression. *Lancet Psychiatry* 3, 1095–1096.

Vieta, E., Garriga, M., Cardete, L., Bernardo, M., Lombraña, M., Blanch, J., et al. (2017). Protocol for the management of psychiatricpatients with psychomotor agitation. *BMC Psychiatry* 17:328. doi: 10.1186/s12888-017-1490-0

Villa, L. P., Carracedo, R. A., Iglesias, V. F., Domínguez, L. G., Justo-Alonso, A., Sueiro, M. J. S., et al. (2007). Severe mental disorder. *Rev. Electrón. Ter. Ocup. Galicia TOG* 4.

Vilibiæ, M., Jukiæ, V., Pandžiæ-Sakoman, M., Bilic, P., and Milosevic, M. (2014). Association between total serum cholesterol and depression, aggression, and

suicidal ideations in war veterans with posttraumatic stress disorder: a cross-sectional study. *Croat Med J.* 55, 520-529 doi: 10.3325/cmj.2014.55.520

Viñado, E. G., Lizano-Díez, I., Arissó, P. N. R., Moreno, J. M. V., and de Viu Bernad, C. M. (2015). El coste económico de los procedimientos de contención mecánica de origen psiquiátrico en España. *Psiquiatria biológica* 22, 12–16.

Witt, K., van Dorn, R., and Fazel, S. (2013). Risk factors for violence in psychosis: systematic review and meta-regression analysis of 110 studies. *PLoS One* 8:e55942. doi: 10.1371/journal.pone.0055942

Wittchen, H. U., Jacobi, F., Rehm, J., Gustavsson, A., Svensson, M., Jönsson, B., et al. (2011). The size and burden of mental disorders and other disorders of the brain in Europe 2010. *Eur. Neuropsychopharmacol.* 21, 655–679. doi: 10.1016/j.euroneuro.2011.07.018

World Health Organization (2018). *International Classification of Diseases 11th Revision (ICD-11)*. Geneva: World Health Organization.

Wu, Y., Kang, R., Yan, Y., Gao, K., Li, Z., Jiang, J., et al. (2018). Epidemiology of schizophrenia and risk factors of schizophrenia-associated aggression from 2011 to 2015. *J. Int. Med. Res.* 46, 4039–4049. doi: 10.1177/0300060518786634

Zhou, J. S., Zhong, B. L., Xiang, Y. T., Chen, Q., Cao, X. L., Correll, C. U., et al. (2015). Prevalence of aggression in hospitalized patients with schizophrenia in China: a meta-analysis. *Asia Pac. Psychiatry* 8, 60-69. doi: 10.1111/appy.12209

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Analysis of Drug and Health Resource Use Before and After COVID-19 Lockdown in a Population Undergoing Treatment for Depression or Anxiety

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Introduction: The arrival of the COVID-19 pandemic modified the functions of Primary Care (PC) teams, which were forced to focus their resources on the diagnosis and treatment of SARS-CoV-2 infected patients. The disrupted healthcare of individuals with pre-existing mental disorders (depression or anxiety), as well as the psychological decompensation resulting from the lockdown caused by the COVID-19 pandemic, may have modified the use of drugs and health resources by these patients. The aim of this study is to determine the changes in these parameters, between the 6 months prior to the lockdown (09/14/2019 to 03/15/2020) and the 6 months following its end (05/03/2020 to 11/04/2020), in a population undergoing active treatment for depression or anxiety, according to the electronic clinical record.

Materials and Methods: Real world data observational study of 110,694 individuals aged >16 years suffering from active or undergoing treatment for depression or anxiety according to the electronic medical records of the Aragon Regional Health Service (Spain). Pharmacological variables [daily dose per inhabitant (DHD) dispensed by pharmacies of: anxiolytics, hypnotics/sedatives, and antidepressants] and variables related to the use of healthcare resources (number of primary and specialized healthcare visits) were considered. Student's T-tests for paired samples were performed to analyze differences between periods (pre–post). The level of significance was established at 5% ($p < 0.05$).

Results: The use of anxiolytic drugs increased as compared to its use over the 6 months prior to the lockdown. In contrast, the consumption of antidepressants was found to decrease. The use of health resources continued to be below pre-pandemic levels, 6 months post-lockdown end.

Conclusion: Changes in the use of health resources could have a negative impact on the parameters of these diseases. The increase in drug use, especially benzodiazepines, may suggest a worsening of the symptoms during the lockdown and in the subsequent months. It is a worrying sign, which points to the growth of this public health problem and the need for its prevention.

Keywords: COVID-19, depression, anxiety, quarantine, lifestyle, primary health care

INTRODUCTION

In March of 2020, the World Health Organization (WHO) declared the COVID-19 pandemic (World Health Organization (WHO), 2020a). Since then, the global population has been exposed to an endless number of stressful events. The huge threat presented by this new virus has forced numerous governments to implement restrictive measures that included limited mobility and at-home confinement. With the continued rise in infections and deaths, Spain's government declared a national state of alarm on 15 March 2020, placing the population in an unprecedented lockdown (Gobierno de España, 2020). These restrictive measures were useful in decreasing the incidence of cases, but they had a major impact on the physical and psychological wellbeing of the population (Ramírez-Ortiz et al., 2020; Valdés-Florido et al., 2020); especially for those who suffer from pre-existing mental disorders (Sheridan Rains et al., 2021).

Despite the high global morbidity caused by these disorders, mental health continues to be one of the most neglected areas of healthcare. Many of these disorders are treated in Primary Healthcare (World Health Organization (WHO), 2018), where the prevalence of psychiatric morbidity ranges between 25 and 30% (Garcia-Toro et al., 2012) and where one out of every four patient appointments is due to these disorders (Gobierno de Canarias, 2008).

The collapse of Primary Care (PC) services at the onset of the COVID-19 pandemic may have interrupted the continuous healthcare services of these patients (World Health Organization (WHO), 2012; Kozloff et al., 2020; United Nations, 2020); and similarly, the fear of infection may have lowered the demand at healthcare centers (World Health Organization (WHO), 2020b), causing the anticipated psychopathological imbalances and an increased a posteriori demand (World Health Organization (WHO), 2012; Kozloff et al., 2020).

Social and physical distancing measures may have also had an especially negative impact on individuals suffering from mental disorders (Kozloff et al., 2020). Maintaining daily routines and social relationships is essential for the proper handling of these disorders (Druss, 2020; Kozloff et al., 2020; Sheridan Rains et al., 2021). Therefore, the interruption of these routines during the lockdown months may have exacerbated their symptoms (Fernández-Aranda et al., 2020; Zhou et al., 2020; Sheridan Rains et al., 2021). and might have favor the acquisition of unhealthy habits, which may, in turn, might have influence the physical health of these patients. In them are frequent comorbidities with other physical and also psychiatric pathologies (Firth et al., 2019).

Despite the considerable changes in daily routines and the potential decline in healthcare services provided to these patients during this crucial lockdown period, few studies have considered the impact of the COVID-19 pandemic and lockdown on the population suffering from pre-existing mental disorders (Vindegaard and Benros, 2020; Sheridan Rains et al., 2021). The few studies that have been carried out on this topic have tended to assess the short-term impact of this situation (during the peak of the pandemic) (Fernández-Aranda et al., 2020; Hao et al., 2020; Liu et al., 2020) using self-completion questionnaires (Vindegaard and Benros, 2020). The use of drugs as anxiolytics and anti-depressants as well as the consumption of health care resources are quantifiable data that can reveal behavioral change (feelings of sadness or anxiety, anhedonia, sleep disturbances, irritability, frustration, etc.) in his population. These indicators could be an indirect means of revealing the variation in psychological suffering of the population. The objective of this study is to determine and to analyze these changes, between the 6 months prior to the lockdown and the 6 months following its end, in a population undergoing active treatment for depression or anxiety, according to the electronic clinical record (ECR).

MATERIALS AND METHODS

Design and Study Population

A real world data observational study of a population of northern Spain (Aragon) over the age of 16, undergoing active treatment for depression or anxiety, according to the ECR.

Patients having registered episodes of depression or anxiety have been included [codes F30–F39 and F41 of the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10)], as well as those who, during the study period, had been dispensed some of the active ingredients used to treat these two disorders, according to the Spanish Society of Family and Community Medicine (semFYC) (Sociedad Española de Medicina de Familia y Comunitaria [semFYC], 2020a,b). According to the anatomical, therapeutic, and chemical classification (ATC), the following analyzed codes were considered: N05B (anxiolytic drugs), N05C (hypnotics and sedatives), and N06A (antidepressants).

For each individual, information was obtained from their ECR during the two distinct time periods. The first measurement was taken from the records from the 6 months prior to the onset of the lockdown (09/14/2019 to 03/15/2020) and the second was taken from the records from the 6 months following the end of the lockdown (05/03/2020 to 11/04/2020).

The ECR is extensively consolidated in Spain and Aragon, where it was fully implemented in 2011. The data contained in it are generated throughout the healthcare process (hospital and PC) for patients seen by the National Healthcare System (90% coverage). This information is unified and available for all healthcare professionals in the system.

Variables

Sex, age, pharmaceutical provision, and basic rural or urban health area (with more than 10,000 inhabitants), were the sociodemographic variables included in this study. For each of the measurement periods, the number of deaths in the study population was also considered; also chronic comorbidities with prevalences of over 5% were considered (Calderón-Larrañaga et al., 2017) [arrhythmias, heart failure, ischemic cardiopathy, dyslipidemia, obesity, excess weight, vein and artery disease, cerebrovascular disease, diabetes, chronic bronchitis, chronic obstructive pulmonary disease (COPD), asthma, chronic kidney disease, hypo and hyperthyroidism, tobacco use, alcoholism, insomnia, attempted suicide, anemia, neoplasia, dementia, deafness, cataracts, glaucoma, arthrosis, osteoporosis, and back pain].

Changes in drug consumption patterns have been assessed via the variation in daily dose per inhabitant (DHD) dispensed by pharmacies. Based on the defined daily dose (DDD) stipulated by the WHO, DHDs were calculated according to the formula shown below:

$$DHD = \frac{Registered\ consumption\ of\ the\ active\ ingredient \times 1,000\ inhabitants}{Standard\ DDD \times no.inhabitants/period \times 365\ days} \quad (1)$$

To calculate this unit of measurement, firstly we considered as denominator the population undergoing active treatment for depression or anxiety. After that, we considered as denominator the total population of Aragon in the middle of each period.

Use of healthcare resources by these patients during the two study periods was assessed according to the use of PC services (number of nursing or general practitioner visits at the healthcare center or number of at-home healthcare visits and number of visits to other healthcare center professionals: physiotherapists, midwives, odontostomatologists, and social workers) and of hospital services [number of specialized care visits, number of diagnostic tests performed, number of visits to urgent care services, hospitalizations, and admission to intensive care units (ICU) and the duration of these stays].

Statistical Analysis

The large sample size permits the use of parametric analysis methods (Lubin et al., 2005). Frequencies, means, and standard variations were used for the descriptive analysis of the study variables.

To determine variations in drug consumption, the DHD for each period and their annual equivalents were calculated. To compare the differences in the use of healthcare resources between the base measurement and the measurement taken 6 months following the lockdown, the paired Student's T-test was used. For those variables with fewer number of observations than 100, Wilcoxon rank test was used. The level of significance was established at 5% ($p < 0.05$).

Statistical analysis was carried out using IBM SPSS Statistic 21 and R version 4.0.5.

Ethical Considerations

The protocol followed for this study was approved by the Clinical Research Ethics Committee of Aragon (PI20–175). The procedures carried out for the creation of this work complied with the ethical standards of the previously mentioned committee and with the 1975 Declaration of Helsinki.

The processing, notification, and transfer of personal data were carried out in accordance with Regulation (EU) 2016/679 of the European Parliament and Organic Law 03/2018 on the Protection of Personal Data and the guarantee of digital rights.

RESULTS

Prior to the onset of the lockdown in Aragon, according to the ECR, 110,694 individuals over the age of 16 were undergoing active treatment for depression or anxiety. Of these, 5,104 (4.61%) were positive for COVID-19 infection during the study period. As for the number of deaths, 1,804 individuals passed away during this period: 4 during the 6 months prior to the onset of the lockdown, 242 during the at-home lockdown months, and 1,558 during the subsequent 6 months.

The sample, having a mean age of 61.7 years (16.9), consisted mainly of women (74.4%). Over 70% had an annual income of less than 18,000 euros (70.3%), and over 50% resided in urban areas (53.4%). Regarding to the presence of comorbidities, dyslipidemia (45.9%), hypertension (40.5%), back pain (35.9%), neoplasia (29.5%), and insomnia (20.0%) were the most frequent chronic conditions found in the study population (**Table 1**).

Table 2 shows the variations in the consumption of drugs for the treatment of depression and anxiety among the population undergoing active treatment for these disorders and among general population. With respect to the pharmacological treatment of anxiety, in both groups there were a notable increase in the number of DHD of Alprazolam, Lormetazepam, and Lorazepam during the 6 months following the end of the lockdown. Other drugs, such as Triazolam or Brotizolam also experienced an increase in use among the population with depression and anxiety and among the general population, although to a lesser degree. With reference to anti-depressants, the number of DHD of both non-selective monoamine oxidase-inhibitors (MAO) and selective serotonin reuptake inhibitors (SSRIs), decreased as compared to the 6 months prior to the onset of the lockdown in both populations groups.

As seen in **Table 3**, the number of ordinary and continuous PC nursing or general practitioner visits at the healthcare center or at-home visits were reduced during the 6 months after the end of the lockdown. Only the number of visits to the PC general practitioner at the healthcare center or by telephone increased during this same period [$p < 0.001$ (95% CI: −0.23 to −0.16)]. Similarly, the number of visits to other professionals at the healthcare center, such as midwives [$p = 0.003$ (95% CI: −0.72 to

TABLE 1 | Sociodemographic date and chronic comorbidities in patients suffering from anxiety or depression in Aragon.

	N (%)
Sex	
Men	28, 294 (25.6)
Women	82, 400 (74.4)
Age	
Mean (SD)	61.7 (16.9)
Pharmaceutical service	
<18,000	77, 779 (70.3)
Between 18,000–100,000	26, 514 (24.0)
>100,000	391 (0.4)
Free pharmacy	5, 505 (5.0)
Mutualist	474 (0.4)
Uninsured	31 (0.0)
Basic health area	
Urban	59, 161 (53.4)
Rural	51, 533 (46.6)
Chronic comorbidities (yes %)	
Arrhythmias	7, 828 (7.1)
Heart failure	3, 343 (3.0)
Ischemic heart disease	5, 495 (5.0)
Hypertension	44, 884 (40.5)
Dyslipidemia	50, 792 (45.9)
Obesity	15, 621 (14.1)
Overweight	2, 432 (2.2)
Disease in veins/arteries	3, 091 (2.8)
Cerebrovascular disease	6, 613 (6.0)
Diabetes	14, 295 (12.9)
Chronic bronchitis	1, 592 (1.4)
COPD	4, 556 (4.1)
Asthma	9, 398 (8.5)
Chronic kidney disease	7, 403 (6.7)
Hypothyroidism	16, 011 (14.5)
Hyperthyroidism	6, 652 (6.0)
Smoking	20, 648 (18.7)
Alcoholism	2, 013 (1.8)
Insomnia	22, 105 (20.0)
Autolytic attempt	1, 075 (1.0)
Anemia	20, 372 (18.4)
Neoplasia	32, 657 (29.5)
Dementia	4, 034 (3.6)
Hearing loss	9, 911 (9.0)
Cataracts	14, 107 (12.7)
Glaucoma	8, 500 (7.7)
Osteoarthritis	14, 001 (12.6)
Osteoporosis	16, 882 (15.3)
Back pain	39, 788 (35.9)

SD, standard deviation; COPD, chronic obstructive pulmonary disease.

TABLE 2 | Number of DHD 6 months before and 6 months after lockdown.

	DHD (patients suffering from anxiety or depression)		DHD (general population)	
	Six months before	Six months after	Six months before	Six months after
Anxiolytics				
Diazepam	14.22	14.19	1.18	1.18
Potassium clorazepate	3.00	2.98	0.25	0.25
Lorazepam	196.74	198.38	16.38	16.50
Bromazepam	3.30	3.26	0.27	0.27
Clobazam	0.16	0.16	0.01	0.01
Ketazolam	0.96	0.95	0.08	0.08
Alprazolam	305.61	316.80	25.44	26.35
Pinazepam	0.004	0.004	0.00	0.00
Bentazepam	0.005	0.000	0.00	0.00
Hypnotics and sedatives				
Flurazepam	0.20	0.20	0.02	0.02
Triazolam	2.35	2.48	0.19	0.21
Lormetazepam	452.00	459.21	37.63	38.19
Midazolam	0.26	0.28	0.02	0.02
Brotizolam	5.18	5.98	0.43	0.50
Quazepam	0.02	0.03	0.00	0.00
Loprazolam	4.15	3.90	0.34	0.32
Antidepressants				
Non-selective monoamine reuptake inhibitors				
Imipramine	0.01	0.01	0.00	0.00
Clomipramine	0.19	0.18	0.02	0.01
Trimipramine	0.00	0.00	0.00	0.00
Amitriptyline	0.50	0.49	0.04	0.04
Nortriptyline	0.04	0.03	0.00	0.00
Doxepin	0.00	0.00	0.00	0.00
Maprotiline	0.02	0.01	0.00	0.00
Selective serotonin reuptake inhibitors				
Fluoxetine	9.78	9.78	0.81	0.81
Citalopram	3.31	3.13	0.27	0.26
Paroxetine	12.98	12.49	1.08	1.04
Sertraline	5.40	5.39	0.45	0.45
Fluvoxamine	0.07	0.07	0.00	0.00
Escitalopram	60.82	58.45	5.06	4.86

previous 6 months [$p = 0.003$ (95% CI: -0.10 to -0.2)]. On the other hand, the number of follow-up visits to these same services decreased [$p < 0.001$ (95% CI: 0.03 to 0.08)].

Diagnostic imaging (X-rays and ultrasounds) and laboratory testing (blood counts, bio-chemical analyses, and immunological tests) experienced a statistically significant decrease ($p \leq 0.001$). There was also a statistically significant increase found in resonance and microbiological testing ($p < 0.05$).

Finally, visits to hospital services (number of visits to urgent care and number of hospitalizations), also decreased during the study period ($p < 0.001$).

-0.14)], dentists [$p = 0.033$ (95% CI: -0.47 to -0.02)], and social workers [$p = 0.001$ (95% CI: -0.67 to -0.17)] increased; unlike the number of visits to physiotherapists, which experienced a notable decline [$p < 0.001$ (95% CI: 1.27 to 2.45)].

Regarding to the number of visits to specialists, the number of initial visits to these services increased as compared to the

TABLE 3 | Number of visits and diagnostic tests prescribed 6 months before and 6 months after lockdown.

	N	Mean (SD)		95% CI	P
		Six months before	Six months after		
Number of nursing visits (ordinary care) at health center or by telephone	45,428	3.91 (4.50)	3.56 (4.17)	0.31; 0.39	< 0.001
Number of nursing visits (ordinary care) at home	4,674	5.98 (8.47)	5.70 (8.48)	0.03; 0.53	0.025
Number of nursing visits (continuous care) at health center	3,727	2.20 (3.21)	1.89 (2.77)	0.23; 0.39	< 0.001
Number of nursing visits (continuous care) at home	615	2.21 (2.90)	2.19 (4.63)	−0.37; 0.42	0.903
Number of general practitioner visits (ordinary care) at health center or by telephone	92,640	5.98 (5.10)	6.18 (5.69)	−0.23; −0.16	< 0.001
Number of general practitioner visit (ordinary care) at home	3,290	3.56 (3.82)	2.80 (3.19)	0.64; 0.89	< 0.001
Number of general practitioner visits (continuous care) al health center	9,358	2.06 (2.38)	2.07 (2.48)	−0.06; 0.04	0.715
Number of general practitioner visits (continuous care) at home	743	1.80 (1.44)	1.66 (1.34)	0.02; 0.26	0.022
Number of visits to other professionals					
Physiotherapist	678	6.30 (6.95)	4.44 (4.68)	1.27; 2.45	< 0.001
Midwife	584	2.35 (2.18)	2.79 (2.86)	−0.72; −0.14	0.003
Dentist	383	2.09 (1.67)	2.34 (1.77)	−0.47; −0.02	0.033
Social worker	653	2.63 (2.52)	3.06 (3.14)	−0.67; −0.17	0.001
Number of visits to specialized care (first consultation)	3,883	1.47 (0.85)	1.53 (0.92)	−0.10; −0.2	0.003
Number of visits to specialized care (successive consultations)	29,264	2.72 (2.32)	2.66 (2.41)	0.03; 0.08	< 0.001
Number of diagnostic tests performed					
X-rays	20,114	1.12 (1.23)	0.98 (1.19)	0.11; 0.16	< 0.001
Ultrasounds	20,114	0.30 (0.54)	0.28 (0.52)	0.01; 0.03	< 0.001
Resonances	20,114	0.14 (0.39)	0.15 (0.39)	−0.02; −0.01	0.010
CT scans	20,114	0.25 (0.57)	0.25 (0.57)	−0.01; 0.00	0.178
Digestive tests	20,114	0.01 (0.11)	0.01 (0.10)	−0.00; 0.00	0.921
Hemograms	22,451	0.30 (0.54)	0.26 (0.52)	0.03; 0.05	< 0.001
Biochemistry	22,451	1.01 (0.69)	0.90 (0.74)	0.10; 0.12	< 0.001
Microbiology	22,451	0.28 (0.67)	0.38 (0.79)	−0.11; −0.09	< 0.001
Immunology tests	22,451	0.11 (0.35)	0.10 (0.34)	0.00; 0.01	0.001
Coagulation	22,451	0.03 (0.19)	0.04 (0.20)	−0.01; −0.00	0.005
Urine tests	22,451	0.32 (0.59)	0.25 (0.56)	0.05; 0.07	< 0.001
Number of visits to A&E department	7,238	1.89 (1.67)	1.75 (1.49)	0.10; 0.18	< 0.001
Number of hospital admissions	6,413	1.27 (0.67)	0.28 (0.71)	0.96; 1.00	< 0.001
Number of days of hospital stays	1,230	16.66 (37.60)	17.11 (35.80)	−1.73; 0.83	0.493
Number of ICU admissions	5	1.00 (0.00)	1.00 (0.00)		*
Number of days of ICU stays	5	108.80 (73.24)	100.80 (81.12)	−40.00; 0.01	0.317[a]

*The correlation and t cannot be calculated because the standard error of the differences is 0. A&E, accident and emergency; ICU, intensive care unit; SD, standard deviation; 95% CI, confidence interval. [a]Wilcoxon signed-rank test.

DISCUSSION

The results of our study reveal variations in the total number of DHD dispensed in pharmacies for the pharmacological groups included in this study: N05B (anxiolytic drugs), N05C (hypnotics and sedatives), and N06A (antidepressants).

Regarding the increase observed in the total number of DHD of anxiolytic drugs (Alprazolam, Lormetazepam, and Lorazepam, mainly) during the 6 months following the onset of the lockdown; only one previous study, conducted in France on patients with depression, revealed similar results (Martinelli et al., 2021). Larger number of studies have analyzed the impact of the COVID-19 pandemic on the symptoms of patients having a past history of anxiety or depression. Individuals with prior mental illnesses appear to have had a higher risk or reporting increased levels of stress, anxiety, depression, impulsivity, anger, insomnias, or suicidal thoughts as compared to the general population (Hao et al., 2020; Liu et al., 2020). The increase in consumption of anxiolytic drugs shown in our study may be explained by the worsening of these symptoms (Martinelli et al., 2021). According to the Spanish Agency for Medicines and Medicinal Devices (AEMPS), at the end of 2019, the DHD of these drugs was 55.51. During the first quarter of 2020, it increased to 57.19, and by the fourth quarter of 2020, the consumption level peaked at 58.69 DHD (Agencia Española de Medicamentos y Productos Sanitarios (AEMPS), 2021). Spain, one of the hardest-hit countries during the first wave of the COVID-19 pandemic (Kontis et al., 2020), was already (before the healthcare crisis) ranked third amongst the European OECD (Organization for Economic Co-operation and Development) countries in terms of consumption of anxiolytic drugs, especially by women (Simó, 2018).

With respect to the minor decline in the number of DHD for anti-depressants, similar results were found in a

study carried out in Portugal (Estrela et al., 2021). According to another study conducted in Aragon (Mestre, 2021), the follow-up period used for our study (6 months following the end of the lockdown) may be insufficient for the detection of changes in the consumption of these drugs. Immediately following the onset of the pandemic and throughout 2020, this study did not report any substantial changes in the prescribing of anti-depressants. As of 2021, however, an increased consumption became evident. This may be due to the continued pandemic situation.

The use of primary level care by these patients also declined during the months following the end of the lockdown. Previously published works (Firth et al., 2019) found interruptions in the care given to these patients as well as a redistribution of resources in response to the high number of positive COVID-19 cases. The increase observed in the number of PC visits to the general practitioner at the healthcare center or by telephone may be explained by the introduction of telemedicine, as a more effective alternative to in-person visits. Mental health is one of the specialties that best adapts to this tool, given that physical examination is not essential (Vieta et al., 2020).

The social and economic impact of the pandemic on the most vulnerable groups *a priori*, may be a cause of the increased social services demands (Grupo Estatal de Intervención en Emergencias Sociales, 2020). As for the increased number of visits to midwifes, although some studies (Ivanuš et al., 2021) suggest a decrease in the number of cervical cytology test during lockdown. The postponement of these visits to the midwife during the lockdown months might have led to an increased number of visits during the months following the end of this confinement period. In the same way, other studies (Davenport et al., 2020; Domínguez-Mejías et al., 2021) reveal an increase in symptoms of anxiety and depression amongst pregnant women during the pandemic months, which might have increased the number of these visits. Similarly might have occurred with the visits to the dentist. Postponing minor treatments may have led to larger problems (Elster and Parsi, 2021).

Finally, the increased number of initial visits to specialists may be a result of the declining physical health of these patients. Some studies (Van Rheenen et al., 2020) have revealed an increase in high-risk behaviors (alcohol consumption) during the pandemic months amongst individuals with previous mental illness; who usually have a higher number of comorbidities (obesity, diabetes, and cardiovascular illnesses) as compared to the general population (Firth et al., 2019), as well as higher prevalences of tobacco use (Prochaska et al., 2017).

The progressive increase in deaths is noteworthy. This increase, which may be the subject of future studies, may be related to the major impact of the first wave of the pandemic on Spain and its social and economic consequences. According to a recently published study (COVID-19 Mental Disorders Collaborators, 2021) in the most harshly hit countries (by the pandemic), an increased prevalence of depression and anxiety is anticipated. Both of these disorders and, even more so, the comorbidity between the two, are considered to be major risk

factors in suicidal behavior (Moitra et al., 2021). The excess of mortality observed in our study during the 6 months following the end of the lockdown period may be explained in part by this fact. Statistics on suicide published in Spain in 2020 revealed an increase of 7.4% as compared to the prior year, a historical maximum (Fundación Española para la prevención del suicidio, 2021).

Any study should be interpreted with caution. Our choice was to analyze the changes in behavior over a short period, between 6 months before and 6 months after lockdown, by collating the modification of the use of the care system and of anti-depressant and anxiety drugs. Starting from a postula: these increases reflect not only the increase in psychological suffering in these patients but also, they may be a proxy for the increase in prevalences of depression in general population.

Although the sample size was large, the mean age of the sample was high (61.7 years).The duration of the study may not be long enough to see variations in the severity of depression. Depression is a disease that sets in gradually. While anxiety is subject to greater variability. But the significant increase in the use of anxiolytics is a warning sign. Studies should be continued to confirm or not the increase in the prevalence of depression, possibly expected thereafter.

Our source of information was a registry: the ECR. But this is not enough to provide objective information on the impact of the pandemic on the mental health of patients. To ensure the diagnosis of depression, the use of validated scales [Goldberg Anxiety and Depression Scale (GADS), Hamilton Anxiety Rating Scale, Beck Anxiety Inventory, etc.] will be necessary. In addition, it would be interesting to organize a qualitative research to complement this analysis. A cohort study using diagnostic tools to perform the sampling would be very useful in answering this question: are we on the cusp of an increase in depression in the general population due to the pandemic and which ones are the measures to deal with it?

Finally, the number of statistical tests and calculated *p*-values in this article is large and therefore needs to be confirmed in further studies.

CONCLUSION

This study offers contributions, from a long-term perspective, with regard to the knowledge of the repercussions of lockdown measures on the use of drugs and health care resources, in a sample of patients undergoing active treatment for anxiety and/or depression, according to the ECR.

The COVID-19 response should consider the mental health of the general population and should be especially cautious when considering more vulnerable groups, such as those with a past clinical history of depression or anxiety. Today, more than ever, it is necessary to invest in mental health services in an attempt to halt the anticipated growth of these disorders. Today, more than ever, it is necessary to invest in research and support measures for mental health services, to halt the anticipated growth of these disorders and the suffering in the population.

DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to the following licenses/restrictions: the data generated during the course of the project may be requested from the senior researcher of the project, in aggregate form. Requests to access these datasets should be directed to BO-B.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Clinical Research Ethics Committee of Aragon (PI-20/175). Written informed consent from the participants' legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

AUTHOR CONTRIBUTIONS

BO-B: conceptualization. SC-V, AC, BO-B, and AL-C: formal analysis. AL-C: writing—original draft preparation. AC, PN, BO-B, and SC-V: writing—review and editing. AC and BO-B: supervision. All authors have read and agreed to the published version of the manuscript.

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REFERENCES

Agencia Española de Medicamentos y Productos Sanitarios (AEMPS) (2021). *Utilización de Medicamentos Ansiolíticos e Hipnóticos en España Durante el Periodo 2010 – 2019.* Available online at: https://www.aemps.gob.es/medicamentos-de-uso-humano/observatorio-de-uso-de-medicamentos/informes-ansioliticos-hipnoticos/ (accessed January 24, 2022).

Calderón-Larrañaga, A., Vetrano, D. L., Onder, G., Gimeno-Feliu, L. A., Coscollar-Santaliestra, C., Carfí, A., et al. (2017). Assessing and measuring chronic multimorbidity in the older population: a proposal for its operationalization. *J. Gerontol. Biol. Sci. Med. Sci.* 72, 1417–1423. doi: 10.1093/gerona/glw233

COVID-19 Mental Disorders Collaborators (2021). Global prevalence and burden of depressive and anxiety disorders in 204 countries and territories in 2020 due to the COVID-19 pandemic. *Lancet* 398, 1700–1712. doi: 10.1016/S0140-6736(21)02143-7

Davenport, M. H., Meyer, S., Meah, V. L., Strynadka, M. C., and Khurana, R. (2020). Moms are not ok: COVID-19 and maternal. *Mental Health Front. Glob. Womens Health* 1:1. doi: 10.3389/fgwh.2020.00001

Domínguez-Mejías, M., Culsán-Fernández, R., and Ortigosa-Arrabal, A. (2021). Impacto de la pandemia por Covid-19 durante el embarazo. alteraciones psicológicas. *SANUM* 5, 20–31.

Druss, B. G. (2020). Addressing the COVID-19 pandemic in populations with serious mental illness. *JAMA Psychiatry* 77, 891–892. doi: 10.1001/jamapsychiatry.2020.0894

Elster, N., and Parsi, K. (2021). Oral health matters: the ethics of providing oral health during COVID-19. *HEC Forum Int. J. Hospitals' Ethical Legal Issues* 33, 157–164. doi: 10.1007/s10730-020-09435-3

Estrela, M., Silva, T. M., Gomes, E. R., Piñeiro, M., Figueiras, A., Roque, F., et al. (2021). Prescription of anxiolytics, sedatives, hypnotics and antidepressants in outpatient, universal care during the COVID-19 pandemic in portugal: a nationwide, interrupted time-series approach. *J. Epidemiol. Commun. Health* 2021:216732. doi: 10.1136/jech-2021-216732

Fernández-Aranda, F., Casas, M., Claes, L., Bryan, D. C., Favaro, A., Granero, R., et al. (2020). COVID-19 and implications for eating disorders. *Eur. Eat. Dis. Rev.* 28, 239–245. doi: 10.1002/erv.2738

Firth, J., Siddiqi, N., Koyanagi, A., Siskind, D., Rosenbaum, S., Galletly, C., et al. (2019). The lancet psychiatry commission: a blueprint for protecting physical health in people with mental illness. *Lancet Psychiatry* 6, 675–712. doi: 10.1016/S2215-0366(19)30132-4

Fundación Española para la prevención del suicidio (2021). *Observatorio del Suicidio en España.* Available online at: https://www.fsme.es/observatorio-del-suicidio-2020/ (accessed January 24, 2022).

Garcia-Toro, M., Roca, M., Monzón, S., Vives, M., Oliván, B., Vicens, E., et al. (2012). Hygienic-dietary recommendations for major depression treatment: study protocol of a randomized controlled trial. *BMC Psychiatry* 12:201. doi: 10.1186/1471-244X-12-201

Gobierno de Canarias (2008). *Salud Mental en Atención Primaria – Recomendaciones Para El Abordaje De Los Trastornos Más Prevalentes.* Available online at: https://www3.gobiernodecanarias.org/sanidad/scs/content/f52829a1-f9cb-11dd-9d99-e96480bea708/salud_mental_at_pr.pdf (accessed January 24, 2022).

Gobierno de España (2020). *Real Decreto 463/2020, de 14 de Marzo, Por el Que se Declara el Estado de Alarma Para la Gestión de La Situación de Crisis Sanitaria Ocasionada Por el COVID - 19.* Available online at: https://www.boe.es/buscar/doc.php?id=BOE-A-2020-3692 (accessed January 24, 2022).

Grupo Estatal de Intervención en Emergencias Sociales (2020). *Actuaciones del Trabajo Social Ante El COVID-19.* Available online at: https://www.cgtrabajosocial.es/files/5f213639cbc10/COVID_II_WEB.pdf (accessed January 24, 2022).

Hao, F., Tan, W., Jiang, L., Zhang, L., Zhao, X., Zou, Y., et al. (2020). Do psychiatric patients experience more psychiatric symptoms during COVID-19 pandemic and lockdown? A case-control study with service and research implications for immunopsychiatry. *Brain Behav. Immun.* 87, 100–106. doi: 10.1016/j.bbi.2020.04.069

Ivanuš, U., Jerman, T., Gašper Oblak, U., Meglič, L., Florjančič, M., Strojan Fležar, M., et al. (2021). The impact of the COVID-19 pandemic on organised cervical cancer screening: the first results of the Slovenian cervical screening programme and registry. *Lancet Reg. Health. Eur.* 5;100101. doi: 10.1016/j.lanepe.2021.100101

Kontis, V., Bennett, J. E., Rashid, T., Parks, R. M., Pearson-Stuttard, J., Guillot, M., et al. (2020). Magnitude, demographics and dynamics of the effect of the first wave of the COVID-19 pandemic on all-cause mortality in 21 industrialized countries. *Nat. Med.* 26, 1919–1928. doi: 10.1038/s41591-020-1112-0

Kozloff, N., Mulsant, B. H., Stergiopoulos, V., and Voineskos, A. N. (2020). The COVID-19 global pandemic: implications for people with schizophrenia and related disorders. *Schizophr Bull.* 46, 752–757. doi: 10.1093/schbul/sbaa051

Liu, C. H., Stevens, C., Conrad, R. C., and Hahm, H. C. (2020). Evidence for elevated psychiatric distress, poor sleep, and quality of life concerns during the

COVID-19 pandemic among U.S. young adults with suspected and reported psychiatric diagnoses. *Psychiatry Res.* 292:113345. doi: 10.1016/j.psychres.2020.113345

Lubin, P., Maciá Antón, M. A., and Rubio de Lemus, P. (2005). *Mathematical Psychology*. Madrid: Universidad Nacional de Educación a Distancia.

Martinelli, N., Gil, S., Chevalère, J., Belletier, C., Dezecache, G., Huguet, P., et al. (2021). The impact of the COVID-19 pandemic on vulnerable people suffering from depression: two studies on adults in france. *Int. J. Environ. Res. Public Health* 18:3250. doi: 10.3390/ijerph18063250

Mestre, G. (2021). *Aragón Detecta un Incremento del Consumo de Ansiolíticos y Antidepresivos Durante la Pandemia. Heraldo de Aragón.* Available online at: https://www.heraldo.es/noticias/aragon/2021/05/23/aragon-detecta-un-incremento-del-consumo-de-antidepresivos-durante-la-pandemia-1494159.html?autoref=true (accessed May 23, 2021)

Moitra, M., Santomauro, D., Degenhardt, L., Collins, P. Y., Whiteford, H., Vos, T., et al. (2021). Estimating the risk of suicide associated with mental disorders: a systematic review and meta-regression analysis. *J. Psychiatr. Res.* 137, 242–249. doi: 10.1016/j.jpsychires.2021.02.053

Prochaska, J. J., Das, S., and Young-Wolff, K. C. (2017). Smoking, mental illness, and public health. *Ann. Rev. Public Health* 38, 165–185. doi: 10.1146/annurev-publhealth-031816-044618

Ramírez-Ortiz, J., Castro-Quintero, D., Lerma-Córdoba, C., Yela-Ceballos, F., and Escobar-Córdoba, F. (2020). Mental health consequences of the COVID-19 pandemic associated with social isolation. *Colomb. J. Anesthesiol.* 48:e930. doi: 10.5554/22562087.e930

Sheridan Rains, L., Johnson, S., Barnett, P., Steare, T., Needle, J. J., Carr, S., et al. (2021). Early impacts of the COVID-19 pandemic on mental health care and on people with mental health conditions: framework synthesis of international experiences and responses. *Soc. Psychiatry Psychiatr. Epidemiol.* 56, 13–24. doi: 10.1007/s00127-020-01924-7

Simó, J. (2018). *Uso de Psicofármacos en España y Europa (2000 – 2015). Salud, Dinero y Atención Primaria [Blog Post].* Available online at http://saludineroap.blogspot.com/2018/04/uso-de-psicofarmacos-en-espana-y-europa.html (accessed January 24, 2022).

Sociedad Española de Medicina de Familia y Comunitaria [semFYC] (2020a). *Guía Terapéutica en Atención Primaria Basada en la Selección Razonada de Medicamentos. Ansiedad Generalizada.* Available online at: https://www.guiaterapeutica.net/problemas/tipo/4/problema/61/ (accessed January 24, 2022).

Sociedad Española de Medicina de Familia y Comunitaria [semFYC]. (2020b). *Guía Terapéutica en Atención Primaria Basada en la Selección Razonada de Medicamentos. Depresión Mayor.* Available online at: https://www.guiaterapeutica.net/problemas/tipo/4/problema/64/ (accessed January 24, 2022).

United Nations (2020). *Policy Brief: COVID - 19 and the Need for Action on Mental Health.* Available online at: https://unsdg.un.org/sites/default/files/2020-05/UN-Policy-Brief-COVID-19-and-mental-health.pdf (accessed January 24, 2022).

Valdés-Florido, M. J., López-Díaz, Á, Palermo-Zeballos, F. J., Martínez-Molina, I., Martín-Gil, V. E., Crespo-Facorro, B., et al. (2020). Reactive psychoses in the context of the COVID-19 pandemic: clinical perspectives from a case series. *Rev. Psiquiatr. Salud. Ment.* 13, 90–94. doi: 10.1016/j.rpsm.2020.04.009

Van Rheenen, T. E., Meyer, D., Neill, E., Phillipou, A., Tan, E. J., Toh, W. L., et al. (2020). Mental health status of individuals with a mood-disorder during the COVID-19 pandemic in Australia: initial results from the COLLATE project. *J. Affect. Dis.* 275, 69–77. doi: 10.1016/j.jad.2020.06.037

Vieta, E., Pérez, V., and Arango, C. (2020). Psychiatry in the aftermath of COVID-19. *Rev. Psiquiatr. Salud. Ment.* 13, 105–110. doi: 10.1016/j.rpsm.2020.04.004

Vindegaard, N., and Benros, M. E. (2020). COVID-19 pandemic and mental health consequences: systematic review of the current evidence. *Brain Behav. Immun.* 89, 531–542. doi: 10.1016/j.bbi.2020.05.048

World Health Organization (WHO) (2012). *Carga Mundial de Trastornos Mentales y Necesidad de Que el Sector de la Salud y el Sector Social Respondan de Modo Integral y Coordinado a Escala de País.* Available online at: https://apps.who.int/iris/bitstream/handle/10665/85966/A65_10-sp.pdf?sequence=1&isAllowed=y (accessed January 24, 2022).

World Health Organization (WHO) (2018). *Mental Health in Primary Care: Illusion or Inclusion?.* Available online at: https://www.who.int/docs/default-source/primary-health-care-conference/mental-health.pdf?sfvrsn=8c4621d2_2 (accessed January 24, 2022).

World Health Organization (WHO) (2020a). *COVID - 19: Cronología de la Actuación de la OMS.* Available online at: https://www.who.int/es/news/item/27-04-2020-who-timeline---covid-19 (accessed January 24, 2022).

World Health Organization (WHO) (2020b). *The Impact of COVID-19 On Mental, Neurological and Substance Use Services.* Available online at: https://www.who.int/publications/i/item/978924012455 (accessed January 24, 2022).

Zhou, J., Liu, L., Xue, P., Yang, X., and Tang, X. (2020). Mental health response to the COVID-19 outbreak in China. *Am. J. Psychiatry* 177, 574–575. doi: 10.1176/appi.ajp.2020.2003030

Anxiety, Depression, and Concern About Employment Status of Hotel Housekeepers in the Balearic Islands During the COVID-19 Pandemic: A Longitudinal Study

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Tourism is a crucial economic sector in the Balearic Islands (Spain). COVID-19 pandemic might severely impact hotel housekeepers (HHs) due to their already precarious employment situation. The purpose is to assess the evolution of the concern about employment status, anxiety, and depression of HHs. This is a longitudinal study conducted with a subset of participants from a primary care, health promotion intervention study. Two additional visits were added (March–April and October–December 2020) for the purpose of this study. We recruited 290 HHs in March–April 2020; 237 were again interviewed during October–December 2020. In the first visit, high level of concern about employment was associated with age under 50, temporary contracts and external locus of control (LOC). Moderate–severe anxiety was associated with low social support and external LOC; moderate–severe depression was associated with low social support. Regarding the second visit, age, years working as HH, type of contract, social support, and LOC were not associated with concern about employment status, anxiety, and depression. There was a larger proportion of HHs with moderate–severe anxiety and depression among HHs with high degree of concern. Concern increased significantly among HHs: over 50 years of age; with more than 15 years in the job, a recurring seasonal contract and normal social support. After adjusting by age, type of contract, LOC, and social support, we found a statistically significant increase (12.0%) of HHs highly concerned about their job situation: compared to the first visit, HHs were 2.3 more likely to have a high degree of concern in December 2020. In contrast, increases in moderate–severe anxiety (0.3%) and depression (4.3%) between the two periods were not significant. In HHs, the COVID-19 pandemic has caused significant concern about employment status and symptoms of depression and anxiety. In the uncertain times of the pandemic, mental wellbeing benefits from variables that confer stability, such as internal LOC, perception of social support, and a stable job. Longitudinal results point at long lasting effects of the COVID-19 pandemic on mental

health. It is crucial to allocate additional resources in primary care to adequately address the anticipated influx of needs.

INTRODUCTION

The first diagnosed case of COVID-19 in Europe occurred in mid-January of 2020. The virus quickly spread throughout the continent, forcing governments to apply stringent control measures that negatively impacted the daily life of citizens, such as home confinement and closure of schools and establishments. In Spain, the lockdown officially began on 14 March 2020. While the COVID-19 pandemic had recognizable effects on the physical health of infected individuals, it also adversely affected the mental health of general population (Gao et al., 2020; Huang and Zhao, 2020; Mazza et al., 2020; Ozamiz-Etxebarria et al., 2020; Wang et al., 2020a; Zhang et al., 2020; O'Connor et al., 2021).

The measures to control COVID-19 had a drastic impact on the Spanish tourism industry. In 2018, tourism accounted for 44% of the gross domestic product (GDP) in the Balearic Islands. The Social and Economic Council of the Balearic Islands forecasted a decline of 75 to 80% in the hospitality sector by the end of 2020 (Consell Econòmic I Social de les Illes Balears, 2020). Predictably, the number of tourists arriving in the Balearic Islands fell from 16.4 million in 2019 to 3.1 in 2020 (Balearic Islands Statistics Institute). The number of tourists in Spain also fell from 83.5 M in 2019 to 18.9 M in 2020, and the contribution of the tourism sector to the GDP in 2020 was 61.4 billion Euros, less than half that of the previous year (Instituto Nacional de Estadística, 2020).

An estimated 13,000 hotel housekeepers (HHs) work in the Balearic Islands, a female-dominated sector in Spain (practically 100%; Cañada, 2018). Most HHs had recurring seasonal or temporary contracts, with no guaranteed income throughout the year. This precarious occupational status was expected to worsen. Some international organizations had forecasted that women would be more vulnerable to the COVID-19 economic crisis and affected for longer due to gender inequalities in a wide range of dimensions (income, wealth, type of jobs, and other; European Institute for Gender Equality, 2020; Organisation for Economic Cooperation and Development, 2020). Moreover, the hospitality sector has been identified as particularly sensitive to temporary layoffs (European Institute for Gender Equality, 2020). Consequently, we anticipated a major negative impact of the current socioeconomic crisis on this occupational group.

To date, several studies have examined the psychological impact of COVID-19 on the general population. Most studies recruited the sample through social networks and enrolled high percentages of well-educated people. The results of these works emphasized higher prevalences of anxiety and depression (Gao et al., 2020; Huang and Zhao, 2020), especially in women and young people (Hidalgo et al., 2020; Huang and Zhao, 2020; Mazza et al., 2020; Nienhuis and Lesser, 2020; Ozamiz-Etxebarria et al., 2020; Wang et al., 2020a; Valiente et al., 2021). In Spain, among women, prevalence of chronic anxiety was 9.1% and the prevalence of chronic depression was 9.2% in 2017 (Sanidad, 2018); in the first stages of the Spanish lockdown, Jacques-Aviñó et al. (2020) found that 31.2% of women reported anxiety symptoms and 28.5%, depression symptoms. Some studies reported poorer physical and mental health status among people who experienced work-related changes (i.e., stopped working, lost their job, and reduced working hours) during the COVID-19 pandemic (Nienhuis and Lesser, 2020; Rodríguez-Rey et al., 2020; Zhang et al., 2020). More women than men reported work-related changes (i.e., reduced hours and loss of employment), and these women expressed more generalized anxiety symptoms compared to women who had not experienced these changes (Nienhuis and Lesser, 2020). In addition, income level showed a negative correlation with fear of infection, disease and death, lack of basic necessities, social isolation, loss of work, and income (Sandín et al., 2020). During COVID-19 pandemic, lower income has been directly associated with increased anxiety and depressive symptoms (Fancourt et al., 2021; Hertz-Palmor et al., 2021).

Some longitudinal studies have analyzed population mental wellbeing throughout lockdown and afterward. Results are conflicting, since while some authors did not find significant changes in depression (Wang et al., 2020b; O'Connor et al., 2021; Pieh et al., 2021; Somma et al., 2021) and anxiety (González-Sanguino et al., 2021; Pieh et al., 2021), others show significant changes in depression and/or anxiety levels (Salfi et al., 2020; Fancourt et al., 2021; González-Sanguino et al., 2021; O'Connor et al., 2021; Somma et al., 2021). Overall, most evidence suggests an improvement in mental health indicators (or at least not deterioration) from the first stages of lockdown to weeks and months later. However, data on mental health among workers outside the health sector are scarce (Savolainen et al., 2021).

Lockdown also entailed an increase in household and childcare tasks for both men and women given the school closures and the impossibility to outsource housework. Evidence has shown that, in several countries—including Spain—, despite the increase of men's participation in housework and childcare, most of the burden continued falling on women (Giurge et al., 2021; Yaish et al., 2021), irrespective the status in the labor market (Farré et al., 2021). Additionally, Farré et al. (2021) showed that the decreasing in paid work during the lockdown affected more men than women, resulting in women working longer hours. Thus, the crisis appears to have widened the gender gap in both paid an unpaid work.

This is a longitudinal study focused on HHs, a female workforce characterized by precarious employment in a sector specially affected by COVID-19 control measures. Due to

the sociodemographic characteristics of our sample and the extended restrictions to tourism, we anticipate that HHs will be a population group strongly affected by the pandemic. We hypothesized that HHs' concerns for employment status, anxiety, and depression symptoms will increased from 1st visit: March–April 2020 to the 2nd visit: October–December 2020, and this increased could be related to age, more precarious employment status (temporary or recurring seasonal contract), years working as HHs, low social support, and an external LOC.

The objective of this study is to evaluate the degree of concern on employment status, anxiety, and depression symptoms of the first 6 months of the COVID-19 pandemic on HHs: firstly, during the first stages of lockdown and secondly, in October–December 2020. In the last trimester 2020, Spain was in the second wave of COVID-19; consequently, on the 25th October, Spanish government ruled a new state of alarm and autonomous communities adopted appropriate measures adapted to their pandemic situation. In autonomous community of the Balearic Islands, during the last trimester 2020, there were limitations in the capacity of indoor places, as well as limitations of number of people in the meetings, and curfew between 12 pm and 6 pm. We evaluated the concerns of HHs regarding their employment status and also their psychological wellbeing. The results of this study should alert occupational health services and prompt measures to improve the wellbeing of HHs.

MATERIALS AND METHODS

The study was conducted by the Primary Care Research Unit of Mallorca. Participants were a selected subset from a randomized controlled, parallel, and multicenter intervention trial to assess the efficacy of a complex intervention conducted in the primary healthcare setting, based on behavioral changes to improve the quality of life of HHs.[1] We added two visits (the first in March–April and the second in October–December 2020) to collect data for this study.

Study Population and Recruitment

Eligibility criteria age over 18 years; having health coverage in the Balearic Public Health System; having worked as HH during 2019; and consent to participate. Exclusion criteria were language barrier (not understanding Spanish or Catalan); pregnancy; being on sick leave; participating in another clinical trial aiming at modifying life styles; severe psychiatric illness; and any positive answer to the physical activity aptitude questionnaire proposed by the American College of Sports Medicine (Adams, 1999). A minimum of 269 subjects were needed to detect an increase (between the start of the pandemic and after 6 months) of at least 8% in the proportion of HHs with moderate–severe depression symptoms (measured by the PHQ-9) with 80% power, a two-sided α value of 0.05, and assuming 20% of loss to follow-up.

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[1] http://www.isrctn.com/ISRCTN14664526

Instruments

The locus of control (LOC), a measure of coping capacity defined as the perception about the cause of events happening in your life, was assessed by answering the question: To what extent do you agree with the statement: "I feel that what happens in my life is often determined by factors beyond my control?" Answers were rated on a 6-point Likert scale (Mounce et al., 2018). LOC was classified as "internal" or "external." A person with an internal LOC believes that what happens in life is a consequence of one's own actions, attitudes, or behaviors, whereas a person with an external LOC believes that life events are the result of fortune, fate, or the actions of others (Rotter, 1966).

The Duke-UNC-11 (Broadhead et al., 1988), an 11-item questionnaire that measured functional elements of social support (including confidant and affective support) and validated for the Spanish population (Cronbach's Alpha = 0.90; de la Revilla Ahumada et al., 1991; Bellón Saameño et al., 1996), was used to measure social support. Each item is valued in a 5-points scale ranging from 1 ("much less than I would like") to 5 points ("as much as I would like"). A final score ranging from 5 to 55 is obtained; 32 points or below correspond to a low social support; and more than 32 points correspond to a normal social support (Bellón Saameño et al., 1996).

Mental health status was assessed using the Generalized Anxiety Disorder (GAD-7; Spitzer et al., 2006) in its Spanish validated version (García-Campayo et al., 2010), a 7-item questionnaire that assesses self-perceived anxiety during the previous 2 weeks (Cronbach's Alpha = 0.936). For each question, the respondent gives an answer of 0 (not at all), 1 (several days), 2 (more than half of the days), or 3 (nearly every day). The Patient Health Questionnaire (PHQ-9; Spitzer et al., 2000; Diez-Quevedo et al., 2001) is a 9-item questionnaire (Cohen's Kappa = 0.74), with an additional question that measures depressive disorders during the previous 2 weeks. As above, for each question, the respondent gives an answer of 0 (not at all), 1 (several days), 2 (more than half of the days), or 3 (nearly every day).

Concern about employment status was asked with the question "In a scale from 1 to 5, in which 1 is 'the lowest degree of concern' and 5 'the highest degree of concern', to what extent are you worried about your employment status after lockdown?"

Procedures

In the first visit (March 25–April 17, 2020), we recorded the following sociodemographic variables: age, nationality, education level, years working as HH, type of contract, and employment status. Since 14 March 2020, all participants were under mandatory lockdown (home confinement, only leaving the house for essential activities, such as going to the supermarket, or the pharmacy). The second visit was done between October and December 2020, 4 months after the end of the lockdown. In both visits, we recorded LOC, social support (DUKE-UNC-11), anxiety (GAD-7), depression (PHQ-9), and degree of concern for employment status.

TABLE 1 | Characteristics of the study population.

	Hotel housekeepers (*n* = 290)
	x̄ (SD)
Age	46.8 (±10.2)
Years working as HHs	14.3 (±10)
	% (95%CI)
Education level	
Primary not finished	3.6 (1.8–6.6)
Compulsory education	63.4 (57.4–69.1)
Secondary post-compulsory education	26.4 (21.3–32.1)
Higher education	6.5 (3.9–10.1)
Nationality	
Spanish	65.8 (60.0–71.6)
Foreign	19.3 (14.4–24.1)
Dual	14.9 (10.5–19.3)
Origin	
Spain	64.7 (58.8–70.4)
Africa	5.5 (3.1–8.8)
America	25.5 (20.4–31.0)
Asia	0.4 (0.0–2.0)
Non-EU	0.4 (0.0–2.0)
EU	3.6 (1.8–6.6)
Type of contract	
Permanent	2.5% (0.1–5.1)
Recurring seasonal contract	72.6% (67.0–77.7)
Temporary	24.9% (20.0–30.4)
Employment status before COVID-19 lockdown	
Working	28.6% (23.5–34.2)
Unemployment benefits	51.7% (45.8–57.6)
Unemployed	9.0% (5.9–12.9)
Other	10.7% (7.4–14.8)
LOC	
Internal	35.4% (29.7–41.5)
External	64.6% (58.5–70.3)
Social support perceived (DUKE-UNC-11)	
Low	5.4% (3.0–8.8)
Normal	94.6% (91.2–97.0)

Data Analysis

Demographic and occupational characteristics, employment status, locus of control, social support, degree of concern for employment status, anxiety, and depression outcomes are shown with absolute numbers and percentages. Age and years working as HH are presented as means and standard deviation (SD). To compare demographic and occupational characteristics, employment status, LOC, social support, degree of concern for employment status, anxiety (GAD7), and depression (PHQ-9), we used the chi-squared test; values of *p* under 0.05 were considered statistically significant (two-sided tests). A limit of $p < 0.20$ was used to select predictors in the multivariate analysis. Repeated measure Generalized Estimating Equations (GEE) were used to estimate the odds ratios (OR) and 95% confidence interval (CI) of the changes over time in anxiety, depression, and concern about employment status associated to demographic and occupational characteristics, employment status, LOC, and social support of the participants (Liang and Zeger, 1986: 22) and Cohen's h index; the arcsine transformation of the proportion of patients with high degree of concern about employment status, moderate or severe anxiety (GAD7), or depression (PHQ) between the two study periods was calculated. McNemar's test

was used for the association between independent variables and the evolution of concern for employment status and mental wellbeing.

Missing outcomes were accounted for using multiple imputation with chained equation (White et al., 2011). Ten imputed samples were generated and estimates were combined using Rubin's rules (Rubin, 2004).

All statistical analyses were done with SPSS for Windows version 23.0.

Ethical Consideration

All HHs included in this study were already participating in an approved RCT.[2] The study was approved by the Balearic Islands Research Ethics Committee (IB 4187/20 PI).

RESULTS

A total of 290 HHs were recruited from 25 March to 17 April 2020, and 237 (82%) were again interviewed for a second visit in October–December of 2020. Participants' characteristics are displayed in **Table 1** and include as: individual, sociodemographic, and working variables. Most HHs included had completed compulsory education (primary and secondary), were Spanish nationals, and had a recurring seasonal contract. Before lockdown, half of the sample was receiving unemployment benefits.

The Spanish lockdown began on 14 March and finished on 21 June. During this period, the HHs showed a high degree of concern about their job, with 15 and 21% presenting high levels of anxiety (GAD7 Cronbach's Alpha = 0.874) and depression (PHQ9 Cronbach's Alpha = 0.875), respectively. We analyzed the association between age, years working as HH, type of contract, social support, and LOC, with the degree of concern for employment status and mental wellbeing (anxiety and depression) for the first and the second visits. In the first visit, more concern about employment status was reported in women under 50 years of age ($p = 0.014$), with a temporary contract ($p = 0.049$) and with an external LOC ($p = 0.017$). Regarding moderate–severe anxiety, a positive significant association was found in cases with low social support ($p = 0.018$) and external LOC ($p = 0.049$); moderate–severe depression was significantly related to low social support ($p = 0.001$). Interestingly, data of the second visit failed to indicate any association between baseline values and concern about employment status, anxiety, and depression.

Table 2 shows the comparison of concern about employment status, anxiety, and depression between the two periods (1st visit: March–April 2020; 2nd visit: October–December 2020) by age, years of working as HH, type of contract, social support, and LOC. A statistically significant increase from the 1st to the 2nd visit in the concern about employment status was detected in HHs: over 50 years of age (1st visit: 66.9%; 2nd visit: 92.0%; $p < 0.001$); who had worked as HH more than 15 years (1st visit: 70.9%; 2nd visit: 85.9%; $p = 0.007$); with a recurring seasonal

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Anxiety, Depression and Hotel Housekeepers

TABLE 2 | Association between hotel housekeepers characteristics (age, years working as HHs, type of contract, social support, and LOC) and degree of concern about employment status and mental wellbeing.

		Degree of concern about employment status					GAD7					PHQ9				
		1st visit		2nd visit		value of p	1st visit		2nd visit		value of p	1st visit		2nd visit		value of p
		Low n/N (%)	High n/N (%)	Low n/N (%)	High n/N (%)		Mild n/N (%)	Moderate–severe n/N (%)	Mild n/N (%)	Moderate–severe n/N (%)		Minimum-Mild n/N (%)	Moderate–severe n/N (%)	Minimum-Mild n/N (%)	Moderate–severe n/N (%)	
Age	<40	15/72 (20.8)	57/72 (79.2)	10/55 (18.2)	45/55 (81.8)	1.000	49/72 (68.1)	23/72 (31.9)	38/54 (70.4)	16/54 (29.6)	0.804	57/72 (79.2)	15/72 (20.8)	43/52 (82.7)	9/52 (17.3)	0.774
	41–50 years	12/77 (15.6)	65/77 (84.4)	11/67 (16.4)	56/67 (84.6)	1.000	63/77 (81.8)	14/77 (18.2)	42/61 (68.9)	19/61 (31.1)	0.238	60/77 (77.9)	17/77 (22.1)	50/62 (80.6)	12/62 (19.4)	1.000
	>50	40/121 (33.1)	81/121 (66.9)	9/97 (9.3)	88/97 (90.7)	<0.001	92/121 (76.0)	29/121 (24.0)	80/101 (79.2)	21/101 (20.8)	0.359	95/121 (78.5)	26/121 (21.5)	83/100 (83.0)	17/100 (17.0)	0.118
Years working as HHs	≤5	16/67 (23.9)	51/67 (76.1)	8/53 (15.1)	45/53 (84.9)	0.289	52/67 (77.6)	15/67 (22.4)	42/50 (84.0)	8/50 (16.0)	0.180	54/67 (80.6)	13/67 (19.4)	41/47 (87.2)	6/47 (12.8)	0.727
	6–15 years	27/106 (25.5)	79/106 (74.5)	10/85 (11.8)	75/85 (88.2)	0.052	78/106 (73.6)	28/106 (26.4)	59/82 (72.0)	23/82 (28.0)	1.000	77/106 (72.6)	29/106 (27.4)	67/80 (83.8)	13/80 (16.3)	0.134
	>15	30/103 (29.1)	73/103 (70.9)	12/84 (14.3)	72/84 (85.7)	0.007	79/103 (76.7)	24/103 (23.3)	65/89 (73.0)	24/89 (27.0)	0.832	84/103 (81.6)	19/103 (18.4)	70/89 (78.7)	19/89 (21.3)	1.000
Type of con-tract	Permanent	2/7 (28.6)	5/7 (71.4)	0/5 (0)	5/5 (100)	NA	4/7 (57.1)	3/7 (42.9)	3/5 (60.0)	2/5 (40.0)	1.000	5/7 (71.4)	2/7 (28.6)	4/5 (80.0)	1/5 (20.0)	1.000
	Recurring seasonal	60/204 (29.4)	144/204 (70.6)	27/166 (16.3)	139/166 (83.7)	0.002	157/204 (77.0)	47/204 (23.0)	122/165 (73.9)	43/165 (26.1)	0.880	159/204 (77.9)	45/204 (22.1)	133/162 (82.1)	29/162 (17.9)	0.311
	Temporary	10/69 (14.5)	59/69 (85.5)	4/57 (7.0)	53/57 (93.0)	0.453	53/69 (76.8)	16/69 (23.2)	43/54 (79.6)	11/54 (19.6)	0.508	56/69 (81.2)	13/69 (18.8)	44/53 (83.0)	9/53 (17.0)	1.000
Social support	Low	3/19 (15.8)	16/19 (84.2)	2/17 (11.8)	15/17 (88.2)	1.000	10/19 (52.6)	9/19 (47.4)	10/17 (58.8)	7/17 (41.2)	0.500	9/19 (47.4)	10/19 (52.6)	12/17 (70.6)	5/17 (29.4)	0.125
	Normal	69/251 (27.5)	182/251 (72.5)	27/200 (13.5)	173/200 (86.5)	<0.001	193/251 (76.9)	58/251 (23.1)	154/198 (77.8)	44/198 (22.2)	0.672	200/251 (79.7)	51/251 (20.3)	162/193 (83.9)	31/193 (16.1)	0.349
LOC	External	41/184 (22.3)	143/184 (77.7)	18/155 (11.6)	137/155 (88.4)	0.008	133/184 (72.3)	51/184 (27.7)	108/147 (73.5)	39/147 (26.5)	0.618	141/184 (76.6)	43/184 (23.4)	118/143 (82.5)	25/143 (17.5)	0.185
	Internal	32/89 (36.0)	57/89 (64.0)	12/66 (18.2)	54/66 (81.8)	0.017	74/89 (83.1)	15/89 (16.9)	56/72 (77.8)	16/72 (22.2)	0.815	72/89 (80.9)	17/89 (19.1)	58/71 (81.7)	13/71 (18.3)	1.000

FIGURE 1 | Association between degree of concern for employment status and mental wellbeing.
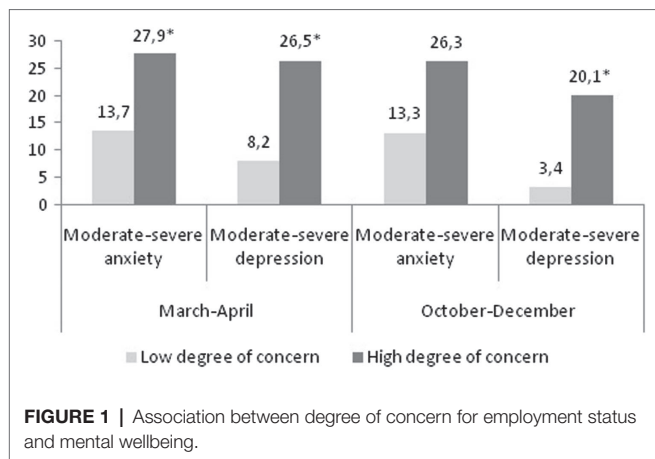
contract (1st visit: 68.9%; 2nd visit: 83.1%; $p = 0.002$); with normal social support (1st visit: 72.5%; 2nd visit: 86.5%; $p < 0.001$). Regarding LOC, there was an increase in the degree of concern without differences between internal ($p = 0.017$) and external LOC ($p = 0.008$).

The evolution of anxiety and depression did not differ significantly by age, years working as HH, type of contract, social support, and LOC.

Figure 1 shows the association between degree of concern and mental wellbeing (moderate–severe anxiety and depression). In March–April, there was a higher proportion of HHs with moderate–severe anxiety ($p = 0.014$) and depression ($p = 0.001$) reporting high degree of concern about their employment status. In October–December, moderate or severe anxiety or depression was more prevalent in HHs with a high degree of concern about employment status. Although these differences were important in magnitude, only reached statistically significance in depression symptoms ($p = 0.029$).

Table 3 shows the evolution of mental wellbeing and degree of concern about employment status from March–April 2020 to October–December 2020; the proportion of HHs declaring a high degree of concern about their employment status (4 and 5 in the Likert scale) increased by 12.0% between the first and the second visit. This increase was statistically significant (adjusted by age, type of contract, LOC, and social support): compared to March–April 2020, HHs were 2.3 more likely to have a high degree of concern for their employment status in October–December. The Cohen's h effect size was 0.3. HHs with moderate–severe symptoms of anxiety decreased by 0.5% during the period studied (**Table 3**); this decrease was not statistically significant (adjusted by age, type of contract, LOC, and social support), and the Cohen's h effect size was 0.012. Although not statistically significant, participants with moderate–severe symptoms of depression decreased by 3.4% from March–April to October–December 2020 (Cohen's h effect size was 0.086).

DISCUSSION

This longitudinal study started during the first stages of the Spanish COVID-19 lockdown (from March 14 to June 21)

and continued in October–December of 2020, when the second wave of COVID-19 was ongoing, lockdown was not current but limitations in the capacity in indoor places and curfew from 12 pm to 6 am were in force. Participants were HHs living in the Balearic Islands, a region economically and socially dominated by tourism. The results reflect the increasing concern of HHs about employment status, probably due to the job insecurity and income loss caused by COVID-19 control measures.

During the Spanish COVID-19 lockdown, HHs showed a high degree of concern about employment status and a high level of anxiety and depression. There was an increase in the degree of concern by employment status from March–April 2020 to October–December 2020 but not in anxiety or depression.

Results showed that HHs who were younger, had temporary jobs and an external LOC were more concerned about their employment status. Low social support and an external LOC were associated to high level of anxiety, and low social support was associated with symptoms of depression. Young age (Rodríguez-Rey et al., 2020; Solomou and Constantinidou, 2020; Ueda et al., 2020; Hubbard et al., 2021), unemployment or job instability (Pieh et al., 2020; Solomou and Constantinidou, 2020; Ueda et al., 2020), external LOC (Sigurvinsdottir et al., 2020), and social support (Hubbard et al., 2021) have been identified as significant to mental wellbeing during the COVID-19 pandemic. Our results support the hypothesis that during the uncertain times of the pandemic, variables conducive to wellbeing are associated with stability, i.e., having an internal LOC, feeling socially supported, and having a stable job. However, the evolution of concern for employment status showed that positive effects of having an internal LOC and a normal social support seemed to have played an important role in the short term. Results indicate that after 6 months, proportions of HHs with high degree of concern for their employment status according to social support and LOC tend to converge.

Results showed a higher prevalence of moderate–severe symptoms of anxiety among HHs compared to Spanish women during the initial stage of the COVID-19 pandemic (Ozamiz-Etxebarria et al., 2020) and compared to Spanish (Rodríguez-Rey et al., 2020) and Italian (Mazza et al., 2020) general populations. HHs also had a higher prevalence of symptoms of depression during this pandemic than Spanish women (Ozamiz-Etxebarria et al., 2020). However, the prevalence of depression was lower than reported by the Spanish (Rodríguez-Rey et al., 2020) and Italian (Mazza et al., 2020) general populations, and similar to that reported by Chinese population (Huang and Zhao, 2020). The divergence in the prevalence of anxiety and depression in different populations might be explained by different participant recruitment procedures, different representativeness of the population samples, or the timing of data collection (early versus later stages of the pandemic). However, these differences can also be explained by the impact of the pandemic on the working population depending on type of employment and sociodemographic and family factors. Most HHs in our sample worked under recurring seasonal contracts, by which

TABLE 3 | Evolution of high degree of concern about employment status (4 and 5), moderate–severe anxiety, and moderate–severe depression between March–April to October–December 2020.

	First visit ($n = 237$)	Second visit ($n = 237$)	Adjusted OR	95%CI		p
	% (95%CI)	% (95%CI)		LL	UL	
High degree of concern about employment status	74.0% (67.9–79.5)	86.0% (80.7–90.3)	2.302	0.400	1.269	>0.001
GAD-7 moderate–severe	25.1%(19.7–31.2)	24.6% (19.2–30.6)	1.016	−0.345	0.377	0.931
PHQ-9 moderate–severe	20.9%(15.8–26.6)	17.5% (12.8–23.1)	0.823	−0.590	0.202	0.337

CI, confidence interval; LL, lower limit; and UL, upper limit.

HHs just work during the touristic season but the establishment commits to hire them again the following season. Results of the first visit detected a higher degree of concern in a greater proportion of HHs with a temporary contract. Indeed, in March 2020, two-thirds of participants were unemployed, which worsened their already precarious and uncertain occupational status. Other studies have linked employment status to mental wellbeing: in a sample of Japanese workers, symptoms of depression were more prevalent in participants with an unstable job (Ueda et al., 2020).

Additionally, levels of anxiety and depression could be explained by different impacts on geographic regions regarding their social and work environments. We found that 1 out of 4 HHs reported poor psychological wellbeing during the first stages of lockdown, a proportion slightly lower than in European female workers during the 2008 recession (Schütte et al., 2014). Notably, pre-pandemic data collected for the Spanish Health Survey (2017; Sanidad, 2018) show that 9.1% of Spanish women had chronic anxiety and 9.2% chronic depression. These data confirm that anxiety and depression rates have considerably increased as a result of the COVID-19 pandemic. In this context, concern about employment status might play an important role among HHs.

In the participants of this study, concern about employment status increased over time regardless of age, type of contract, LOC, and social support. When interviews were conducted in March–April, the employment uncertainty in hospitality sector was high: HHs were unsure whether they would be able to work during the summer and there were doubts about the governmental Temporary Workforce Adjustment Plan—who would be protected, for how long, how much they would earn, etc. Probably, increase in concern in the second visit reflects the fact that HHs realized that uncertainty about when they would be able to work would last for several months. Our findings underscore the negative association between concern for employment status and mental wellbeing. Accordingly, in Spain, the economic crisis originating from the COVID-19 pandemic was the main concern among the population (Rodríguez-Rey et al., 2020).

These results indicate long lasting effects of the COVID-19 pandemic on mental health and agree with most longitudinal studies in the general population, which have reported similar outcomes or a decreasing trend of anxiety and depression between these periods (Niedzwiedz et al., 2020; Salfi et al., 2020; Fancourt et al., 2021; González-Sanguino et al., 2021; O'Connor et al., 2021; Pieh et al., 2021; Somma et al., 2021). Our results regarding anxiety and depression might be explained by the job uncertainty of HHs. Previous research shows that not working, ceasing to work during lockdown, losing, or perceiving a high risk of losing their job had a significant association with stress, anxiety, and depression (Mazza et al., 2020; Pieh et al., 2020; Rodríguez-Rey et al., 2020; Solomou and Constantinidou, 2020; Ueda et al., 2020; Burstyn and Huynh, 2021). Other factors related to mental distress during the pandemic were being female (Mazza et al., 2020; Pieh et al., 2020; Rodríguez-Rey et al., 2020; Solomou and Constantinidou, 2020; Hubbard et al., 2021), having a lower educational level (Mazza et al., 2020; Rodríguez-Rey et al., 2020; Fancourt et al., 2021) and a low income or financial difficulties (Pieh et al., 2020; Rodríguez-Rey et al., 2020; Ueda et al., 2020; Hubbard et al., 2021; O'Connor et al., 2021).

During the study period, the Spanish government implemented the Temporary Workforce Adjustment Plan, which provided financial assistance to workers with recurring seasonal contracts. We believe that this measure prevented larger increases in anxiety and depression. Nonetheless, our results indicate that the mental health of HHs is still at risk, basically due to the uncertainty related to employment. A greater demand for mental health-related visits in primary care is anticipated. It is essential to allocate additional resources to prevent overwhelming of the primary care services (Roca et al., 2020).

Summarizing, in agreement with the literature, our results indicate that during the pandemic period, there were a high degree of concern about employment status and high rates of anxiety and depression. The results are also a warning about long-term effects on mental health, especially in workers affected by income loss due to enforced governmental measures aimed at controlling the spread of SARS-CoV-2. Importantly, research clearly exposes that the negative impact on mental health is not homogeneously distributed among the population. On the contrary, the people most affected are the most socioeconomically disadvantaged.

Strengths and Limitations
To our knowledge, many studies on psychological distress caused by the pandemic recruited participants from social

networks and most of them well-educated, which do not fully represent the population at large. However, the most studied occupational group was healthcare personnel, overworked and very specifically affected by the pandemic. The relevance of our study lies in focusing attention to the effects of the pandemic on workers' mental health in economic sectors affected by measures taken to stem the spread of SARS-CoV-2.

Among the limitations of our study, we should mention that we recruited HHs among women who were already participating in the aforementioned clinical trial, and they may not be representative of all HHs in the Balearic Islands' workforce. However, we believe that our results reflect the main problems of HHs in our setting. On the other hand, we are aware that psychological distress of HHs in other regions might differ. In particular, the pandemic might even have hit HHs harder in countries without programs similar to the Spanish Temporary Workforce Adjustment Plan. Additionally, HHs in the Balearic Islands are hired directly by the different establishments. In contrast, in other regions, outsourcing is the norm, leaving HHs with an even more precarious employment status (i.e., contracts per days and lower salaries). These contextual differences may affect the external validity of our results.

DATA AVAILABILITY STATEMENT

The data presented in this study are available upon reasonable request from the corresponding author.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Balearic Islands Research Ethics Committee (IB 4187/20 PI). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

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REFERENCES

Adams, R. (1999). Revised physical activity readiness questionnaire. *Can. Fam. Physician* 45:992.

Bellón Saameño, J. A., Delgado Sánchez, A., del Castillo, J. D., and Lardelli Claret, P. (1996). Validity and reliability of the Duke-UNC-11 questionnaire of functional social support. *Aten. Primaria* 18, 158–163.

Broadhead, W. E., Gehlbach, S. H., Gruy, F. V., and Kaplan, B. H. (1988). The Duke-UNC functional social support questionnaire. Measurement of social support in family medicine patients. *Med. Care* 26, 709–723. doi: 10.1097/00005650-198807000-00006

Burstyn, I., and Huynh, T. (2021). Symptoms of anxiety and depression in relation to work patterns during the first wave of the COVID-19 epidemic in Philadelphia PA: a cross-sectional survey. *J. Occup. Environ. Med.* 63, e283–e293. doi: 10.1097/JOM.0000000000002179

Cañada, E. (2018). Too precarious to be inclusive? Hotel Maid Employment in Spain. *Tour. Geo.* 20, 653–674. doi: 10.1080/14616688.2018.1437765

Consell Econòmic I Social de les Illes Balears (2020). Càlcul de l'impacte del coronavirus a l'economia balear, per branques productives. Available at: https://www.caib.es/sites/ces/es/n/calculo_del_impacto_del_coronavirus_a_la_economaa_balear_por_ramas_productive/archivopub.do?ctrl=MCRST16 ZI317620&id=317620 (Accessed December 2020).

De la Revilla Ahumada, L., Bailón, E., de Dios Luna, J., Delgado, A., Prados, M. A., and Fleitas, L. (1991). Validation of a functional social support scale for use in the family doctor's office. *Aten. Primaria* 8, 688–692.

Diez-Quevedo, C., Rangil, T., Sanchez-Planell, L., Kroenke, K., and Spitzer, R. L. (2001). Validation and utility of the patient health questionnaire in diagnosis mental disorders in 1003 general hospital Spanish inpatients. *Psychosom. Med.* 63, 679–686. doi: 10.1097/00006842-200107000-00021

European Institute for Gender Equality (2020). Economic hardship. Available at: https://eige.europa.eu/covid-19-and-gender-equality/economic-hardship-and-gender (Accessed September, 2021).

Fancourt, D., Steptoe, A., and Bu, F. (2021). Trajectories of anxiety and depressive symptoms during enforced isolation due to COVID-19 in England: a longitudinal observational study. *Lancet Psychiatry* 8, 141–149. doi: 10.1016/S2215-0366(20)30482-X

Farré, L., Fawaz, Y., González, L., and Graves, J. (2021). Gender inequality in paid and unpaid work during COVID-19 times. *Rev. Income Wealth.* doi: 10.1111/roiw.12563

Gao, J., Zheng, P., Jia, Y., Chen, H., Mao, Y., Chen, S., et al. (2020). Mental health problems and social media exposure during COVID-19 outbreak. *PLoS One* 15:e0231924. doi: 10.1371/journal.pone.0231924

García-Campayo, J., Zamorano, E., Ruiz, M. A., Pardo, A., Pérez-Páramo, M., López-Gómez, V., et al. (2010). Cultural adaptation into Spanish of the generalized anxiety disorder-7 (GAD-7) scale as a screening tool. *Health Qual. Life Outcomes* 8, 8–11. doi: 10.1186/1477-7525-8-8

Giurge, L. M., Whillans, A. V., and Yemiscigil, A. (2021). A multicountry perspective on gender differences in time use during COVID-19. *Proc. National Academy Sci.* 118:e2018494118. doi: 10.1073/pnas.2018494118

González-Sanguino, C., Ausín, B., Castellanos, M. A., and Muñoz, M. (2021). Mental health consequences of the COVID-19 outbreak in spain. A longitudinal study of the alarm situation and return to the new normality. *Prog. Neuro. Psychopharmacol. Biol. Psychiatry* 107:110219. doi: 10.1016/j.pnpbp.2020.110219

Hertz-Palmor, N., Moore, T. M., Gothelf, D., DiDomenico, G. E., Dekel, I., Greenberg, D. M., et al. (2021). Association among income loss, financial strain and depressive symptoms during COVID-19: evidence from two longitudinal studies. *J. Affect. Disord.* 291, 1–8. doi: 10.1016/j.jad.2021.04.054

Hidalgo, M. D., Balluerka, N., Gorostiaga, A., Espada, J. P., Santed, M. Á., Padilla, J. L., et al. (2020). The psychological consequences of COVID-19

and lockdown in the Spanish population: An exploratory sequential design. *Int. J. Environ. Res. Public Health* 17, 1–17. doi: 10.3390/ijerph17228578

Huang, Y., and Zhao, N. (2020). Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 epidemic in China: a web-based cross-sectional survey. *Psychiatry Res.* 288, 1–19. doi: 10.1016/j.psychres.2020.112954

Hubbard, G., Daas, C.Den, Johnston, M., and Dixon, D. (2021). Sociodemographic and psychological risk factors for anxiety and depression: findings from the COVID-19 health and adherence research in Scotland on mental health (CHARIS-MH) cross-sectional survey. *Int. J. Behav. Med.* doi:10.1007/s12529-021-09967-z, 28, 788-800.

Instituto Nacional de Estadística (2020). Cuenta satélite del turismo de España. Available at: https://www.ine.es/dyngs/INEbase/es/operacion.htm?c=Estadistica_Candcid=1254736169169andmenu=ultiDatosandidp=1254735576863 (Accessed September, 2021).

Jacques-Aviñó, C., López-Jiménez, T., Medina-Perucha, L., Queiroga Gonçalves, A., Duarte-Salles, T., and Berenguera, A. (2020). Gender-based approach on the social impact and mental health in Spain during COVID-19 lockdown: a cross-sectional study. *BMJ Open* 10:e044617. doi: 10.1136/bmjopen-2020-044617

Liang, K. Y., and Zeger, S. L. (1986). Longitudinal data analysis using generalized linear models. *Biometrika* 73, 13–22. doi: 10.1093/biomet/73.1.13

Mazza, A., Ricci, E., Biondi, S., Colasanti, M., Ferracuti, S., Napoli, C., et al. (2020). A nationwide survey of psychological distress among Italian people during the COVID-19 pandemic: immediate psychological responses and associated factors. *Int. J. Environ. Res. Public Health* 17, 1–14. doi: 10.3390/ijerph17093165

Mounce, L. T. A. A., Campbell, J. L., Henley, W. E., Tejerina Arreal, M. C., Porter, I., and Valderas, J. M. (2018). Predicting incident multimorbidity. *Ann. Fam. Med.* 16, 322–329. doi: 10.1370/afm.2271

Niedzwiedz, C. L., Green, M. J., Benzeval, M., Campbell, D., Craig, P., Demou, E., et al. (2020). Mental health and health behaviours before and during the initial phase of the COVID-19 lockdown: longitudinal analyses of the UK household longitudinal study. *J. Epidemiol. Commun. Health* 75, 224–231. doi: 10.1136/jech-2020-215060

Nienhuis, C. P., and Lesser, I. A. (2020). The impact of COVID-19 on women's physical activity behavior and mental well-being. *Int. J. Environ. Res. Public Health* 17, 1–12. doi: 10.3390/ijerph17239036

O'Connor, R. C., Wetherall, K., Cleare, S., McClelland, H., Melson, A. J., Niedzwiedz, C. L., et al. (2021). Mental health and well-being during the COVID-19 pandemic: longitudinal analyses of adults in the UK COVID-19 mental health and wellbeing study. *Br. J. Psychiatry* 218, 326–333. doi: 10.1192/bjp.2020.212

Organisation for Economic Cooperation and Development (2020). *Women at the Core of the Fight against COVID-19 Crisis. In Tackling Coronavirus (COVID-19). Contributing to a Global Effort*. United Kingdom: OECD.

Ozamiz-Etxebarria, N., Dosil-Santamaria, M., Picaza-Gorrochategui, M., and Idoiaga-Mondragon, N. (2020). Niveles de estrés, ansiedad y depresión en la primera fase del brote del COVID-19 en una muestra recogida en el norte de España. *Cad. Saude Publica.* 36:e00054020. doi: 10.1590/0102-311X00054020

Pieh, C., Budimir, S., Humer, E., and Probst, T. (2021). Comparing mental health during the COVID-19 lockdown and 6 months after the lockdown in Austria: A longitudinal study. *Front. Psych.* 12, 1–8. doi: 10.3389/fpsyt.2021.625973

Pieh, C., Budimir, S., and Probst, T. (2020). The effect of age, gender, income, work, and physical activity on mental health during coronavirus disease (COVID-19) lockdown in Austria. *J. Psychosom. Res.* 136:110186. doi: 10.1016/j.jpsychores.2020.110186

Roca, M., Vicens, C., and Gili, M. (2020). COVID-19 and the future of mental health in primary care. *BMJ* 369:m2520. doi: 10.1136/bmj.m2520

Rodríguez-Rey, R., Garrido-Hernansaiz, H., and Collado, S. (2020). Psychological impact and associated factors during the initial stage of the coronavirus (COVID-19) pandemic among the general population in Spain. *Front. Psychol.* 11:1540. doi: 10.3389/fpsyg.2020.01540

Rotter, J. B. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychol. Monogr. Gen. Appl.* 80, 1–28. doi: 10.1037/h0092976

Rubin, D. B. (2004). *Multiple Imputation for Nonresponse in Surveys*. United States: Wiley.

Salfi, F., Lauriola, M., Amicucci, G., Corigliano, D., Viselli, L., Tempesta, D., et al. (2020). Gender-related time course of sleep disturbances and psychological symptoms during the COVID-19 lockdown: A longitudinal study on the Italian population. *Neurobiol. Stress* 13:100259. doi: 10.1016/j.ynstr.2020.100259

Sandín, B., Valiente, R. M., García-escalera, J., Campagne, D. M., and Chorot, P. (2020). Psychological impact of the COVID-19 pandemic: negative and positive effects in Spanish population during the mandatory national quarantine. *J. Psychopathol. Clin. Psychol.* 25, 1–21. doi: 10.5944/rppc.27569

Sanidad, M. D. (2018). Nota Técnica Encuesta Nacional de Salud. España 2017.

Savolainen, I., Oksa, R., Savela, N., and Celuch, M. (2021). COVID-19 anxiety — a longitudinal survey study of psychological and situational risks among finish workers. *Int. J. Environ. Res. Health. Pub. Health* 18:794. doi: 10.3390/ijerph18020794

Schütte, S., Chastang, J. F., Malard, L., Parent-Thirion, A., Vermeylen, G., and Niedhammer, I. (2014). Psychosocial working conditions and psychological well-being among employees in 34 European countries. *Int. Arch. Occup. Environ. Health* 87, 897–907. doi: 10.1007/s00420-014-0930-0

Sigurvinsdottir, R., Thorisdottir, I. E., and Gylfason, H. F. (2020). The impact of COVID-19 on mental health: The role of locus on control and internet use. *Int. J. Environ. Res. Public Health* 17, 1–15. doi: 10.3390/ijerph17196985

Solomou, I., and Constantinidou, F. (2020). Prevalence and predictors of anxiety and depression symptoms during the COVID-19 pandemic and compliance with precautionary measures: age and sex matter. *Int. J. Environ. Res. Public Health* 17, 1–19. doi: 10.3390/ijerph17144924

Somma, A., Krueger, R. F., Markon, K. E., Gialdi, G., Colanino, M., Ferlito, D., et al. (2021). A longitudinal study on clinically relevant self-reported depression, anxiety and acute stress features among Italian community-dwelling adults during the COVID-19 related lockdown: evidence of a predictive role for baseline dysfunctional personality dime. *J. Affect. Disord.* 282, 364–371. doi: 10.1016/j.jad.2020.12.165

Spitzer, R. L., Kroenke, K., and Williams, J. B. W. (2000). Validation and utility of a self-report version of PRIME-MD. *J. Clin. Psychiatry* 2:31.

Spitzer, R. L., Kroenke, K., Williams, J. B. W., and Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Arch. Intern. Med.* 166, 1092–1097. doi: 10.1001/archinte.166.10.1092

Ueda, M., Stickley, A., Sueki, H., and Matsubayashi, T. (2020). Mental health status of the general population in Japan during the COVID-19 pandemic. *Psychiatry Clin. Neurosci.* 74, 505–506. doi: 10.1111/pcn.13105

Valiente, C., Contreras, A., Peinado, V., Trucharte, A., Martínez, A. P., and Vázquez, C. (2021). Psychological adjustment in Spain during the COVID-19 pandemic: positive and negative mental health outcomes in the general population. *Span. J. Psychol.* 24:e8. doi: 10.1017/SJP.2021.7

Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., et al. (2020a). Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *Int. J. Environ. Res. Public Health* 17:1729. doi: 10.3390/ijerph17051729

Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., and Mcintyre, R. S. (2020b). A longitudinal study on the mental health of general population during the OCIVD-19 epidemic in China. *Brain Behav. Immun.* 87, 40–48. doi: 10.1016/j.bbi.2020.04.028

White, I. R., Royston, P., and Wood, A. M. (2011). Multiple imputation using chained equations: Isuues and guidance for practice. *Stat. Med.* 30, 377–399. doi: 10.1002/sim.4067

Yaish, M., Mandel, H., and Kristal, T. (2021). Has the economic lockdown following the Covid-19 pandemic changed the gender division of labor in Israel? *Gend. Soc.* 35, 256–270. doi: 10.1177/08912432211001297

Zhang, S. X., Wang, Y., Rauch, A., and Wei, F. (2020). Unprecedented disruption of lives and work: health, distress and life satisfaction of working adults in China one month into the COVID-19 outbreak. *Psychiatry Res.* 288:112958. doi: 10.1016/j.psychres.2020.112958

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The Influence of Growth Mindset on the Mental Health and Life Events of College Students

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Growth mindset refers to our core belief that our talents can be developed through practice, which may influence our thoughts and behaviors. Growth mindset has been studied in a variety of fields, including education, sports, and management. However, few studies have explored whether differences in individuals' growth mindsets influence college students' self-reported mental health. Using the Growth Mindset Scale, Adolescent Self-rating Life Events Checklist, and SCL-90 Scale, data was collected from 2,505 freshmen in a University in China. Findings revealed that the students within the growth mindset group scored significantly lower on "mental health issues" and "stress due to life events" than the students in the fixed mindset group. Our findings suggest that individuals with a growth mindset are less prone to mental health problems than individuals with a fixed mindset.

Keywords: growth mindset, life events, mental health, fixed mindset, college students

INTRODUCTION

Current Status of Mental Health

Approximately 13.4% of adolescents suffer from mental health issues worldwide (Polanczyk et al., 2015). Findings from a nationwide epidemiological study in China found that the prevalence of depression and anxiety among college students was 11.7% (Chen et al., 2013), and 16.3% (Wu et al., 2015) respectively. Mood disorders are also common in China (Hardeveld et al., 2013; Gitlin and Miklowitz, 2016). The prevalence of mental disorders in China has continuously risen over the past 30 years (Huang et al., 2019). According to the statistics reported by the World Health Organization, the total number of people afflicted with depression worldwide is approximately 350 million, and the percentage of people globally suffering from depression is estimated at 4.4% (Smith, 2014; Liu et al., 2021). These statistics are also inclusive of children, with depression estimated to be the largest contributor of global burden of adolescent disease worldwide (Zheng and Zheng, 2015; Saxena and Kline, 2021). Poor interpersonal skills, poor grades, and lower graduation rates have been linked to mental health issues and suicidal behavior in college students (Tang et al., 2018).

Gender variables may also play a large role in mental health and wellbeing. A recent study demonstrated that gender was a major contributing factor to one's self-rated health and functional wellbeing. Gender differences have also been demonstrated in physical and psychological functioning

discrepancies along with many other health-related variables (Lorant et al., 2003; Gyasi and Phillips, 2018). Additionally, one's socioeconomic status (SES) can have a large impact on mental health (Wagstaff and Doorslaer, 2000). The role of SES in the differential prevalence of depression is strongly supported by a large body of empirical evidence. That is, individuals who perceive themselves as having a low SES, are more susceptible to experiencing depressive symptoms (Sánchez-Moreno and Gallardo-Peralta, 2021; MacCarthy et al., 2022).

Growth Mindset

The belief that one has the capacity to grow is known as a growth mindset. Growth mindset, or attributes that are malleable, encourage healthy and adaptive ways of facing and tolerating anxiety, frustration, and disappointment, which promotes resilience (Schroder, 2020). Growth mindset may make individuals more resilient and persistent in the face of challenges or difficulties, as they are more likely to adopt effort-oriented strategies in their efforts to achieve their goals (Zhao et al., 2021a). People with a growth mindset may suffer fewer stress and self-reported symptoms of psychological disease. For instance, when adolescents experience family stress, growth mindset can relieve the stress and reduce the protective effects of externalizing behaviors (Walker and Jiang, 2022). On the other hand, fixed mindset (entity theories of personality) have been shown to predict greater self-reported stress (Yeager et al., 2014) and anxiety following ostracism, as well as greater reports of psychosocial stress and psychopathology (Schleider et al., 2015; Miu and Yeager, 2016) compared to a growth mindset (incremental theories of personality; Yeager et al., 2016a). Entity theories of personality are associated with negative self-conscious emotions, such as shame (Yeager et al., 2011). Furthermore, findings from a meta-analysis study demonstrated a negative correlation between growth mindset and psychological distress ($r = -0.220$), a positive correlation between growth mindset and treatment value ($r = 0.137$), and a positive correlation between growth mindset and positive coping ($r = 0.207$; Burnette et al., 2020). While the impact of these findings were small, they support the notion that growth mindset was associated with psychological distress, treatment value, and positive coping.

Growth mindset refers to our core belief that our talents can be developed through practice, which may subsequently influence our thoughts and behaviors (Dweck, 2006). Mindset can affect one's motivation, which in turn can affect academic resilience and performance. Both grit (Duckworth et al., 2007; Strayhorn, 2014) and mindset (Claro et al., 2016; Mccutchen et al., 2016; Wang et al., 2020; Sun et al., 2021) are linked to academic achievement, subjective wellbeing of the individual and the reduction of psychopathology (Clark and Malecki, 2022). A substantial body of research has shown that the belief that one's abilities and talents can be developed (growth mindset), rather than fixed, can stimulate long-term learning. In terms of behavioral outcomes, growth mindset stimulates persistence in the face of obstacles and challenge-seeking behaviors and positively influences academic performance in primary, secondary, and higher education (Burnette et al., 2013; Jia et al., 2021). Specifically, growth mindset is significantly and positively

correlated with academic performance (Wang et al., 2020) and predicts higher academic achievement than fixed mindset (Grant and Dweck, 2003; Blackwell et al., 2007). Moreover, a range of motivational factors, such as growth mindset, has been proven to positively affect individual performance such as mental rotation performance (Moè, 2016). However, growth mindset and grit are not always conducive to academic achievement (Bazelais et al., 2019). It is important to be cautious when drawing conclusions about the impact of growth mindset. But the effectiveness of growth mindset on academic performance cannot be ignored.

Additionally, growth mindset describes a type of mindset an individual may possess that describes their underlying beliefs about their ability to learn and their own intelligence (Dweck, 2006). For instance, if a student who has a growth mindset receives a poor grade on a test, they would likely put additional effort into studying for the next test, due to their core beliefs that they are able to grow, learn, and perform better. Thus, children with a growth mindset believe that they can develop their abilities through hard work, good strategies, and guidance from others (Blackwell et al., 2007; Haimovitz and Dweck, 2017). Having a growth mindset may also benefit individuals in a variety of different careers and educational fields, as it will allow them to persevere in the face of rejection and/or failure. In the 1980s, Dweck et al. developed a theory of implicit intelligence. They suggested that individuals would choose different achievement goals based on their own core beliefs, which would subsequently result in corresponding psychological and behavioral tendencies. These core beliefs were described in terms of having a growth mindset or a fixed mindset. That is, where individuals with a growth mindset will embrace challenges, constructive criticism, and will persevere in the face of setbacks, and individual with a fixed mind set will exhibit the opposite. Individuals with fixed mindset are more afraid of failure and mistakes. Thus, they will choose to avoid challenges which may result in failure, and will mistakenly attribute the failure to their incompetence, believing that only those who are not smart need to work hard.

Benefits of Growth Mindset

Earlier studies in elementary and secondary schools have shown that a growth mindset is linked to better academic outcomes and lower levels of stress (Dweck, 2000; Rattan et al., 2012; Dweck and Yeager, 2019). Having a growth mindset has been demonstrated to be positively correlated with learning engagement and negatively correlated with perceived COVID-19 event intensity and stress (Zhao et al., 2021b). Furthermore, a positive correlation exists between the mindset of teachers and the appraisal of achievement for students who demonstrate increasing marks (De Kraker-Pauw et al., 2017). Moreover, students from lower-income families are less likely to maintain a growth mindset compared to their wealthier peers. However, the students who were able to maintain a growth-mindset were much more successful in overcoming the adverse effects of poverty on their academic achievement, then those who exhibited a fixed-mindset (Claro et al., 2016). The link between growth-mindset and academic performance may be explained by students'

behaviors such as learning strategies and learning habits (Lewis et al., 2020). In a study investigating the effects of growth mindset on navigation ability, a unique portion of variance in self-reported navigation ability was found, suggesting that a growth mindset can encourage people to seek out navigation challenges and train themselves to be better navigators in daily life (He and Hegarty, 2020). Additionally, research on the relationship between growth mindset and obesity in adolescents has demonstrated that those with a growth mindset are more likely to be successful at losing weight (Orvidas et al., 2018).

A positive correlation has been found between growth mindset and self-efficacy for health behaviors (Orvidas et al., 2018) and perceived control (Doron et al., 2009), such that individuals who possess a growth mindset are more likely to take control of their own health. Cognitive neuroscience approaches have been used to explore the mechanisms involved in mindset patterns, errors, and adjustments (Puusepp, 2021). Resilience has also been found to be related to improved attention to errors; that is, individuals with a growth mindset find it easier to bounce back from failures than individuals with a fixed mindset (Schroder et al., 2017b). Further, subtle feedback and information related to growth mindset could have a significant positive effect on students' attitudes and motivation.

The SCL-90 and ASLEC Applications

The Symptom Checklist-90-Revised (SCL-90) and Adolescent Self-rating Life Events Checklist (ASLEC) are self-report tools commonly used to measure clinical psychiatric symptoms and mental health status (Derogatis, 1983). The SCL-90 has been widely used to screen for mental health issues and is commonly used to assess the subjective mental health symptoms of college students (Xie and Dai, 2006). According to Ren (2009), the SCL-90 was used in 63.8% of the published articles regarding the mental health of college students, illustrating its strong validity and reliability. In addition, the Adolescent Self-rating Life Events Checklist (ASLEC) is a widely used self-assessment tool for measuring varying levels of life stress (Zhao et al., 2017).

Up to now, few studies have explored the relationship between growth mindsets, mental health and life events. The purpose of the current study is to explore whether individuals with a growth mindset might have better mental health and life event outcomes than those with a fixed mindset. We hypothesized that: (1) individuals with a growth mindset have better mental health than those with a fixed mindset; (2) individuals with a growth mindset have better self-report life events than those with a fixed mindset; and (3) individual family socioeconomic status will have an effect on growth mindset.

MATERIALS AND METHODS

Participants

A total of 2,505 participants were recruited from Huzhou University in China. All participants were 1st-year college students (690 men, 27.54%; 1,815 women, 72.46%; mean age: 18.38 years; see **Table 1**). Informed consent was obtained from all participants. The study was reviewed and approved by the

Institutional Review Board of the Human Research Ethics Committee of Huzhou University.

Measures

Data were collected in a computer room *via* online questionnaires that were divided into two sections. The first part consisted of a survey to gather demographic information of each participant, including gender, age, occupation, self-reported economic level, and place of birth. The second part included three scales: Growth Mindset Scale, SCL-90 Scale, and Adolescents Self-Rating Life Events Checklist (ASLEC).

The Growth Mindset Scale was created by Dweck (2006) and revised by Zhai (2018) in the Chinese version. The scale was used to measure the degree of growth mindset of participants. The Growth Mindset Scale is made up of six items and measures two dimensions: fixed mindset and growth mindset. A 6-point Likert scale was used to collect responses (1 indicated "disagree," 6 indicated "strongly agree," and 2, 3, 4, and 5 indicated varying degrees of agreement). The higher the score, the stronger the orientation of the dimension. Cronbach's alpha for the six items in this study was 0.93.

The Symptom Checklist-90-Revised (SCL-90) was developed by Derogatis (1983) and revised by Tang (1999) in the Chinese version. SCL-90 has been a widely used self-report assessment of mental health (Hardt et al., 2012). It measures the degree of mental health on 10 dimensions, including somatization, obsessive–compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, psychoticism, and other factors. The scale has 90 items, and which are scored from 0 to 4. Each question is rated according to how much the individual was bothered by the item in the last week on a five-point Likert scale (0 = "not at all," 1 = "a little bit," 2 = "moderately," 3 = "quite a bit," and 4 = "extremely"). Cronbach's alpha for the SCL-90 was 0.96 in the present study.

The Adolescents' Self-Rating Life Events Checklist (ASLEC; Liu et al., 1997; Hardt et al., 2012) was used to assess the frequency and intensity of stressful life events among adolescents, especially middle school students and college students. The scale included six factors, including interpersonal relationships, study pressure, being punished, bereavement, pressure of health and adaptation, and other factors. Within the six factors there

TABLE 1 | Descriptive characteristics of participants.

	N or Mean (% or SD)
Gender	
Male	690 (27.54)
Female	1815 (72.46)
Self-report family economic	
Poor	219 (8.74)
General	1891 (75.49)
Relatively wealthy and wealthy	395 (15.77)
Birth place	
Countryside	830 (33.13)
Township	442 (17.64)
Non-provincial capital city	844 (33.69)
Capital city	389 (15.54)

are 27 items, which are scored from 1 to 5 (1 = "occurred but exercised no influence" to 5 = "occurred and exercised a severe influence"), with higher summed scores indicating higher levels of life stress. Each subscale has a total score based on subscale entries. In the present study, the Cronbach's alpha for the ASLEC was 0.85. The scale is generally used to measure the stress levels of children and adolescents with negative life events (Wang et al., 2016).

Statistical Analyses

Statistical analyses were performed using the SPSS 22.0. Descriptive analyses were used to examine the descriptive characteristics of the study population. We used the independent samples T-test to test gender differences in the results on the growth mindset. A one-way ANOVA was used to test the degree of socioeconomic status (SES) factor and the place of birth factor. The significance level was set at $p < 0.05$.

RESULTS

Differences in the Results of Growth Mindset Scale Due to Gender and SES

There was no significant difference between men and women [$t_{(2503)} = 1.53$, $p > 0.05$] in having a growth-mindset. The degree of SES was divided into four levels. Since the wealthy sample size was too small [$N = 18$], SES was further divided into three levels: poverty, ordinary, and preferably. A significant difference was found between the varying SES groups [$F_{(2, 2502)} = 6.30$, $p < 0.01$]. Birth of place factors were divided into four categories: rural area, township, non-provincial capital cities, and provincial capital cities. Result showed that there was no significant effect of the place of birth factor on growth-mindset [$F_{(3, 2501)} = 2.37$, $p > 0.05$].

One-Way ANOVA of Adolescents Self-Rating Life Events Checklist and SCL-90 Scale

Based on individual growth-mindset scores, participants were divided into three groups: top growth mindset group with 27% having scores between 26 and 36 (687 participants), middle group with scores between 19 and 25 (1,189 participants), and the fixed mindset group with scores between 6 and 18 (629 participants). A main effects of group on study pressure [$F_{(2, 2502)} = 12.02$, $p < 0.001$], interpersonal relationships [$F_{(2, 2502)} = 20.93$, $p < 0.001$], being punished [$F_{(2, 2502)} = 8.81$, $p < 0.01$], bereavement [$F_{(2, 2502)} = 4.95$, $p < 0.01$], and others [$F_{(2, 2502)} = 14.45$, $p < 0.001$] was seen (**Figure 1**; **Table 2**). However, no significant differences were seen for pressure of health and adaptation [$F_{(2, 2502)} = 2.72$, $p > 0.05$].

A one-way ANOVA was conducted on the SCL-90 scale scores. Results showed there was a significant main effect of group on somatization [$F_{(2, 2502)} = 12.21$, $p < 0.001$], obsessive–compulsive [$F_{(2, 2502)} = 24.13$, $p < 0.001$], interpersonal sensitivity [$F_{(2, 2502)} = 23.95$, $p < 0.001$], depression [$F_{(2, 2502)} = 30.41$, $p < 0.001$], anxiety [$F_{(2, 2502)} = 13.03$, $p < 0.001$], hostility [$F_{(2, 2502)} = 15.35$, $p < 0.001$], phobic anxiety [$F_{(2, 2502)} = 6.83$, $p < 0.01$], paranoid ideation [$F_{(2, 2502)} = 8.13$, $p < 0.001$], psychoticism [$F_{(2, 2502)} = 11.94$, $p < 0.001$], and other [$F_{(2, 2502)} = 9.96$, $p < 0.001$; **Figure 2**; **Table 3**].

Correlation Analysis

A significant negative correlation was found between growth mindset and SCL-90 [$r = -0.145$, $p < 0.001$]. A significant negative correlation was found between growth mindset and ALSF ($r = -0.13$, $p < 0.001$), and a significant positive correlation between life event and mental health ($r = 0.563$, $p < 0.001$).

DISCUSSION

The current study aimed to investigate whether growth mindset has an influence on an individual's mental health status and life events compared to having a fixed mindset. Two main findings came out from the present study. First, SES has a significant effect on the likelihood of having a growth mindset, such that, the higher one's SES, the less likely that they will have a growth mindset. Second, the growth mindset group scored significantly lower on SCL-90 and ALSEC than the fixed mindset group. These results suggest that that having a growth mindset has a positive effect on one's mental health.

Gender Difference and SES in Growth Mindset

We found no significant difference between gender and mindset, suggesting that gender does not play a contributing role in determining whether one will have a growth or fixed mindset. These results are consistent with previous studies (Heyman et al., 2002; Kornilova et al., 2009; Yan et al., 2014; Tucker-Drob et al., 2016; Macnamara and Rupani, 2017). The differences in self-reported SES had a significant effect on growth mindset, such that individuals of lower SES were found to have greater growth mindset. Findings regarding the effect of SES and growth mindset have been mixed in the literature. Some studies have demonstrated that those with higher SES had higher growth mindset, while those with lower SES had lower growth mindset (Claro et al., 2016; Yeager et al., 2016b; Miyamoto et al., 2018; Destin et al., 2019; Bernardo, 2021). The reason behind our findings may be due to the face that compared to individuals of higher SES, poorer students hold a stronger belief that they can bridge the gap by working hard and persevering (Burnette et al., 2017). That is, individuals who are raised in families of high SES were more likely to have been often praised and rewarded for their work. This in turn, may have resulted in greater fear of failure and challenge later in life, resulting in a more fixed mindset than in their lower SES counterparts.

There were no significant differences in the place of birth of students. These findings likely reflect the degree
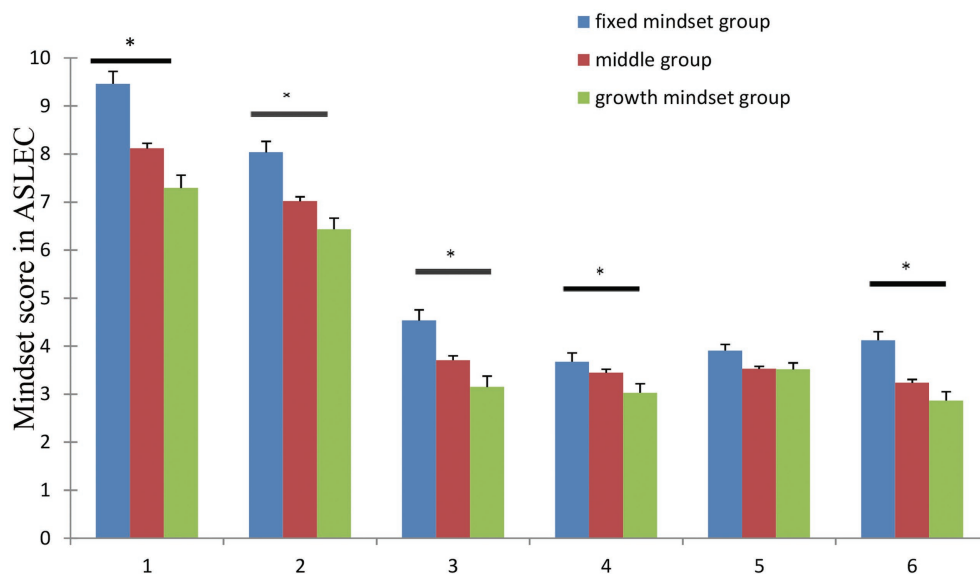
FIGURE 1 | Mean score of subscale of Adolescent Self-rating Life Events Checklist in different groups with error bars representing standard error of the mean and asterisks representing significant difference among groups.

TABLE 2 | One-way ANOVA of Adolescents Self-Rating Life Events Checklist.

	M (SD)	F	P
1. Interpersonal relationship	8.19 (4.64)	20.93	< 0.001
2. Study pressure	7.08 (4.05)	12.02	< 0.001
3. Being punished	3.74 (3.96)	8.81	< 0.01
4. Bereavement	3.42 (3.25)	4.95	< 0.01
5. Pressure of health and adaptation	3.57 (2.36)	2.73	> 0.05
6. Others	3.30 (3.16)	14.56	< 0.001

of the gap of socioeconomic status, as the gap between the rich and the poor may be narrowing due to the economic development. Another possible explanation rests in our participant sample. The sample of this study comes from an undergraduate university. As an undergraduate who come from low SES families need to make much more efforts to succeed in China. Therefore, they tend to form growth mindset.

In regard to mental health status and growth mindset, our findings demonstrated that college students with a growth-mindset had lower scores on the SCL-90 and ASLEC scales, while students with a fixed mindset had higher scores on these two scales, indicating that individuals with a growth mindset have greater mental health and better life event perception ability. As a result, having a growth mindset likely provides an individual with potential life benefits. In the present study, the association between the number of stressful life events and post-traumatic stress symptoms, depression, substance use, and non-suicidal self-injury was lower in the growth mindset group than in the fixed mindset group. These results suggest that having a growth mindset increase one's resilience to poor mental health (Schroder et al., 2017a).

The Practical Implications of Growth Mindset

Our findings also demonstrated that individuals who had the greatest growth mindset were healthier on most subscales of the SCL-90 and ASLEC scales. This may be due to the fact that the growth mindset group underestimated their self-assessment when they filled out self-report questionnaires. Mindsets are conceptualized as a framework through which individuals can explain their domain-related experiences that influence subsequent thoughts, emotions, goals, and behaviors (Dweck et al., 1995). Students with a growth mindset interpret mistakes as learning opportunities, stay focused when facing challenges, and tend to underestimate their own symptoms on the SCL-90 and ASLEC. They are more cautious and focused when completing the scales, resulting in lower scores. In contrast, students with fixed mindsets view mistakes as a sign of lack of competence and tended to escape when faced with challenges. They are more likely to overestimate their own symptoms and pay attention to the results when completing the scale.

The current study also found that groups with different mindsets might have different abilities in terms of life event perception. Individuals with a growth mindset demonstrated better life perception ability than those with a fixed mindset. In terms of study stress factors, individuals with a growth-mindset scored lower on the study pressure subscale. Individuals with a growth mindset may take initiative and derive strategies to adjust their thoughts, modify their expected goals in time, and maintain an optimistic and positive attitude. In contrast, individuals with a fixed mindset might adhere to goals when facing learning pressure, and if they fail to achieve their goals, demonstrate increased pressure and negative emotions. College students with a growth mindset show better adaptability when facing difficult situations or challenges, and appear to be more optimistic. They believe that their abilities can be cultivated and
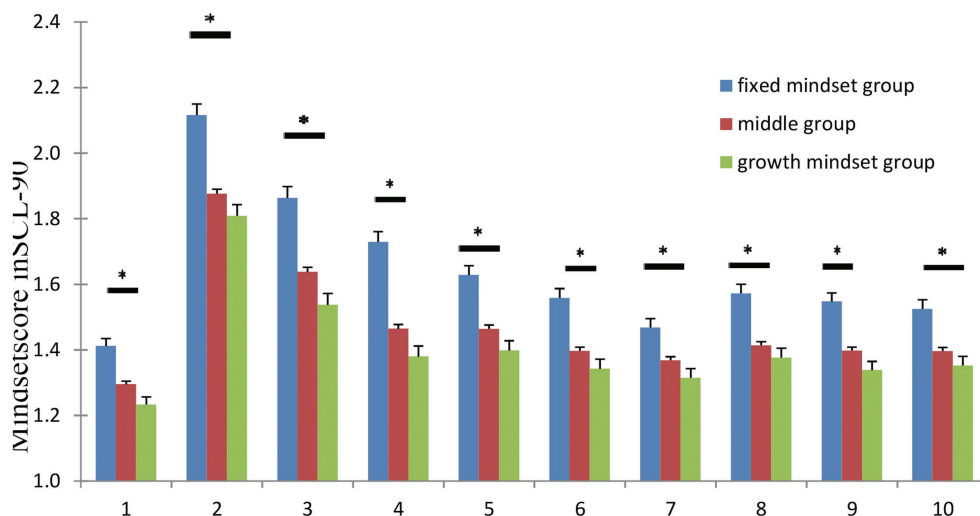
FIGURE 2 | Mean score of subscale of SCL-90 in different groups with error bars representing standard error of the mean and asterisks representing significant difference among groups.

TABLE 3 | One-way ANOVA of SCL-90 Scale.

	M (SD)	F	p
1. Somatization	1.30 (0.41)	12.21	< 0.001
2. Obsessive–compulsive	1.90 (0.61)	24.14	< 0.001
3. Interpersonal sensitivity	1.65 (0.61)	23.95	< 0.001
4. Depression	1.49 (0.56)	30.41	< 0.001
5. Anxiety	1.48 (0.51)	13.03	< 0.001
6. Hostility	1.41 (0.51)	15.35	< 0.001
7. Phobic anxiety	1.37 (0.48)	6.83	< 0.01
8. Paranoid ideation	1.43 (0.50)	8.18	< 0.001
9. Psychoticism	1.41 (0.46)	11.94	< 0.001
10. Other	1.41 (0.49)	9.96	< 0.001

that they can achieve their goals through hard work and perseverance. However, college students with a fixed mindset believe that their abilities are stable, and that they cannot be improved through effort. When they have difficulties, they may avoid challenges and demonstrate negative coping mechanisms.

Another possible explanation for these findings is that the growth-mindset group may have more positive coping strategies, and therefore might have better mental health and lower life event awareness than the fixed mindset group. The study pressure factor in ASLEC included questions such as "unsatisfactory test results," "heavy study burden," "family financial difficulties," "expected (good students) failure," and "pressure to enter school." Individuals with a fixed mindset might employ more negative coping strategies than those with a growth mindset. Students with a fixed mindset often have external motivation to learn or work (Dweck, 2006). They tend to demonstrate much more negative coping strategies for justifying failures, such as finding excuses for failures. In fact, this occupies the cognitive resources of learning and hinders their own development (Dweck, 2006; Dweck et al., 2014). However, students with a growth mindset demonstrate much more positive coping strategies. They analyze their own reasons and believe that hard work can improve their

performance and ability. They mobilize all available cognitive resources to promote their own development. These individuals are more likely to overcome difficult academic transitions (Yeager et al., 2014), and to embrace active learning strategies, compared to students with a fixed mindset (Cavanagh et al., 2018).

Future Research

The primary limitation of this study is a lack of investigation on the transformation of individuals with a fixed mindset to a growth mindset through intervention. Future studies should employ certain interventions that allow for this measurement. Furthermore, this study was unable to answer whether better mental health of growth mindset individuals is due to higher self-assessment or more positive coping strategies. Nonetheless, our findings support the results of previous research that college students with a growth mindset have better overall mental health than college students with a fixed mindset. Future studies could explore neural mechanisms underlying the possession of a growth mindset versus a fixed mindset. Furthermore, future studies ought to investigate the effects of growth mindset training on individuals with a fixed mindset.

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 study was reviewed and approved by the Institutional Review Board of the Human Research Ethics Committee of Huzhou University. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

WT and HY: conceptualization. DZ and ZX: formal analysis. DZ: visualization. WT, DZ, and XT: writing—original draft. H-JS and IH: writing—review and editing. All authors contributed to the article and approved the submitted version.

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REFERENCES

Bazelais, P., Lemay, D. J., Doleck, T., Hu, X. S., Vu, A., and Yao, J. (2019). Grit, mindset, and academic performance: a study of pre- university science students. Journal of mathematics, science and technology. *Education* 14:em1615. doi: 10.29333/ejmste/94570

Bernardo, A. B. I. (2021). Socioeconomic status moderates the relationship between growth mindset and learning in mathematics and science: evidence from PISA 2018 Philippine data. *Int. J. Sch. Educ. Psychol.* 9, 208–222. doi: 10.1080/21683603.2020.1832635

Blackwell, L. S., Trzesniewski, K. H., and Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: a longitudinal study and an intervention. *Child Dev.* 78, 246–263. doi: 10.1111/j.1467-8624.2007.00995.x

Burnette, J. L., Knouse, L. E., Vavra, D. T., O'Boyle, E., and Brooks, M. A. (2020). Growth mindsets and psychological distress: a meta-analysis. *Clin. Psychol. Rev.* 77:101816. doi: 10.1016/j.cpr.2020.101816

Burnette, J. L., O'Boyle, E. H., VanEpps, E. M., Pollack, J. M., and Finkel, E. J. (2013). Mind-sets matter: a meta-analytic review of implicit theories and self-regulation. *Psychol. Bull.* 139, 655–701. doi: 10.1037/a0029531

Burnette, J. L., Russell, M. V., Hoyt, C. L., Orvidas, K., and Widman, L. (2017). An online growth mindset intervention in a sample of rural adolescent girls. *Br. J. Educ. Psychol.* 88, 428–445. doi: 10.1111/bjep.12192

Cavanagh, A. J., Chen, X., Bathgate, M., Frederick, J., Hanauer, D. I., and Graham, M. J. (2018). Trust, growth mindset, and student commitment to active learning in a college science course. *CBE life Sci. Educ.* 17:ar10. doi: 10.1187/cbe.17-06-0107

Chen, L., Wang, L., Qiu, X. H., Yang, X. X., Qiao, Z. X., Yang, Y. J., et al. (2013). Depression among Chinese university students: prevalence and socio-demographic correlates. *PLoS One* 8, 1–6. doi: 10.1371/journal.pone.0058379

Clark, K. N., and Malecki, C. K. (2022). Adolescent mental health profiles through a latent dual-factor approach. *J. Sch. Psychol.* 91, 112–128. doi: 10.1016/j.jsp.2022.01.003

Claro, S., Paunesku, D., and Dweck, C. S. (2016). Growth mindset tempers the effects of poverty on academic achievement. *Proc. Natl. Acad. Sci.* 113, 8664–8668. doi: 10.1073/pnas.1608207113

De Kraker-Pauw, E., Van Wesel, F., Krabbendam, L., and Van Atteveldt, N. (2017). Teacher mindsets concerning the malleability of intelligence and the appraisal of achievement in the context of feedback. *Front. Psychol.* 8:1594. doi: 10.3389/fpsyg.2017.01594

Derogatis, L. R. (1983). SCL-90-R: administration, scoring, and procedures manual for the revised version. Clinical psychometric Research

Destin, M., Hanselman, P., Buontempo, J., Tipton, E., and Yeager, D. S. (2019). Do student mindsets differ by socioeconomic status and explain disparities in academic achievement in the United States? *AERA Open* 5:233285841985770. doi: 10.1177/2332858419857706

Doron, J., Stephan, Y., Boiché, J., and Scanff, C. L. (2009). Coping with examinations: exploring relationships between students' coping strategies, implicit theories of ability, and perceived control. *Br. J. Educ. Psychol.* 79, 515–528. doi: 10.1348/978185409X402580

Duckworth, A. L., Peterson, C., Matthews, M. D., and Kelly, D. R. (2007). Grit: perseverance and passion for long-term goals. *J. Pers. Soc. Psychol.* 92, 1087–1101. doi: 10.1037/0022-3514.92.6.1087

Dweck, C. S. (2000). *Self-theories: Their Role in Motivation, Personality, and Development. 1st Edn.* New York, NY: Psychology Press.

Dweck, C. S. (2006). *Mindset: The New Psychology of Success.* New York, NY: Random House.

Dweck, C., Chi-Yue, C., and Ying-Yi, H. (1995). Implicit theories and their role in judgments and reactions: A word From two perspectives. *Psychol. Inq.* 6, 267–285. doi: 10.1207/s15327965pli0604_1

Dweck, C., Walton, G. M., and Cohen, G. L. (2014). *Academic Tenacity: Mindsets and Skills that Promote Long-Term Learning.* Seattle, WA: Gates Foundation.

Dweck, C. S., and Yeager, D. S. (2019). Mindsets: a view from two eras. *Perspect. Psychol. Sci.* 14, 481–496. doi: 10.1177/1745691618804166

Gitlin, M. J., and Miklowitz, D. J. (2016). The difficult lives of individuals with bipolar disorder: A review of functional outcomes and their implications for treatment. *J. Affect. Disord.* 209, 147–154. doi: 10.1016/j.jad.2016.11.021

Grant, H., and Dweck, C. S. (2003). Clarifying achievement goals and their impact. *J. Pers. Soc. Psychol.* 85, 541–553. doi: 10.1037/0022-3514.85.3.541

Gyasi, R. M., and Phillips, D. R. (2018). Gender, self-rated health and functional decline among community-dwelling older adults. *Arch. Gerontol. Geriatr.* 77, 174–183. doi: 10.1016/j.archger.2018.05.010

Haimovitz, K., and Dweck, C. S. (2017). The origins of children's growth and fixed mindsets: new research and a new proposal. *Child Dev.* 88, 1849–1859. doi: 10.1111/cdev.12955

Hardeveld, F., Spijker, J., De Graaf, R., Hendriks, S. M., Licht, C. M. M., Nolen, W. A., et al. (2013). Recurrence of major depressive disorder across different treatment settings: results from the NESDA study. *J. Affect. Disord.* 147, 225–231. doi: 10.1016/j.jad.2012.11.008

Hardt, J., Gerbershagen, H. U., and Franke, P. (2012). The symptom check-list, SCL-90-R: its use and characteristics in chronic pain patients. *Eur. J. Pain* 4, 137–148. doi: 10.1053/eujp.2000.0162

He, C., and Hegarty, M. (2020). How anxiety and growth mindset are linked to navigation ability: impacts of exploration and GPS use. *J. Environ. Psychol.* 71:101475. doi: 10.1016/j.jenvp.2020.101475

Heyman, G. D., Martyna, B., and Bhatia, S. (2002). Gender and achievement-related beliefs among engineering students. *J. Women Minorities Sci. Eng.* 8:12. doi: 10.1615/JWomenMinorScienEng.v8.i1.30

Huang, Y., Wang, Y., Wang, H., Liu, Z., Yu, X., Yan, J., et al. (2019). Prevalence of mental disorders in China: a cross-sectional epidemiological study. *Lancet Psychiatry* 6, 211–224. doi: 10.1016/S2215-0366(18)30511-X

Jia, L., Lim, C. H., Ismail, I., and Tan, Y. C. (2021). Stunted upward mobility in a learning environment reduces the academic benefits of growth mindsets. *Proc. Natl. Acad. Sci.* 118:e2011832118. doi: 10.1073/pnas.2011832118

Kornilova, T. V., Kornilov, S. A., and Chumakova, M. A. (2009). Subjective evaluations of intelligence and academic self-concept predict academic achievement: evidence from a selective student population. *Learn. Individ. Differ.* 19, 596–608. doi: 10.1016/j.lindif.2009.08.001

Lewis, L. S., Williams, C. A., and Dawson, S. D. (2020). Growth mindset training and effective learning strategies in community college registered nursing students. *Teach. Learn. Nurs.* 15, 123–127. doi: 10.1016/j.teln.2020.01.006

Liu, X., Liu, I., and Yang, J. (1997). Compilation and reliability and validity test of Adolescents Self-rating Life Events Checklists. *Shandong Psychiatric Medicine* 10, 15–19.

Liu, X., Zhao, W., Hu, F., Hao, Q., Hou, L., Sun, X., et al. (2021). Comorbid anxiety and depression, depression, and anxiety in comparison in multi-ethnic community of West China: prevalence, metabolic profile, and related factors. *J. Affect. Disord.* 298, 381–387. doi: 10.1016/j.jad.2021.10.083

Lorant, V., Deliège, D., Eaton, W., Robert, A., Philippot, P., and Ansseau, M. (2003). Socioeconomic inequalities in depression: a meta-analysis. *Am. J. Epidemiol.* 157, 98–112. doi: 10.1093/aje/kwf182

MacCarthy, S., Saunders, C. L., and Elliott, M. N. (2022). Sexual minority adults in England have greater odds of chronic mental health problems: variation by sexual orientation, age, ethnicity, and socioeconomic status. *LGBT Health* 9, 54–62. doi: 10.1089/lgbt.2021.0011

Macnamara, B. N., and Rupani, N. S. (2017). The relationship between intelligence and mindset. *Intelligence* 64, 52–59. doi: 10.1016/j.intell.2017.07.003

McCutchen, K. L., Jones, M. H., Carbonneau, K. J., and Mueller, C. E. (2016). Mindset and standardized testing over time. *Learn. Individ. Differ.* 45, 208–213. doi: 10.1016/j.lindif.2015.11.027

Miu, A. S., and Yeager, D. S. (2016). Preventing symptoms of depression by teaching adolescents that people can change effects of a brief incremental theory of personality intervention at 9-month follow-up. *Health Serv. Rep.* 3, 726–743. doi: 10.1177/2167702614548317

Miyamoto, Y., Yoo, J., Levine, C. S., Park, J., Boylan, J. M., Sims, T., et al. (2018). Culture and social hierarchy: self- and other-oriented correlates of socioeconomic status across cultures. *J. Pers. Soc. Psychol.* 115, 427–445. doi: 10.1037/pspi0000133

Moè, A. (2016). Teaching motivation and strategies to improve mental rotation abilities. *Intelligence* 59, 16–23. doi: 10.1016/j.intell.2016.10.004

Orvidas, K., Burnette, J. L., and Russell, V. M. (2018). Mindsets applied to fitness: growth beliefs predict exercise efficacy, value and frequency. *Psychol. Sport Exerc.* 36, 156–161. doi: 10.1016/j.psychsport.2018.02.006

Polanczyk, G. V., Salum, G. A., Sugaya, L. S., Caye, A., and Rohde, L. A. (2015). Annual research review: a meta-analysis of the worldwide prevalence of mental disorders in children and adolescents. *J. Child Psychol. Psychiatry* 56, 345–365. doi: 10.1111/jcpp.12381

Puusepp, I., Linnavalli, T., Huuskonen, M., Kukkonen, K., Huotilainen, M., Kujala, I., et al. (2021). Mindsets and neural mechanisms of automatic reactions to negative feedback in mathematics in elementary school students. *Front. Psychol.* 12:635972. doi: 10.3389/fpsyg.2021.635972

Rattan, A., Good, C., and Dweck, C. S. (2012). "It's ok — not everyone can be good at math": instructors with an entity theory comfort (and demotivate) students. *J. Exp. Soc. Psychol.* 48, 731–737. doi: 10.1016/j.jesp.2011.12.012

Ren, J. (2009). Study on College Students' Mental Health Status and a Reflection on the SCL-90. *Chin. J. Health Psychol.* 17, 958–961.

Sánchez-Moreno, E., and Gallardo-Peralta, L. P. (2021). Income inequalities, social support and depressive symptoms among older adults in Europe: a multilevel cross-sectional study. *Eur. J. Ageing.* doi: 10.1007/s10433-021-00670-2

Saxena, S., and Kline, S. (2021). Countdown global mental health 2030: data to drive action and accountability. *Lancet Psychiatry* 8, 941–942. doi: 10.1016/s2215-0366(21)00391-6

Schleider, J. L., Abel, M. R., and Weisz, J. R. (2015). Implicit theories and youth mental health problems: a random-effects meta-analysis. *Clin. Psychol. Rev.* 35, 1–9. doi: 10.1016/j.cpr.2014.11.001

Schroder, H. S. (2020). Mindsets in the clinic: Appling mindset theory to clinical psychology. *Clin. Psychol. Rev.* 83. doi: 10.1016/j.cpr.2020.101957

Schroder, H. S., Fisher, M. E., Lin, Y., Lo, S. L., Danovitch, J. H., and Moser, J. S. (2017a). Neural evidence for enhanced attention to mistakes among school-aged children with a growth mindset. *Dev. Cogn. Neurosci.* 24, 42–50. doi: 10.1016/j.dcn.2017.01.004

Schroder, H. S., Yalch, M. M., Dawood, S., Callahan, C. P., Donnellan, M. B., and Moser, J. S. (2017b). Growth mindset of anxiety buffers the link between stressful life events and psychological distress and coping strategies. *Personal. Individ. Differ.* 110, 23–26. doi: 10.1016/j.paid.2017.01.016

Smith, K. (2014). Mental health: a world of depression. *Nature* 515, 180–181. doi: 10.1038/515180a

Strayhorn, T. L. (2014). What role does grit play in the academic success of black male collegians at predominantly white institutions? *J. Afr. Am. Stud.* 18, 1–10. doi: 10.1007/s12111-012-9243-0

Sun, X., Nancekivell, S., Gelman, S. A., and Shah, P. (2021). Growth mindset and academic outcomes: a comparison of US and Chinese students. *NPJ Sci. Learn.* 6:21. doi: 10.1038/s41539-021-00100-z

Tang, F., Byrne, M., and Qin, P. (2018). Psychological distress and risk for suicidal behavior among university students in contemporary China. *J. Affect. Disord.* 228, 101–108. doi: 10.1016/j.jad.2017.12.005

Tang, Q., Du, Z., Yuan, A., and Deng, Y. (1999). Application and analysis of SCL-90 in China. *Chin. J. Clin. Psychol.* 7, 16–20.

Tucker-Drob, E. M., Briley, D. A., Engelhardt, L. E., Mann, F. D., and Harden, K. P. (2016). Genetically-mediated associations between measures of childhood character and academic achievement. *J. Pers. Soc. Psychol.* 111, 790–815. doi: 10.1037/pspp0000098

Wagstaff, A., and Doorslaer, E. V. (2000). Income inequality and health: what does the literature tell us? *Annu. Rev. Public Health* 21, 543–567. doi: 10.1146/annurev.publhealth.21.1.543

Walker, K. A., and Jiang, X. (2022). An examination of the moderating role of growth mindset in the relation between social stress and externalizing behaviors among adolescents. *J. Adolesc.* 94, 69–80. doi: 10.1002/jad.12006

Wang, L., Feng, Z., Yang, G., Yang, Y., Wang, K., Dai, Q., et al. (2016). Depressive symptoms among children and adolescents in western China: an epidemiological survey of prevalence and correlates. *Psychiatry Res.* 246, 267–274. doi: 10.1016/j.psychres.2016.09.050

Wang, D., Yuan, F., and Wang, Y. (2020). Growth mindset and academic achievement in Chinese adolescents: a moderated mediation model of reasoning ability and self-affirmation. *Curr. Psychol.* 41, 783–792. doi: 10.1007/s12144-019-00597-z

Wu, X., Tao, S., Zhang, Y., Zhang, S., and Tao, F. (2015). Low physical activity and high screen time can increase the risks of mental health problems and poor sleep quality among Chinese college students. *PLoS One* 10:e0119607. doi: 10.1371/journal.pone.0119607

Xie, H., and Dai, H. S. (2006). Evaluation of the Scl-90 scale. *Neurological Disorders and Mental Health* 6 156–159.

Yan, V. X., Thai, K. P., and Bjork, R. A. (2014). Habits and beliefs that guide self-regulated learning: do they vary with mindset? *J. Appl. Res. Mem. Cogn.* 3, 140–152. doi: 10.1016/j.jarmac.2014.04.003

Yeager, D. S., Johnson, R., Spitzer, B. J., Trzesniewski, K. H., Powers, J., and Dweck, C. S. (2014). The far-reaching effects of believing people can change: implicit theories of personality shape stress, health, and achievement during adolescence. *J. Pers. Soc. Psychol.* 106, 867–884. doi: 10.1037/a0036335

Yeager, D. S., Lee, H. Y., and Jamieson, J. P. (2016a). How to improve adolescent stress responses: insights from integrating implicit theories of personality and biopsychosocial models. *Psychol. Sci.* 27, 1078–1091. doi: 10.1177/0956797616649604

Yeager, D. S., Trzesniewski, K. H., Tirri, K., Nokelainen, P., and Dweck, C. S. (2011). Adolescents' implicit theories predict desire for vengeance after peer conflicts: correlational and experimental evidence. *Dev. Psychol.* 47, 1090–1107. doi: 10.1037/a0023769

Yeager, D. S., Walton, G. M., Brady, S. T., Akcinar, E. N., Paunesku, D., Keane, L., et al. (2016b). Teaching a lay theory before college narrows achievement gaps at scale. *Proc. Natl. Acad. Sci.* 113, E3341–E3348. doi: 10.1073/pnas.1524360113

Zhai, X. (2018). *The Relationship between Growth Mindset and Grit: Multiple Mediation Effects of the Future time Perspective and Achievement Motivation.* School of Educational Science, Ludong University.

Zhao, S., Du, H., Li, Q., Wu, Q., and Chi, P. (2021a). Growth mindset of socioeconomic status boosts subjective well-being: a longitudinal study. *Personal. Individ. Differ.* 168:110301. doi: 10.1016/j.paid.2020.110301

Zhao, H., Xiong, J., Zhang, Z., and Qi, C. (2021b). Growth mindset and college Students' learning engagement During the COVID-19 pandemic: A serial mediation model. *Front. Psychol.* 12:621094. doi: 10.3389/fpsyg.2021.621094

Zhao, F., Zhang, Z.-H., Bi, L., Xiao-Shuang, W., Wang, W.-J., Li, Y.-F., et al. (2017). The association between life events and internet addiction among Chinese vocational school students: the mediating role of depression. *Comput. Hum. Behav.* 70, 30–38. doi: 10.1016/j.chb.2016.12.057

Zheng, Y., and Zheng, X. (2015). Current state and recent developments of child psychiatry in China. *Child Adolesc. Psychiatry Ment. Health* 9:10. doi: 10.1186/s13034-015-0040-0

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Socio-Economic Development and Mental Health: Case Study of the Spanish Region of Aragon (2010–20)

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Introduction: Considering health as a cross-cutting element of all public policies leads to rethinking its interactions with the environment in which people live. The collection of large volumes of data by public administrations offers the opportunity to monitor and analyze the possible associations between health and territory. The increase in the incidence and prevalence of mental health diseases, particularly depression, justifies the need to develop studies that seek to identify links with the socioeconomic and environmental setting.

Objective: The objective of this study is to explain the behavior of the depression in a mediterranean region of Northeastern Spain from an ecological and diachronic perspective.

Methods: We conducted a correlation and multivariate logistic regression analysis to identify explanatory factors of the prevalence of depression in 2010 and 2020 and in the variation rate. Potential explanatory factors are related to the socioeconomic status and to the territorial development level.

Results: The regression models retained both socioeconomic and territorial development variables as predictors of the prevalence in both years and in the variation rate. Rural areas seem to play a protective role against the prevalence.

Conclusion: It is under the territorial prism that epidemiological studies could offer useful guidelines for proactive decision-making. The integration of data on diseases and territory must be considered when developing policies for the creation of healthier environments and for directing health services with more specific resources to where they may be needed.

Keywords: primary health care, depression, social determinants of health, territorial development, decision making, socioeconomic status

INTRODUCTION

Advancing upon our current understanding of "health" raises the need to consider it beyond the mere lack of discomfort including the overall wellbeing of the individual as well as social welfare (Santoro-Lamelas, 2016). Mental health conditions, and specifically depression-related ones, are the main cause of disability in western countries (WHO, 2017). The increasing provision of services linked to economic growth is often associated to wellbeing and, in parallel, good health. Indeed, economic development has fostered medical advances and increasing access to health services, which ultimately contribute to welfare (Jorm and Ryan, 2014). However, economic growth does not necessarily improve mental health and several studies support the notion that psychiatric disorders and depression go hand in hand with industrialization and urbanization, as it favors income inequality (Gupta et al., 2016; Yu and Wang, 2016; Ribeiro et al., 2017). There is a growing interest in monitoring and reducing inequalities both from the approach of the UN SDGs and the OECD, from the assertion that inequality affects the social fabric and harms long-term economic growth (OECD, 2015; United Nations, 2015). The drivers of depression are not yet fully understood, being it attributed to different factors such as genetic predisposition, personality traits, as well as impaired social interactions (Dunn et al., 2015; Gariépy et al., 2016; Cai et al., 2020). The socioeconomic status, gender or the residential environment could also pose a risk of depression (Freeman et al., 2016; Kuehner, 2017; Razzak et al., 2019). Other risk factors could be specifically manifested in rural or urban settings, especially in terms of diagnosis, treatment and use of health services (Wang, 2004; Fortney et al., 2010; Purtle et al., 2019).

The Determinants of Health (DH) approach and the Health in All Policies [HiAP; (WHO, 2014)], stress the importance of policies, actions and interventions outside the direct remits of the healthcare sector, e.g., regional planning or economic development (Puska, 2007; Ollila, 2011). These approaches advocate for assessing the wide array of protective and/or risk factors mediating health conditions, i.e., individual lifestyles, social and community networks, food production systems, the socioeconomic and residential environment, the access to health services or policies in place (Dahlgren and Whitehead, 2007; Gnanapragasam et al., 2021). Parallel to the inception and evolution of the HiAP and DH approaches, the "information revolution" has enabled compiling and cataloging large amounts of data with increasing complexity in their structures and interrelationships (the so-called Big Data). Today, public administrations collect large amounts of data on a regular basis that can be put at the service of healthcare and resource management.

We hypothesize that an uneven territorial development and the environmental settings influence health status and, specifically, depression and mental conditions. Hence, landscape and urban planning may play a role in improving mental health. It is in this context of necessary interaction between health, environment, and data availability to satisfy the pressing need for management that this study is proposed. We investigate the link between socioeconomic and territorial indicators, and the prevalence of depression in Aragon. We leverage official data sources to conduct a diachronic analysis of their association. The socioeconomic factors are expressed through deprivation indicators referring to the demographic structure, the work environment, and the level of education. Those referring to the territorial development illustrate the accessibility to facilities and services and to the transportation network, the condition of residential buildings and the quality of the landscape. The hypothesis of this study is that a greater vulnerability to the prevalence of depression corresponds to a higher socioeconomic deprivation and lower levels of territorial development.

MATERIALS AND METHODS

The methodological process was divided into three phases. First, a spatial database was generated on depression prevalence (as dependent variable) and indicators on socioeconomic environment and territorial development (as independent variables). Second, the variables were aggregated at the Basic Health Area (BHA) level to prepare the cartographic representation and statistical analysis. Third, a correlation and logistic regression analysis was performed to explore associations between the variables.

Study Population and Sample Size

The target population of our study are all individuals inside the National Health System registered in Aragon (Spain) during 2010 or 2020. The sample consists of patients with a digital medical record being 18 years and older, including elderly people (over 65), having been diagnosed with Depression, according to the International Classification in Primary Care (ICPC) of the World Organization of Family Doctors (WONCA) (ICPC 2 – P76). to the universal nature of the health system and the absence of other health care data providers, the sample analyzed in this study can be considered as representative of practically the 100% of the adult population diagnosed with depression.

Study Area

The study area is the Autonomous Community of Aragon. The territorial administrative unit for primary health care in Aragon is the BHA. BHAs are groupings of municipalities except in the case of the three main towns, Zaragoza, Huesca and Teruel, which group census tracts. BHAs are grouped into eight health sectors: Huesca, Barbastro, Zaragoza I, Zaragoza II, Zaragoza III, Calatayud, Teruel, and Alcañiz. The region covers an area of 47.720 square km with a population density of 27.8 inhabitants per square km (in 2021). The multivariable map in **Figure 1** illustrates the large contrasts that characterize this region in terms of population distribution, territorial development, and socioeconomic conditions. We find the main population concentrations in the middle and mid-west of the region. These areas are characterized by a high level of territorial development that in many cases, is accompanied by a high socioeconomic deprivation (dark cyan tones). The BHAs displayed in purple illustrate intermediate territorial development. These regions host health-care centers assigned to people in the surrounding
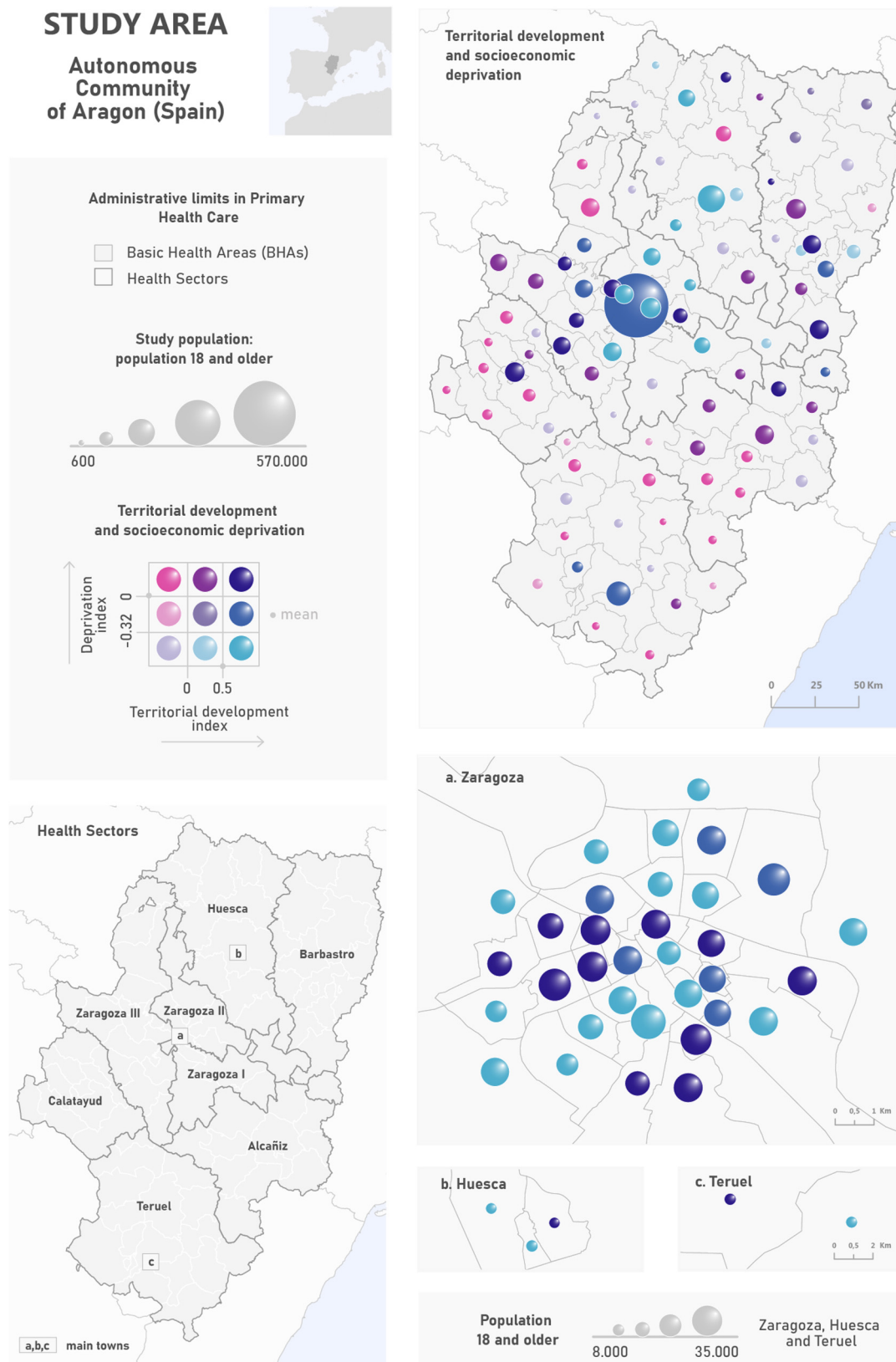
FIGURE 1 | Study area and spatial distribution of the privation and territorial development indexes by BHA.

settlements. Populations living in these areas are even young or aged and the deprivation conditions can be high (dark purple tones). In contrast with previous ones, we found numerous BHAs that show a smaller population size, especially in the north and south of the region. These are characterized by lower levels of territorial development and an overaged demographic structure. These disadvantages can be accompanied by socioeconomic deprivation (intense magenta tones). These contrasts in the settlement distribution are derived from physical factors such as the arrangement of the main relief units which ultimately explain climate conditions and land cover. There is a gradient from wet and cool conditions in the two surrounding mountain ranges (Pyrenees, 3,400 m.a.s.l. and Iberian System, 2,300 m.a.s.l.) to warm and dry situations in the central corridor of the River Ebro Valley.

Variables and Data Collection

The dependent variable of this study is the prevalence rate of depression. The Aragon Health Sciences Institute of the University of Zaragoza provided standardized rates by gender and age at BHA level in the years 2010 and 2020. As independent variables, we retrieved and compiled a comprehensive set of socioeconomic and demographic indicators from official datasets and databases in Aragon (**Table 1**).

The core information for our analyses comes from the Aragon's Deprivation index (Compés Dea et al., 2018). The database was created by the General Directorate of Public Health of the Government of Aragon, the Aragon Statistics Institute (ASI) and the Department of Microbiology, Preventive Medicine and Public Health of the University of Zaragoza. They developed a cross-sectional study linking mortality and deprivation, taking the BHA as the unit of analysis, aggregating data from all the inhabitants of Aragon as of January the 1st 2011 (Spanish Population Census of 2011). Out of the 26 indicators that make up the Deprivation index, we selected the following: unemployment, casual wage earners, insufficient instruction and Foreigners. In this work, we analyze both the Deprivation Index and a selection of the original indicators.

We included a second set of indicators related to territorial development, collected from the spatial database of the Synthetic Index of Territorial Development of Aragon (SITD). The SITD was created by the General Directorate of Territorial Integration, Mobility and Housing of the Government of Aragon. It consists of a combination of factors that illustrate different development

TABLE 1 | Variables of the study, indicators, and units of measure.

Dependent variable	Unit of measure
Prevalence of depression in 2010 and 2020 by BHA.	Percentage
Independent variables	
Socioeconomic factors	
Deprivation index. Linear combination of Unemployment, Casual Wage Earners, Insufficient Instruction in persons aged 16 to 64 and Foreigners.	Range from −2.33 to 3.04
Temporary workers: ratio between (a, as numerator) the number of temporary or temporary employees and (b, as denominator) the employed population.	Percentage
Manual workers: ratio between (a) persons aged 16 and over employed in catering, personal services, protection, salesclerks, skilled workers in agriculture and fishing, craftsmen, skilled workers in manufacturing, construction and mining, except plant and machinery operators, plant and machinery operators, assemblers and unskilled workers; and the employed population.	Percentage
Unemployment: ratio between (a) unemployed persons seeking their first job or who have previously worked and the employed and (b) unemployed persons either seeking their first job or who have previously worked.	Percentage
Low education level: ratio between (a) illiterate population or having incomplete primary education and (b) the population 16 years and older.	Percentage
Low education level in young population: ratio between (a) 16–29 years old illiterate population or having incomplete primary education and (b) the population 16 years and older.	Percentage
Low education level in foreign population: ratio between (a) foreign illiterate population or having incomplete primary education and (b) the population 16 years and older.	Percentage
Overaging rate: ratio between (a) people aged 65 years and older and (b) total population.	Percentage
Population 85 and older: ratio between (a) people aged 85 years and older and (b) total population.	Percentage
Single-person > 65 households: ratio between (a) households consisting of an only person aged 65 years and older and (b) total households.	Percentage
Households without internet access: ratio between (a) households without internet access and (b) total households.	Percentage
Territorial development factors	
SITD: synthetic index constructed by the combination of partial indicators related to Economy, Households, Facilities and services, Mobility and Vital scenery.	Range from −0.8 to 12
Economy: represents economic activity, considering general economic indicators such as the number of Social Security affiliations, unemployment, youth unemployment, and sectorial variables on primary, secondary, or tertiary sector activities. Also incorporates a set of demographic variables that indirectly condition economic development such as population growth, distribution and demographic structure by sex and age.	Range from −1.2 to 17
Residential environment: illustrates building characteristics using indicators such as the age, the cadastral value, and the state of conservation.	Range from −0.7 to 14.1
Facilities and services: the criteria of accessibility to facilities and services is measured in time through the road network to different educational, health and administrative facilities.	Range from −2.2 to 6.6
Mobility: the mobility factor relates to ease of transportation, access to the high-capacity road and the rail network and communication technologies.	Range from −1.1 to 4.6
Landscape: takes in account related to landscape such as its quality and social appreciation, as well as other indicators such as the percentage of the municipal surface included in figures of environmental protection and the presence of trails that run through the municipality.	Range from −0.5 to 7.2
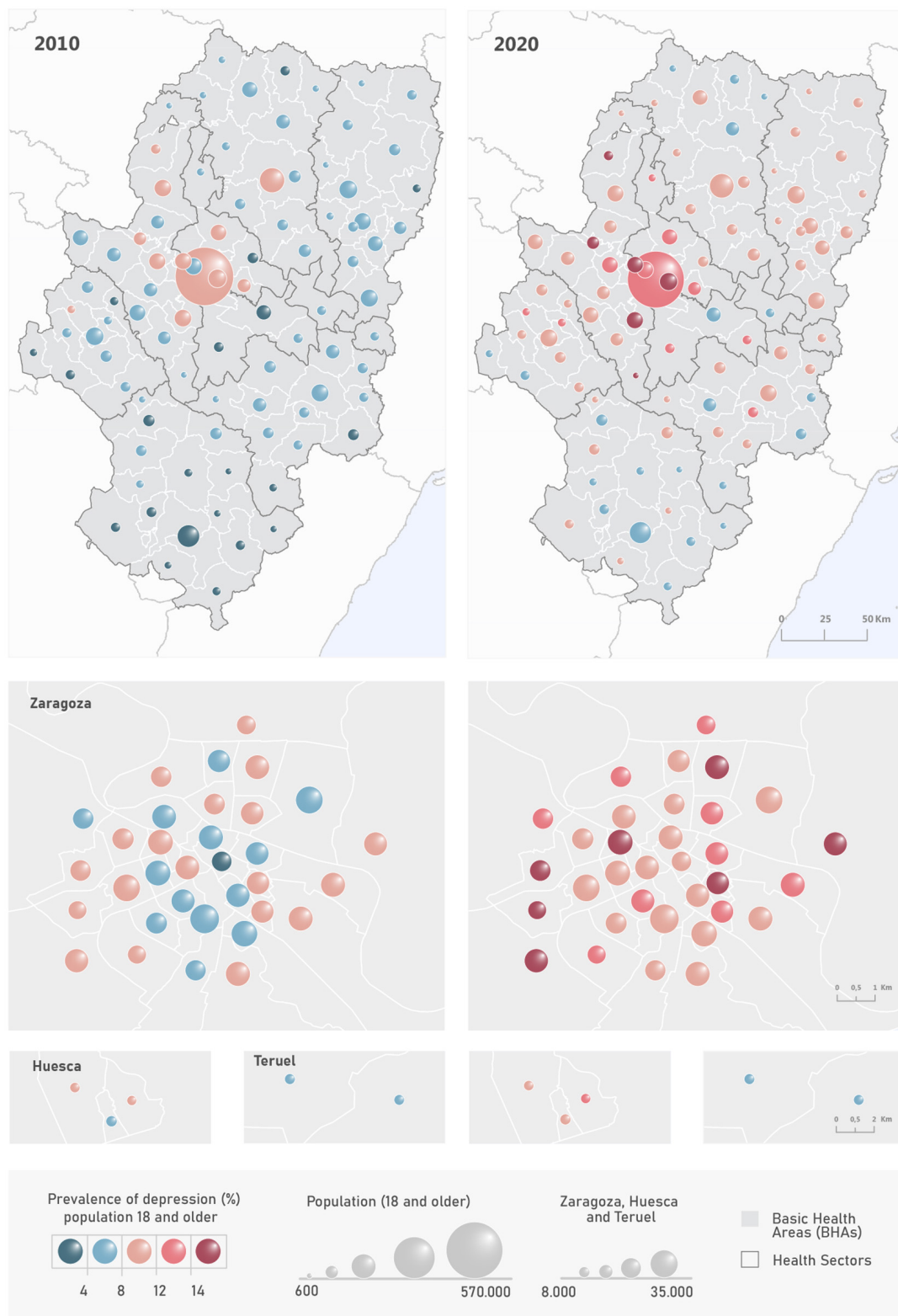
FIGURE 2 | Spatial distribution of the prevalence of depression in 2010 and 2020.

axes: Economy, Residential environment, Facilities and services, Mobility and Landscape.

Statistical Analysis

To analyze the association between the prevalence of depression and the socioeconomic and territorial variables, we calculated the Spearman's or Person's R correlation coefficient, retrieving both the coefficient value and its significance level (*p*-value). Pearson was calculated when data were normally distributed, while Spearman was used if at least one covariate did not follow a normal distribution. To further investigate potential relationships, we conducted a multivariate regression analysis. Since the assumption of normality does not hold for all covariates, we leaned toward logit regression. We constructed a separate binary response variable for 2010 and 2020, classifying as "1" all records above the median prevalence rate (6.37 in 2010 and 10.6 in 2020) and as "0" otherwise. Additionally, we analyzed the change in the prevalence rate, calculating the variation rate between 2010 and 2020. Again, the resulting variable was recoded as 0–1 using the median as separation threshold. Three separate models were evaluated (2010, 2020 and change). For each one, we calibrated a null model containing all variables as candidate predictors. We discarded those found to be collinear (VIF > 5), subsequently retaining significant predictors through a backwards stepwise procedure minimizing the AIC. Each "final" model was submitted to the Hosmer Lemeshow goodness of fit test and the Likelihood ratio test. Additionally, we computed the Nagelkerke pseudo-R2 coefficient to inform about the performance of the model.

RESULTS

In 2010, 80,030 adult individuals were diagnosed with depression in Aragon, a figure that rose to 123,174 in 2020, increasing by 53% during the period. Conversely, the total population in the same age group slightly decreased from 1,111,812 in 2010 to 1,096,878 in 2020. The highest prevalence rates in 2010 were observed around Zaragoza and its metropolitan area while the lowest were observed in the southern and northern ends of the region, especially in Teruel (**Figure 2**). All socioeconomic factors -aside from wage earners, unemployment, and the Deprivation index itself- attained significant and negative correlations in both 2010 and 2020. Territorial indicators showed stronger associations, being all significant and positively correlated but landscape quality, which aroused a negative correlation (**Table 2**). This implies that BHAs with an overaged population, low instruction level, which are less advantageous in terms of economic development and access to infrastructures/equipment are less prone to depression; meaning that rural enclaves may exert a sheltering effect. But the same indicators -either socioeconomic or territorial- were found significantly associated with the change in the prevalence rate between 2010 and 2020. However, the direction of the association was reversed in all cases. Hence, regardless of the suggested protective effect of rural areas, it is precisely these settings that are increasing faster in relative terms. The results from the logit regression models support the

behavior from the correlation analyses (**Table 3**). The 2010 and 2020 models retained the same variables as predictors of the prevalence of depression, i.e., overaging rate, manual workers, and landscape quality. In both cases it means that a lower level of over-aging, a lower proportion of manual workers and a lower quality of the landscape are associated with an increased probability of depression. In the case of the variation rate the model identified three variables with explanatory capacity (though only one was significant $p < 0.05$): low level of education in the young and foreign population and the overaging rate. The direction of the relationship suggests a greater probability of finding a higher increase in prevalence by 2020 in areas with an overaged demographic structure accompanied -to a lesser extent- by a lower level of education in the foreign population. The results from the goodness of fit tests are favorable in all cases (HL > 0.05 and LR < 0.05). However, the performance of the models was higher in the case of 2010, followed by the 2020 and the variance models.

DISCUSSION

In this study we explore the spatial distribution of the prevalence of depression from a socioeconomic and territorial approach. Our findings reinforce the notion that the circumstances in which people live are linked to the variability in the prevalence of depression (Lopizzo et al., 2015; Rautio et al., 2018). The rural-to-urban continuum seems to be the underlying driver of the spatial distribution of the prevalence rates. However,

TABLE 2 | Correlations between the prevalence of depression and the variables studied.

	Prevalence of depression		
	2010	**2020**	**Variable**
Socioeconomic indicators			
Deprivation index	−0.035	−0.093	−0.011
Temporary workers	0.074	0.074	−0.096
Manual workers	−0.476**	−0.396*	0.418*
Unemployment	0.113	0.069	−0.127
Low education level	−0.517**	−0.414**	0.448**
Low education level in young population	−0.195*	−0.195*	0.195*
Low education level in foreign population	−0.189*	−0.189*	0.117
Overaging rate	−0.551**	−0.551**	0.476**
Population 85 and older	−0.463**	−0.343**	0.406*
Single-person > 65 households	−0.398**	−0.296**	0.298**
Households without internet access	−0.571**	−0.427**	0.502**
Territorial development indicators			
SITD	0.622**	0.622**	−0.522**
Economy	0.597**	0.597**	−0.519**
Residential environment	0.560**	0.560**	−0.497**
Facilities and services	0.648**	0.648**	−0.496**
Mobility	0.603**	0.603**	−0.496**
Landscape	−0.615**	−0.615**	0.503**

*p-value < 0.05; **p-value < 0.001.

TABLE 3 | Summary of logit regression models.

Model	Variable	Beta Coeff.	p-value	pseudo R2	HL test	LR test
2010	Overaging rate	−0.24	0.02*	0.56	0.56	0.00
	Manual workers	−0.07	0.00**			
	Landscape	−1.86	0.02*			
2020	Overaging rate	−0.17	0.03*	0.33	0.91	0.00
	Manual workers	−0.05	0.01**			
	Landscape	−0.71	0.06			
Var	Low education level in young population	0.06	0.14	0.28	0.47	0.02
	Low education level in foreign population	−0.03	0.15			
	Overaging rate	0.34	0.00**			

*p-value < 0.05; **p-value < 0.001; HL, Hosmer Lemeshow test; LR, Likelihood ratio.*

the observed associations and relationships revealed manifold nuances. The initial hypothesis about a greater vulnerability expected in areas with greater socioeconomic deprivation and lower levels of territorial development, can only be partially accepted.

The BHAs of the city of Zaragoza, its metropolitan area and those of the central-east sector of the region correspond to predominantly urban areas where high rates of depression have been observed in 2010 and 2020. The explanatory factors identified by the regression models (higher probability of prevalence with lower overaging, proportion of manual workers and landscape quality) lead to reconsideration of these areas. The positive correlations between the prevalence and the territorial development factors (except for the quality of the landscape) support such reexamination, leading us to qualify the initial hypothesis. We observe that an advantageous situation in terms of territorial development does not necessarily protect against the prevalence of depression. In urban areas, the social ties are less solid than in rural environments, the feeling of belonging to the community is lower, the urban way of life is associated with greater stress, and the enjoyment of natural spaces compared to rural areas is less affordable. In contrast, rural enclaves are usually located in natural environments attaining higher landscape quality than their urban counterparts. In addition, social relationships are strong and derive to a large extent from the existence of a sense of attachment to the place of residence. In this regard, the seemingly sheltering effect of rural livelihoods (Ayuso-Mateos et al., 2001) could be explained by the social support networks (Rubio-Aranda et al., 2012; Gariépy et al., 2016), the greater sense of belonging to the community (Kim et al., 2004; Romans et al., 2010) and the positive effects of rural landscapes on mental health (Velarde et al., 2007).

Regarding socioeconomic status (SES), there is a scientific consensus on the link between SES and mental health (Ostler et al., 2001; Patel et al., 2018). However, in the particular case of depression, a greater heterogeneity in the results and controversy exists due to the way the psychiatric disorder and the SES is measured as well as to the contextual background (Lorant et al., 2003). It is noteworthy that in our study the composite indicator of deprivation did not explain the prevalence of depression, while

some partial index factors did. The explanatory factors of the variance model revealed a greater probability of an increase in the prevalence in overaged areas with lower educational attainment. This factor has been highlighted in previous studies for its protective role against the prevalence of depression (Zimmerman and Katon, 2005; Bjelland et al., 2008; Freeman et al., 2016), especially in the elderly (Miech and Shanahan, 2000; Domènech-Abella et al., 2018). In turn, other SES measurements such as the marital status or the income level have proven to be more significant than educational level (Inaba et al., 2005). In other studies, these associations also vary depending on population characteristics such as sex and age (Elliott, 2001; Back and Lee, 2011; Arias-de la Torre et al., 2018).

We consider that in addition to the educational attainment, there are other factors that may contribute to explain the increase in the prevalence of depression in rural areas in Aragon. The median prevalence of depression in Aragon was 6.37% in 2010 and 10.6% in 2020. The prevalence from primary care consultations offered by the PREDICT study was 12.2% (King et al., 2006) and 10.6% in the ESEMED-Spain project (Gabilondo et al., 2010). These figures reveal a possible under-diagnosis in the prevalence of depression in 2010 (Llorente et al., 2018), a frequent situation, especially in the elderly (Faisal-Cury et al., 2022). The regression results revealed an increased prevalence of depression in areas with aged population (Kyu-man et al., 2019; Linder, 2019). This implies that, although the elderly population living in rural areas may enjoy protective environmental factors against mental health conditions, they still deserve special attention from the healthcare system. In this context, it should be noted that between 2010 and 2020, the healthcare sector in Aragon has improved the mechanisms of diagnosis and the follow-up of the prevalence through the so-called "Aragon's mental health plan 2017–2021." This effort has been translated into a higher integration of mental health centers in the BHAs and the incorporation of the figure of the consultant psychiatrist for primary care. In addition, screening tests for geriatric depression have been incorporated into medical history follow-up programs, such as the Yesavage test (Yesavage, 1988). Therefore, the increase in prevalence in rural settings could be linked to the increased accuracy in the diagnosis capability.

In summary, this study illustrates an assessment based on the integration of official healthcare, socioeconomic and territorial information to analyze the prevalence of diseases from the DH approach. Our findings encourage the incorporation of Geographical Information Systems (GIS) to support decision-making (Wang, 2020). In addition to broad patterns and relationships, GIS-based analyses offer interesting capabilities. An illustrative example is the possible underdiagnosis of depression in the elderly mentioned above. If such underdiagnosis is to be confirmed in a population group or in a given area, actions can be developed to this end.

It should also be mentioned the limitations of the study derived from the databases used. In mental diseases, the process of diagnosis, registration and treatment is subject to greater subjectivity comparted to the non-mental ones. The health inventory protocol of Aragon contains specific codes for mental pathologies that allow their unequivocal compilation

(e.g., depressive disorder, anxiety disorder). However, the clinical tools for diagnosis, highly diverse and mainly based on clinical interviews, are subject to variability in medical practice (WHO, 2004; Muñoz and Jaramillo, 2015). Actions aimed at homogenizing the diagnostic tools may minimize the bias in the information derived from this variability, though they are not in place yet. There is also a temporal mismatch between prevalence data and the socioeconomic indicators, referred to 2011 as reported in the Spanish Population and Housing Census. Despite offering an adequate spatial coverage, their frequency and update timing hinders the multitemporal analysis.

Likewise, the suite of selected indicators was able to unravel broad relationships but might be lacking "thematic sensitivity," holding limited capability to provide further insights. It would be of great interest to incorporate in future studies variables specifically related with structural processes that take place on a regional scale but with profound effects on DH manifestations at the local and the individual level. For instance, covariates linked to economic recession, prevailing situation in Spain at the beginning of the study period. These processes impact the labor and economic environments, leading to situations of precarious, temporary employment or unemployment; to migrant workers, to situations of lack of funds that ultimately result in sadness, despair, and isolation. This information related to individual factors is recorded by health administrations in patients' medical records. Consequently, the identification of cause-effect relationships between structural and individual factors would lead to future studies, preferably of the observational type. In the case of the ecological type, a greater level of spatial and temporal disaggregation of the data will be sought, which will require joint work and continuous feedback between the scientific community and the public administrations.

CONCLUSION

The interaction between depression prevalence and HD should not be reduced to the socioeconomic environment. There are other factors such as territorial development and organizational aspects of the health system that can support the explanation of the spatial distribution of depression prevalence from the DH approach. Public administrations offer information that, when integrated with that generated in the health system, can be used for research and decision-making aimed at reducing social and health inequalities. This demonstration case is focused on the prevalence of depression, one of the most prevalent and complex diseases in diagnosis and treatment in primary care. However, our approach can be easily adapted to other diseases and regions elsewhere.

REFERENCES

Arias-de la Torre, J., Vilagut, G., Martín, V., Molina, A. J., and Alonso, J. (2018). Prevalence of major depressive disorder and association with personal and socio-economic factors. Results for Spain of the European Health Interview

DATA AVAILABILITY STATEMENT

The data analyzed in this study is subject to the following licenses/restrictions: Data on the prevalence of depression have been provided by the Research Ethics Committee of the Autonomous Community of Aragón (BIGAN database). Data on HD have been collected from official and public sources of the Government of Aragon: (i) https://idearagon.aragon.es/atlas/# (ii) https://www.aragon.es/-/indice-sintetico-desarrollo-territorial. Requests to access these datasets should be directed to CB-M, cbentue@unizar.es.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Research Ethics Committee of the Autonomous Community of Aragon: CEICA. The ethics committee waived the requirement of written informed consent for participation.

AUTHOR CONTRIBUTIONS

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Survey 2014–2015. *J. Affect. Disord.* 239, 203–207. doi: 10.1016/j.jad.2018. 06.051

Ayuso-Mateos, J. L., Vázquez-Barquero, J. L., Dowrick, C., Lehtinen, V., Dalgard, O. S., Casey, P., et al. (2001). Depressive disorders in Europe: prevalence figures from the ODIN study. *Br. J. Psychiatry* 179, 308–316. doi: 10.1192/bjp.179.4.308

Back, J. H., and Lee, Y. (2011). Gender differences in the association between socioeconomic status (SES) and depressive symptoms in older adults. *Arch. Gerontol. Geriatr.* 52, e140–e144. doi: 10.1016/j.archger.2010.09.012

Bjelland, I., Krokstad, S., Mykletun, A., Dahl, A. A., Tell, G. S., and Tambs, K. (2008). Does a higher educational level protect against anxiety and depression? The HUNT study. *Soc. Sci. Med.* 66, 1334–1345. doi: 10.1016/j.socscimed.2007.12.019

Cai, N., Choi, K. W., and Fried, E. I. (2020). Reviewing the genetics of heterogeneity in depression : operationalizations, manifestations and etiologies. *Hum. Mol. Genet.* 29, 10–18. doi: 10.1093/hmg/ddaa115

Compés Dea, M., Olivan Bellido, E., Feja Solana, C., Aguilar Palacio, I., García-Carpintero Romero del Hombrebueno, G., and Adiego Sancho, B. (2018). Construcción de un índice de privación por zona básica de salud en Aragón a partir de datos de censo de 2011. *Rev. Esp. Salud Publica* 92:10.

Dahlgren, G., and Whitehead, M. (2007). *Concepts and Principles for Tackling Social Inequities in Health: Levelling up Part 2.* Copenhagen: WHO regional office for europe.

Domènech-Abella, J., Mundó, J., Leonardi, M., Chatterji, S., Tobiasz-Adamczyk, B., Koskinen, S., et al. (2018). The association between socioeconomic status and depression among older adults in Finland, Poland and Spain: a comparative cross-sectional study of distinct measures and pathways. *J. Affect. Disord.* 241, 311–318. doi: 10.1016/j.jad.2018.08.077

Dunn, E. C., Brown, R. C., Dai, Y., Rosand, J., Nugent, N. R., Amstadter, A. B., et al. (2015). Genetic determinants of depression: recent findings and future directions. *Harv. Rev. Psychiatry* 23, 1–18. doi: 10.1097/HRP.0000000000000054

Elliott, M. (2001). Gender differences in causes of depression. *Women Health* 33, 183–198. doi: 10.1300/J013v33n03_11

Faisal-Cury, A., Ziebold, C., Rodrigues, D. M. O., and Matijasevich, A. (2022). Depression underdiagnosis: prevalence and associated factors. A population-based study. *J. Psychiatr. Res.* 151, 157–165. doi: 10.1016/j.jpsychires.2022.04.025

Fortney, J. C., Harman, J. S., Xu, S., and Dong, F. (2010). The association between rural residence and the use, type, and quality of depression care. *J. Rural Health* 26, 205–213. doi: 10.1111/j.1748-0361.2010.00290.x

Freeman, A., Tyrovolas, S., Koyanagi, A., Chatterji, S., Leonardi, M., Ayuso-Mateos, J. L., et al. (2016). The role of socio-economic status in depression: results from the COURAGE (aging survey in Europe). *BMC Public Health* 16:1098. doi: 10.1186/s12889-016-3638-0

Gabilondo, A., Rojas-Farreras, S., Vilagut, G., Haro, J. M., Fernández, A., Pinto-Meza, A., et al. (2010). Epidemiology of major depressive episode in a southern European country: results from the ESEMeD-Spain project. *J. Affect. Disord.* 120, 76–85. doi: 10.1016/j.jad.2009.04.016

Gariépy, G., Honkaniemi, H., and Quesnel-Vallée, A. (2016). Social support and protection from depression: systematic review of current findings in Western countries. *Br. J. Psychiatry* 209, 284–293. doi: 10.1192/bjp.bp.115.169094

Gnanapragasam, S. N., Astill Wright, L., Pemberton, M., and Bhugra, D. (2021). Outside/inside: social determinants of mental health. *Ir. J. Psychol. Med.* 1–11. doi: 10.1017/ipm.2021.49

Gupta, S., Methuen, C., Kent, P., Chatain, G., Christie, D., Torales, J., et al. (2016). Economic development does not improve public mental health spending. *Int. Rev. Psychiatry* 28, 415–419. doi: 10.1080/09540261.2016.1210582

Inaba, A., Thoits, P. A., Ueno, K., Gove, W. R., Evenson, R. J., and Sloan, M. (2005). Depression in the United States and Japan: gender, marital status, and SES patterns. *Soc. Sci. Med.* 61, 2280–2292. doi: 10.1016/j.socscimed.2005.07.014

Jorm, A. F., and Ryan, S. M. (2014). Cross-national and historical differences in subjective well-being. *Int. J. Epidemiol.* 43, 330–340. doi: 10.1093/ije/dyt188

Kim, J.-M., Stewart, R., Shin, I.-S., Yoon, J.-S., and Lee, H.-Y. (2004). Lifetime urban/rural residence, social support and late-life depression in Korea. *Int. J. Geriatr. Psychiatry* 19, 843–851. doi: 10.1002/gps.1175

King, M., Weich, S., Torres-González, F., Svab, I., Maaroos, H.-I., Neeleman, J., et al. (2006). Prediction of depression in European general practice attendees: the PREDICT study. *BMC Public Health* 6:6. doi: 10.1186/1471-2458-6-6

Kuehner, C. (2017). Why is depression more common among women than among men? *Lancet Psychiatry* 4, 146–158. doi: 10.1016/S2215-0366(16)30263-2

Kyu-man, H., Jisoon, C., Ho-kyoung, Y., Young-hoon, K., and Byung-joo, H. (2019). Relationships between hand-grip strength, socioeconomic status, and depressive symptoms in community-dwelling older adults. *J. Affect. Disord.* 252, 263–270. doi: 10.1016/j.jad.2019.04.023

Linder, A. (2019). Inequalities in the economic consequences of depression and anxiety in Europe : a systematic scoping review. *Eur. J. Public Health* 30, 767–777. doi: 10.1093/eurpub/ckz127

Llorente, J. M., Oliván-Blázquez, B., Zuñiga-Antón, M., Masluk, B., Andrés, E., García-Campayo, J., et al. (2018). Variability of the prevalence of depression in function of sociodemographic and environmental factors: ecological model. *Front. Psychol.* 9:2182. doi: 10.3389/fpsyg.2018.02182

Lopizzo, N., Bocchio Chiavetto, L., Cattane, N., Plazzotta, G., Tarazi, F. I., Pariante, C. M., et al. (2015). Gene–environment interaction in major depression: focus on experience-dependent biological systems. *Front. Psychiatry* 6:68. doi: 10.3389/fpsyt.2015.00068

Lorant, V., Deliège, D., Eaton, W., Robert, A., Philippot, P., and Ansseau, M. (2003). Socioeconomic inequalities in depression: a meta-analysis. *Am. J. Epidemiol.* 157, 98–112. doi: 10.1093/aje/kwf182

Miech, R. A., and Shanahan, M. J. (2000). Socioeconomic status and depression over the life course. *J. Health Soc. Behav.* 41, 162–176. doi: 10.2307/2676303

Muñoz, L. F., and Jaramillo, L. E. (2015). DSM-5: ¿Cambios significativos? *Rev. Asoc. Española Neuropsiquiatría* 35, 111–121.

OECD (2015). *¿Por qué Reducir la Desigualdad nos Beneficia?.en España.* Paris: OECD.

Ollila, E. (2011). Health in All Policies: from rhetoric to action. *Scand. J. Public Health* 39, 11–18. doi: 10.1177/1403494810379895

Ostler, K., Thompson, C., Kinmonth, A.-L. K., Peveler, R. C., Stevens, L., and Stevens, A. (2001). Influence of socio-economic deprivation on the prevalence and outcome of depression in primary care: the Hampshire Depression Project. *Br. J. Psychiatry* 178, 12–17. doi: 10.1192/bjp.178.1.12

Patel, V., Burns, J. K., Dhingra, M., Tarver, L., Kohrt, B. A., and Lund, C. (2018). Income inequality and depression: a systematic review and meta-analysis of the association and a scoping review of mechanisms. *World Psychiatry* 17, 76–89. doi: 10.1002/wps.20492

Purtle, J., Nelson, K. L., Yang, Y., Langellier, B., Stankov, I., and Roux, A. V. D. (2019). Urban - rural differences in older adult depression: a systematic review and meta-analysis of comparative studies. *Am. J. Prev. Med.* 56, 603–613. doi: 10.1016/j.amepre.2018.11.008

Puska, P. (2007). Health in all policies. *Eur. J. Public Health* 17:328. doi: 10.1093/eurpub/ckm048

Rautio, N., Filatova, S., Lehtiniemi, H., and Miettunen, J. (2018). Living environment and its relationship to depressive mood: a systematic review. *Int. J. Soc. Psychiatry* 64, 92–103. doi: 10.1177/0020764017744582

Razzak, H. A., Harbi, A., and Ahli, S. (2019). Depression: prevalence and associated risk factors in the united arab emirates. *Oman Med. J.* 34, 274–282. doi: 10.5001/omj.2019.56

Ribeiro, W. S., Bauer, A., Andrade, M. C. R., York-Smith, M., Pan, P. M., Pingani, L., et al. (2017). Income inequality and mental illness-related morbidity and resilience: a systematic review and meta-analysis. *Lancet Psychiatry* 4, 554–562. doi: 10.1016/S2215-0366(17)30159-1

Romans, S. E., Cohen, M., and Forte, T. (2010). Rates of depression and anxiety in urban and rural Canada. *Soc. Psychiatry Psychiatr. Epidemiol.* 46, 567–575. doi: 10.1007/s00127-010-0222-2

Rubio-Aranda, E., Blasco-Montón, G., Comín-Comín, M., Martínez-Terrer, T., Magallón-Botaya, R., and García-Campayo, J. (2012). Mental health and social relations in older rural population. *Actas Esp. Psiquiatr.* 40, 239–247.

Santoro-Lamelas, V. (2016). La salud pública en el continuo salud-enfermedad: un análisis desde la mirada profesional. *Rev. Salud Publica* 18, 530–542. doi: 10.15446/rsap.v18n4.47854

United Nations (2015). *UN General Assembly, Transforming Our World : the 2030 Agenda for Sustainable Development, 21 October 2015, A/RES/70/1. 16301.* New York, NY: United Nations, 1–35.

Velarde, M. D., Fry, G. L. A., and Tveit, M. S. (2007). Health effects of viewing landscapes – Landscape types in environmental psychology. *Urban For. Urban Green.* 6, 199–212. doi: 10.1007/s12110-021-09396-7

Wang, F. (2020). Why public health needs GIS: a methodological overview. *Ann. GIS* 26, 1–12. doi: 10.1080/19475683.2019.1702099

Wang, J. L. (2004). Rural–urban differences in theprevalence of major depression and associatedimpairment. *Soc. Psychiatry Psychiatr. Epidemiol.* 39, 19–25. doi: 10.1007/s00127-004-0698-8

WHO (2004). *ICD-10 : International Statistical Classification of Diseases and Related Health Problems: Tenth Revision*, 2nd Edn. Geneva: World Health Organization.

WHO (2014). *Health in All Policies (HiAP) Framework for Country Action*. Geneva: World Health Organization, doi: 10.1093/heapro/dau035

WHO (2017). *Depression and Other Common Mental Disorders: Global Health Estimates*. Geneva: World Health Organization.

Yesavage, J. A. (1988). Geriatric depression scale. *Psychopharmacol. Bull.* 24, 709–711.

Yu, Z., and Wang, F. (2016). Socio-economic development and emotion-health connection revisited: a multilevel modeling analysis using data from 162 counties in China. *BMC Public Health* 16:257. doi: 10.1186/s12889-016-2926-z

Zimmerman, F. J., and Katon, W. (2005). Socioeconomic status, depression disparities, and financial strain: what lies behind the income-depression relationship? *Health Econ.* 14, 1197–1215. doi: 10.1002/hec.1011

Psychological Wellbeing of Diabetic Individuals, Prediabetics, and Non-diabetics: A Population-Based Study in Saudi Arabia

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Background: The increased burden of diabetes affects the quality of life, including psychosocial problems. The study aims to compare the psychological well-being of individuals who are prediabetic, diabetic, or non-diabetic.

Methods: A cross-sectional exploratory study was conducted from January to June 2016 ($n = 1,019$) in Al Kharj, Saudi Arabia. After consent and questionnaires were filled out, trained staff took blood samples followed by anthropometry. Chi-squared tests, one-way ANOVA, and multiple linear regression analyses were conducted to examine the association between diabetes classes defined by HbA1c cut-off levels set by the American Diabetes Association (three categories), individual items, and total score in general health questionnaire (GHQ). An ROC curve was plotted for the total GHQ-12 score against HbA1c.

Findings: The mean GHQ score for psychological distress was significantly higher ($F = 6.569$, $P = 0.038$) in the diabetics (mean $= 14.7$) and the prediabetics (12.4) than in the non-diabetics (10.71). Four out of six positive GHQ items and three out of six negative GHQ items significantly differed among the three classes of diabetes. The adjusted multivariate analysis revealed that people with diabetes were most likely to report psychological distress compared to non-diabetics (unstandardized beta $= 2.414$; $P = 0.037$). The AUC examining the relationship between HBA1c and GHQ scores showed a moderate but statistically insignificant sensitivity/specificity of 0.643 ($P = 0.23$).

Conclusion: This study demonstrates that psychological wellbeing is substantially poorer among diabetic or prediabetic individuals than non-diabetic individuals. Future longitudinal studies are required to examine a plausible causal relationship between diabetes/prediabetes and psychological distress.

Keywords: diabetes mellitus, prediabetics, psychological wellbeing, GHQ, Saudi Arabia

INTRODUCTION

A significant global public health concern, diabetes is the most common chronic multifactorial condition affecting individuals of all age groups. The World Health Organization (WHO) estimated that between 1980 and 2014, the rate of diabetes doubled (from 4.7 to 8.5%) and predicted that if current trends continue to progress in the same manner, the number of cases will reach 700 million by 2045 (WHO, 2018; Pradhan et al., 2020). Currently, 463 million cases of diabetes are reported globally (IDF, 2019). Type 2 diabetes comprises most patients with diabetes, which is caused by inefficiency of insulin and is related mainly to environmental factors like dietary intake and physical inactivity (IDF, 2019).

Prediabetes, an intermediate condition of diabetes with blood glucose level above normal or at borderline but below the diabetic threshold, is an early marker indicating a high risk for developing diabetes (Bansal, 2015). Therefore, screening for prediabetes is recommended as lifestyle modification can help reduce or prevent the progression of diabetes by 40–70% (Katon, 2008; Bansal, 2015).

Because of the current high prevalence of diabetes and increasing trends of diabetes in the future, it is imposing a substantial burden on the healthcare system and the individuals' quality of life. Literature related to diabetes is replete in addressing the effect of diabetes on cardiovascular diseases, renal diseases, retinopathy, foot ulcer, sexual dysfunction, and depression (Trikkalinou et al., 2017). However, general health related to functional psychiatric disorders, including social dysfunction, anxiety, confidence, and other related factors, is not well reported. Few studies have reported the quality of life of diabetics in terms of sleep, social support, and depression (Semenkovich et al., 2015; Trikkalinou et al., 2017). The increasing prevalence of diabetes affects the quality of life with more psychosocial problems. Thus, there has been an increasing need to assess psychosocial and mental health among patients with life-long chronic diseases in the last decade, which has become of utmost importance. This is important in identifying important psychological aspects that are affected most. It can also help modify the intervention and treatment needs to improve and manage the condition and target the underlying psychological issues (Trikkalinou et al., 2017). Globally, different studies have used different psychometric tools for assessing the quality of life among diabetic patients and reported high anxiety and depression levels compared to non-diabetic people or individuals not yet diagnosed with diabetes (Das-Munshi et al., 2007; Al-Aboudi et al., 2015).

In Saudi Arabia, diabetes is also one of the significant contemporary chronic conditions affecting children, young adults, and the elderly. Recent studies have reported the prevalence of diabetes and prediabetes among women as 3.8 and 18.8% and 9.2 and 27.6% among men, respectively (Aldossari et al., 2018; Al-Zahrani et al., 2019). In comparison, other community-based studies reported the age- and sex-standardized prevalence of prediabetes as 9% among adults and prevalence of diabetes as 12.1% (Bahijri et al., 2016). Many tools are available for assessing individuals' mental and psychological wellbeing. However, GHQ is considered a very reliable and standard assessment tool for psychological disorders in primary healthcare settings (Montazeri et al., 2003; Jackson, 2007). Moreover, quality of life has been assessed using the Heath Related Quality of Life (HRQoL) tool in Saudi Arabia (Al-Aboudi et al., 2015, 2016). However, the general health questionnaire (GHQ) has not been used previously to evaluate psychological disorder and strain scores of diabetic and prediabetic patients. The GHQ was reported as an efficient and validated tool among the Saudi population for evaluating general health (El-Metwally et al., 2018). As this questionnaire tool is very straightforward and takes only 10 min to complete, it makes it a very efficient and unique self-reported questionnaire to use in an outpatient setting (Montazeri et al., 2003). We aim to compare the psychological wellbeing of individuals with prediabetes to that of individuals with diabetes using the validated GHQ tool in this study.

MATERIALS AND METHODS

Study Design and Setting
A cross-sectional exploratory population-based study was conducted, with data drawn from the general population in Al-Kharj city from January 2016 to the end of June 2016.

Inclusion and Exclusion Criteria
The selection criteria included Saudi citizens with type 2 diabetes, 18 years of age or older, based on their eligibility as well as willingness to participate in the study. On the other hand, the exclusion criteria were non-Saudi Arabians, patients with type 1 diabetes, younger than 18 years, and individuals not willing to give and sign the informed consent form.

Sample Size
A sample size of with a total of 1,200 participants was included with a response rate of 85%. Sample size calculation was based on the prevalence of diabetes in the general population in Saudi Arabia, which is 14.4%, while the prevalence of depression among patients with T2DM is 37% (WHO, 2016; Alhunayni et al., 2020).

Using a confidence level of 95% and a power of 80%, the sample size needed was estimated to be 600.

Sampling Technique

A multi-stage sampling method was utilized. A list of all clusters was made, and the investigators drew a random number of clusters to be included in the study. Samples from 21 government and 11 private institutes were selected through a cluster sampling technique. The total population of the institutions was divided into groups called clusters after acquiring a list of participants in each institute nominated. Samples of the respondents were then selected by simple random sampling from each of the groups (cluster).

Instruments

For data collection, a structured and self-administered questionnaire was used. The questionnaire had multiple sections. Data such as age, education, employment, marital status, and diabetes status were recorded. For the assessment of psychological wellbeing, a self-reported and validated GHQ-12 for the Arabic population was used (Daradkeh et al., 2001). Each item comprises a 4-point scale (0, less than usual; 1, no more than usual; 2, rather more than usual; 3 or more, much more than usual) (Abubakar and Fischer, 2012).

Blood Sampling and Anthropometry

A trained phlebotomist took blood samples from all the participants to calculate HbA1c measured at baseline. After following all aseptic procedures, a blood sample was taken from all the participants. A test tube with a purple top is used for blood collection for HbA1c, and 3 cc blood was collected from each participant. A unique ID is given to each participant, and the specimen was labeled using a specific ID. Tubes were gently rolled to avoid clotting, and then each tube was placed in a roller mixer. The samples (within 1–2 h) were then taken to the central laboratory in a container with ice. The complete blood sampling procedure has already been defined previously (Aldossari et al., 2018).

Trained staff also took the anthropometric measurements, including weight, height, and waist circumference. Height was taken in inches without shoes in an upright position using a standard scale. Weight was measured in kg in light clothes and without shoes, while waist circumference was measured in cm using a standard measuring tape.

Operational Definitions

Diabetes mellitus was defined as fasting plasma glucose (FPG) $\geq$ 126 mg/dl or HbA1c cut-off level of $\geq$6.5%, or as defined by the American Diabetes Association (ADA) criteria having a history of diabetes. Prediabetes was defined as FPG 100 125 mg/dl or using the HbA1c cut-off level of 5.7–6.4 % according to ADA 2020 (American Diabetes Association, 2020).

In this study, we used HbA1c to define diabetes and prediabetes (as it does not require fasting), and we can collect blood at any time of the day, keeping in mind the convenience of the participants and achieving a large sample size. This is a standard method used for diagnosing diabetes in government

hospitals in Saudi Arabia. Furthermore, in this study, we also included participants who were diagnosed with diabetes.

Statistical Analysis

Data were analyzed using SPSS version 26.0 for Windows (IBM Corp., Armonk, NY, United States). There were six positive items (GHQ-1 to GHQ-6) and six negative items (GHQ-7 to GHQ-12) to assess positive and negative mental health in the GHQ-12 questionnaire. The association of diabetic status (categorical variable: diabetic vs. prediabetic vs. non-diabetic) was compared across all the 12 GHQ variables (GHQ-1 to GHQ-6 positive items and GHQ-7 to GHQ-12 negative items). We conducted a chi-squared (X^2) test for each of the GHQ items against diabetic status. We conducted twelve ($n = 12$) cross-tabulation (X^2) tests to assess the association between each of the 12 GHQ items and diabetic status. We also used a one-way ANOVA model to compare the mean GHQ score across the three groups: non-diabetic, prediabetic, and diabetic. In the one way ANOVA model, Tukey's *post-hoc* multiple comparison tests were performed (the three diabetes groups were compared against each other). A multiple linear regression model was used to examine the association between diabetic classes (three categories) and total GHQ score (outcome).

RESULTS

Results related to the description of the population and prevalence of diabetes, prediabetes, and general health of the population were published previously (Aldossari et al., 2018; El-Metwally et al., 2018).

We conducted twelve ($n = 12$) cross-tabulation (X^2) to assess the association between each of the 12 GHQ items to diabetic status. The summarized results are presented in **Table 1**.

Positive GHQ 12 Item Results

Compared to the prediabetic and diabetic people, the non-diabetic individuals were "better than usual" in being "able to concentrate on whatever they are doing". However, this result was not statistically significant, as observed by the chi-squared test: (X^2) = 6.806, P = 0.339 (**Table 1**). Regarding GHQ-2, there was no difference among the three groups. When asked whether they have "recently been feeling reasonably happy" (GHQ-3), the data showed that the non-diabetic individuals indicated that they were significantly "better than usual or the same as usual" regarding this positive feeling/item, in comparison with the prediabetic and diabetic individuals. The chi-squared test was (X^2) = 12.717, P = 0.03. In terms of whether someone has "recently felt capable of making decisions about things", the prediabetic and diabetic people were less likely to feel "better than usual or same as usual" than the non-diabetics. The proportion of prediabetics (30%) and diabetics (10%) was higher in what they expressed as "much worse than usual/much less than usual". The chi-squared test was (X^2) = 15.859, P = 0.047. The GHQ-5 results did not show any statistical significance among the three diabetic groups when asked "have you recently been able to enjoy your normal day-to-day activities". When asked whether they have "recently been able to face up to problems", the proportion of non-diabetic

TABLE 1 | Comparison among diabetic, prediabetic, and non-diabetic subjects according to positive and negative general health questionnaire (GHQ)-12 items in the Al Kharj study ($n = 1,016$).

GHQ	Diabetes ($n = 44$)	Pre-diabetes ($n = 230$)	No-diabetes ($n = 741$)	P-value
Positive items				
GHQ1: Have you recently been able to concentrate on whatever you're doing?				0.339
0	5 (5.3%)	23 (24.5%)	66 (70.2%)	
1	35 (4.9%)	156 (22.0%)	519 (73.1%)	
2	4 (2.1%)	45 (23.2%)	145 (74.7%)	
3	0 (0.0%)	7 (38.9%)	11 (61.1%)	
GHQ2: Have you recently felt that you were playing a useful part in things?				0.600
0	8 (4.1%)	45 (23.2%)	141 (72.7%)	
1	33 (4.6%)	164 (22.9%)	520 (72.5%)	
2	3 (3.2%)	22 (23.4%)	69 (73.4%)	
3	0 (0.0%)	0 (0.0%)	11 (100.0%)	
GHQ3: Have you recently been feeling reasonably happy, all things considered?				0.031
0	3 (2.6%)	24 (20.5%)	90 (76.9%)	
1	36 (4.7%)	176 (22.9%)	555 (72.4%)	
2	4 (3.4%)	29 (24.4%)	86 (72.3%)	
3	1 (7.7%)	2 (15.4%)	10 (76.9%)	
GHQ4: Have you recently felt capable of making decisions about things?				0.047
0	5 (3.0%)	34 (20.7%)	125 (76.2%)	
1	32 (5.0%)	151 (23.4%)	463 (71.7%)	
2	5 (2.7%)	39 (21.3%)	139 (76.0%)	
3	2 (10.0%)	6 (30.0%)	12 (60.0%)	
GHQ5: Have you recently been able to enjoy your normal day-to-day activities?				0.393
0	7 (5.7%)	30 (24.4%)	86 (69.9%)	
1	30 (4.7%)	147 (23.0%)	461 (72.3%)	
2	7 (3.1%)	51 (22.6%)	168 (74.3%)	
3	0 (0.0%)	3 (10.3%)	26 (89.7%)	
GHQ6: Have you recently been able to face up to problems?				0.036
0	6 (3.8%)	36 (22.9%)	115 (73.2%)	
1	31 (4.5%)	161 (23.2%)	501 (72.3%)	
2	6 (4.1%)	28 (18.9%)	114 (77.0%)	
3	1 (5.9%)	5 (29.4%)	11 (64.7%)	
Negative items				
GHQ7: Have you recently felt constantly under strain?				0.085
0	8 (3.8%)	39 (18.5%)	164 (77.7%)	
1	13 (4.7%)	56 (20.1%)	210 (75.3%)	
2	13 (3.4%)	92 (24.1%)	276 (72.4%)	
3	9 (6.3%)	43 (30.1%)	91 (63.6%)	
GHQ8: Have you recently felt you couldn't overcome your difficulties?				0.164
0	18 (4.6%)	84 (21.5%)	288 (73.8%)	
1	4 (1.6%)	54 (21.5%)	193 (76.9%)	
2	21 (6.2%)	83 (24.3%)	237 (69.5%)	
3	1 (3.2%)	8 (25.8%)	22 (71.0%)	
GHQ9: Have you recently lost much sleep over worry?				0.056
0	18 (5.6%)	73 (22.8%)	229 (71.6%)	
1	11 (4.2%)	61 (23.6%)	187 (72.2%)	
2	12 (3.8%)	73 (23.2%)	229 (72.9%)	
3	3 (2.5%)	23 (19.0%)	95 (78.5%)	
GHQ10: Have you recently been feeling unhappy or depressed?				0.030
0	23 (4.3%)	102 (19.2%)	407 (76.5%)	

(Continued)

TABLE 1 | Continued

GHQ	Diabetes (*n* = 44)	Pre-diabetes (*n* = 230)	No-diabetes (*n* = 741)	*P*-value
1	6 (2.8%)	51 (23.7%)	158 (73.5%)	
2	14 (6.3%)	64 (28.6%)	146 (65.2%)	
3	1 (2.3%)	13 (30.2%)	29 (67.4%)	
GHQ11: Have you recently been losing confidence in yourself?				0.017
0	31 (4.7%)	136 (20.5%)	496 (74.8%)	
1	3 (2.1%)	33 (23.1%)	107 (74.8%)	
2	9 (5.0%)	48 (26.5%)	124 (68.5%)	
3	1 (3.7%)	13 (48.1%)	13 (48.1%)	
GHQ12: Have you recently been thinking of yourself as a worthless person?				0.039
0	33 (4.6%)	153 (21.2%)	536 (74.2%)	
1	2 (1.6%)	30 (23.6%)	95 (74.8%)	
2	7 (5.1%)	36 (26.1%)	95 (68.8%)	
3	2 (7.7%)	11 (42.3%)	13 (50.0%)	

0 (better than usual or > usual).
1 (same usual or as usual).
2 (worse than usual or less than usual or < usual).
3 (much worse than usual or much less than usual or << usual).

people who reported "better than usual or same as usual" was higher than that of the prediabetic and diabetic people. There was a statistically significant result in the chi-squared test: $(X^2) = 12.146, P = 0.036$.

Negative GHQ 12 Item Results

The GHQ-7 and GHQ-8 results did not show any statistical significance among the three diabetic groups when asked "have you recently felt constantly under strain" and "have you recently felt you couldn't overcome your difficulties".

There were marginally statistically significant differences among the three diabetic groups when asked "have you recently lost much sleep over worry". There was a notably higher proportion of the prediabetic individuals (than the diabetic persons) who indicated "worse than usual/or much worse than usual". The chi-squared test was $(X^2) = 13.853, P = 0.056$. For, GHQ-10, which is "recently been feeling unhappy or depressed", the prediabetic individuals particularly indicated that they feel "worse than usual" (28.6%) or "much worse than usual" (30.2%) compared with a lesser proportion of the diabetic individuals (6.3% felt "worse than usual" and 2.3% felt "much worse than usual"). The chi-squared test was $(X^2) = 13.933, P = 0.03$. GHQ-11 showed significant findings pertaining to the diabetic and prediabetic individuals reporting significantly higher proportions/responses to the question "have you recently been losing confidence in yourself" in the "negative categories" (worse than usual: 5% for the diabetics and 26.5% for the prediabetics). The chi-squared test was $(X^2) = 15.449, P = 0.017$. Also, GHQ-12 showed significant findings pertaining to the diabetic and prediabetic individuals reporting significantly higher proportions/responses to the question "have you recently been thinking of yourself as a worthless person" in the "negative categories": ("worse than usual": 5.1% for the diabetics and 26.1% for the prediabetics); "much worse than usual": 7.7% for the

TABLE 2 | Mean difference in total GHQ-12 score across diabetic class categories.

		n	Mean	Std. deviation	Std. error
0 non-diabetic		733	10.71	5.12	0.189
1 pre-diabetic		227	12.41	5.23	0.366
2 diabetic		43	14.69	5.39	0.821
Total		1,003	12.60	5.26	0.165
Model	Fixed effects			5.224	0.165
	Random effects				0.267

diabetics and 42.3% for the prediabetics). The chi-squared test was $(X^2) = 11.459, P = 0.039$ (**Table 1**).

GHQ Score and Diabetic Class Categorical Variable (One-Way ANOVA)

The total GHQ score (mean = 12.6; SD = 5.26), as previously reported (El-Metwally et al., 2018) to compare the three diabetic class categories: non-diabetic, prediabetic, and diabetic subjects. Overall, the one-way ANOVA model was statistically significant (F = 6.569, d = 2, P = 0.038).

A comparison between the mean total GHQ score and the three diabetic class categories is shown in **Table 2**.

Findings of Tukey's *post-hoc* Analyses

The first *post-hoc* analysis showed that compared to the non-diabetic group (reference category), the diabetic group was statistically significant (mean difference 2.547, P = 0.027). The 95% confidence interval (CI) was from 2.148 to 5.381. The second *post-hoc* analysis showed that the prediabetic group was also statistically significant when compared to the non-diabetic group

TABLE 3 | Multiple linear regression model regressing total GHQ score on diabetic class and other sociodemographic factors ($n = 1{,}018$).

Total GHQ score	Unstandardized beta (B)	S.E. of B	Sig.	Standardized B	95% CI for odds ratio	
					Lower	Upper
Diabetic class(binary variable: diabetic vs. non-diabetic individuals)	2.414	0.331	0.037	2.135	2.017	3.461
Age	0.018	0.028	0.516	0.030	0.037	0.074
Gender (female)	1.309	0.465	0.048	1.22	0.397	2.221
Marital status (single/not married)	−0.484	0.443	0.275	−0.045	−1.354	0.386
Job (not working; or civilian)	1.416	0.413	0.045	0.043	1.214	3.402

TABLE 4 | Multiple linear regression model regressing total GHQ score on hypertension status, HBA1c, and other sociodemographic and diabetes risk factors in diabetic individuals ($n = 45$).

Total GHQ score	Unstandardized beta (B)	S.E. of B	Sig.	Standardized B	95% CI for odds ratio	
					Lower	Upper
Hypertension status	2.342	0.294	0.043	1.186	2.114	3.611
Age	0.021	0.090	0.816	0.044	0.205	0.163
Gender (female)	2.510	0.915	0.028	1.22	1.887	3.691
Marital status (single/not married)	0.123	2.117	0.954	0.010	−4.190	4.435
Education level attainment	0.383	0.808	0.658	0.089	− 1.263	2.029
Job (not working; or civilian)	4.723	3.477	0.039	0.234	2.860	5.806
Body Mass Index (BMI)	0.016	0.156	0.918	0.020	−0.302	0.334
Cholesterol level	− 0.252	1.165	0.830	−0.052	− 2.625	2.122
Smoking status	− 2.893	1.563	0.073	−0.340	−6.076	0.291
Waist circumference	0.017	0.033	0.623	0.094	− 0.051	0.085
HbA1c	0.581	0.439	0.195	0.231	− 0.314	1.476
Presence of chronic disease (hypertension or dyslipidemia)	4.016	3.104	0.021	0.364	2.859	5.244

(mean difference 1.185, $P = 0.042$). The 95% CI was from 0.97 to 2.36.

Findings of Multiple Linear Regression Analyses

Using the entire sample ($n = 1{,}018$) and after adjusting for sociodemographic variables, the first multiple regression analysis was conducted. It was found that higher psychological distress (as evidenced by higher total GHQ score) was significantly and positively associated with the diabetic class (i.e., in more diabetic and prediabetic individuals). The unstandardized beta regression coefficient was $= 2.414$ ($P = 0.037$). Being diabetic has 2.4 times greater risk of psychological distress. Women were most likely to have greater psychological distress than men (unstandardized beta $= 1.309$, $P = 0.048$). Job status, whether unemployed or civilian (civil worker) is significantly associated with higher psychological distress (unstandardized beta $= 1.416$, $P = 0.045$), as shown in **Table 3**.

In the second multiple regression analysis, we only selected individuals who were diabetic ($n = 45$). After adjusting for other variables (sociodemographic), higher total GHQ score (reflecting higher psychological distress) was significantly and positively associated with hypertension status (unstandardized beta regression coefficient $= 2.342$; $P = 0.043$). "Presence of chronic disease" (either hypertension or dyslipidemia, or both)

was also significantly and positively associated with higher psychological distress (unstandardized beta regression coefficient $= 4.016$; $P = 0.021$). Furthermore, women were more likely to have significantly higher psychological distress (unstandardized beta regression coefficient $= 2.51$, $P = 0.028$). In terms of employment status, those who were not working (unemployed) or civilian workers were also more significantly susceptible to higher psychological distress (unstandardized beta regression coefficient $= 4.723$, $P = 0.039$), as evident in **Table 4**.

Receiver Operating Characteristic (ROC) Curve Analysis

An ROC curve analysis was performed, and the area under the curve was reported. This technique plots a sensitivity (on the Y-axis) against the false positive rate (1-specificity) on the X-axis of a plot. The area under the curve (AUC) normally ranges from 0.5 for models with no discrimination ability to 1 for models with ideal discrimination ability (Kim et al., 2013). Generally speaking, an AUC of 0.5 recommends no discrimination (i.e., ability to diagnose patients with and without the disease), while 0.7–0.8 is suggested as acceptable, 0.8–0.9 is excellent, and more than 0.9 is considered outstanding (Park et al., 2004).

We used the HbA1c continuous variable as the test result (independent) variable. Larger values of the test result variable indicate more substantial evidence of the actual positive state.
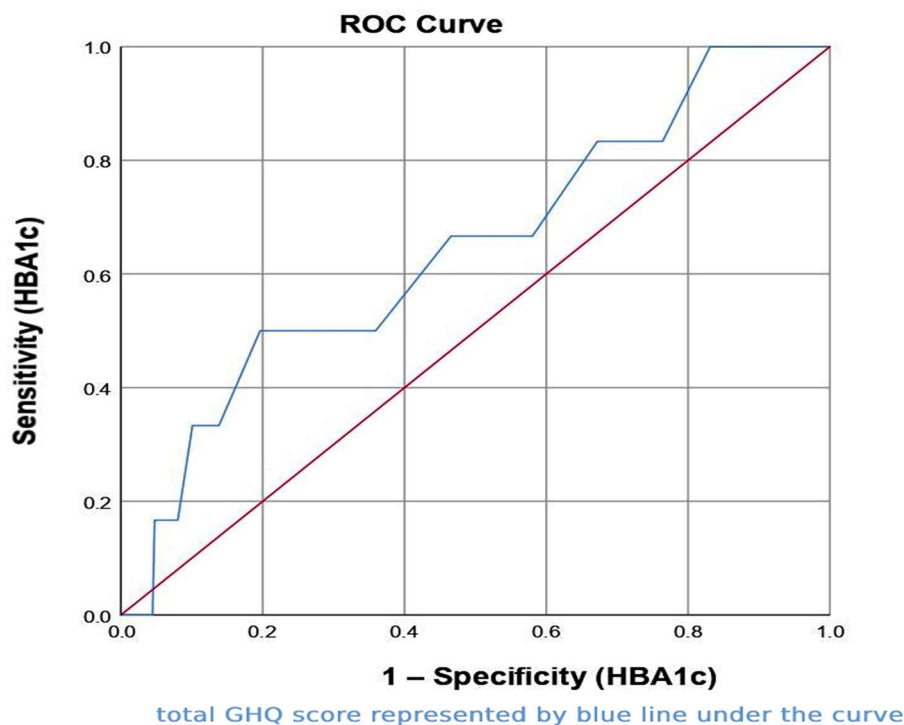
FIGURE 1 | Receiver operating characteristic (ROC) curve for total general health questionnaire (GHQ)-12 score against HbA1c (as the test result variable).

The AUC examining the relationship between total GHQ score (**Figure 1**) showed a moderate sensitivity/specificity of 0.643, which was statistically not significant ($p = 0.226$). Nonetheless, we suggest that this moderate sensitivity/specificity of 0.643 is acceptable for a notable association between total GHQ score (as the dependent variable) and HBA1c as test result (independent) variable (**Figure 1**).

DISCUSSION

Our study revealed that the non-diabetic individuals provided affirmative responses for most of the positive items (GHQ-1 to GHQ-6) compared to the diabetic and prediabetic individuals. This indicates that the mental health of the non-diabetic individuals was much better than that of the diabetic and prediabetic individuals. More specifically, the non-diabetic individuals reported that they could concentrate on whatever they were doing, and they were found to be reasonably happy compared to the prediabetic or the diabetic individuals. Similarly, we found that the non-diabetic individuals were also more capable of making decisions on specific tasks than their counterparts. Likewise, they outweighed in numbers in terms of being able to face problems the prediabetic and diabetic individuals.

In contrast, The GHQ-12 results showed that mental health was significantly worse among the diabetics and prediabetics than among the non-diabetics. More specifically, our study illustrated that the diabetic or the prediabetic individuals reported more

on negative items (GHQ-7 to GHQ-12) with the tool assessing mental health. They seemed to have more negative attributes of mental health than the non-diabetics. In particular, the diabetic or the prediabetic individuals were higher in proportion in terms of losing sleep because of feeling worrisome or feeling unhappy or depressed about something. However, there were differences in proportion between the prediabetic and the diabetic individuals for some negative items. It was found that the prediabetic people outweighed the people with diabetes in terms of negative items in the GHQ. For instance, we found a significantly higher proportion of prediabetic individuals indicating feeling depressed or unhappy when compared to their diabetic counterparts. Likewise, losing confidence or thinking of oneself as a worthless person was reported more by the prediabetic than the diabetic individuals.

Furthermore, the findings of the adjusted analysis revealed that the patients with diabetes were more psychologically distressed than their counterparts. Likewise, with respect to gender, we found the women to be more psychologically distressed than the men. Unsurprisingly, the unemployed individuals were found to be more psychologically distressed than the employed individuals while adjusting for the sociodemographic variables.

As suggested by the GHQ-12 results, numerous previous studies point to poorer mental health among people with diabetes than among the general population. Some authors even advocate specific preventative treatments in such cases, given the importance they attach to the problem (Donmez et al., 2005).

Our findings are consistent with majority of the studies in the existing literature. For instance, a case-control study conducted in Madrid city (Spain) shows that patients with diabetes in Madrid have poorer self-rated health and psychological wellbeing than subjects of the same age and gender without the disease (y Pena et al., 2010). Similarly, another study also found that diabetic patients were more likely to suffer from poor mental health and subclinical psychological distress than their counterparts of the same age and gender without diabetes (Jimenez-Garcia et al., 2012). Also, a cross-sectional study was conducted in the United Kingdom that conducted diagnostic interviews to screen for common mental health problems (Das-Munshi et al., 2007). The prevalence of mental health problems was 21.6% for diabetic individuals compared to 16.3% for those without diabetes (adjusted OR 1.5; 95% CI 1.1–2.2) (Das-Munshi et al., 2007). Likewise, another study conducted in the United States found that based on diagnostic codes of theVeterans HealthAdministration, the prevalence of any mental health problem among diabetes sufferers was 24.5% (Frayne et al., 2005).

"Fair/poor or very poor" self-perception of mental health is strongly related to suffering from diagnosed mental conditions or has a high result in the GHQ12 among individuals with diabetes in Saudi Arabia. Self-rated health status is a valuable gauge of the population's overall wellbeing and is a reliable measure of quality of life (Undén et al., 2008). Our results are aligned with most studies that have been conducted among diabetic individuals, found that two of the factors more obviously define diabetics' poorer quality of life or self-rated health include "suffering mental health problems" or "psychological distress" (Frayne et al., 2005; Das-Munshi et al., 2007; Undén et al., 2008).

This study's findings are consistent with other previous studies conducted across the globe. For example, the findings of a systematic review revealed that patients with type 2 diabetes (T2D) are more likely to be depressed, and that there is higher prevalence of depression among diabetic patients than among their non-diabetic counterparts (Ali et al., 2006). Furthermore, the same systematic review also found that diabetic women are more likely to be depressed than men (Ali et al., 2006). These results can be supported by the fact that patients with diabetes are more likely to be psychologically upset because of the nature of the disease. The existing evidence from cross-sectional and longitudinal studies finds an association between diabetes and negative psychological outcomes (Lin et al., 2010). Furthermore, such studies also reveal the relationship between glycemic control and negative psychological outcomes (Lustman et al., 2000). These findings are very germane to the context of Saudi Arabia from the perspective of taking preventive actions before such negative outcomes become causes of diabetic complications. This is because the existing evidence reveals that diabetic patients with poor psychological outcomes are more likely to develop complications from diabetes (Katon et al., 2010). This includes a myriad of complications such as diabetic retinopathy, neuropathy, nephropathy, diabetic foot, and microvascular complications (Lin et al., 2010). For instance, the findings of a meta-analysis demonstrated a strong association between depression and diabetes complications

ranging from diabetic retinopathy to sexual dysfunction (Katon et al., 2010). Furthermore, the evidence also suggested that negative psychological outcomes such as depression can lead to dementia among diabetic individuals in the long run if untreated (Katon et al., 2010). In Taiwan, a population-based prospective cohort study followed up patients for up to 14 years. The study found that depression was associated with increased risk of macrovascular complications, and all-cause mortality in the diabetic cohort (Wu et al., 2020). The relationship between depression and prevalence of macrovascular complications is a complex multifactorial process in which the exact underlying mechanisms are still unknown, and only few studies have suggested some common processes. For instance, a study reported that depressive individuals usually follow an unhealthy lifestyle, smoke tobacco, lack physical activity, and take unhealthy diet (Deschênes et al., 2017). Mostly, depression is frequently accompanied with behavioral changes such us limited self-care and lack of adherence to medications. These behaviors in diabetic patients lead to poor glycemic control, which is eventually associated with higher risk of complications (Nouwen et al., 2019). Collectively, this evidence and the strong association between diabetes and negative psychological outcomes in our study call for urgent secondary prevention programs for diabetic people to prevent complications in the short and long run.

Likewise, our findings regarding the association between women and negative psychological outcomes based on GHQ score are analogous to the existing evidence, i.e., numerous studies have shown that women are more depressed than men (Albert, 2015). These findings of women being more affected by negative psychological outcomes are rooted in biological sex differences rather than external factors such as culture, dietary habits, level of education, and several other theoretically confounding social and economic reasons. However, it has also been found that this distorted ratio of negative psychological disorders prevails mainly at a young age and gets obscured in the older age (Cyranowski et al., 2000). The possible reason for explaining this finding could be due to the exposure of women to different reproductive phases of life (Albert and Newhouse, 2019). This is, in turn, correlated with hormonal changes, meaning that women are more affected by negative psychological outcomes because of hormonal changes during puberty, after becoming pregnant, and around menopause. This might suggest that hormonal changes could explicate the negative psychological outcomes in women (Albert and Newhouse, 2019). However, this was not ruled out in our study, but the existing evidence was sufficient to explain such findings. Irrespective of underlying mechanisms or causes of the negative outcomes, women, being vulnerable, are at higher risk of negative outcomes and should be paid more attention to avoid deterioration in their quality of life.

Lastly, in this study, the unemployed individuals were at greater risk of developing negative psychological outcomes than the employed individuals. This finding is comparable to other studies around the world. For example, findings from a meta-analysis showed that jobless individuals have a decreased level of psychological and physical wellbeing compared to employed individuals (McKee-Ryan et al., 2005). Such finding suggests that unemployed individuals might be defamed in

society, which eventually affects their mental health status and reflects negative psychological outcomes (O'Donnell et al., 2015). This is further strengthened and supported by the contradictory evidence, which suggests that employed people are psychologically sound because of their satisfying life, fulfillment of their needs, and respect in society (Briner, 2000; Herriot, 2013). Furthermore, unemployment is related to marginalization, where unemployed people are disregarded or ignored in society and thereby not accepted in mainstream society, which is reflected in negative psychological outcomes (Kossen and McIlveen, 2018). Irrespective of underlying mechanisms for the association between unemployment and negative psychological outcomes, the government of Saudi Arabia needs to take urgent actions to help unemployed people by raising the job opportunities for them to protect them from experiencing negative psychological outcomes.

Given the findings of our study and their consistency with the existing evidence, healthcare providers need to be aware of the higher risk of psychological non-wellbeing and poor mental health among diabetic patients. We agree with previous studies that suggest screening for psychological distress, anxiety, and other mental health disorders multiple times per year among those diagnosed with diabetes and those who are borderline diabetics (Fisher et al., 2007). Concordant with previous studies that indicate that poorer mental health conditions may be under-diagnosed by clinicians, psychological problems are "least priority" compared to "overt" medical conditions in diabetic patients. Many physicians give less attention to poor mental health, because they feel that it is "expected" in patients with diabetes (Shao et al., 1997; Katon, 2008).

Similar to other studies, our study also has some limitations. One of the potential limitations of the research is that it has a cross-sectional study design. Thus, it could not assess the temporal relationship between self-perceived mental health and diabetes. We also did not evaluate the role of other factors such as age, gender, depression, lack of exercise, and obesity in the relationship between poorest self-perceived mental health and diabetes. These factors, therefore, need to be explored further in future epidemiological studies. Also, we did not record type 1 diabetes, duration of diabetes, the standard of care (antidiabetic agents or insulin) given to patients, and quality of care. All of these factors could impact patients' mental health and should, therefore, be included in any future investigations. This study has several strengths. Primarily, this study is conducted on a very large sample of both men and women from all the institutes of Al-Kharj by recruiting participants through a robust sampling technique. This allowed for us to recruit participants with different sociodemographic characteristics, thus enabling us to generalize our findings to the Saudi population.

CONCLUSION

This study reveals that self-rated mental health and psychological wellbeing are substantially poorer among patients with diabetes or those who are prediabetics than those without diabetes. Thus, there is a need to screen diabetic patients for psychological wellbeing instead of waiting for an exact problem to be identified or worsening of psychological status. In addition, diagnosis, screening, and treatment need to be routinely incorporated into patients' regular care. Moreover, in light of the current findings, targeted programs and interventions need to be designed and implemented to cater to the mental health needs of diabetic and prediabetic individuals in Saudi Arabia. Furthermore, the government of Saudi Arabia needs to focus on diabetic, female, and unemployed individuals to prevent them from having negative psychological outcomes and long-term complications. Well-designed longitudinal studies are required in the future to study the cause-and-effect relationship between poor mental health and diabetes, mainly in Saudi Arabia. Moreover, further studies are needed to make causal inferences to examine the relationship between poor mental health and diabetes as well as important determinants of this relationship in the Saudi population.

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.

ETHICS STATEMENT

This study was reviewed and approved by the Institutional Review Board (IRB) of the College of Medicine, Prince Sattam Bin Abdulaziz University. The patients/participants provided their written and verbal informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors contributed to the writing of different manuscript sections and had access to the data. The final draft of the manuscript was read and approved by all authors.

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REFERENCES

Abubakar, A., and Fischer, R. (2012). The factor structure of the 12-item General Health Questionnaire in a literate Kenyan population. *Stress Health* 28, 248–254. doi: 10.1002/smi.1420

Al-Aboudi, I. S., Hassali, M. A., and Shafie, A. A. (2016). Knowledge, attitudes, and quality of life of type 2 diabetes patients in Riyadh, Saudi Arabia. *J. Pharm. Bioallied Sci.* 8, 195. doi: 10.4103/0975-7406.171683

Al-Aboudi, I. S., Hassali, M. A., Shafie, A. A., Hassan, A., and Alrasheedy, A. A. (2015). A cross-sectional assessment of health-related quality

of life among type 2 diabetes patients in Riyadh, Saudi Arabia. *SAGE Open Med.* 3, 2050312115610129. doi: 10.1177/2050312115610129

Albert, K. M., and Newhouse, P. A. (2019). Estrogen, stress, and depression: cognitive and biological interactions. *Annu. Rev. Clin. Psychol.* 15, 399–423. doi: 10.1146/annurev-clinpsy-050718-095557

Albert, P. R. (2015). Why is depression more prevalent in women? *J. Psychiatry Neurosci.* 40, 219–221. doi: 10.1503/jpn.150205

Aldossari, K. K., Aldiab, A., Al-Zahrani, J. M., Al-Ghamdi, S. H., Abdelrazik, M., Batais, M. A., et al. (2018). Prevalence of prediabetes, diabetes, and its associated risk factors among males in Saudi Arabia: a population-based survey. *J. Diabetes Res.* 2018: 2194604. doi: 10.1155/2018/2194604

Alhunayni, N. M., Mohamed, A. E., and Hammad, S. M. (2020). Prevalence of depression among type-II diabetic patients attending the diabetic clinic at Arar National Guard Primary Health Care Center, Saudi Arabia. *Psychiatry J.* 2020, 9174818. doi: 10.1155/2020/9174818

Ali, S., Stone, M. A., Peters, J. L., Davies, M. J., and Khunti, K. (2006). The prevalence of co-morbid depression in adults with Type 2 diabetes: a systematic review and meta-analysis. *Diabet Med.* 23, 1165–1173. doi: 10.1111/j.1464-5491.2006.01943.x

Al-Zahrani, J. M., Aldiab, A., Aldossari, K. K., Al-Ghamdi, S., Batais, M. A., Javad, S., et al. (2019). Prevalence of prediabetes, diabetes and its predictors among females in Alkharj, Saudi Arabia: a cross-sectional study. *Ann. Global Health* 85, 109. doi: 10.5334/aogh.2467

American Diabetes Association (2020). Classification and diagnosis of diabetes: standards of medical care in diabetes-–2020. *J. Diabetes Care* 43, S14–S31. doi: 10.2337/dc20-S002

Bahijri, S. M., Jambi, H. A., Al Raddadi, R. M., Ferns, G., and Tuomilehto, J. (2016). The prevalence of diabetes and prediabetes in the adult population of Jeddah, Saudi Arabia-a community-based survey. *PLoS ONE* 11, e0152559. doi: 10.1371/journal.pone.0152559

Bansal, N. (2015). Prediabetes diagnosis and treatment: a review. *World J. Diabetes* 6, 296. doi: 10.4239/wjd.v6.i2.296

Briner, R. B. (2000). Relationships between work environments, psychological environments and psychological well-being. *Occup. Med.* 50, 299–303. doi: 10.1093/occmed/50.5.299

Cyranowski, J. M., Frank, E., Young, E., and Shear, M. K. (2000). Adolescent onset of the gender difference in lifetime rates of major depression: a theoretical model. *Arch. Gen. Psychiatry* 57, 21–27. doi: 10.1001/archpsyc.57.1.21

Daradkeh, T. K., Ghubash, R., and El-Rufaie, O. E. (2001). Reliability, validity, and factor structure of the Arabic version of the 12-item General Health Questionnaire. *Psychol. Rep.* 89, 85–94. doi: 10.2466/pr0.2001.89.1.85

Das-Munshi, J., Stewart, R., Ismail, K., Bebbington, P. E., Jenkins, R., and Prince, M. J. (2007). Diabetes, common mental disorders, and disability: findings from the UK National Psychiatric Morbidity Survey. *Psychosom. Med.* 69, 543–550. doi: 10.1097/PSY.0b013e3180cc3062

Deschênes, S. S., Burns, R. J., Pouwer, F., and Schmitz, N. (2017). Diabetes complications and depressive symptoms: prospective results from the montreal diabetes health and well-being study. *Psychosom. Med.* 79, 603–612. doi: 10.1097/PSY.0000000000000447

Donmez, L., Gokkoca, Z., and Dedeoglu, N. (2005). Disability and its effects on quality of life among older people living in Antalya city center, Turkey. *Arch. Gerontol. Geriatr.* 40, 213–223. doi: 10.1016/j.archger.2004.08.006

El-Metwally, A., Javed, S., Razzak, H. A., Aldossari, K. K., Aldiab, A., Al-Ghamdi, S. H., et al. (2018). The factor structure of the general health questionnaire (GHQ12) in Saudi Arabia. *BMC Health Serv. Res.* 18, 595. doi: 10.1186/s12913-018-3381-6

Fisher, L., Skaff, M. M., Mullan, J. T., Arean, P., Mohr, D., Masharani, U., et al. (2007). Clinical depression versus distress among patients with type 2 diabetes: not just a question of semantics. *Diabetes Care* 30, 542–548. doi: 10.2337/dc06-1614

Frayne, S. M., Halanych, J. H., Miller, D. R., Wang, F., Lin, H., Pogach, L., et al. (2005). Disparities in diabetes care: impact of mental illness. *Arch. Internal Med.* 165, 2631–2638. doi: 10.1001/archinte.165.22.2631

Herriot, P. (2013). *The Employment Relationship: A Psychological Perspective.* London: Routledge.

IDF (2019). International Diabetes Federation. Available online at: https://diabetesatlas.org/upload/resources/material/20191218_144459_2019_global_factsheet.pdf (accessed September 20, 2019).

Jackson, C. (2007). The general health questionnaire. *Occup. Med.* 57, 79. doi: 10.1093/occmed/kql169

Jimenez-Garcia, R., Huedo, M. A. M., Hernandez-Barrera, V., de Andres, A. L., Martinez, D., Jimenez-Trujillo, I., et al. (2012). Psychological distress and mental disorders among Spanish diabetic adults: a case–control study. *Primary Care Diabetes* 6, 149–156. doi: 10.1016/j.pcd.2011.10.002

Katon, W. J. (2008). The comorbidity of diabetes mellitus and depression. *Am. J. Med.* 121, S8–S15. doi: 10.1016/j.amjmed.2008.09.008

Katon, W. J., Lin, E. H., Williams, L. H., Ciechanowski, P., Heckbert, S. R., Ludman, E., et al. (2010). Comorbid depression is associated with an increased risk of dementia diagnosis in patients with diabetes: a prospective cohort study. *J. Gen. Intern. Med.* 25, 423–429. doi: 10.1007/s11606-009-1248-6

Kim, Y. J., Cho, M. J., Park, S., Hong, J. P., Sohn, J. H., Bae, J. N., et al. (2013). The 12-item general health questionnaire as an effective mental health screening tool for general Korean adult population. *Psychiatry Investig.* 10, 352. doi: 10.4306/pi.2013.10.4.352

Kossen, C., and McIlveen, P. (2018). Unemployment from the perspective of the psychology of working. *J. Career Dev.* 45, 474–488. doi: 10.1177/0894845317711043

Lin, E. H., Rutter, C. M., Katon, W., Heckbert, S. R., Ciechanowski, P., Oliver, M. M., et al. (2010). Depression and advanced complications of diabetes: a prospective cohort study. *Diabetes Care* 33, 264–269. doi: 10.2337/dc09-1068

Lustman, P. J., Anderson, R. J., Freedland, K. E., de Groot, M., Carney, R. M., and Clouse, R. E. (2000). Depression and poor glycemic control: a meta-analytic review of the literature. *Diabetes Care* 23, 934–942. doi: 10.2337/diacare.23.7.934

McKee-Ryan, F., Song, Z., Wanberg, C. R., and Kinicki, A. J. (2005). Psychological and physical well-being during unemployment: a meta-analytic study. *J. Appl. Psychol.* 90, 53–76. doi: 10.1037/0021-9010.90.1.53

Montazeri, A., Vahdaninia, M., Ebrahimi, M., and Jarvandi, S. (2003). The hospital anxiety and depression scale (HADS): translation and validation study of the Iranian version. *Health Quality Life Outcomes* 1, 14. doi: 10.1186/1477-7525-1-14

Nouwen, A., Adriaanse, M. C., van Dam, K., Iversen, M. M., Viechtbauer, W., Peyrot, M., et al. (2019). Longitudinal associations between depression and diabetes complications: a systematic review and meta-analysis. *Diabet Med.* 36, 1562–72. doi: 10.1111/dme.14054

O'Donnell, A. T., Corrigan, F., and Gallagher, S. (2015). The impact of anticipated stigma on psychological and physical health problems in the unemployed group. *Front. Psychol.* 6, 1263. doi: 10.3389/fpsyg.2015.01263

Park, S. H., Goo, J. M., and Jo, C. H. (2004). Receiver operating characteristic (ROC) curve: practical review for radiologists. *Korean J. Radiol.* 5, 11–18. doi: 10.3348/kjr.2004.5.1.11

Pradhan, N., Rani, G., Dhaka, V. S., and Poonia, R. C. (2020). "Diabetes prediction using artificial neural network," in *Deep Learning Techniques for Biomedical and Health Informatics* (Jaipur: Elsevier), 327–39.

Semenkovich, K., Brown, M. E., Svrakic, D. M., and Lustman, P. J. (2015). Depression in type 2 diabetes mellitus: prevalence, impact, and treatment. *Drugs* 75, 577–587. doi: 10.1007/s40265-015-0347-4

Shao, W.-A., Williams, J. W., Lee, S., Badgett, R. G., Aaronson, B., and Cornell, J. E. (1997). Knowledge and attitudes about depression among non-generalists and generalists. *J. Family Pract.* 44, 161–168.

Trikkalinou, A., Papazafiropoulou, A. K., and Melidonis, A. (2017). Type 2 diabetes and quality of life. *World J. Diabetes* 8, 120. doi: 10.4239/wjd.v8.i4.120

Undén, A.-L., Elofsson, S., Andréasson, A., Hillered, E., Eriksson, I., and Brismar, K. (2008). Gender differences in self-rated health, quality of life, quality of care, and metabolic control in patients with diabetes. *Gender Med.* 5, 162–180. doi: 10.1016/j.genm.2008.05.003

WHO (2016). *Saudi Arabia—World Health Organization—Diabetes Country Profiles.*

WHO (2018). World Health Organization. Available online at: https://www.who.int/news-room/fact-sheets/detail/diabetes (accessed December 20, 2019).

Wu, C. S., Hsu, L. Y., and Wang, S. H. (2020). Association of depression and diabetes complications and mortality: a population-based cohort study. *Epidemiol. Psychiatr. Sci.* 29, e96. doi: 10.1017/S2045796020000049

y Pena, M. E., Barrera, V. H., Cordero, X. F., de Miguel, A. G., Pérez, M. R., Lopez-de Andres, A., et al. (2010). Self-perception of health status, mental health and quality of life among adults with diabetes residing in a metropolitan area. *Diabetes Metabol.* 36, 305–311. doi: 10.1016/j.diabet.2010.02.003

Quality of Life, Hopelessness, Impulsivity, and Suicide in the Rural Elderly in China: A Moderated Mediation Analysis of Psychological Autopsy Data

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Background: People who had died by suicide always being associated with negative emotions and even mental disorders. Understanding mechanisms underlying the association between quality of life (QOL), hopelessness, and suicide are of great significance. In this study, we aimed to test a model in which the QOL-suicide relationship was mediated by hopelessness and moderated by impulsivity.

Methods: Participants ($N = 484$, including 242 suicide deaths and 242 matched controls) were rural residents 60 years of age and older, randomly selected from 12 rural counties in China using a two-stage stratified cluster sampling method. Data were collected with standard psychological autopsy technique from informants ($n = 968$). The outcome variable was a suicide death. QOL, hopelessness, and impulsivity were assessed using validated scales. The proposed relationships were tested using mediation and moderated mediation models.

Results: Of the total sample, 55.8% were men with a median age of 75.5 years. Results from the moderated mediation analysis indicated that QOL was negatively associated with suicide (beta = -0.141, $p < 0.01$); this association was mediated by hopelessness (indirect effect: beta = 0.578, $p < 0.01$), accounting for 73% of the total effect. Impulsivity significantly moderated the mediation effect from QOL to hopelessness (beta = 0.005, $p < 0.01$).

Conclusions: Study findings have confirmed the negative association between QOL and suicide with psychological autopsy data, and demonstrated the role of hopelessness in mediating the QOL-suicide relation that is further modified by impulsiveness. These findings depend on our understanding of the suicide epidemiology among the elder in rural China and provide information much needed for suicide prevention.

Keywords: suicide, quality of life, hopelessness, impulsivity, moderated mediation

INTRODUCTION

Suicide is one of the most important public health challenges across the world, (1, 2) including in China (3). China has experienced a dramatic decline in suicide mortality per 100,000 from 17.6 in 1987 to 7.46 in 2014 (4). However, large disparities exist with the rate of suicide much higher for the elderly living in rural areas than in others (5). The high suicide rates underscore the need for investigating modifiable factors that are associated with suicide among the elderly in rural China as well as mechanisms underpinning the relationship between risk factors and suicide.
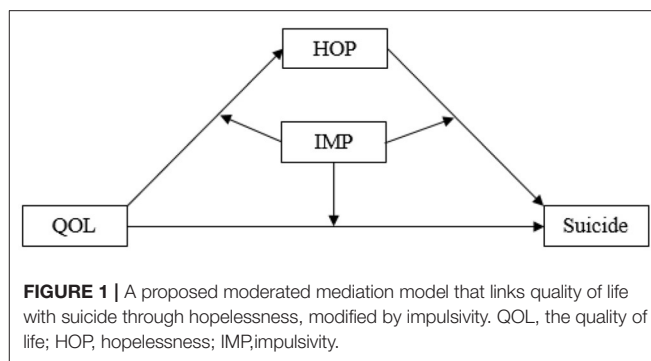
A number of studies have identified a series of bio-psycho-social factors for suicide, and a significant one is quality of life (QOL) (6). QOL is generally referred to as a positive sense of an individual's physical, psychological, and social well-being in the current social context (5). Understanding the impact of QOL on suicide among the elderly in rural China is of particular significance. QOL has often been linked to suicidal behaviors in various countries (6, 7), including China (8, 9).

Since the economic reforms in the 1980s, a large number of rural young people in China have left their homes and moved to urban areas while vulnerable elderly remain in rural areas waiting for assistance. Consequently, reductions in quality of life and increases in hopelessness may expose the rural elderly to an increased risk of suicide. The elderly in rural China may suffer from large reductions in QOL, including declines in the standard of living, and increases in many challenges, such as safety and social separation. In addition to suicidal behaviors, QOL has been directly related to suicide death in other populations (10).

Hopelessness is a negative cognition of one's future (11). Empirical studies have indicated that hopelessness is a warning sign, often prior to or co-existing with suicidal behaviors, and immediately prior to suicide death (12). Furthermore, hopelessness has also been empirically associated with suicidal behaviors (13, 14) and death (15) in other populations. A 10-year cohort study reported that hopelessness was reliable to predict the occurrence of suicide attempts among patients with psychosis (13).

Studies summarized in the previous sections indicate that QOL and hopelessness both are likely to be associated with suicide. Relative to QOL, hopelessness is a more proximal predictor (16); furthermore, documented studies indicate that QOL can significantly predict hopelessness (14), suggesting a potential role of hopelessness in mediating the QOL-suicide relationship. Empirical studies also indicate that hopelessness can mediate the relationship between perceived QOL and suicidal behaviors (17), but no study has examined the mediation mechanism by which hopelessness may mediate the QOL-suicide death relationship.

The impression has been arising that temperament or personality characteristics are associated with suicidal risk (18). Impulsivity is an important personality trait characterized by reflection impulsivity, impulsive action, and impulsive choice (19). Individuals with the personality of impulsivity are more likely to take risk behaviors, including suicide (20, 21). To test the proposed mediation mechanism that links QOL and hopelessness

FIGURE 1 | A proposed moderated mediation model that links quality of life with suicide through hopelessness, modified by impulsivity. QOL, the quality of life; HOP, hopelessness; IMP, impulsivity.

to suicide, the impact of this personality trait must be considered. This is because, with the same QOL level, individuals with higher levels of impulsivity may be more likely to become hopeless and more likely to commit suicide. Similarly, with the same level of hopelessness, the more impulsive individuals may be more likely to commit suicide than the less impulsive individuals. No reported study has examined these moderation effects.

Few studies have examined the complex mechanisms underpinning the relationship between QOL, hopelessness, impulsivity, and suicide. With psychological autopsy data, this study tested proposed models in which hopelessness mediated the relationship between QOL and suicide death that was modified by impulsivity (**Figure 1**). The ultimate goal is to provide evidence supporting future prevention interventions targeting the elderly living in rural China for suicide reduction.

MATERIALS AND METHODS

Participants and Sampling

This study is an analysis of data collected. A detailed description of participants and sampling has been reported elsewhere (22). A two-stage stratified cluster sampling method was used in our study. These provinces were selected based on GDP ranking from the top 10 (Shandong), 11–20 (Hunan), and 21–31 (Guangxi). Of the selected province, a total of 12 counties were randomly selected after ranking individual counties of a province by annual income, including three counties from Shandong, three from Hunan, and 6 from Guangxi.

Suicide deaths (cases) were identified using information from the death certificates available from the Center for Disease Control and Prevention at the county level. Participants were those with a formal record of suicide death reported by trained village doctors and local public health professionals, aged 60 years and older, and who committed suicide between February 2014 and September 2015. For each suicide death, a living control was selected through matching age (±3 years), gender, and geographic location (living in the same community). Whenever a suicide case was identified, the investigators would list and enumerate all candidates that matched. Then one living comparison was randomly selected from the list using a computer program. In a few cases when there were no appropriate living comparisons available, the investigators expanded the search to the nearest villages.

TABLE 1 | Demographic characteristics for the study subjects.

Variable	Suicides	Controls	Total	χ^2/t	P
Total, n (%)	242 (50%)	242(50%)	484 (100%)		
Gender, n (%)					
Male	135 (55.8)	135 (55.8)	270 (55.8)	–	–
Female	107 (44.2)	107 (44.2)	214 (44.2)		
Age (in years) [Median (QR)]	75 (68, 81)	76 (67.75, 80)	75.5 (68, 80)	0.511	
Education, n (%)					
Less than primary school	111 (45.9)	96 (39.7)	207 (42.8)	1.920	0.383
Primary school	105 (43.4)	116 (47.9)	221 (45.7)		
More than primary school	26 (10.7)	30 (12.4)	56 (11.6)		
Marriage stability, n (%)					
Stable	122 (50.4)	170 (70.2)	292 (60.3)	19.890	<0.001
Unstable	120 (49.6)	72 (29.8)	192 (39.7)		
Being left-behind, n (%)					
Yes	41 (16.9)	25 (10.3)	66 (13.6)	4.491	0.034
No	201 (83.1)	217 (89.7)	418 (86.4)		
Employment, n (%)					
Employed	40 (16.5)	59 (24.4)	99 (20.5)	7.837	0.021
Unemployed	195 (80.6)	169 (69.8)	364 (75.2)		
Retired	7 (2.9)	14 (5.8)	21 (4.3)		
Family annual income (Chinese yuan, RMB), n (%)					
0–3,600	88 (36.4)	74 (30.6)	162 (33.5)	1.865	0.394
3,601–10,000	88 (36.4)	98 (40.5)	186 (38.4)		
above 10,001	66 (27.3)	70 (28.9)	136 (28.1)		
Living alone, n (%)					
Yes	64 (26.4)	35 (14.5)	99 (20.5)	10.679	0.002
No	178 (73.6)	207 (85.5)	385 (79.5)		
Physical diseases, n (%)					
Yes	202 (83.5)	161 (64.9)	363 (75.0)	18.523	<0.001
No	40 (16.5)	81 (35.1)	121 (25.0)		
Mental disorders, n (%)					
Yes	122 (50.4)	12 (5.0)	134 (27.7)	124.870	<0.001
No	120 (49.6)	230 (95.0)	350 (72.3)		

Psychological Autopsy

Data were collected using the standard psychological autopsy technique (22). For each participant, two informants were selected. For each participant, two informants who were a family member and a friend or a neighbor, or other relevant people were selected to obtain the data related to them.

Data collectors were trained faculty and graduate students from three universities located within the selected provinces, including Shandong University, Central South University, and Guangxi Medical University. Data were collected through face-to-face interviews with an average interview time of 90 min.

The study was approved by the IRB of Shandong University, Central South University, and Guangxi Medical University.

Measurements

Quality of life was measured using the Quality of Life Scale previously tested among Chinese in a psychological autopsy study (10). The scale consists of 6 items, assessing (a) physical health, (b) mental health, (c) economic circumstances, (d) work relationships, (e) family relationships, and (f) relationships with non-family associates. The time range was a month prior to suicide (cases) or the investigation (control). Scale items were assessed using a five-point Likert scale varying from 1 (*very bad*) to 5 (*very good*). The reliability and the validity have been reported in our previous study (23). Total scores were computed such that larger scores indicated a higher level of quality of life.

Hopelessness was measured by a short version of the Beck Hopelessness Scale (24). The short version uses 4 items to assess the four key constructs of hopelessness, including expectancies of the future with (a) success, (b) darkness, (c) lack of opportunity, and (d) faith. Individual items were measured using another five-point Likert scale ranging from 1 (*absolutely yes*) to 5 (*absolutely no*). The Cronbach's α was 0.834 in this study. Total scores were computed such that larger scores indicated higher levels of hopelessness.

TABLE 2 | The correlation among the variables of the rural elderly.

Variable	Median (QR)	Suicide		Sex		Age in year	
		Correlation coefficient	P	Correlation coefficient	P	Correlation coefficient	P
Suicide	–	–					
Sex	–	–		–			
Age in year	75.5 (68, 80)	0.02	0.61	0.03	0.47	–	
Education	2 (0, 4)	−0.06	0.17	0.38	<0.001	−0.21	<0.001
Marriage	1 (1, 2)	0.2	<0.001	−0.15	<0.001	0.4	<0.001
Quality of life	17 (15, 20)	−0.55	<0.001	−0.09	0.06	−0.07	0.11
Hopelessness	12 (9, 15)	0.68	<0.001	0.06	0.22	0.05	0.31
Impulsiveness	92 (80, 105)	0.35	<0.001	−0.05	0.31	0.12	<0.001

Variable	Education		Marriage		Quality of life		Hopelessness	
	Correlation coefficient	P	Correlation coefficient	P	Correlation coefficient	P	Correlation coefficient	P
Suicide								
Sex								
Age in year								
Education	–							
Marriage	−0.16	<0.001	–					
Quality of life	0.04	0.35	−0.11	0.01	–			
Hopelessness	−0.05	0.25	0.15	0.001	−0.71	<0.001	–	
Impulsiveness	0.17	<0.001	−0.2	<0.001	−0.5	<0.001	0.49	<0.001

Impulsivity was measured using Barratt Impulsiveness Scale (Chinese version) (25). This 30-item scale assesses (a) impulsive planning, (b) motor impulsiveness, and (c) cognitive impulsiveness. Individual items were measured using another five-point Likert scale ranging from 1 (*never*) to 5 (*always*). The Cronbach's α was 0.913 in this study. Total scores were computed such that higher scores indicated more impulsiveness.

Demographic variables were gender (male/female), age (in years), stability of marriage (stable vs. unstable), an education level (less than primary school/primary school/more than primary school), employment (employed/unemployed/retired), family annual income (RMB Chinese yuan), physical disease (y/n), mental disorder (y/n), and if living alone (y/n).

Statistical Analyses

Descriptive statistics were used to describe the study sample. Correlation analysis was used to explore the relationship between suicide and other factors, including quality of life, hopelessness, and impulsivity, as well as demographic and social-economic status. A moderated mediation model was proposed and used in investigating the mechanism by which the perception of hopelessness in the mediation of the relationship between quality of life and suicide, is moderated by impulsivity (**Figure 1**). The SAS macro PROCESS developed Hayes (26) was used to assess the moderated mediation model. Type I error was set at P-values <0.05 level for statistical inference. All statistical analysis was conducted using the commercial software SAS, version 9.4 (SAS Institute Inc, Cary, NC, USA).

RESULTS

Study Participants

Table 1 summarizes the main characteristics of the study participants. Of the total sample, 242 were cases and 242 controls with a median age of 75.5 years and 55.8% men. Among the participants, 42.8% had less than primary education, and 33.5% had a family annual income of <3,600 Chinese yuan. Relative to the controls, the suicide cases were more likely to be left-behind with an unstable marriage, lived alone, unemployed, and diagnosed with physical and mental disorders.

Correlations Between Suicide and Other key Variables

Results in **Table 2** indicate that suicide was significantly correlated with QOL ($r = -0.55$, $p < 0.01$) and hopelessness ($r = 0.68$, $p < 0.01$), and QOL and hopelessness was also correlated ($r = -0.71$, $p < 0.01$), suggesting a potential role of hopelessness in mediating the QOL-suicide relationship. In addition, impulsivity was significantly correlated with QOL ($r = -0.5$, $p < 0.01$) and hopelessness ($r = 0.49$, $p < 0.01$) and suicide ($r = 0.35$, $p < 0.01$), suggesting potential roles of this variable in modifying the relationship between QOL, hopelessness and suicide.

Results From the Mediation Modeling Analysis

Results in **Figure 2** indicate that QOL was associated with suicide deaths through two paths, a direct effect (coefficient c1 = −0.141,

FIGURE 2 | Schematic model of hopelessness as the mediator in the relationship between quality of life and suicide. QOL, quality of life, and HOP, hopelessness. Model coefficients were estimated using the SAS Macro PROCESS (see text for detail); *: $p < 0.05$, and **: $p < 0.01$.

FIGURE 3 | Schematic model of impulsivity as the moderator in the relationship between quality of life and hopelessness, quality of life and suicide. QOL, quality of life; HOP, hopelessness; IMP, impulsivity. Model coefficients were estimated using the SAS Macro PROCESS (see text for detail); *: $p < 0.05$, **: $p < 0.01$.

$p < 0.01$) and an indirect effect (a1*b1 $= -0.397$) through hopeless with coefficient a1 $= -0.687$, $p < 0.01$ for the QOL – hopelessness relation and b1 $= 0.578$, $p < 0.01$ for the hopelessness-suicide relation. The total effect = indirect effect + direct effect $= -0.141 + -0.379 = -0.52$, with the indirect effect for 73% (0.379/0.52) of the total effect.

Results From the Moderated Mediation Analysis

Of several moderated mediation models, a significant moderation effect was detected for only one model (**Figure 3**). The result in the figure indicates that impulsivity significantly moderated the QOL-hopelessness relationship with the model coefficient $= 0.005$, $p < 0.01$, suggesting a stronger QOL-hopelessness relationship for individuals with a higher level of impulsivity.

DISCUSSION

In this study, the QOL-suicide relationship that is mediated by hopelessness and moderated by impulsivity has been tested with data collected through psychological autopsy among the rural elderly in China. Study findings provide valuable data deepening our understanding of the factors related to suicide

among the elderly in rural China and informing evidence-based interventions for suicide reduction.

Quality of life is a modifiable and protective factor for suicide (10, 27). In this study, we confirmed the negative association between QOL and suicide among the elderly in rural China as reported in other populations within and outside of China (17). With quick economic growth and a large number of rural-to-urban migrants, more attention should be paid to rural elderly who may not benefit but suffer from the development. It is indicating that the quality of life for the rural elderly should be improved in the rapid economic development to reduce their risk of suicide.

A novel finding of this study is that a majority of the QOL-suicide relationship for the elderly in rural China is mediated through hopelessness. This means that although low QOL may increase suicide among the elderly in rural areas, this will not happen for most elderly if they still have hope in their life.

According to this finding, one approach to suicide prevention for the elderly in rural China would be to fight against hopelessness (28). Hopelessness is often resulted from the lack of perceived capabilities to cope with the challenges (29) and alleviation of hopelessness cognition may reduce suicide risk (30). Therefore, hopelessness can be reduced by the provision of assistance and training to solve problems, such as separation from family members, poor transportation, poverty, chronic diseases, and lack of access to healthcare. Another issue is that most Chinese elderly tend to solve problems by themselves rather than asking their children for help with the intention not to add extra burden to their children while their children may in fact want to help them. We must consider this factor in devising intervention programs to reduce the level of hopelessness among the elderly.

The findings of the study also indicate that impulsivity is a significant moderator that can alter the relationship between QOL and hopelessness. Compared to those with low levels of impulsivity, the elderly with a high-level are more likely to experience hopelessness and commit suicide. This may be because impulsivity is a personal trait affecting individuals' coping behaviors. People with a higher level of impulsivity tend to make decisions without rational and analytical thinking, thus, they are more likely to develop hopelessness (31). We must also consider this factor in devising programs for suicide prevention blocking the process from low QOL to hopelessness for the elderly in rural China.

There are limitations to this study. Firstly, the interview was held after suicide death 2–6 months, the information was collected from informants with recall bias. Secondly, there are methodological limitations in psychological autopsy studies. The use of proxy informants, the lack of blinding about suicide, and comparison have an impact on the reliability of the data. Thirdly, the study participants were selected using a two-stage stratified cluster sampling method, they were selected only from three provinces in China. There was its own cultural background in each region which has a special influence on people's cognition. Caution is needed when generalizing the findings of this study to the elderly population across China given the high heterogeneity in the elder population across the large area of China.

CONCLUSION

In conclusion, this study is the first to apply a moderated mediation model in investigating three key influential factors, QOL, hopelessness, and impulsivity. Also, the first one is to investigate the mechanisms underpinning the complex relationship linking these factors to suicide among the elderly in rural China with psychological autopsy data. The findings of this study provide new data advancing our understanding of the epidemiology of suicide among the elderly and informing evidence-based interventions for suicide reduction. The quality of life should be improved and the hopelessness should be reduced to decrease the rate of rural elderly in China. What is more important is to reduce the risk of suicide among older people by improving their ability to deal with problems.

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 study was approved by the IRB of the Central South University, Shandong University, and Guangxi Medical University. The aim and procedure of the research were explained to all participants. Written informed consent must be obtained before interviews were conducted. The patients/participants provided their written informed consent to participate in this study.

REFERENCES

1. Turecki G, Brent D. Suicide and Suicidal Behaviour. *Lancet.* (2016) 387:1227–39. doi: 10.1016/S0140-6736(15)00234-2

2. Oonarom A, Wongpakaran T, Kuntawong P, Wongpakaran N. attachment anxiety, depression, and perceived social support: a moderated mediation model of suicide ideation among the elderly. *Int psychogeriatr.* (2020) 32:1009. doi: 10.1017/S1041610220001581

3. Sha F, Chang Q, Law Y, Hong Q, Yip P. Suicide rates in China, 2004-2014: comparing data from two sample-based mortality surveillance systems. *BMC Public Health.* (2018) 18:239. doi: 10.1186/s12889-018-5161-y

4. Zhong B, Chiu H, Conwell Y. Elderly suicide trends in the context of transforming China, 1987-2014. *Sci Rep.* (2016) 6:37724. doi: 10.1038/srep37724

5. Chen X, Yu B, Gong J, Wang P, Elliott A. Social capital associated with quality of life mediated by employment experiences: evidence from a random sample of rural-to-urban migrants in China. *Soc Indic Res.* (2018) 139:327–46. doi: 10.1007/s11205-017-1617-1

6. Minayo M, Cavalcante F. Suicide attempts among the elderly: a review of the literature (2002/2013). *Ciencia saude coletiva.* (2015) 20:1751–62. doi: 10.1590/1413-81232015206.10962014

7. Alves VM, Francisco L, Belo F. de-Melo-Neto V, Barros V, Nardi A. Evaluation of the quality of life and risk of suicide. *Clinics.* (2016) 71:135–9. doi: 10.6061/clinics/2016(03)03

8. Lu C, Yuan L, Lin W, Zhou Y, Pan S. Depression and resilience mediates the effect of family function on quality of life of the elderly. *Arch Gerontol Geriatr.* (2017) 71:34–42. doi: 10.1016/j.archger.2017.02.011

9. Zhao P, Yang R, Phillips M. Age-specific characteristics of serious suicide attempters in China. *Suicide Life Threat Behav.* (2010) 40:383–93. doi: 10.1521/suli.2010.40.4.383

10. Phillips M, Yang G, Zhang Y, Wang L, Ji H, Zhou M. Risk factors for suicide in China: a national case-control psychological autopsy study. *Lancet.* (2002) 360:1728–36. doi: 10.1016/S0140-6736(02)11681-3

11. Ma Z, He Q, Nie G, Jia C, Zhou L. Reliability and validity of short beck hopelessness scale in psychological autopsy study among Chinese rural elderly. *Int psychogeriatr.* (2020) 32:525–31. doi: 10.1017/S1041610219001315

12. Bagge C, Lamis D, Nadorff M, Osman A. Relations between hopelessness, depressive symptoms and suicidality: mediation by reasons for living. *J Clin Psychol.* (2014) 70:18–31. doi: 10.1002/jclp.22005

13. David Klonsky E, Kotov R, Bakst S, Rabinowitz J, Bromet E. Hopelessness as a predictor of attempted suicide among first admission patients with psychosis: a 10-year cohort study. *Suicide Life Threat Behav.* (2012) 42:1–10. doi: 10.1111/j.1943-278X.2011.0066.x

14. Kay N, Xiao K, Xia N, Park N, Hee B. Hopelessness and suicidal behavior among Chinese, Thai and Korean College students and predictive effects of the World Health Organization's WHOQOL-BREF. *Int J Health Promot Educ.* (2009) 12:16–32. Available online at: http://www.iejhe.com/archives/2009/4186-14115-1-CE.pdf

15. Ribeiro J, Huang XX, Fox K, Franklin J. Depression and Hopelessness as Risk Factors for Suicide Ideation, Attempts and Death: Meta-Analysis of Longitudinal Studies. *Br J Psychiatry.* (2018) 212:279–86. doi: 10.1192/bjp.2018.27

16. Berardelli I, Sarubbi S, Rogante E, Hawkins M, Cocco G, Erbuto D, et al. The role of demoralization and hopelessness in suicide risk in schizophrenia: a review of the literature. *Medicine.* (2019) 55:200. doi: 10.3390/medicina55050200

17. Pompili M, Lester D, Innamorati M, De Pisa E, Amore M, Ferrara C, et al. Quality of life and suicide risk in patients with diabetes mellitus. *Psychosomatics.* (2009) 50:16–23. doi: 10.1176/appi.psy.50.1.16

18. Baldessarini RJ, Innamorati M, Erbuto D, Serafini G, Fiorillo A, Amore M, et al. Differential associations of affective temperaments and diagnosis

of major affective disorders with suicidal behavior. *J Affect Disord.* (2016) 210:19–21. doi: 10.1016/j.jad.2016.03.002

19. Dalley J, Everitt B, Robbins T. Impulsivity, compulsivity, and top-down cognitive control. *Neuron.* (2011) 69:680–94. doi: 10.1016/j.neuron.2011.01.020

20. Lim M, Lee S, Park J. Differences between impulsive and non-impulsive suicide attempts among individuals treated in emergency rooms of South Korea. *Psychiatry Investig.* (2016) 13:389–96. doi: 10.4306/pi.2016.13.4.389

21. Lin L, Zhang J. Impulsivity, mental disorder, and suicide in rural China. *Arch Suicide Res.* (2017) 21:73–82. doi: 10.1080/13811118.2015.1004478

22. Zhou L, Wang G, Jia C, Ma Z. Being left-behind, mental disorder, and elderly suicide in rural China: a case-control psychological autopsy study. *Psychol Med.* (2019) 49:458–64. doi: 10.1017/S003329171800106X

23. He H, Mo Q, Bai X, Chen X, Jia C, Zhou L, et al. Studying suicide using proxy-based data: reliability and validity of a short version scale for measuring quality of life in rural China. *PeerJ.* (2021) 9:e12396. doi: 10.7717/peerj.12396

24. Aish A, Wasserman D, Renberg E. Does Beck's Hopelessness scale really measure several components? *Psychol Med.* (2001) 31:367–72. doi: 10.1017/S0033291701003300

25. Lu C, Jia C, Xu A, Dai A, Qin P. Psychometric characteristics of Chinese Version of Barratt Impulsiveness Scale-11 in suicides and living controls of rural China. *Omega.* (2012) 66:215–29. doi: 10.2190/OM.66.3.b

26. Hayes AF. *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach.* New York, NY: The Guilford Press (2013).

27. Fairweather-Schmidt A, Batterham P, Butterworth P, Nada-Raja S. The impact of suicidality on health-related quality of life: a latent growth curve analysis of community-based data. *J Affect Disord.* (2016) 203:14–21. doi: 10.1016/j.jad.2016.05.067

28. Chang E, Sanna L, Hirsch J, Jeglic E. Loneliness and negative life events as predictors of hopelessness and suicidal behaviors in hispanics: evidence for a diathesis-stress model. *J Clin Psychol.* (2010) 66:1242–53. doi: 10.1002/jclp.20721

29. Steeg S, Haigh M, Webb R, Kapur N, Awenat Y, Gooding P, et al. The exacerbating influence of hopelessness on other known risk factors for repeat self-harm and suicide. *J Affect Disord.* (2016) 190:522–8. doi: 10.1016/j.jad.2015.09.050

30. Zhang J, Li Z. The Association between depression and suicide when hopelessness is controlled for. *Compr Psychiatry.* (2013) 54:790–6. doi: 10.1016/j.comppsych.2013.03.004

31. Neufeld E, O'Rourke N. Impulsivity and hopelessness as predictors of suicide-related ideation among older adults. *Can J Psychiatry.* (2009) 54:684–92. doi: 10.1177/070674370905401005

Depressive Symptoms and Cognitive Decline Among Chinese Rural Elderly Individuals: A Longitudinal Study With 2-Year Follow-Up

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Background: Depressive symptoms and mild cognitive impairment (MCI) are highly prevalent in rural China. The study aimed to investigate the longitudinal associations between changes in depressive symptoms and cognitive decline and MCI incidence among Chinese rural elderly individuals.

Methods: A 2-year follow-up study was conducted among 1,477 participants from the Anhui Healthy Longevity Survey (AHLS). Depressive symptoms were assessed by the 9-item Patient Health Questionnaire (PHQ-9), and cognitive status was evaluated by the Mini Mental State Examination (MMSE). Multivariable linear regression and logistic regression were employed.

Results: Every 1-unit PHQ-9 score increase was significantly associated with more cognitive decline ($\beta = 0.157$, 95% CI: 0.092, 0.221, $p < 0.001$) and a higher risk of MCI incidence (OR = 1.063, 95% CI: 1.025, 1.103, $p = 0.001$). The participants who experienced worsening of depression symptoms had a larger decline in the 2-year MMSE score ($\beta = 0.650$, 95% CI: 0.039, 1.261, $p = 0.037$) and elevated risks of incident MCI (OR = 1.573, 95% CI: 1.113, 2.223, $p = 0.010$).

Limitations: Screening tools rather than standard diagnostic procedures were used in the study. Moreover, the long-term associations still need further exploration since the follow-up time was short.

Conclusions: Increased depressive symptoms were associated with more cognitive decline and higher risks of incident MCI among Chinese rural residents.

Keywords: depression, mild cognitive impairment, elderly, rural area, Alzheimer's disease

INTRODUCTION

Alzheimer's disease (AD) is a significant and common public health threat worldwide, not only creating enormous physical, emotional and economical stress for individuals and their families but also imposing a very large disease burden on societies. In China, the number of people living with AD has been projected to be 300 million, with a disease burden as high as 2000 billion RMB in 2050 (1). Due to the slow progress toward curing AD, preventive strategies through elucidating and modifying its risk factors might be the key response initiatives to combat AD (2). Mild cognitive impairment (MCI) has been regarded as a predementia stage of great public health importance (3, 4), because individuals with MCI have the potential to regain normal cognitive function if early and effective interventions can be taken (5).

Depression and cognitive decline often present together (6–8), indicating the possible close relationship between them, although the exact mechanism seems to be complicated and needs further exploration. Many studies have suggested that depressive symptoms increase the risk of cognitive impairment through pathways of immune dysregulation, which may simultaneously drive other comorbid medical conditions (9, 10). However, some researchers hold the view that depression is one of the prodromes of cognitive decline because people with depression show a negative bias in information processing that affects their attention, memory, and response to feedback (11). Additional evidence has revealed that depressive symptoms play a major role in the progression of MCI to AD (12, 13); thus, depression has been regarded as a predictor of progressive cognitive decline (14, 15).

Despite relatively numerous studies on the relationship between depression and cognitive decline, a few gaps exist in the literature. First, although depression is very common among elderly individuals (16), available studies are often limited to middle-aged people (17), clinical patients (18), and urban areas (19, 20). In addition, longitudinal studies, which are essential to investigate the causal effect of depression on the onset of cognitive decline, are still insufficient (21, 22). Although several longitudinal studies have implied a relationship between depression and cognitive decline (23, 24), evidence from less developed areas, e.g., rural China, is still very rare.

Therefore, in the current study, we aimed to explore the relationship between depression and cognitive decline and the incidence of MCI among a rural Chinese elderly sample through a longitudinal study with 2-year follow-up, particularly to determine whether baseline depression and depression status change were associated with cognitive decline and MCI incidence. The findings of the current study might contribute to preventing MCI and slowing the development of AD among older adults in rural areas.

METHODS

Study Population

The present study was based on data collected from the Anhui Healthy Longevity Survey (AHLS), the details of which have been reported elsewhere (25). Briefly, 6,211 participants who were aged 60 or higher were initially enrolled from four cities (Chuzhou, Lu'an, Xuancheng, and Fuyang) in July 2019. After approximately two years, the follow-up visit (wave 1) was conducted the participants from rural areas of the three cities (Chuzhou, Lu'an and Xuancheng). Among the 2,308 rural participants who were investigated at baseline, 1,566 participants completed the follow-up in 2021, for a response rate of 67.9% (742 participants were lost to follow-up, including 88 cases of death, 23 cases of loss of communication ability, 201 cases of migration and 430 cases of refusal to participate).

In the current study, we further excluded the participants if they (1) were not able to finish the cognitive function assessment or depressive symptoms assessment ($n = 16$) or (2) had any missing covariate data ($n = 73$). Finally, 1,477 participants were included in the analysis, and none of them reported a previous history of depression or cognitive impairment. For the analysis of the relationship between depression and 2-year MCI incidence, the participants with pre-existing MCI at baseline ($n = 983$) were excluded. All the procedures complied with the ethical standards of the Anhui Medical University committee (No. 2020H011).

Assessment of Depressive Symptoms

The Patient Health Questionnaire (PHQ-9) (26) was used to measure the depression symptoms of the participants at baseline and at follow-up. The instrument assessed the severity of depression by asking about the frequency of occurrence of the major symptoms of depression within the last two weeks. The total score of the PHQ-9 is 30, with higher scores indicating more severe depression symptoms. The Cronbach's α was 0.89 in the pilot study, showing the appropriate internal consistency of the PHQ-9 scale. For the current analysis, total PHQ-9 scores were categorized as "not depressed" (0–4) and "depressed" (5–30).

The depression score change was calculated by the formula

$i = P - Q$ where, $P =$ PHQ-9 score at follow up; $Q =$ PHQ-9 score at baseline.

A greater value of i indicates an increase in PHQ-9 scores at follow-up, i.e., more elevated depressive symptoms. Worsening depressive symptoms were classified into "None" (i was ≤ 0) and "Yes" (i was higher than 0).

Assessment of Cognitive Function

The cognitive status of the participants was evaluated by the Mini Mental State Examination (MMSE) (27) at baseline and at follow-up. The MMSE was the most widely used tool for cognition assessment, with good accuracy in the detection of dementia (sensitivity and specificity were 87 and 89%, respectively) (28) as well as in MCI (sensitivity and specificity were 79.8 and 81.3% respectively) (29). A previous study concluded good applicability of MMSE as a cognitive function screen instrument in community settings of China (30). The total score of the MMSE scale is 30 points, with higher scores indicating better cognitive function. The Cronbach's α was 0.69 in the pilot

study, showing the acceptable internal consistency of the MMSE. In the current study, the education-based criterion for MCI was adopted due to the potential impact of educational level (31). Specifically, MCI was determined if the participants were illiterate and had MMSE scores < 18, if they had 1–6 years of education and had MMSE scores lower than 21, or if they had 6 or more years of education with MMSE scores lower than 25 (32).

Two-year cognitive change and MCI incidence were also identified according to the measurement of MMSE scores at baseline and at follow-up. The changes in MMSE scores were calculated by the formula

$j = M - E$ where, M = MMSE score at baseline; E = MMSE score at follow-up.

A greater value of j indicates a larger decrease in the MMSE score after 2 years of follow-up, i.e., a severe decline in cognitive performance.

The participants who were free of MCI at baseline and classified as having MCI at follow-up were judged as having incident MCI. The participants were divided into two groups (yes, no) according to whether they developed MCI within the 2-year follow-up.

Assessment of Covariates

Baseline data of sociodemographic characteristics (city, sex, age, education, marital status, annual income, and living alone), behavioral factors [body mass index (BMI), drinking, smoking, sedentary hours, self-rated sleep quality], and chronic conditions (diabetes and hypertension) were treated as covariates. Age was self-reported by the participants. Education was divided into three groups according to the participant's years of formal education (low: 0, medium: 1–6 years and high: more than 6 years). Marital status was classified into married and others (including divorce, widowed and never married). Annual income was classified into two groups (lower than 6,500 RMB and 6,500 RMB or higher). Living alone was assessed by asking the participants "Do you live alone?" The options were "yes" and "no." BMI was calculated by measuring height and weight by the formula *weight (kg)/height (m)^2* and introduced as a continuous variable. Drinking status was dichotomized as never, former, and current. Smoking was classified into two groups (yes and no) according to whether they smoked. Self-rated sleep quality was assessed by asking the participants "How do you evaluate your sleep quality in the last month?" The options were "very good," "good," and "not good." Continuous daily sitting time was self-reported and used as an indicator reflecting the physical activity status of the participants. Two chronic conditions (hypertension and diabetes) were divided into two groups (yes and no) according to whether the participants had been diagnosed with hypertension/diabetes at a hospital at the county level or above.

Statistical Analyses

Multivariable linear regression and logistic regression were employed to assess the associations between depressive symptoms and cognition by including 2-year cognitive decline and MCI incidence as dependent variables, respectively. The

baseline PHQ-9 score and changes in PHQ-9 scores (*i*) were treated as independent variables and introduced into the regression models together with all the covariates. The regression models used simultaneous entry of variables (enter method). Since many studies have indicated that sex and age might be related to cognitive decline and depression (33–35), sex- and age-stratified analyses were also performed. In addition, accumulating evidence suggested that having more years of

TABLE 1 | Basic characteristics of the sample.

	N	Mean/percentage
City		
Lu'an (West)	488	33.0
Chuzhou (East)	568	38.5
Xuancheng (South)	421	28.5
Sex		
Male	711	48.1
Female	766	51.9
Age	1,477	70.36
Education		
Low (0 year of education)	839	56.8
Medium (1~6 years of education)	480	32.5
High (more than 6 years of education)	158	10.7
Marital status		
Married	1,097	74.3
Others (divorce/widowed/Never married)	380	25.7
Annual income		
<6,500	1,168	79.1
≥6,500	309	20.9
BMI	1,477	23.79
Drinking status		
Never	785	53.2
Former	71	4.8
Current	621	42.0
Current smoker		
Yes	371	25.1
No	1,106	74.9
Physical activity		
Daily sitting time (hours)	1,477	4.12
Self-rated sleeping quality		
Very good	256	17.3
Good	843	57.1
Not good	378	25.6
Diabetes		
Yes	212	14.4
No	1,265	85.6
Hypertension		
Yes	773	52.3
No	704	47.7
Living alone		
Yes	259	17.5
No	1,218	82.5

education is a protective factor for cognitive impairment (36, 37); thus, additional analyses stratified by education levels were also conducted to examine the associations in different subgroups.

Stata version 15.1 software (Stata Corp, College Station, TX) was used for all analyses. All the tests were two-sided, and the significance level was set at $p < 0.05$.

RESULTS

Table 1 presents the basic characteristics of the study sample ($n = 1,477$). The mean age of the participants was 70.36 years, and 51.9% of the participants were women. More than half of the participants (56.8%) enrolled in the current study were illiterate. The mean BMI of the participants was 23.79 kg/m^2. A total of 14.4% of the participants reported having diabetes, and more than half of the participants (52.3%) reported having high blood pressure.

The associations between depression status at baseline and at follow-up and cognitive function are shown in **Table 2**. Depression status at baseline was not associated with two-year cognitive decline or MCI incidence. For depression status at follow-up, every 1-unit PHQ-9 score increase was significantly associated with a larger 2-year cognitive decline ($\beta = 0.157$, 95% CI: 0.092, 0.221, $p < 0.001$) and a higher risk of MCI incidence (OR = 1.063, 95% CI: 1.025, 1.103, $p = 0.001$). The participants who experienced worsening depressive symptoms had a larger decline in the 2-year MMSE score ($\beta = 0.650$, 95% CI: 0.039, 1.261, $p = 0.037$) and elevated risks of incident MCI (OR = 1.573, 95% CI: 1.113, 2.223, $p = 0.010$).

Table 3 shows the results of the sex-stratified analysis. No significant association was detected between baseline depression and cognitive decline and 2-year MCI incidence for either males or females. For males, PHQ-9 score increases were associated with cognitive decline ($\beta = 0.277$, 95% CI: 0.128, 0.326, $p < 0.001$) and 2-year MCI incidence (OR = 1.103, 95% CI: 1.041, 1.168, $p = 0.001$), whereas PHQ-9 score increases were associated with only 2-year cognitive decline among females ($\beta = 0.103$, 95% CI: 0.015, 0.190, $p = 0.022$). Experienced worsening depression symptoms was associated with a significant larger decline in the 2-year MMSE score in males ($\beta = 1.016$, 95% CI: 0.135, 1.897, $p = 0.024$) but not in females.

The results of the age-stratified analysis are shown in **Table 4**. For both the older group (aged 70 and older) and younger group (aged under 70), baseline depression status was associated with neither 2-year cognitive decline nor MCI incidence. For both of the age-stratified groups, PHQ-9 score increases were associated with 2-year cognitive decline: for the participants who were under 70, a 1-unit PHQ-9 score increase was significantly associated with a 2-year MMSE score decline of 0.135 ($\beta = 0.135$, 95% CI: 0.051, 0.220, $p = 0.002$), and for those who were aged 70 and older, a 1-unit PHQ-9 score increase was significantly associated with a 0.168-unit MMSE score decline ($\beta = 0.168$, 95% CI: 0.066, 0.270, $p = 0.001$). Whereas PHQ-9 score increases were only associated with 2-year MCI incidence in older group (OR = 1.062, 95% CI: 1.005, 1.222, $p = 0.033$) but not in younger group. Worsening depressive symptoms was not statistically associated with 2-year cognitive decline or MCI incidence for either the older or younger group.

The results of the analysis stratified by different education levels are shown in **Supplementary Table S1**. Baseline depression was not associated with cognitive decline and 2-year MCI

TABLE 2 | The associations between depression and cognitive function: Coefficients and 95% CIs for 2-year cognitive decline and Odds Ratios and 95% CIs for 2-year MCI incidence.

	2-year cognitive decline (j)[a]			2-year MCI incidence[b]		
	β	95% CI	p-Value	OR	95% CI	p-Value
Baseline						
PHQ-9 score	−0.018	−0.084,0.048	0.594	1.009	0.970, 1.049	0.650
Depression status						
No (ref)						
Yes	−0.338	−0.949, 0.274	0.279	1.084	0.764, 1.540	0.651
Follow up						
PHQ-9 score increase (i)	0.157	0.092, 0.221	<0.001*	1.063	1.025, 1.103	0.001*
Worsening						
None (ref)						
Yes	0.650	0.039, 1.261	0.037*	1.573	1.113, 2.223	0.010 *

*p < 0.05.
The model adjusted city (Chuzhou, Lu'an and Xuancheng), age (≤70 and >70), sex (male and female), education (0, 1–6 years and more than 6 years), marital status (married and others), annual income(Lower than 6,500 RMR and 6,500 RMR or higher), BMI (continuous), drinking status (never, former and current), current smoker (Yes and No), Physical activity (daily sitting time), self-rated sleeping quality (very good, good and not good), diabetes (yes and no), hypertension (yes and no), living alone (yes and no), PHQ-9 score at baseline.
[a]Multivariable linear regression analysis included 1,477 participants.
[b]Multivariable logistic regression analysis included 983 participants.
j = M − E (M = MMSE score at baseline; E = MMSE score at follow-up).
i = P − Q (P = PHQ-9 score at follow up; Q = PHQ-9 score at baseline).

TABLE 3 | The associations between depression and cognitive function by sexes: Coefficients and 95% CIs for 2-year cognitive decline and Odds Ratios and 95% CIs for 2-year MCI incidence.

	2-year cognitive decline (j)[a]			2-year MCI incidence[b]		
	β	95% CI	p-Value	OR	95% CI	p-Value
Male						
Baseline						
PHQ-9 score	0.037	−0.067, 0.142	0.483	1.022	0.963, 1.084	0.475
Depression status						
No (ref)						
Yes	0.008	−0.898, 0.915	0.986	1.259	0.743, 2.132	0.392
Follow up						
PHQ-9 score increase (i)	0.227	0.128, 0.326	<0.001*	1.103	1.041, 1.168	0.001*
Worsening						
None (ref)						
Yes	1.016	0.135, 1.897	0.024*	1.610	0.973, 2.666	0.064
Female						
Baseline						
PHQ-9 score	−0.060	−0.147, 0.028	0.181	1.009	0.956,1.065	0.736
Depression status						
No (ref)						
Yes	−0.657	−1.499, 0.185	0.126	1.043	0.643, 1.693	0.865
Follow up						
PHQ-9 score increase (i)	0.103	0.015, 0.190	0.022*	1.039	0.990, 1.093	0.136
Worsening						
None (ref)						
Yes	0.290	−0.574, 1.154	0.510	1.615	0.986, 2.647	0.057

*p < 0.05.

The model adjusted city (Chuzhou, Lu'an and Xuancheng), age (≤70 and >70), sex (male and female), education (0, 1–6 years and more than 6 years), marital status (married and others), annual income (Lower than 6,500 RMR and 6,500 RMR or higher), BMI (continuous), drinking status (never, former and current), current smoker (Yes and No), Physical activity (daily sitting time), self-rated sleeping quality (very good, good and not good), diabetes (yes and no), hypertension (yes and no), living alone (yes and no), PHQ-9 score at baseline.

[a]Multivariable linear regression analysis included 1,477 participants.

[b]Multivariable logistic regression analysis included 983 participants.

$j = M − E$ (M = MMSE score at baseline; E = MMSE score at follow-up).

$i = P − Q$ (P = PHQ-9 score at follow up; Q = PHQ-9 score at baseline).

incidence in the three subgroups. For those who were categorized into the low education group, PHQ-9 score increases were significantly associated with cognitive decline ($\beta = 0.124$, 95% CI: 0.036, 0.212, $p = 0.006$) and 2-year MCI incidence (OR = 1.066, 95% CI: 1.018, 1.118, $p = 0.007$), whereas this factor was only associated with 2-year cognitive decline ($\beta = 0.207$, 95% CI: 0.097, 0.317, $p < 0.001$) among the participants who had a medium education level. For those who had a high education level, PHQ-9 score increases were only associated with 2-year MCI incidence (OR = 1.272, 95% CI: 1.028, 1.573, $p = 0.027$). Experiencing worsening depressive symptoms was associated with elevated risks of 2-year MCI incident only among those who were categorized in the low education group (OR = 2.184, 95% CI: 1.362, 3.503, $p = 0.001$).

DISCUSSION

In this longitudinal study with 2-year follow-up, aggravated depressive symptoms were associated with greater cognitive decline and an increased MCI incidence among rural elderly

people. Many previous studies have suggested a higher prevalence of depression and cognitive impairment in rural areas than in urban areas in China (38–42). Considering the relatively lower educational level of rural dwellers as well as the barriers due to the constraints of the economy and medical resources in rural regions (43, 44), urban-rural disparities will further expand if effective intervention are not adopted. The current study was the first to investigate the longitudinal associations between depressive symptoms and cognition among Chinese rural elderly individuals.

Consistent with our findings, longitudinal associations between increased depressive symptoms and cognitive decline as well as higher MCI risks have been revealed in many studies (20, 45, 46). However, baseline depression status was not associated with cognitive decline or MCI incidence in this study, which contradicts some studies (21, 47). This might be attributed to the relatively short follow-up duration (2 years) and may also be related to different screening tools for depression assessment, differences in study design and sample size, and heterogeneity of the population.

TABLE 4 | The associations between depression and cognitive function by age: Coefficients and 95% CIs for 2-year cognitive decline and Odds Ratios and 95% CIs for 2-year MCI incidence.

	2-year cognitive decline (j)[a]			2-year MCI incidence[b]		
	β	95% CI	*p*-Value	OR	95% CI	*p*-Value
Younger (aged under 70)						
Baseline						
PHQ-9 score	−0.038	−0.126, 0.049	0.390	1.033	0.974, 1.095	0.282
Depression status						
No (ref)						
Yes	−0.236	−1.015, 0.543	0.553	1.209	0.743, 1.968	0.445
Follow up						
PHQ-9 score increase (i)	0.135	0.051, 0.220	0.002*	1.051	0.999, 1.108	0.056
Worsening						
None (ref)						
Yes	0.439	−0.318, 1.196	0.255	1.498	0.927, 2.421	0.099
Older (aged 70 or older)						
Baseline						
PHQ-9 score	0.016	−0.087, 0.118	0.765	0.996	0.944, 1.051	0.880
Depression status						
No (ref)						
Yes	−0.306	−1.286, 0.673	0.539	1.005	0.595, 1.699	0.985
Follow up						
PHQ-9 score increase (i)	0.168	0.066, 0.270	0.001*	1.062	1.005, 1.122	0.033*
Worsening						
None (ref)						
Yes	0.838	−0.183, 1.858	0.107	1.513	0.896, 2.554	0.121

*$p < 0.05$.
The model adjusted city (Chuzhou, Lu'an and Xuancheng), age ($\leq$70 and >70), sex (male and female), education (0, 1–6 years and more than 6 years), marital status (married and others), annual income (Lower than 6,500 RMR and 6,500 RMR or higher), BMI (continuous), drinking status (never, former and current), current smoker (Yes and No), Physical activity (daily sitting time), self-rated sleeping quality (very good, good and not good), diabetes (yes and no), hypertension (yes and no), living alone (yes and no), PHQ-9 score at baseline.
[a]Multivariable linear regression analysis included 1,477 participants.
[b]Multivariable logistic regression analysis included 983 participants.
$j = M − E$ (M = MMSE score at baseline; E = MMSE score at follow-up).
$i = P − Q$ (P = PHQ-9 score at follow up; Q = PHQ-9 score at baseline).

Similar to many studies (34, 48), in the current study, sex disparities were also found in the associations between depression and cognition, which might be explained through biological or psychosocial pathways. A previous study reported that a type of vascular depression among males might be linked to cerebral vascular pathology, which in turn accelerated the process of cognitive decline, although this phenomenon was not investigated among females (49). Underreported depression symptoms due to the gender bias in reporting depressive symptoms might also contribute to sex disparities since males tend to be unwilling to express their discomfort due to the influences of societal expectations (50). Although some studies reported age-modified associations between depression and cognition (35, 51), in the current study, increased depression symptoms were similarly associated with more cognitive decline among different age groups. Some previous studies reported education-modified associations between depression and cognition (36, 52). Similarly, education level moderated associations between depression symptoms and cognition decline were also detected in the current study.

The strengths of the present study include the prospective study design with a 2-year follow-up period and the relatively high follow-up rate. Moreover, depression symptoms were measured at baseline and at follow-up so that the 2-year change in depressive symptoms could be investigated. However, this study also has several limitations. First, the widely used MMSE was used for assessing the cognitive performance of the participants. However, the MMSE is not a diagnostic tool, although the validity of MMSE has been verified by many studies worldwide. This limitation makes it difficult to grasp the true associations between depression symptoms and cognitive decline. A standard diagnostic procedure should be considered in future studies to achieve a more reliable conclusion. Second, reverse causation cannot be totally avoided due to the short period of follow-up. Future studies addressing the long-term relationship between depression and cognition are still needed. Finally, many studies indicated that some neurological and endocrine conditions might affect the associations, for example, stroke (53, 54) and hypothyroidism (55, 56) might lead to both depression and cognitive impairment; however, such conditions

were not considered in the present study. Additionally, some genetic factors were not included in the current study. Future studies conducted under a more comprehensive framework with additional measurements such as blood tests and neuroimaging are needed to verify the associations.

CONCLUSION

Worsening depressive symptoms were related to more cognitive decline and a higher risk of incident MCI among rural-dwelling Chinese elderly individuals. Our study highlighted the great importance of depression intervention for preventing cognitive impairment in Chinese elderly individuals living in rural areas. Considering the significant vulnerability of Chinese rural-dwelling elderly individuals, special attention should be given to providing health services regarding effective interventions to reduce depression to combat AD challenges in the future.

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 authors.

AUTHOR CONTRIBUTIONS

SZ drafted the manuscript. SH, GS, and YZ framed the concept and designed the study. The data collection and material preparation were conducted by SZ, QioW, QinW, and JZ and the data analysis was performed by FH and YZ. All authors meet the criteria for authorship according to their contributions to the manuscript. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

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REFERENCES

1. Jia J, Wei C, Chen S, Li F, Tang Y, Qin W, et al. The cost of Alzheimer's disease in China and re-estimation of costs worldwide. *Alzheimers Dement.* (2018) 14:483–91. doi: 10.1016/j.jalz.2017.12.006
2. Diniz BS, Butters MA, Albert SM, Dew MA, Reynolds CF 3rd. Late-life depression and risk of vascular dementia and Alzheimer's disease: systematic review and meta-analysis of community-based cohort studies. *Br J Psychiatry.* (2013) 202:329–35. doi: 10.1192/bjp.bp.112.118307
3. Sanford AM. Mild cognitive impairment. *Clin Geriatr Med.* (2017) 33:325–37. doi: 10.1016/j.cger.2017.02.005
4. Demurtas J, Schoene D, Torbahn G, Marengoni A, Grande G, Zou L, et al. Physical activity and exercise in mild cognitive impairment and dementia: an umbrella review of intervention and observational studies. *J Am Med Dir Assoc.* (2020) 21:1415–22.e6. doi: 10.1016/j.jamda.2020.08.031
5. Anderson ND. State of the science on mild cognitive impairment (MCI). *CNS Spectrums.* (2019) 24:78–87. doi: 10.1017/S1092852918001347
6. Ismail Z, Elbayoumi H, Fischer CE, Hogan DB, Millikin CP, Schweizer T, et al. Prevalence of depression in patients with mild cognitive impairment: a systematic review and meta-analysis. *JAMA Psychiatry.* (2017) 74:58–67. doi: 10.1001/jamapsychiatry.2016.3162
7. Panza F, Frisardi V, Capurso C, D'Introno A, Colacicco AM, Imbimbo BP, et al. Late-life depression, mild cognitive impairment, and dementia: possible continuum? *Am J Geriatr Psychiatry.* (2010) 18:98–116. doi: 10.1097/JGP.0b013e3181b0fa13
8. Steffens DC. Depressive symptoms and mild cognitive impairment in the elderly: an ominous combination. *Biol Psychiatry.* (2012) 71:762–4. doi: 10.1016/j.biopsych.2012.02.002
9. Smith RS. The macrophage theory of depression. *Med Hypotheses.* (1991) 35:298–306. doi: 10.1016/0306-9877(91)90272-Z
10. Hayley S, Hakim AM, Albert PR. Depression, dementia and immune dysregulation. *Brain.* (2021) 144:746–60. doi: 10.1093/brain/awaa405
11. Dehn LB, Beblo T. Depressed, biased, forgetful: The interaction of emotional and cognitive dysfunctions in depression. *Neuropsychiatrie.* (2019) 33:123–30. doi: 10.1007/s40211-019-0307-4
12. Ismail Z, Malick A, Smith EE, Schweizer T, Fischer C. Depression versus dementia: is this construct still relevant? *Neurodegener Dis Manag.* (2014) 4:119–26. doi: 10.2217/nmt.14.5
13. Mourao RJ, Mansur G, Malloy-Diniz LF, Castro Costa E, Diniz BS. Depressive symptoms increase the risk of progression to dementia in subjects with mild cognitive impairment: systematic review and meta-analysis. *Int J Geriatr Psychiatry.* (2016) 31:905–11. doi: 10.1002/gps.4406
14. Hu M, Shu X, Wu X, Chen F, Hu H, Zhang J, et al. Neuropsychiatric symptoms as prognostic makers for the elderly with mild cognitive impairment: a meta-analysis. *J Affect Disord.* (2020) 271:185–92. doi: 10.1016/j.jad.2020.03.061
15. Ismail Z, Gatchel J, Bateman DR, Barcelos-Ferreira R, Cantillon M, Jaeger J, et al. Affective and emotional dysregulation as pre-dementia risk markers: exploring the mild behavioral impairment symptoms of depression, anxiety, irritability, and euphoria. *Int Psychogeriatr.* (2018) 30:185–96. doi: 10.1017/S1041610217001880
16. Udeh-Momoh C, Price G, Ropacki MT, Ketter N, Andrews T, Arrighi HM, et al. Prospective evaluation of cognitive health and related factors in elderly at risk for developing Alzheimer's dementia: a longitudinal cohort study. *J Prev Alzheimers Dis.* (2019) 6:256–66. doi: 10.14283/jpad.2019.31
17. Aguilera M, Paz C, Compañ V, Medina JC, Feixas G. Cognitive rigidity in patients with depression and fibromyalgia. *Int J Clin Health Psychol.* (2019) 19:160–4. doi: 10.1016/j.ijchp.2019.02.002

18. Egan SJ, Laidlaw K, Starkstein S. Cognitive behaviour therapy for depression and anxiety in parkinson's disease. *J Parkinsons Dis.* (2015) 5:443–51. 10.3233/JPD-150542. doi: 10.3233/JPD-150542

19. Sundermann EE, Katz MJ, Lipton RB. Sex differences in the relationship between depressive symptoms and risk of amnestic mild cognitive impairment. *Am J Geriatr Psychiatry.* (2017) 25:13–22. doi: 10.1016/j.jagp.2016.08.022

20. Makizako H, Shimada H, Doi T, Tsutsumimoto K, Hotta R, Nakakubo S, et al. Comorbid mild cognitive impairment and depressive symptoms predict future dementia in community older adults: a 24-Month follow-up longitudinal study. *J Alzheimers Dis.* (2016) 54:1473–82. doi: 10.3233/JAD-160244

21. Vloeberghs R, Opmeer EM, De Deyn PP, Engelborghs S, De Roeck EE. Apathy, depression and cognitive functioning in patients with MCI and dementia. *Tijdschr Gerontol Geriatr.* (2018) 49:95–102. doi: 10.1007/s12439-018-0248-6

22. Aajami Z, Kazazi L, Toroski M, Bahrami M, Borhaninejad V. Relationship between depression and cognitive impairment among elderly: a cross-sectional study. *J Caring Sci.* (2020) 9:148–53. doi: 10.34172/jcs.2020.022

23. Yaffe K, Blackwell T, Gore R, Sands L, Reus V, Browner WS. Depressive symptoms and cognitive decline in nondemented elderly women: a prospective study. *Arch Gen Psychiatry.* (1999) 56:425–30. doi: 10.1001/archpsyc.56.5.425

24. Wilson RS, Barnes LL, Mendes de. Leon CF, Aggarwal NT, Schneider JS, Bach J, et al. Depressive symptoms, cognitive decline, and risk of AD in older persons. *Neurology.* (2002) 59:364–70. doi: 10.1212/WNL.59.3.364

25. Fangfang H, Xiao H, Shuai Z, Qiong W, Jingya Z, Guodong S, et al. Living Environment, Built environment and cognitive function among older Chinese adults: results from a cross-sectional study. *J Prev Alzheimers Dis.* (2022) 9:126–35. doi: 10.14283/jpad.2021.59

26. Levis B, Benedetti A, Thombs BD. Accuracy of patient health questionnaire-9 (PHQ-9) for screening to detect major depression: individual participant data meta-analysis. *BMJ.* (2019) 365:l1476. doi: 10.1136/bmj.l1476

27. Arevalo-Rodriguez I, Smailagic N, Roqué IFM, Ciapponi A, Sanchez-Perez E, Giannakou A, et al. Mini-mental state examination (MMSE) for the detection of Alzheimer's disease and other dementias in people with mild cognitive impairment (MCI). *Cochrane Database Syst Rev.* (2015) 2015:Cd010783. doi: 10.1002/14651858.CD010783.pub2

28. Huo Z, Lin J, Bat BKK, Chan JYC, Tsoi KKF, Yip BHK. Diagnostic accuracy of dementia screening tools in the Chinese population: a systematic review and meta-analysis of 167 diagnostic studies. *Age Ageing.* (2021) 50:1093–101. doi: 10.1093/ageing/afab005

29. Mitchell AJ, A. meta-analysis of the accuracy of the mini-mental state examination in the detection of dementia and mild cognitive impairment. *J Psychiatr Res.* (2009) 43:411–31. doi: 10.1016/j.jpsychires.2008.04.014

30. Lu L, Chen L, Wu W, Wang Y, Liu Z, Xu J, et al. Consistency and applicability of different brief screen instrument of cognitive function in elderly population. *BMC Neurol.* (2021) 21:95. doi: 10.1186/s12883-021-02048-4

31. Bravo G, Hébert R. Age- and education-specific reference values for the Mini-Mental and modified mini-mental state examinations derived from a non-demented elderly population. *Int J Geriatr Psychiatry.* (1997) 12:1008–18. doi: 10.1002/(sici)1099-1166(199710)12:10<1008::aid-gps676>3.0.co;2-a

32. Zhang MY, Katzman R, Salmon D, Jin H, Cai GJ, Wang ZY, et al. The prevalence of dementia and Alzheimer's disease in Shanghai, China: impact of age, gender, and education. *Ann Neurol.* (1990) 27:428–37. doi: 10.1002/ana.410270412

33. Fuhrer R, Antonucci TC, Gagnon M, Dartigues JF, Barberger-Gateau P, Alperovitch A. Depressive symptomatology and cognitive functioning: an epidemiological survey in an elderly community sample in France. *Psychol Med.* (1992) 22:159–72. doi: 10.1017/S0033291700032815

34. Geda YE, Knopman DS, Mrazek DA, Jicha GA, Smith GE, Negash S, et al. Depression, apolipoprotein E genotype, and the incidence of mild cognitive impairment: a prospective cohort study. *Arch Neurol.* (2006) 63:435–40. doi: 10.1001/archneur.63.3.435

35. Eraydin IE, Mueller C, Corbett A, Ballard C, Brooker H, Wesnes K, et al. Investigating the relationship between age of onset of depressive disorder and cognitive function. *Int J Geriatr Psychiatry.* (2019) 34:38–46. doi: 10.1002/gps.4979

36. Jansen MG, Geerligs L, Claassen J, Overdorp EJ, Brazil IA, Kessels RPC, et al. Positive effects of education on cognitive functioning depend on clinical status and neuropathological severity. *Front Hum Neurosci.* (2021) 15:723728. doi: 10.3389/fnhum.2021.723728

37. Staekenborg SS, Kelly N, Schuur J, Koster P, Scherder E, Tielkes CEM, et al. Education as proxy for cognitive reserve in a large elderly memory clinic: 'window of benefit'. *J Alzheimers Dis.* (2020) 76:671–9. doi: 10.3233/JAD-191332

38. Dong X, Simon MA. Health and aging in a Chinese population: urban and rural disparities. *Geriatr Gerontol Int.* (2010) 10:85–93. doi: 10.1111/j.1447-0594.2009.00563.x

39. Li N, Pang L, Chen G, Song X, Zhang J, Zheng X. Risk factors for depression in older adults in Beijing. *Canad J Psychiatry.* (2011) 56:466–73. doi: 10.1177/070674371105600804

40. Chen R, Wei L, Hu Z, Qin X, Copeland JR, Hemingway H. Depression in older people in rural China. *Arch Intern Med.* (2005) 165:2019–25. doi: 10.1001/archinte.165.17.2019

41. Zhang L, Xu Y, Nie H, Zhang Y, Wu Y. The prevalence of depressive symptoms among the older in China: a meta-analysis. *Int J Geriatr Psychiatry.* (2012) 27:900–6. doi: 10.1002/gps.2821

42. Saenz JL, Downer B, Garcia MA, Wong R. Cognition and context: rural-Urban differences in cognitive aging among older Mexican adults. *J Aging Health.* (2018) 30:965–86. doi: 10.1177/0898264317703560

43. Galvin JE, Fu Q, Nguyen JT, Glasheen C, Scharff DP. Psychosocial determinants of intention to screen for Alzheimer's disease. *Alzheimers Dement.* (2008) 4:353–60. doi: 10.1016/j.jalz.2007.09.005

44. Kirk Wiese L, Williams CL, Tappen RM. Analysis of barriers to cognitive screening in rural populations in the United States. *ANS Adv Nurs Sci.* (2014) 37:327–39. doi: 10.1097/ANS.0000000000000049

45. Han FF, Wang HX, Wu JJ, Yao W, Hao CF, Pei JJ. Depressive symptoms and cognitive impairment: a 10-year follow-up study from the survey of health, ageing and retirement in Europe. *Eur Psychiatry.* (2021) 64:e55. doi: 10.1192/j.eurpsy.2021.2230

46. Lara E, Koyanagi A, Domènech-Abella J, Miret M, Ayuso-Mateos JL, Haro JM. The Impact of depression on the development of mild cognitive impairment over 3 years of follow-up: a population-based study. *Dement Geriatr Cogn Disord.* (2017) 43:155–69. doi: 10.1159/000455227

47. Lee CH, Kim DH, Moon YS. Differential associations between depression and cognitive function in MCI and AD: a cross-sectional study. *Int Psychogeriatr.* (2019) 31:1151–8. doi: 10.1017/S1041610218001527

48. Dal Forno G, Palermo MT, Donohue JE, Karagiozis H, Zonderman AB, Kawas CH. Depressive symptoms, sex, and risk for Alzheimer's disease. *Ann Neurol.* (2005) 57:381–7. doi: 10.1002/ana.20405

49. Fuhrer R, Dufouil C, Dartigues JF. Exploring sex differences in the relationship between depressive symptoms and dementia incidence: prospective results from the PAQUID Study. *J Am Geriatr Soc.* (2003) 51:1055–63. doi: 10.1046/j.1532-5415.2003.51352.x

50. Joiner TE, Jr., Alfano MS, Metalsky GI. When depression breeds contempt: reassurance seeking, self-esteem, and rejection of depressed college students by their roommates. *J Abnorm Psychol.* (1992) 101:165–73. doi: 10.1037/0021-843X.101.1.165

51. Lugtenburg A, Zuidersma M, Wardenaar KJ, Aprahamian I, Rhebergen D, Schoevers RA, et al. Subtypes of late-life depression: a data-driven approach on cognitive domains and physical frailty. *J Gerontol A Biol Sci Med Sci.* (2021) 76:141–50. doi: 10.1093/gerona/glaa110

52. da Costa Dias FL, Teixeira AL, Guimarães HC, Santos APB, Resende EPF, Machado JCB, et al. The influence of age, sex and education on the phenomenology of depressive symptoms in a population-based sample aged 75+ years with major depression: the Pietà Study. *Aging Ment Health.* (2021) 25:462–7. doi: 10.1080/13607863.2019.1698517

53. Makin SD, Turpin S, Dennis MS, Wardlaw JM. Cognitive impairment after lacunar stroke: systematic review and meta-analysis of incidence, prevalence and comparison with other stroke subtypes. *J Neurol Neurosurg Psychiatry.* (2013) 84:893–900. doi: 10.1136/jnnp-2012-303645

54. Das J, Rajanikant GK. Post stroke depression: the sequelae of cerebral stroke. *Neurosci Biobehav Rev.* (2018) 90:104–14. doi: 10.1016/j.neubiorev.2018.04.005

55. Gorkhali B, Sharma S, Amatya M, Acharya D, Sharma M. Anxiety and depression among patients with thyroid function disorders. *J Nepal Health Res Counc*. (2020) 18:373–8. doi: 10.33314/jnhrc.v18i 3.2499

56. Juárez-Cedillo T, Basurto-Acevedo L, Vega-García S, Sánchez-Rodríguez Martha A, Retana-Ugalde R, Juárez-Cedillo E, et al. Prevalence of thyroid dysfunction and its impact on cognition in older Mexican adults: (SADEM study). *J Endocrinol Invest*. (2017) 40:945–52. doi: 10.1007/s40618-017-0654-6

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Psychometric properties of the Chinese version of quality of life in life-threatening illness-family carer version

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Background: The Quality of Life (QOL) in Life-threatening Illness-Family Carer Version (QOLLTI-F) has been proven to be a brief, reliable, and valid instrument for measuring the caregivers' QOL in western cultures. However, whether it is suitable to be used in Chinese culture is unclear. This study aimed to test the reliability and validity of the Chinese version of (QOLLTI-F-CV).

Materials and methods: A total of 202 family caregivers (FCs) of advanced cancer patients from Fujian Provincial hospice care center were investigated using the Chinese version of QOLLTI-F-CV from September 2019 to August 2020. The questionnaire was evaluated using an exploratory structural equation model. Its psychometric properties were examined in terms of factor structure, convergent validity, discriminant validity, internal consistency, and test−retest reliability.

Results: Differently from the seven-domain original QOLLTI-F, its Chinese version had only three domains including caregiver's self-feelings, caregiver's stress, and caregiver's outlooks. The total variance explanation rate for the domains was 55.4%. The Chinese version fitted well with the structure model (χ^2 = 153.932, df = 75, P < 0.001); its comparative fit index (CFI) was 0.971; Tucker−Lewis index was 0.954; and the root mean square error of approximation (RMSEA) was 0.072. The success rate of its convergent and discriminant validity calibration test was 100%. Its Cronbach's alpha coefficient of the whole questionnaire and three domains was from 0.650 to 0.874, and test−retest reliability was 0.836.

Conclusion: The 3-domain QOLLTI-F-CV is a valid and reliable instrument for identifying QOL concerns of FCs of advanced cancer patients in China. The refactoring structure optimally matches Chinese culture and value system well.

Introduction

The incidence and mortality of cancer are growing rapidly. The International Agency for Research on Cancer has reported that there were 19.3 million new cases of cancer and almost 10 million deaths from cancer in 2020. Among them, China accounted for 23.4% of the new cancer cases and 30.1% of the cancer deaths, which are ranked number one worldwide (Sung et al., 2021). Cancer puts burdens not only on cancer patients themselves but also on their family caregivers (FCs), especially in China, a family tie country. FCs assist patients in daily living activities, diet preparation, symptom management, and emotional support, which may interfere FCs' own normal life and work (Geng et al., 2018; Teixeira et al., 2019). Meanwhile, FCs have to deal with their lovers' imminent death. Oechsle et al. (2019) have revealed that FCs even experience more psychosocial burdens than cancer patients. Furthermore, their poor quality of life (QOL) could negatively impact the QOL of cancer patients (Sun et al., 2019; Lin Y. et al., 2020). Thus, it is necessary and important to assess the QOL of FCs.

Reliable and valid tools are essential to identify the QOL concerns of FCs of cancer patients. In China, some general QOL scales are available to measure FCs' QOL, such as the *World Health Organization Quality of Life short version* and the *MOS item short from health survey* (Yu et al., 2017; Wang Y. et al., 2021). At oversea, some specific QOL scales have already been designed for FCs of cancer patients (Cohen et al., 2006; Lafaye et al., 2013). Among them, the *Quality of Life in Life-threatening Illness-Family Carer Version* (QOLLTI-F) is highly recommended. It was initially developed based on the seven themes that emerged from the qualitative research by Cohen et al. (2006), including environment, patient condition, carer's own state, carer's outlook, relationships, quality of care, and financial worries. It is unique that caregivers' perception of patients' conditions was included to attest to their close relationship. It not only covers the core attributes of the concept of QOL but also reflects the actual QOL of FCs. Additionally, it has only 16 items and seldomly increases the investigation burden of caregivers (Schur et al., 2014; Sawatzky et al., 2018).

The QOLLTI-F, originally designed in English and French, has been translated into several languages, such as German, Malaysian, Indian, Czech, Chinese, Swedish, Spanish, and Persian (Alnjadat et al., 2014; Nayak et al., 2014; Schur et al., 2014; Bužgová et al., 2015; Xiao et al., 2015; Axelsson et al., 2020; Arias-Rojas et al., 2021; Fereidouni et al., 2022). Previous studies have indicated that the QOLLTI-F may produce various domains under different cultural backgrounds. For example, Alnjadat et al. (2014) translated the QOLLTI-F into Malay and captured seven domains after forced extraction by exploratory factor analysis (EFA). However, only three of the seven domains totally complied with the original QOLLTI-F. Given the weak factor structure of the QOLLTI-F, Schur et al. (2014) performed a series of EFA, which cleanly

supports a four-factor structure in the German version, in terms of feelings about carers' own life, professional care, interaction with the patient and others, and carers' outlook on life. But they pointed out that there was problematic cross-loading in some items in the factor analysis, and some farfetched explanations for the attribution of some items in the domains (Osborne and Costello, 2009; Schur et al., 2014). Similarly, Arias-Rojas et al. (2021) failed to replicate the original structure of the scale but obtained a new three-factor structure. They named the extracted three factors as impact of caregiving, social and health interactions, and measuring of life. Additionally, Fereidouni et al. (2022) also used the EFA method to extract three factors and employed confirmative factor analysis (CFA) to verify the structure. The three factors are caregiver's physical emotional status, satisfaction with the situation, and caregiver's concerns. But this population is the caregivers of patients with COVID-19, not the caregivers of cancer patients. To date, some other versions, such as the Swedish and Chinese versions, have not been validated so far, which may greatly hinder their application. In particular, considering that Chinese culture is quite different from western culture. This study, therefore, aimed to validate the Chinese version of (QOLLTI-F-CV) among FCs of advanced cancer patients in China.

Materials and methods

Study design and participants

A cross-sectional study was conducted in a hospice care center in Fujian Province, China. The sample size was calculated according to the ratio of participants to items at least 10:1 (Pett et al., 2003). A total of 214 FCs of advanced cancer patients were recruited for this study. The inclusion criteria were as follows: (1) age $\geq$18 years; (2) able to communicate with Mandarin Chinese; (3) the primary FC of cancer patients with less than 6-month life expectancy, who could be parents, adult children, spouses, or siblings; and (4) if there were several primary caregivers, the patient was responsible for identifying the primary one. The exclusion criteria were as follows: (1) not able to communicate and (2) cognition impairments (SPMSQ $\geq$3; the Short Portable Mental Status Questionnaire) (Pfeiffer, 1975).

Instrument and measures

Personal information form

Personal information of the FCs was recorded, including gender, age, marital status, education, self-perceived health status, and relationship between patients and caregivers.

The quality of life in life-threatening illness-family carer version

The original QOLLTI-F was developed by Cohen et al. (2006) with 16 items and seven domains, including environment, patient condition, carer's own state, carer's outlook, relationships, quality of care, and financial worries. Its Cronbach's alpha was 0.85, and test–retest reliability was 0.77. Pang et al. translated the QOLLTI-F-CV through the cross-cultural adaption and item analysis process (Xiao et al., 2015). The responses to every item were provided with a five-point score system ranging from 0 to 4 (0 = strongly disagree and 4 = strongly agree).

Procedure

Study data were collected by two research assistants from September 2019 to August 2020. After obtaining the permission of Prof. Cohen, the author of the original QOLLTI-F, and Prof. Pang, the translator of the Chinese version, the physician from the study setting screened and referred the eligible participants to the research assistants. Then, the research assistants introduced the study and invited the eligible participants to fill in the questionnaires with informed consent. For participants with literacy difficulties, a research assistant read each item to them and then wrote down their oral responses objectively. At the beginning of the survey, the data were individually collected at the hospice care clinic face to face. Totally, 102 out of 105 valid questionnaires were gathered. Due to the COVID-19 epidemic, the remained data were collected online *via* "powered by www.wjx.cn." In total, 100 out of 109 valid questionnaires were collected. The online survey quality was monitored by checking the time that FCs finished the questionnaires. The total of valid questionnaires was 202, with a response rate of 94.4% (202/214). According to Li's study (Li, 2016), 30 FCs were invited to explore the test–retest reliability of the QOLLTI-F-CV after 2 weeks of the first survey.

Analysis

Data input, processing, and statistical analysis were performed using IBM SPSS version 25.0. The exploratory structural equation modeling (ESEM) was conducted using Mplus version 7.0. The continuous missing values were replaced by the mean substitution (Streiner et al., 2015). The corrected item-total correlations and the Cronbach's alpha if the item was deleted were computed for the item analysis. Corrected item-total correlations of 0.20–0.80 were considered satisfactory (Kline, 1986).

Before ESEM, Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was used to inspect the data (Hair et al., 1995). The number of extraction

factors was determined by parallel analysis (PA) of the data. Retained the factors that the actual eigenvalues obtained by principal component analysis (PCA) are greater than the mean random data eigenvalues generated by Monte Carlo simulation (O'Conner, 2000).

The weighted least squares with mean and variance adjustment estimator were used for structural equation modeling analyses with categorical variables (Beauducel and Herzberg, 2006). The model's goodness-of-fit was established using the following cutoff criteria: $\chi^2/df < 5.0$; the comparative fit index (CFI) > 0.90; the Tucker-Lewis index (TLI) > 0.90; and the root mean square error of approximation (RMSEA) < 0.08 (Hu and Bentler, 1999; Hooper et al., 2008).

In addition, the convergent validity and discriminant validity of the Chinese version were evaluated by correlation analysis. Validity was assessed using the Spearman's correlation coefficient. $P < 0.05$ was considered significant. If the correlation coefficient between the item and its domain is greater than or equal to 0.4, the convergent validity calibration experiment is considered successful. If the correlation coefficient between the item and its latitude is greater than that with other domains, the discriminant validity calibration experiment is considered successful. If the success rate of the calibration experiment is more than 80%, it means that convergence or discriminant validity is good (Li et al., 2002). In addition, the correlation of the domains of QOLLTI-F-CV with the self-perceived health status was measured using a correlation coefficient (Krabbe, 2016).

Internal consistency analyses were evaluated using the Cronbach's alpha, with a value greater than 0.7 considered to be satisfactory (Devon et al., 2007). In terms of test–retest reliability, the value of the test–retest interclass correlation coefficient (ICC) that exceeded 0.60 was considered good (Kurtz, 2017).

Results

Participant characteristics

In total, 202 participants participated with a mean age of 48.36 ± 13.64 years, of which 55.0% were women and 90.3% were married. The majority of the FCs were adult children (41.1%) and spouses (37.1%) of patients. The participants' characteristics are presented in **Table 1**.

Item analysis

As shown in **Table 2**, the correlation coefficients of item-total correlations ranged from 0.232 to 0.680, except for item 1 care place and item 10 spirituality comforting. As deleting any

TABLE 1 Distribution of participant characteristics (*N* = 202).

Characteristics	Mean (SD)/Frequency (%)
Age	48.36 ± 13.64
Gender	
Male	91 (45.0%)
Female	111 (55.0%)
Marital status	
Unmarried	13 (6.4)
Married	183 (90.6)
Divorced or widowed	6 (3.0)
Education level	
Uneducated	9 (4.5)
Primary school	44 (21.8)
Secondary school	54 (26.7)
High school and technical secondary school	48 (23.8)
Undergraduate or above	47 (23.3)
Self-evaluation of health status	
Excellent	85 (42.1)
Good	96 (47.5)
Fair	20 (9.9)
Poor	1 (0.5)
Relationship to the patient	
Parent	27 (13.4)
Child	83 (41.1)
Spouse	75 (37.1)
Sibling	6 (3.0)
Other	11 (5.4)

item did not significantly increase the reliability of the QOLLTI-F-CV and "care place" and "spirituality comforting" might have a potential impact on the QOL of FCs, we retained both two items for further factorial validity.

Construct validity

The findings showed that Bartlett's test of sphericity (χ^2 = 1,191.160; *df* = 120) of the QOLLTI-F-CV was significant (*P* < 0.001), and the KMO was 0.821. Thus, all items were used for proceeding with PCA. **Figure 1** presents the results from PA. The 16 items were grouped into three factors accounting for 55.371% of the total variance. The domains were entitled *carer's self-feelings* (six items), *carer's stress* (five items), and *carer's outlooks* (five items). The approximate fit indices all indicated good model fit: χ^2 = 153.932, *df* = 75, *P* < 0.001; CFI = 0.971; TLI = 0.954; and RMSEA = 0.072. However, item 1 (*It's appropriate to take care of patients at home*) was problematic due to its factor load of <0.3. Considering its unique significance in FCs' QOL, we kept it in the final questionnaire. The results from ESEM models are shown in **Table 2**.

Convergent validity and discriminant validity

The correlation coefficient between the score of each item and the score of its domain was ≥0.4, which was higher than that between the score of this item and the score of other domains (*P* < 0.05). The achievement ratios of the convergent validity and the discriminant validity calibration test of the three domains were 100% (**Table 3**). Additionally, significant correlations were found among self-perceived health status and the "*carer's self-feelings*" domain (*r* = 0.495, *P* < 0.001), "*carer's stress*" domain (*r* = 0.192, *P* < 0.001), and total scores of QOLLTI-F-CV (*r* = 0.437, *P* < 0.001).

Reliability

The Cronbach's alpha of the QOLLTI-F-CV was 0.827. The internal consistency of the three domains ranged from 0.650 to 0.874 (**Table 2**). The ICC of the test–retest measure was 0.836 for the total questionnaire.

Discussion

This is the first study to examine the psychometric properties of the QOLLTI-F-CV. The findings support that it is a valid and reliable instrument for measuring the QOL of FCs of Chinese advanced cancer patients. Different from the original QOLLTI-F, our study suggests a three-factor structure solution for the Chinese population.

All 16 items of the original QOLLTI-F were retained in the QOLLTI-F-CV, but our study has revealed a stable three-factor solution. This is consistent with the results of the study by Arias-Rojas et al. (2021) and Fereidouni et al. (2022). Although some entries have a slightly different distribution of domains, we conducted PA to determine the number of factor extraction, which is more robust than the K1 method used by O'Conner (2000), Mu and Gu (2011), and Schur et al. (2014). Since ESEM has the advantage in terms of exploring factor structure flexibly and verifying the factor model systematically (Liu and Liu, 2013), it can make the model structure more consistent with the actual situation and the fitting more robust, compared with EFA which is used by Schur et al. (2014), Arias-Rojas et al. (2021), and Fereidouni et al. (2022). The results showed that the three-factor structured model fitted the empirical data well, as indicated by the fit indices. In addition, each item had good independence and representativeness.

Among the three domains of the QOLLTI-F-CV, domain 1 contains six items, which mainly reflects the FCs' physical and mental endurance, and self-feelings toward care task (e.g., items 2, 5, 6, 7, 8, and 9), so it was named "carer's self-feelings." This domain contains items quite similar to the domain of

TABLE 2 Exploratory structural equation modeling solution with three factors and Cronbach's alpha coefficients of the Chinese version of the quality of life in life-threatening illness-family carer version (QOLLTI-F-CV).

Factor (no. of items)	Factor loadings			Cronbach's alpha	Item-total correlation	Cronbach's alpha if the item was deleted
	F1	**F2**	**F3**			
F1: Carer's Self-feelings (6)				0.874		
5. have time to take care of my physical and mental health	**0.885**	0.019	−0.070		0.600	0.806
2. I still have the private space I need	**0.819**	−0.035	−0.092		0.511	0.813
6. I can think clear	**0.622**	0.002	0.309		0.567	0.811
7. I feel in physical wellbeing	**0.757**	0.195	−0.003		0.667	0.803
8. I feel in physical wellbeing emotional wellbeing	**0.682**	0.293	0.016		0.680	0.800
9. Being able to take care of patients makes me feel good	**0.433**	0.333	0.193		0.652	0.803
F2: Carer's Stress (5)				0.772		
14. I have stress to get along with patient	−0.031	**0.895**	−0.213		0.519	0.813
15. I have stress to get along with other relatives	0.030	**0.761**	−0.316		0.399	0.823
3. The patient's condition distressed me	−0.208	**0.733**	0.016		0.378	0.821
4. I have difficulty in controlling the arrangement of my life	−0.198	**0.755**	−0.003		0.394	0.820
16. My financial situation is very tense	0.029	**0.608**	−0.164		0.394	0.820
F3: Carer's Outlooks (5)				0.650		
12. I agree with the care decision-making for patients recently	0.009	−0.007	**0.811**		0.232	0.827
13. The quality of health care I and my patients get is excellent	0.047	0.027	**0.786**		0.284	0.826
10. My outlook on life, beliefs or religion give me strength and support	−0.061	−0.148	**0.691**		0.075	0.838
11. I think life is meaningful	0.078	0.134	**0.640**		0.335	0.823
1. It's appropriate to take care of patients at home	0.263	−0.162	**0.288**		0.149	0.831
Total QOLLTI-F-CV (16)				0.827		

For exploratory structural equation modeling (ESEM) solution with five factors, all parameter estimates are standardized, and *a priori* target loadings designed to measure each factor are in bold.

"feelings about carers' own life" in the German version and "caregiver's physical emotional status" in the Persian version. When taking care of patients, FCs are endowed with a new role, which may compete and create conflicts with their other social roles (Yeung et al., 2020). Therefore, an in-depth understanding of FCs' self-feelings is helpful for assessing their QOL. However, different from the German version, items 3 (*The patient's condition distressed me*) and 4 (*I have difficulty in controlling*

the arrangement of my life) are not included in this domain. It may be due to emotional suppression that is encouraged in Chinese culture (Chen et al., 2005). Furthermore, under the family norms of Chinese Confucianism, self-sacrifice is often made to provide "perfect" care for family patients. In the Persian version, items 2 (*I still have the private space I need*) and 9 (*Being able to take care of patients makes me feel good*) are classified as "satisfied with the situation." Fereidouni et al. (2022) pointed
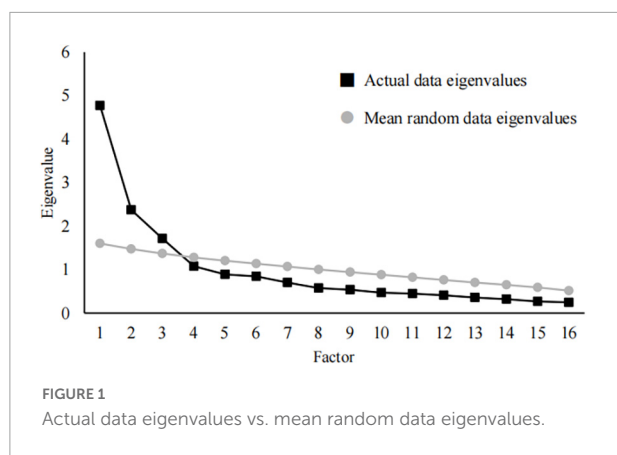
out that this difference may be caused by the nature of the disease and the sample size.

Domain 2 entitled "carer's stress" contains five items, which results from economic hardship, mental strain, and interpersonal relationship (e.g., items 3, 4, 14, 15, and 16). This is exactly the same as "caregiver's concerns" in the Persian version. Compared with the original questionnaire, the German version, and the Spanish version, the Chinese version adds item 16 (*My financial situation is very tense*), item 14 (*I have stress to get along with patients*), and item 15 (*I have stress to get along with other relatives*) to "carer's stress." This could be explained by the following reasons. First, the financial situation is the most concern for Chinese families of advanced cancer patients (Xiao et al., 2015). In China, the cost of treatment and care for advanced cancer is regarded as a "bottomless pit" (Li, 2020; Zhou et al., 2020). Second, in many cases, FCs are not ready to take care of the dying patient. The closer relationship between FCs and patients, the more worried FCs are about patients, and the greater stress in facing the deterioration of their patients (Teng and Chen, 2013). It is reported that 96% of Chinese FCs have to reduce their working hours, and 72% even interrupt their work in order to take care of patients (Zhou et al., 2020). This not only has a great impact on their income but also leads to the limitation of their interpersonal activities (Shieh et al., 2012; Lin J. Q. et al., 2020). Generally, the stressors of Chinese FCs cover family finance and interpersonal relationship.

Domain 3 named "carer's outlooks" contains five items, which reflect the FCs' attitudes toward the role of care, medical decision-making, care quality, and personal value (e.g., items 1, 10, 11, 12, and 13). This domain not only includes the evaluation of caregivers' care roles and personal values but also involves professional care. In China, medical staffs are the main consultants of patients and their families due to their professional authority (Soroka et al., 2021; Wang T. et al., 2021). In the process of caring patients, FCs frequently contact and communicate with medical staff, especially making a medical decision. Additionally, care quality also falls into the carer's outlook domain. It may be related to Chinese strong family ties (Hou et al., 2018; Chung et al., 2021), which could explain why FCs much care about their patients. With regard to item 11 (*I Think Life is Meaningful*), except the Persian version, the German version, the Spanish version, and the Chinese version all suggest that it is not just a simple physical and emotional status, but more of a spiritual value. This may be related to the different effects of disease progression of cancer and COVID-19 on their caregiver's awareness.

This study showed that the achievement ratios of the three domains of convergent validity and discriminant validity were all 100%. It showed that the items of each domain belong clearly and could distinguish each domain well (John and Benet-Martinez, 2000). Additionally, the better the self-perceived health status of caregivers, the better the QOL of FCs. The Cronbach's alpha of the QOLLTI-F-CV was 0.827, and that of each domain was between 0.650 and 0.874. Only the Cronbach's alpha of the "carer's outlooks" domain was less than 0.7, but at least exceeded 0.6, which is considered satisfactory in practical research. The test–retest ICC of the scale was 0.836, indicating that it has good stability.

Limitations

Several limitations in this study should be considered. First, the survey is carried out only in one hospice care center in Southeast China, which may affect the generation of the study results. The second limitation is that some respondents may be reluctant to express negative feelings related to care burden due to social expectation bias. Third, this study used on-site and

TABLE 3 The convergent validity and discriminant validity.

Domain	No. of items	Item convergent validity		Item discriminant validity	
		Range of correlations[a]	Rate of success[b] (%)	Range of correlations[c]	Rate of success[d] (%)
Carer's self-feelings	6	0.681–0.852	100	0.089–0.412	100
Carer's stress	5	0.400–0.854	100	0.001–0.400	100
Carer's outlooks	5	0.463–0.747	100	0.016–0.266	100

[a]Correlations with own assumed domain. [b]The correlation coefficient between items and assumed domain which is greater than 0.4. [c]Correlations with other domains. [d]The correlation coefficient between item and all domains which is significant.

online data collection due to the COVID-19 pandemic, which may affect the consistency and authenticity of data. Therefore, a multicenter with a larger sample survey could be conducted to copy the factor structure of the QOLLTI-F-CV in the future.

Conclusion

This study provides evidence that the 3-domain QOLLTI-F-CV is a valid and reliable instrument. The refactoring structure optimally matches Chinese culture and value system well. It is a promising and accessible instrument for identifying QOL concerns of FCs of advanced cancer patients in China in clinical practices.

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 Ethics Committee of Fujian Medical University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

YW was responsible for the acquisition of data and manuscript drafting. HX was responsible for the conception and design of this study, critical revision of the manuscript, and supervision. HW was responsible for recruiting participants and supervision. BY was responsible for the analysis and interpretation of data. ZW and WC were responsible for recruiting participants and the acquisition of data. All authors read and approved the final 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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References

Alnjadat, R. M., Adnan, W., and Ismail, Z. (2014). Psychometric properties of the QOLLTI-F questionnaire to assess quality of life in caregivers of cancer patients. *Educ. Med. J.* 6, 41–47. doi: 10.5959/eimj.v6i2.217

Arias-Rojas, M., Arredondo Holgín, E., Carreño Moreno, S., Posada López, C., and Tellez, B. (2021). Validation of the latin American-Spanish version of the scale 'quality of life in life-threatening illness-family caregiver version' (QOLLTI-F). *Health Soc. Care Commun.* 30, e832–e841. doi: 10.1111/hsc.13453

Axelsson, L., Alvariza, A., Carlsson, N., Cohen, S. R., and Restedt, K. (2020). Measuring quality of life in life-threatening illness content validity and response processes of MQOL-E and QOLLTI-F in Swedish patients and family carers. *BMC Palliat. Care* 19:40. doi: 10.1186/s12904-020-00549-6

Beauducel, A., and Herzberg, P. Y. (2006). On the performance of maximum likelihood versus means and variance adjusted weighted least squares estimation in CFA. *Struct. Eq. Model.* 13, 186–203. doi: 10.1207/s15328007sem1302_2

Bužgová, R., Kozáková, R., and Sikorová, L. (2015). Assessment of quality of life of family members of inpatients with end-stage disease. *J. Palliat. Care* 31, 250–257. doi: 10.1177/082585971503100407

Chen, S. X., Cheung, F. M., Bond, M. H., and Leung, J. P. (2005). Decomposing the construct of ambivalence over emotional expression in a Chinese cultural context. *Eur. J. Personal.* 19, 185–204. doi: 10.1002/per.538

Chung, H., Harding, R., and Guo, P. (2021). Palliative care in the greater China region: a systematic review of needs, models, and outcomes. *J. Pain Symptom Manage.* 61, 585–612. doi: 10.1016/j.jpainsymman.2020.08.040

Cohen, R., Leis, A. M., Kuhl, D., Charbonneau, C., Ritvo, P., and Ashbury, F. D. (2006). QOLLTI-F: measuring family carer quality of life. *Palliat. Med.* 20, 755–767. doi: 10.1177/0269216306072764

Devon, H. A., Block, M. E., Moyle-Wright, P., Ernst, D. M., and Kostas-Polston, E. (2007). A psychometric toolbox for testing validity and reliability. *J. Nurs. Scholarsh.* 39, 155–164. doi: 10.1111/j.1547-5069.2007.00161.x

Fereidouni, A., Ebadi, A., Rassouli, M., Hosseini, S. M., Mollahadi, M., Khorshidvand, A., et al. (2022). Psychometric properties of the "quality of life in life-threatening illness-family carer version" (QOLLTI-F) in persian-speaking carers of COVID-19 patients. *Front. Psychol.* 13:838074. doi: 10.3389/fpsyg.2022.838074

Geng, H. M., Chuang, D. M., Yang, F., Yang, Y., Liu, W. M., Liu, L. H., et al. (2018). Prevalence and determinants of depression in caregivers of cancer patients: a systematic review and meta-analysis. *Medicine* 97:e11863. doi: 10.1097/MD.0000000000011863

Hair, J. F., Anderson, R. E., Tatham, R. L., and Black, W. C. (1995). *Multivariate Data Analysis*, 4th Edn. Upper Saddle River, NJ: Prentice-Hall.

Hooper, D., Coughlan, J., and Mullen, M. R. (2008). Structural equation modelling: guidelines for determining model fit. *Electron. J. Bus. Res. Methods* 6, 53–60. doi: 10.3109/03005364000000039

Hou, W. K., Lau, K. M., Shum, T. C. Y., Cheng, A. C. K., and Lee, T. M. C. (2018). Do concordances of social support and relationship quality predict psychological distress and well-being of cancer patients and caregivers? *Eur. J. Cancer Care* 27:e12857. doi: 10.1111/ecc.12857

Hu, L. T., and Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct. Eq. Model.* 6, 1–55. doi: 10.1080/10705519909540118

John, O. P., and Benet-Martinez, V. (2000). "Measurement: reliability, construct validation, and scale construction," in *Handbook of Research Methods in Social and Personality Psychology*, eds H. T. Reis and C. M. Judd (Cambridge: Cambridge University Press), 339–370.

Kline, P. (1986). *A Handbook of Test Construction: Introduction to Psychometric Design*. New York, NY: Methuen.

Krabbe, P. (2016). *The Measurement of Health and Health Status: Concepts, Methods and Applications from a Multidisciplinary Perspective*. Cambridge, MA: Academic Press.

Kurtz, J. E. (2017). "Test-retest reliability," in *Encyclopedia of Personality and Individual Differences*, eds V. Zeigler-Hill and T. K. Shackelford (New York, NY: Meteor Springer), 1–2.

Lafaye, A., De Chalvron, S., Houédé, N., Eghbali, H., and Cousson-Gélie, F. (2013). The caregivers quality of life cancer index scale (CQoLC): an exploratory factor analysis for validation in French cancer patients' spouses. *Qual. Life Res.* 22, 119–122. doi: 10.1007/s11136-012-0113-y

Li, C. (2020). General situation and countermeasures of health poverty alleviation. *China National Conditions and Strength* 43–46. doi: 10.13561/j.cnki.zggqgl.2020.06.013

Li, J. H. (2016). *Development of the Post-Stroke Early Depression Screening Tool and Its Preliminary Application*. doctoral dissertation. Chongqing: Chongqing Medical University, doi: 10.7666/d.D01119861.

Li, L., Wang, H. M., and Shen, Y. (2002). Development and psychometric tests of a Chinese version of the SF-36 health survey scales. *Chin. J. Preventive Med.* 36, 109–113. doi: 10.3760/j:issn:0253-9624.2002.02.011

Lin, J. Q., He, Z. X., and Fan, G. H. (2020). Quality of life in primary family caregivers of patients with advanced cancer: a comparative study based on hospital and home-based hospice. *Med. Philos.* 41, 20–25+55. doi: 10.12014/j.issn.1002-0772.2020.13.04

Lin, Y., Hu, C., Xu, Y., Zhao, J., and Li, Q. (2020). The mutual impact and moderating factors of quality of life between advanced cancer patients and their family caregivers. *Support. Care Cancer* 28, 5251–5262. doi: 10.1007/s00520-020-05351-x

Liu, H., and Liu, H. Y. (2013). "A comparative study on the fitting of EFA, CFA and ESEM: simulation research," in *Proceedings of the 16th National Psychological Academic Conference: Improvement of Psychology and Innovation Ability*, (Beijing: Chinese Psychological Society).

Mu, S. K., and Gu, H. G. (2011). The comparison of factor retaining methods in exploratory factor analysis. *Psychol. Explorat.* 31, 477–480. doi: 10.3969/j.issn.1003-5184.2011.05.018

Nayak, M. G., George, A., Vidyasagar, M., and Kamath, A. (2014). Quality of life of family caregivers of patients with advanced cancer. *J. Nurs. Health Sci.* 3, 70–75.

O'Conner, B. P. (2000). SPSS and SAS programs for determining the number of components using parallel analysis and velicer's MAP test. *Behav. Res. Methods Instrum. Comput.* 32, 396–402. doi: 10.3758/bf03200807

Oechsle, K., Ullrich, A., Marx, G., Benze, G., and Bergelt, C. (2019). Psychological burden in family caregivers of patients with advanced cancer at initiation of specialist inpatient palliative care. *BMC Palliat. Care* 18:102. doi: 10.1186/s12904-019-0469-7

Osborne, J. W., and Costello, A. B. (2009). Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. *Pract. Assess. Res. Eval.* 10, 1–9. doi: 10.1515/TJJ.1998.15.3.165

Pett, M. A., Lackey, N. R., and Sullivan, J. J. (2003). *Making Sense of Factor Analysis: The Use of Factor Analysis for Instrument Development in Health Care Research*. Thousand Oaks, CA: Sage Pubns.

Pfeiffer, E. (1975). A short portable mental status questionnaire for the assessment of organic brain deficit in elderly patients. *J. Am. Geriatr. Soc.* 23, 433–441. doi: 10.1111/j.1532-5415.1975.tb00927.x

Sawatzky, R., Laforest, E., Schick-Makaroff, K., Stajduhar, K., and Cohen, S. R. (2018). Design and introduction of a quality of life assessment and practice support system: perspectives from palliative care settings. *J. Patient. Rep. Outcomes* 2:36. doi: 10.1186/s41687-018-0065-2

Schur, S., Ebert-Vogel, A., Amering, M., Masel, E. K., Neubauer, M., Schrott, A., et al. (2014). Validation of the "quality of life in life-threatening illness—family carer version" (QOLLTI-F) in German-speaking carers of advanced cancer patients. *Support. Care Cancer* 22, 2783–2791. doi: 10.1007/s00520-014-2272-6

Shieh, S. C., Tung, H. S., and Liang, S. Y. (2012). Social support as influencing primary family caregiver burden in taiwanese patients with colorectal cancer. *J. Nurs. Scholarsh.* 44, 223–231. doi: 10.1111/j.1547-5069.2012.01453.x

Soroka, J. T., Fling, K. J., Heibel, J. M., Kutcher, G. R., and Ward, S. J. (2021). Terminal delirium in hospice: the experiences and perspectives of caregivers providing care to terminally Ill patients in home settings. *Am. J. Hosp. Palliat. Care* 39, 27–33. doi: 10.1177/10499091211000729

Streiner, D. L., Norman, G. R., and Cairney, J. (2015). *Health Measurement Scales: A Practical Guide to Their Development and Use*. New York, NY: Oxford University Press.

Sun, V., Raz, D. J., and Kim, J. Y. (2019). Caring for the informal cancer caregiver. *Curr. Opin. Support. Palliat. Care* 13, 238–242. doi: 10.1097/SPC.0000000000000438

Sung, H., Ferlay, J., Siegel, R. L., Laversanne, M., Soerjomataram, I., Jemal, A., et al. (2021). Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J. Clin.* 71, 209–249. doi: 10.3322/caac.21660

Teixeira, R. J., Remondes-Costa, S., Graça, P. M., and Brandapo, T. (2019). The impact of informal cancer caregiving: a literature review on psychophysiological studies. *Eur. J. Cancer Care* 28:e13042. doi: 10.1111/ecc.13042

Teng, N., and Chen, C. B. (2013). The quality of life among caregivers of cancer patients: a literature review. *Chin. J. Nurs.* 48, 181–183. doi: 10.3761/jissn.0254-1769.2013.02.029

Wang, T., Molassiotis, A., Chung, B., Zheng, S. L., and Tan, J. Y. (2021). A qualitative exploration of the unmet information needs of Chinese advanced cancer patients and their informal caregivers. *BMC Palliat. Care* 20:83. doi: 10.1186/s12904-021-00774-7

Wang, Y., Yan, J., Chen, J., Wang, C., Lin, Y., Wu, Y., et al. (2021). Comparison of the anxiety, depression and their relationship to quality of life among adult acute leukemia patients and their family caregivers: a cross-sectional study in China. *Qual. Life Res.* 30, 1891–1901. doi: 10.1007/s11136-021-02785-6

Xiao, H., Zheng, J., Lan, X., and Pang, S. (2015). The impact of advanced cancer patients' quality of life on family caregivers' quality of life. *Chin. J. Nurs.* 50, 415–419. doi: 10.3761/j.issn.0254-1769.2015.04.007

Yeung, N. C. Y., Ji, L., Zhang, Y., Lu, G., and Lu, Q. (2020). Caregiving burden and self-efficacy mediate the association between individual characteristics and depressive symptoms among husbands of Chinese breast cancer patients. *Suppor. Care Cancer* 28, 3125–3133. doi: 10.1007/s00520-019-05102-7

Yu, H., Li, L., Liu, C., Huang, W., Zhou, J., Fu, W., et al. (2017). Factors associated with the quality of life of family caregivers for leukemia patients in China. *Health Qual. Life Outcomes* 15:55. doi: 10.1186/s12955-017-0628-6

Zhou, Y., Cai, S., Jin, M., Jiang, C., Xu, N., Duan, C., et al. (2020). Economic burden for retinoblastoma patients in China. *J. Med. Econ.* 23, 1553–1557. doi: 10.1080/13696998.2020.1831518

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Development of a nomogram prediction model for depression in patients with systemic lupus erythematosus

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Systemic lupus erythematosus (SLE) is an inflammatory autoimmune disease with depression as one of its most common symptoms. The aim of this study is to establish a nomogram prediction model to assess the occurrence of depression in patients with SLE. Based on the Hospital Anxiety and Depression Scale cutoff of 8, 341 patients with SLE, recruited between June 2017 and December 2019, were divided into depressive and non-depressive groups. Data on socio-demographic characteristics, medical history, sociopsychological factors, and other risk factors were collected. Between-group differences in clinical characteristics were assessed with depression as the dependent variable and the variables selected by logistic multiple regression as predictors. The model was established using R language. Marital status, education, social support, coping, and anxiety predicted depression ($p < 0.05$). The nomogram prediction model showed that the risk rate was from 0.01 to 0.80, and the receiver operating characteristic curve analysis showed that the area under the curve was 0.891 ($p < 0.001$). The calibration curve can intuitively show that the probability of depression predicted by the nomogram model is consistent with the actual comparison. The designed nomogram provides a highly predictive assessment of depression in patients with SLE, facilitating more comprehensive depression evaluation in usual clinical care.

KEYWORDS

systemic lupus erythematosus, depression, nomogram, prediction, China

Introduction

Systemic lupus erythematosus (SLE) is a chronic autoimmune disorder that contributes to limitations in physical, psychological, and social functioning. Many cross-sectional studies have found a high prevalence of depression among persons with autoimmune diseases. In 1999, the American College of Rheumatology *Ad Hoc* Committee on Neuropsychiatric Lupus published standardized nomenclature and diagnostic recommendations for the 19 syndromes of neuropsychiatric SLE. Based on the Diagnostic and Statistical Manual of Mental Disorders Fourth Edition criteria, five of these 19 syndromes are psychiatric: depression, anxiety disorders, cognitive dysfunction, psychosis, and acute confusional state (American College of Rheumatology, 1999). Among these psychiatric manifestations, depression and anxiety disorders represent the most common complaints (Nikpour et al., 2014). Further, depression has been associated with greater disease severity in populations with autoimmune diseases (Shakeri et al., 2015). Increased immune activation associated with depression is a plausible biological pathway that could trigger autoimmune disease (Deverts et al., 2010).

Specific to SLE, the prevalence of depression has been reported to be twice that in the general population (Bachen et al., 2009). At the same time, a history of depression has been associated with 2.5 times greater risk of developing SLE as compared with the absence of a history of depression (Roberts et al., 2018). Depression entails "feelings of sadness, despair, emptiness, discouragement, or hopelessness; having no feelings; or appearing tearful" (American Psychiatric Association, 2013). In patients with SLE, depression can have a profound impact on health and wellbeing; this includes an increased incidence of cardiovascular diseases, myocardial infarction, suicidal ideation, and physical disability; decreased quality of life; and a higher risk of premature mortality (Zhang et al., 2017). Depression-like symptoms in patients with autoimmune diseases results in poor disease control; depression is generally thought to be associated with increased disease activity, decreased medication adherence, and decreased work productivity. Up to 50% of patients with autoimmune diseases show impaired health-related quality of life and exhibit depression-like symptoms. The immune system not only leads to inflammation in affected organs but also mediates behavior abnormalities, including fatigue and depression-like symptoms (Pryce and Fontana, 2017). Physical exercise and psychological interventions can act as adjuncts to traditional medical therapy for improvement in depression and quality of life for SLE (Fangtham et al., 2019).

Therefore, early identification and intervention for depression not only reduces patients' psychological burden but also improves their quality of life. While stress, including psychosocial factors (inclusive of having SLE itself), is a relevant factor, depression can also be caused by organic changes in the brain (neuropsychiatric SLE) and therapeutic agents such as steroids (side effect). To develop a depression assessment tool specific to patients with SLE, all the above seem to be essential elements (Palagini et al., 2013).

Estimates of depression vary by diagnostic and screening tools (Zhang et al., 2017). However, in addition to patient psychology, socio-demographic characteristics can also be predictive of depression. Patients with lupus who have depression will deliberately conceal their inner suffering. Other people are only alerted to their condition when it develops to a serious level, such as with self-harm and suicidal tendencies; thus, the best time for intervention passes. Therefore, looking for simple and efficient methods to screen high-risk patients for depression is necessary. In this context, nomograms—statistical models for individualized predictions of clinical events—have been developed to provide risk estimates for the presence of a disease or event during the future course of the disease (Jia et al., 2019). Nomograms can be used to perform single-item scoring and aggregate total scores for the corresponding variables of each influencing factor in Cox or logistic regression models and predict the corresponding probability based on the total score. This study is an attempt to establish a predictive nomogram for depression based on socio-demographic characteristics, medical history, sociopsychological factors, and other risk factors in patients with SLE. Through this study, we seek to establish a comprehensive visual predictive model for depression in patients with SLE. The proposed nomogram can inform clinical decision-making and enable the identification of individuals at high risk for depression, who should undergo further screening tests, thus promoting early detection of and intervention for depression.

Materials and methods

Participants

Patients with SLE were recruited from a hospital in Nantong between June 2017 and December 2019. In total, 360 consecutive patients with SLE were invited to participate in this cross-sectional study. All patients fulfilled the 1997 American College of Rheumatology revised criteria for the classification of SLE. Patients were excluded if they (1) did not complete the questionnaire or (2) had comorbidities (e.g., serious infections or cardiac, respiratory, gastrointestinal, neurological, or endocrine diseases) that could influence SLE activity. The Hospital Ethics Committee approved this study (2017-016) and written informed consent was obtained from all participants.

Demographic and clinical characteristics

Demographic data included gender, age, body mass index, residential area, marital status, education (years), employment

status, income, medicare, smoking, alcohol consumption, and exercise. Clinical data, obtained through medical records and patients' self-reports, included disease duration (years).

Measures

Systemic Lupus Erythematosus Disease Activity Index

The SLE Disease Activity Index (SLEDAI; Hochberg, 1997) was used to measure disease activity over the past month. It evaluated 16 clinical characteristics and eight laboratory indicators. Higher scores indicated more severe disease activity.

Hospital Anxiety and Depression Scale

The Hospital Anxiety and Depression Scale (HADS) (Bjelland et al., 2002) was used to estimate levels of anxiety and depression. It consists of 14 items, with seven items each for anxiety and depression. The cutoff for the identification of the occurrence of anxiety and depression was 8 points, and higher scores indicated more severe mood disorders. The HADS demonstrated good validity and reliability among the Chinese patient population (Zhang et al., 2017).

Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) (Tsai et al., 2005) was used to estimate the quality of sleep over the past month. The PSQI contains a total of 24 questions (19 self-rated questions and five rated by the bed partner or roommate), and 18 items divided into seven domains of sleep difficulties including sleep quality, sleep onset latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medicine, and daytime dysfunction. The sum of each domain generates the overall index for sleep quality evaluation. The total score ranges from 0 to 21, with higher scores indicating poorer sleep quality. The PSQI demonstrated good validity and reliability among the Chinese patient population (Chen et al., 2022).

Coping style questionnaire

Xie's (1998) 20-item Coping Questionnaire was used to estimate coping style. On this self-assessment scale consisting of positive and negative responses, each item is rated on a four-point Likert-type scale the score range is from 0 to 3; coping tendency greater than 0 is a positive attitude, less than 0 is a negative attitude. This scale demonstrated good validity and reliability among the Chinese patient population (Sun et al., 2019).

Social Support Rating Scale

The Social Support Rating Scale (SSRS) (Piel et al., 2017) was used to estimate levels of social support. It consists of three subscales (subjective support, objective support, and support availability). Each item is scored on a five-point Likert scale from 0 to 4. The total score, which is the sum of the scores of subjective support, objective support, and support availability, is used as a measure of the current total social support status, with higher scores indicating more social support. The SSRS demonstrated good validity and reliability among the Chinese patient population (Xu et al., 2019).

Statistical analysis

SPSS 24.0 (IBM Corp., Armonk, NY, United States) and R 3.5.2 software were used to process the data. According to the data and distribution characteristics, the two-sample t-test, Wilcoxon rank sum test, and χ^2 test were used to compare the differences between the depression and non-depression groups; logistic regression was used to analyze the influencing factors of depression. Depression was the dependent variable, and the variables selected by logistic regression were used as predictors. The nomogram prediction model was established using R language. The predictive and prognostic nomograms were developed using the "rms" package in R software based on the independent predictive factors. Additionally, the area under the receiver operating characteristic curve (AUC) was used to evaluate the discrimination of nomograms. The AUC value ranges between 0.5 and 1; the higher the value, the higher the resolution of the nomogram. Moreover, calibration curves were established for the nomogram. The significance level was set at $\alpha = 0.05$.

Results

Nineteen patients with SLE did not complete the questionnaire; thus, the data of 341 patients were analyzed. The baseline demographic characteristics of patients with and without depression are summarized in Table 1. The average age in the depression group was 35.6 ± 10.89 years. Eighty-nine cases (two men, 87 women) fulfilled the criteria for depression, and the cumulative incidence of depression was 26.1%. There were significant differences in residential area, marital status, education, and income between the depressive and non-depressive groups. Regarding the analysis of sociopsychological factors, anxiety, SSRS, PSQI, and coping style scores were significantly different ($p < 0.01$) between the depression and non-depression groups.

Multivariable logistic regression model predicting outcomes

The dependent variable was the occurrence of anxiety. Residential area, marital status, education, income, anxiety,

TABLE 1 Baseline characteristics of patients with and without depression.

Characteristic	Depression (*n* = 89)	Non-depression (*n* = 252)	*P*-value
Socio-demographic characteristics (%)			
Gender			0.73
Male	2 (2.24)	9 (3.57)	
Female	87 (97.76)	243 (96.43)	
Age, mean (SD), y	35.6 (10.89)	37.33 (11.85)	0.11
Residential area			**0.004****
City	27 (30.33)	123 (48.80)	
Village	62 (69.67)	129 (51.20)	
Marital status			**<0.001****
Married	84 (94.38)	185 (73.41)	
Unmarried	5 (5.62)	67 (26.59)	
Education, y			**<0.001****
≤9	59 (66.29)	95 (35.79)	
>9	30 (33.71)	157 (64.21)	
Employment status			0.42
Employed	43 (48.31)	141 (59.95)	
Unemployed	45 (51.69)	111 (40.05)	
Income			**0.02***
Low	25 (28.09)	84 (33.33)	
Medium	47 (52.80)	92 (36.50)	
High	17 (19.10)	76 (30.15)	
Medicare			0.15
Yes	50 (56.17)	167 (66.26)	
No	39 (43.83)	85 (33.74)	
Exercise			1.00
Yes	38 (42.69)	106 (42.06)	
No	51 (57.31)	146 (57.94)	
BMI (SD)	22.75 (3.71)	22.31 (3.91)	0.811
Medical history (*n*, %)			
Smoker	0 (0)	6 (2.38)	0.35
Alcohol drinker	0 (0)	11 (4.36)	0.07
Course of disease (SD)	7.69 (6.62)	7.36 (6.43)	0.68
SLEDAI (SD)	4.72 (3.58)	4.3 (3.47)	0.344
Socio-psychological factors, mean (SD)			
Anxiety (%)	72 (81.00)	50 (19.84)	**<0.001****
SSRS	39.70 (5.68)	42.49 (6.74)	**0.001****
PSQI	6.39 (3.15)	4.37 (2.86)	**<0.001****
Coping (%)			**<0.001****
Positive	72 (80.89)	110 (43.65)	
Avoidance or giving up	17 (19.11)	142 (56.35)	

SD, standard deviation; BMI, body mass index; SLEDAI, Systemic Lupus Erythematosus Disease Activity Index; SSRS, Social Support Rating Scale; PSQI, Pittsburgh Sleep Quality Index.
*p < 0.05, **p < 0.01, ***p < 0.001.

TABLE 2 Multivariable logistic regression model predicting outcomes.

Predictors	OR	95% CI	SE	*P*-value
Marital status	5.06	1.51–17.00	0.06	0.009**
Education	3.16	1.27–7.88	0.05	0.036*
SSRS	1.13	1.04–1.22	0.01	0.043*
Coping	3.36	1.44–7.80	0.05	0.002*
Anxiety	0.09	0.04–0.19	0.05	<0.001***

CI, confidence interval; OR, odds ratio; SE, standard error.
*p < 0.05, **p < 0.01, ***p < 0.001.

regression analysis, marital status [odds ratio (OR), 5.06; 95% confidence interval (CI), 1.51–17.00; *p* = 0.009], education (OR, 3.16; 95% CI, 1.27–7.88; *p* = 0.036), SSRS score (OR, 1.13; 95% CI, 1.04–1.22; *p* = 0.043), Coping Questionnaire score (OR, 3.36; 95% CI, 1.44–7.80; *p* = 0.002), and HADS anxiety score (OR, 0.09; 95% CI, 0.04–0.19; *p* < 0.001) were significant predictors of depression.

Development and application of the depression prediction model

To establish a predictive model for early prevention and intervention, we defined the cutoff for depression as a HADS score >8. To use the nomogram, a response was selected for each variable, with a straight line subsequently drawn to the corresponding point at the top. The total points for all variables were calculated after which the value on the line labeled "total points" was identified. Last, a straight line was drawn from the value on the total point line to the bottom line to determine the risk of depression in patients with SLE (Figure 1). Based on the analysis of the nomogram, the risk of depression was 0.01–0.80 and the area under the receiver operating characteristic curve was 0.891 (Figure 2). The calibration curve can intuitively show that the probability of depression predicted by the nomogram model is consistent with the actual comparison (Figure 3).

Discussion

The results showed that of the 341 patients with SLE, 26.1% had depression, which was consistent with previous studies (Zhang et al., 2017). Research on depression risk has mainly relied on logistic regression analysis; however, this approach by itself does not allow for the visualization of the risk assessment model. Therefore, we utilized nomogram analysis because it facilitated the development of a visual statistical prediction model for the risk of depression in patients with SLE.

According to recent evidence, lower educational levels among patients with SLE are correlated with increased depressive symptoms (McCormick et al., 2018). In a previous study, lower educational attainment was the demographic

social support, sleep quality, and coping style were the independent variables. After multivariable logistic regression, as shown in Table 2, according to the multivariable backward
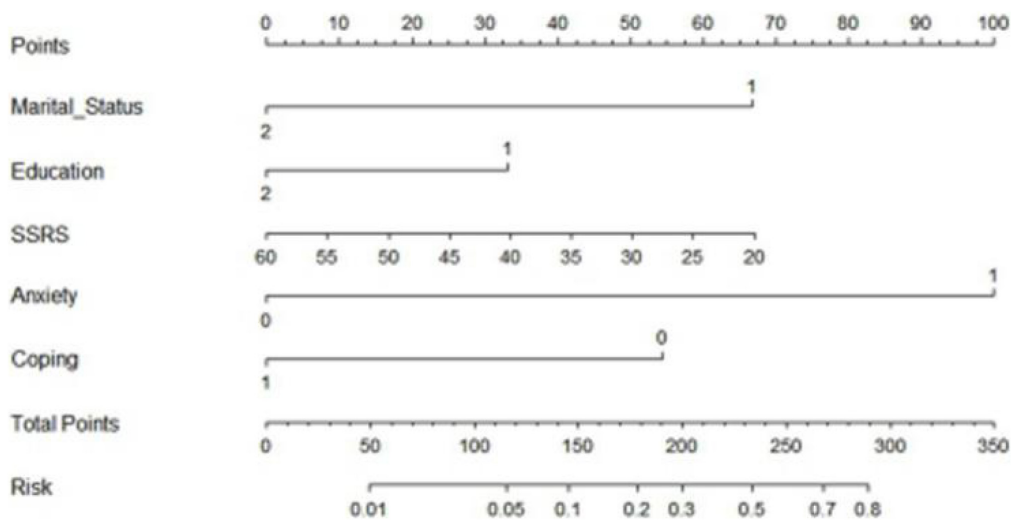
FIGURE 1
Construction of the depression nomogram.
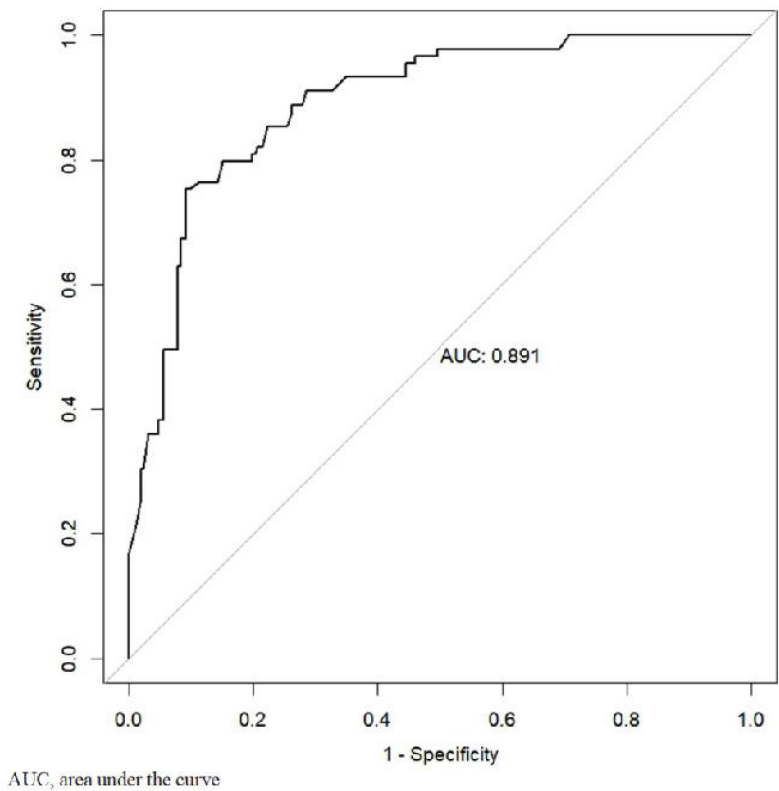
FIGURE 2
Receiver operating characteristic analyses for prediction of depression.

predictor most strongly associated with major depression (Knight et al., 2018). It may be that low educational level results in patients being less competitive in their work. These patients also have limited opportunities available to them. This could be

possible, as greater educational attainment has been associated with better social functioning and coping skills (Ladin, 2008). Marital status also affects the risk of depression in patients with SLE (Shen et al., 2013) as evidenced by both longitudinal and
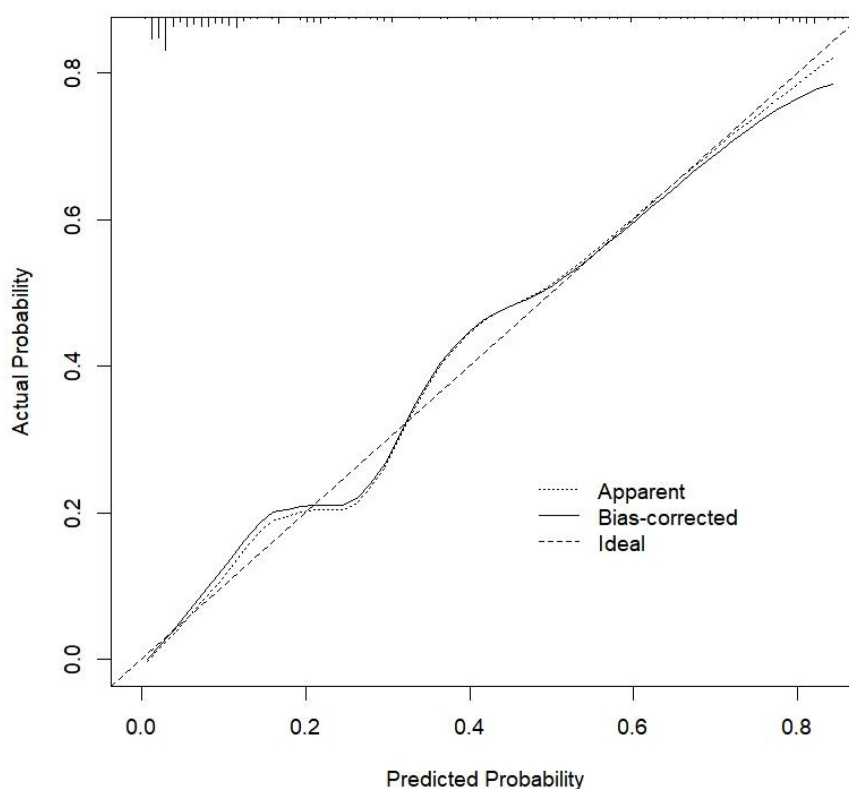
FIGURE 3
Calibration curve of the nomogram prediction model.

cross-sectional studies. The quality of the marital relationship may also be significant with regard to depression. Thus, there is a need to pay greater attention to patients' educational levels and marital status.

Contrary to our findings, a previous study reported a significant correlation between disease activity and depression severity (Alsowaida et al., 2018). Patients with high SLEDAI scores (>12) had an obviously higher rate of depression (40%) compared to the 20% among those with mild or moderate disease (Abd-Alrasool et al., 2017). There was no important or statistically significant difference in the median SLEDAI score between depression severity categories ($p > 0.05$) (Abd-Alrasool et al., 2017). In our study, the mean SLEDAI score was <5 points, indicating low disease activity. The predictive role of SLEDAI scores in depression needs further exploration.

Anxiety usually coexists with depression (Moustafa et al., 2020), and in our study, the nomogram demonstrated that anxiety had a great influence on depression. Given the importance of anxiety and mood disorders and symptoms for overall quality of life, functionality, and health-related outcomes in SLE, the effective management of these conditions is of paramount importance (Papadaki et al., 2019).

Social support refers to the experience of being valued, respected, cared about, and loved by the people in one's life.

It may come from different sources such as family, friends, teachers, community, or any social groups to which one is affiliated (Piel et al., 2017). A healthy marital relationship is a comprehensive source of social support. Previous research shows that low social support is one of the predictors of psychological issues such as depression and anxiety (Roohafza et al., 2014; Galán et al., 2020). Social support has been reported to play an important role in daily life (Roohafza et al., 2014). Support from others eases the pressures of life and reduces depression. In China, family is the most important source of social support. Therefore, we recommend that family members collaborate with healthcare providers in managing patients' depression.

Coping styles are cognitive efforts to manage stress (Diamond et al., 2006). Similar to social support, coping could play a buffering role with regard to psychological problems. Coping styles can be categorized as active and passive. The former refers to taking a direct and rational approach to deal with a problem, while the latter involves avoidance, withdrawal, and denial (Jia et al., 2004). Active coping styles and perceived social support, particularly positive reinterpretation and support from family, are protective factors for depression and anxiety.

It is well known that depression is a significant contributor to sleep quality disturbances in patients with

SLE (Palagini et al., 2014). Moreover, this relationship has been shown in epidemiological studies of sleep in the general population, and with other patient groups (e.g., arthritis, chronic pain) (Katz et al., 2016; Nijs et al., 2018). Vina et al. (2013) reported that depression was related to sleep disturbance, adequacy, and quantity. However, in this study, sleep and depression were related, and the total score of PSQI could not be included in the prediction model, indicating that compared with sleep, other factors have a greater impact.

This is the first published nomogram for depression in patients with SLE. This study explored potential risk factors to develop a model, which was used to predict the risk of depression within one month. Furthermore, the nomogram showed satisfactory validity, discrimination, and clinical utility, indicating good performance, with a high area under the curve of 0.891. A substantial amount of evidence shows that identifying the possibility of depression in patients with SLE in advance and intervening as soon as possible can improve their quality of life (Bachen et al., 2009; Conceição et al., 2019; Margiotta et al., 2019). Nomograms are not only associative but also predictive; the criterion for the inclusion of a variable is its ability to demonstrably improve the probability that the model will correctly predict depression (as quantified by the area under the curve). The establishment of the prediction model provides a tool for the early identification of depression. It also provides a basis for formulating relevant intervention strategies. This nomogram could be used as a convenient screening tool in clinical practice to guide follow-up and aid accurate prognostic assessment. It also provides new ideas for improving the quality of life in patients with SLE.

Limitations

The present study has several limitations. First, as it was conducted at a single hospital in the Nantong area, the results are not widely generalizable. The next step is to conduct a multi-region survey to ensure that the results are more representative. Second, there is a need to add relevant biological and drug-related indicators to the prediction model.

Conclusion

This study revealed that marital status, education, social support, coping, and anxiety are predictors for depression in patients with SLE. Moreover, the risk nomogram based on these five factors accurately predicted the likelihood of depression in patients with SLE, which could help clinicians recognize high-risk patients to some extent. Overall, this study highlights the clinical significance of nomograms and the need to use them to screen for depressive symptoms before diagnosis or intervention by doctors.

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 Ethics Committee of Nantong First People's Hospital (2017-016). The patients/participants provided their written informed consent to participate in this study.

Author contributions

HyC and HmC performed the experiment, prepared the figures and the manuscript, and analyzed the data. YG, HyC, TJ, SS, YL, and XC collected the data. BS designed and supervised the experiments and finalized the manuscript. All the authors have read and approved 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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References

Abd-Alrasool, Z. A., Gorial, F. I., and Hashim, M. T. (2017). Prevalence and severity of depression among Iraqi patients with systemic lupus erythematosus: a descriptive study. *Mediterr. J. Rheumatol.* 28, 142–146. doi: 10.31138/mjr.28.3.142

Alsowaida, N., Alrasheed, M., Mayet, A., Alsuwaida, A., and Omair, M. A. (2018). Medication adherence, depression and disease activity among patients with systemic lupus erythematosus. *Lupus* 27, 327–332. doi: 10.1177/0961203317725585

American College of Rheumatology (1999). The American college of rheumatology nomenclature and case definitions for neuropsychiatric lupus syndromes. *Arthritis Rheumatol.* 42, 599–608. doi: 10.1002/1529-0131(199904)42:4<599::AID-ANR2>3.0.CO;2-F

American Psychiatric Association (2013). *Diagnostic and Statistical Manual of Mental Disorders: DSM-5^{TM}*, 5th Edn. Virginia, VA: American Psychiatric Publishing, Inc.

Bachen, E. A., Chesney, M. A., and Criswell, L. A. (2009). Prevalence of mood and anxiety disorders in women with systemic lupus erythematosus. *Arthritis Rheum.* 61, 822–829. doi: 10.1002/art.24519

Bjelland, I., Dahl, A. A., Haug, T. T., and Neckelmann, D. (2002). The validity of the hospital anxiety and depression scale. An updated literature review. *J. Psychosom. Res.* 52, 69–77. doi: 10.1016/s0022-3999(01)00296-3

Chen, H. J., Wang, H., Qiu, L. J., Ling, H. Y., Wu, L. L., Wang, T. R., et al. (2022). Relation among anxiety, depression, sleep quality and health-related quality of life among patients with systemic lupus erythematosus: path analysis. patient prefer. A*dherence* 16, 1351–1358. doi: 10.2147/PPA.S366083

Conceição, C. T. M., Meinão, I. M., Bombana, J. A., and Sato, E. I. (2019). Psychoanalytic psychotherapy improves quality of life, depression, anxiety and coping in patients with systemic lupus erythematosus: a controlled randomized clinical trial. *Adv. Rheumatol.* 59:4. doi: 10.1186/s42358-019-0047-y

Deverts, D. J., Cohen, S., DiLillo, V. G., Lewis, C. E., Kiefe, C., Whooley, M., et al. (2010). Depressive symptoms, race, and circulating C-reactive protein: the Coronary Artery Risk Development in Young Adults (CARDIA) study. *Psychosom. Med.* 72, 734–741. doi: 10.1097/PSY.0b013e3181ec4b98

Diamond, L. M., Hicks, A. M., and Otter-Henderson, K. (2006). Physiological evidence for repressive coping among avoidantly attached adults. *J. Soc. Pers. Relat.* 23, 205–229. doi: 10.1177/0265407506062470

Fangtham, M., Kasturi, S., Bannuru, R. R., Nash, J. L., and Wang, C. (2019). Non-pharmacologic therapies for systemic lupus erythematosus. *Lupus* 28, 703–712. doi: 10.1177/0961203319841435

Galán, C. A., Wang, F. L., Shaw, D. S., and Forbes, E. E. (2020). Early childhood trajectories of conduct problems and hyperactivity/attention problems: predicting adolescent and adult antisocial behavior and internalizing problems. *J. Clin. Child. Adolesc. Psychol.* 49, 200–214. doi: 10.1080/15374416.2018.1534206

Hochberg, M. C. (1997). Updating the American college of rheumatology revised criteria for the classification of systemic lupus erythematosus. *Arthritis Rheumatol.* 40:1725. doi: 10.1002/art.1780400928

Jia, H., Uphold, C. R., Wu, S., Reid, K., Findley, K., and Duncan, P. W. (2004). Health-related quality of life among men with HIV infection: effects of social support, coping, and depression. *AIDS Patient Care STDs* 18, 594–603. doi: 10.1089/apc.2004.18.594

Jia, Y., Zhang, W., You, S., Li, M., Lei, L., and Chen, L. (2019). A nomogram for predicting depression in patients with hepatocellular carcinoma: an observational cross-sectional study. *Int. J. Psychiatry Clin. Pract.* 23, 273–280. doi: 10.1080/13651501.2019.1619777

Katz, P., Margaretten, M., Trupin, L., Schmajuk, G., Yazdany, J., and Yelin, E. (2016). Role of sleep disturbance, depression, obesity, and physical inactivity in fatigue in rheumatoid arthritis. *Arthritis Care Res.* 68, 81–90. doi: 10.1002/acr.22577

Knight, A. M., Trupin, L., Katz, P., Yelin, E., and Lawson, E. F. (2018). Depression risk in young adults with juvenile- and adult-onset lupus: twelve years of followup. *Arthritis Care Res.* 70, 475–480. doi: 10.1002/acr.23290

Ladin, K. (2008). Risk of late-life depression across 10 European Union countries: deconstructing the education effect. *J. Aging Health.* 20, 653–670. doi: 10.1177/0898264308321002

Margiotta, D. P. E., Fasano, S., Basta, F., Pierro, L., Riccardi, A., Navarini, L., et al. (2019). The association between duration of remission, fatigue, depression and health-related quality of life in Italian patients with systemic lupus erythematosus. *Lupus* 28, 1705–1711. doi: 10.1177/0961203319884651

McCormick, N., Trupin, L., Yelin, E. H., and Katz, P. P. (2018). Socioeconomic predictors of incident depression in systemic lupus erythematosus. *Arthritis Care Res.* 70, 104–113. doi: 10.1002/acr.23247

Moustafa, A. T., Moazzami, M., Engel, L., Bangert, E., Hassanein, M., Marzouk, S., et al. (2020). Prevalence and metric of depression and anxiety in systemic lupus erythematosus: a systematic review and meta-analysis. *Semin. Arthritis Rheum.* 50, 84–94. doi: 10.1016/j.semarthrit.2019.06.017

Nijs, J., Mairesse, O., Neu, D., Leysen, L., Danneels, L., Cagnie, B., et al. (2018). Sleep disturbances in chronic pain: neurobiology, assessment, and treatment in physical therapist practice. *Phys. Ther.* 98, 325–335. doi: 10.1093/ptj/pzy020

Nikpour, M., Bridge, J. A., and Richter, S. (2014). A systematic review of prevalence, disease characteristics and management of systemic lupus erythematosus in Australia: identifying areas of unmet need. *Intern. Med. J.* 44, 1170–1179. doi: 10.1111/imj.12568

Palagini, L., Mosca, M., Tani, C., Gemignani, A., Mauri, M., and Bombardieri, S. (2013). Depression and systemic lupus erythematosus: a systematic review. *Lupus* 22, 409–416. doi: 10.1177/0961203313477227

Palagini, L., Tani, C., Bruno, R. M., Gemignani, A., Mauri, M., Bombardieri, S., et al. (2014). Poor sleep quality in systemic lupus erythematosus: does it depend on depressive symptoms? *Lupus* 23, 1350–1357. doi: 10.1177/0961203314540762

Papadaki, E., Kavroulakis, E., Bertsias, G., Fanouriakis, A., Karageorgeou, D., Sidiropoulous, P., et al. (2019). Regional cerebral perfusion correlates with anxiety in neuropsychiatric SLE: evidence for a mechanism distinct from depression. *Lupus* 28, 1678–1689. doi: 10.1177/0961203319887793

Piel, M. H., Geiger, J. M., Julien-Chinn, F. J., and Lietz, C. A. (2017). An ecological systems approach to understanding social support in foster family resilience. *Child Fam. Soc. Work* 22, 1034–1043. doi: 10.1111/cfs.12323

Pryce, C. R., and Fontana, A. (2017). Depression in autoimmune diseases. *Curr. Top. Behav. Neurosci.* 31, 139–154. doi: 10.1007/7854_2016_7

Roberts, A. L., Kubzansky, L. D., Malspeis, S., Feldman, C. H., and Costenbader, K. H. (2018). Association of depression with risk of incident systemic lupus erythematosus in women assessed across 2 decades. *JAMA Psychiatry* 75, 1225–1233. doi: 10.1001/jamapsychiatry.2018.2462

Roohafza, H. R., Afshar, H., Keshteli, A. H., Mohammadi, N., Feizi, A., Taslimi, M., et al. (2014). What's the role of perceived social support and coping styles in depression and anxiety? *J. Res. Med. Sci.* 19, 944–949.

Shakeri, H., Arman, F., Hossieni, M., Omrani, H. A., Vahdani, A., and Shakeri, J. (2015). Depression, anxiety and disease-related variables and quality of life among individuals with systemic lupus erythematosus living in Kermanshah province, Iran. *Iran. Red Crescent Med. J.* 17:e31047. doi: 10.5812/ircmj.31047

Shen, B., Tan, W., Feng, G., He, Y., Liu, J., Chen, W., et al. (2013). The correlations of disease activity, socioeconomic status, quality of life, and depression/anxiety in Chinese patients with systemic lupus erythematosus. *Clin. Dev. Immunol.* 2013:270878. doi: 10.1155/2013/270878

Sun, Y., Gao, L., Kan, Y., and Shi, B. X. (2019). The Perceived Stress Scale-10 (PSS-10) is reliable and has construct validity in Chinese patients with systemic lupus erythematosus. *Lupus* 28, 149–155. doi: 10.1177/0961203318815595

Tsai, P. S., Wang, S. Y., Wang, M. Y., Su, C. T., Yang, T. T., Huang, C. J., et al. (2005). Psychometric evaluation of the Chinese version of the Pittsburgh sleep quality index (CPSQI) in primary insomnia and control subjects. *Qual. Life Res.* 14, 1943–1952. doi: 10.1007/s11136-005-4346-x

Vina, E. R., Green, S. L., Trivedi, T., Kwoh, C. K., and Utset, T. O. (2013). Correlates of sleep abnormalities in systemic lupus: a cross-sectional survey in an urban, academic center. *J. Clin. Rheumatol.* 19, 7–13. doi: 10.1097/RHU.0b013e31827cd20d

Xie, Y. N. (1998). The initial exploration of reliability and validity of simplified coping style questionnaire. *Chinese J. Clin. Psychol.* 6, 114–115.

Xu, Q., Liu, D., Zeng, F., Luo, H., Zuo, X., and Li, Y. (2019). Social support and management strategies for chronic disease in patients with systemic lupus erythematosus. *Zhong Nan Da Xue Xue Bao Yi Xue Ban* 44, 67–73. doi: 10.11817/j.issn.1672-7347.2019.01.011

Zhang, L., Fu, T., Yin, R., Zhang, Q., and Shen, B. (2017). Prevalence of depression and anxiety in systemic lupus erythematosus: a systematic review and meta-analysis. *BMC Psychiatry* 17:70. doi: 10.1186/s12888-017-1234-1

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Correlates of cognitive impairment in the elderly in China: A cross-sectional study

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Background: To identify correlates of the incidence of cognitive impairment among older Chinese populations through the use of logistic regression analysis-based decision tree approaches.

Methods: Correlates of cognitive impairment among older Chinese adults were identified through logistic regression analyses, with significant variables subsequently being incorporated into a decision tree analysis, with the CHAID method being employed for pre-pruning.

Results: The risk score derived from the combination of logistic regression and decision tree analyses (0.237) was lower than that derived from a decision tree analysis alone (0.389). The primary factors related cognitive impairment in this patient population included age, gender, residence status, physical health status, and caring for grandchildren.

Conclusion: A combination of logistic regression and decision tree analyses can lower predicted risk scores, enabling the subdivision of populations with different characteristics and providing intuitive and specific insight regarding the effects of individual variables on predictive analyses. Overall, these results suggest that older adults in rural areas of China should be the focus of further cognitive impairment screening and interventions, particularly for older women.

KEYWORDS

cognitive impairment, the elderly, decision tree, China, CHARLS

Introduction

Dementia is the third-highest burden of disease after cancer and cardiovascular disease, and in 2019 (1), dementia patients aged 65 and older spent a combined $290 billion on healthcare, long-term care and hospice services (2). Early detection, early diagnosis and early treatment were currently the most cost-effective measures to control dementia (3). Cognitive impairment (CI) is an intermediate process in the transition to dementia, characterized by mild but marked deficits in memory and/or other thinking abilities (4), affecting activities of daily living, mostly in older adults.

According to data from the seventh national Chinese census, there were 264.02 million adults 60 years of age or older in China, accounting for 18.70% of the total population. A number of studies on community-based elderly screening in China show

that the prevalence of cognitive impairment in the elderly ranges from 4.2 to 44.2%.[4] One study showed that the prevalence of cognitive impairment (MCI) among the elderly in Shenyang was 30.3%, which was significantly higher than that in the 2013 survey of Japanese elderly (18.8%) and the 2016 survey of American community elderly (21.0%) ([5]). Compared with normal people, the annual conversion rate of patients with mild MCI to dementia is 10 times higher ([6]). CI in the elderly brings great pressure and burden to the elderly themselves, their families and the society. The management and intervention of the elderly before they develop dementia can effectively delay the course of dementia ([7–10]). There is thus an urgent need to better define the factors associated with the incidence and progression of such cognitive impairment in an effort to better prevent its onset or mitigate associated morbidity in affected individuals ([11–14]).

Common risk factors for CI include demographic factors such as age, gender, and education level. These studies show that the age and gender differences of cognitive impairment were obvious, the cognitive impairment of the female elderly is more serious than that of the male, and the cognitive impairment of the older elderly is more serious than that of the younger elderly ([15], [16]). And now there's evidence that the higher the education level or the longer duration of education they have, the lower chance of cognitive impairment happens in older adults, and vice versa ([17], [18]). These factors were also relevant to cognitive impairment such as behavioral and lifestyle factors such as diet and exercise. Healthy diet and regular exercise were protective factors of cognitive impairment in the elderly ([19], [20]). But the disease factors such as hypertension ([21], [22]), diabetes ([23], [24]), stroke ([25]), and obesity ([26]) were risk factors for cognitive impairment in the elderly. A 3-year follow-up study on socioeconomic status and cognitive impairment in Italy found that people with cognitive impairment were generally less educated, more engaged in manual labor, and less engaged in white-collar, technical or academic work ([27]). At the same time, a study of four provinces in China showed that there were population differences in the distribution of MCI detection rates, and the detection rate of MCI in rural populations was higher than that in urban areas ([28]).

Understanding the influencing factors of CI, early intervention on modifiable factors, and preventing the occurrence of the disease have an important role. At present, a certain number of investigations and studies have been carried out on the influencing factors of CI in the elderly in China, but most of them were limited to specific regions, and there are few national samples. This study used the China Health and Retirement Longitudinal Study (CHARLS), a set of high-quality microdata representing families and individuals of middle-aged and elderly people aged 45 and above in China, to analyze the influencing factors of CI in the elderly in China. At the same time, two methods of logistic regression and decision tree model were used to analyze the influencing factors of CI in the elderly

in China, and the factors correlating with CI of the elderly in China was comprehensively analyzed to provide a basis for the development of CI preventive measures.

Methods

Study design and data selection

The present study was developed using the data derived from the 2018 CHARLS from The Center for Healthy Aging and Development of Peking University ([29], [30]). This survey covered 22 provinces and autonomous regions in China home to ∼85% of the overall Chinese population. The CHARLS's baseline survey includes one person per household aged 45 years of age or older and their spouse, totaling 17,708 individuals, living in 10,257 households in 450 villages/urban communities ([29], [30]). A stratified (by per capita GDP of urban districts and rural counties) multi-stage (county/district-village/community-household) PPS random sampling strategy was adopted. These survey data were thus highly representative of the population as a whole.

We followed the research object selection strategy of CHARLS and only selected the elderly aged 60 and above at the time of the investigation as the research object. There were 11,153 participants aged 60 and above of the total 17,708 people. The personal basic information, residence type, health status, and family structure information etc. were taken as research variables. The variables consist of basic demographics and health-related information were shown in Table 1.

Measurement of CI

The Mini-Mental Status Examination (MMSE) questionnaire was used to gauge CI in the subjects of this study. This questionnaire consists of 30 total items pertaining to six dimensions (orientation, attention and computation, memory, language ability, executive ability, and visuospatial ability), with correct and incorrect/unknown answers, respectively being scored with a 1 and a 0. 10 questions for orientation (e.g., 'What is the year? Season? Date? Day of the week? Month?' and 'Where are we now: State? County? Town/city? Hospital? Floor?'), the total score of this dimension was 10 points. 2 questions for Attention and computation (e.g., 'The examiner names three unrelated objects clearly and slowly, then asks the patient to name all three of them.' and 'I would like you to count backward from 100 by sevens. Stop after five answers.'), the total score of this dimension was eight points. One question for memory such as "Earlier I told you the names of three things. Can you tell me what those were?," the total score of this dimension was three points. Two for language ability (e.g., 'Show the patient two simple objects, such as a wristwatch and a pencil, and ask

TABLE 1 Single-factor analysis of cognitive impairment among elderly Chinese individuals with different characteristics.

	Total (N = 11,153)	Cognition		χ²	p-value
		No CI (N = 6,059)	CI (N = 5,094)		
Gender				91.448	<0.001
Male	5422(48.6)	3197(52.8)	2225(43.7)		
Female	5731(51.4)	2862(47.2)	2869(56.3)		
Age(years)				468.368	<0.001
60–69	6807(61.0)	4111(67.8)	2696(52.9)		
70–79	3219 (28.9)	1651(27.2)	1568(30.8)		
≥80	1127(10.1)	297(4.90)	830(16.3)		
Education level				62.648	<0.001
Illiterate	6029(54.0)	2770(45.7)	3259(64.0)		
Primary	2373(21.3)	1615(26.7)	758(14.9)		
Junior high school and above	2751(24.7)	1674(27.6)	1077(21.1)		
Marital status				196.762	<0.001
Married	8716(78.1)	5040 (83.2)	3676(72.2)		
Not married	2437(21.9)	1019(16.8)	1418(27.8)		
Living at home				6.799	0.009
Yes	10906(97.8)	5945(98.1)	4961(97.4)		
No	247(2.2)	114(1.9)	133(2.6)		
Type of residence				116.264	<0.001
Urban	2676(24.0)	1696(28.0)	980(19.2)		
Rural	8477(76.0)	4363(72.0)	4114 (80.8)		
Religious belief				0.322	0.570
Yes	1221(10.9)	654(10.8)	567(11.1)		
No	9932(89.1)	5405(89.2)	4527(88.9)		
Caring for grandchildren				129.601	<0.001
Yes	2527(22.7)	1623(26.8)	904(17.7)		
No	8626(77.3)	4436(73.2)	4190(82.3)		
Pain				48.470	<0.001
Never	4221(37.8)	2371(39.2)	1850(36.3)		
Occasionally	4604(41.3)	2572(42.4)	2032(39.9)		
Often	2328(20.9)	1116(18.4)	1212(23.8)		
Financial support				3.510	0.061
Yes	4267(38.3)	2366(39.0)	1901(37.3)		
No	6886 (61.7)	3693(61.0)	3193(62.7)		
Live with children				47.710	<0.001
Never	2913(26.1)	1696(28.0)	1217(23.9)		
≤6 months	1089 (9.8)	651(10.7)	438(8.6)		
>6months	7151(64.1)	3712(61.3)	3439(67.5)		

the patient to name them.'), the total score of this dimension was three points. Three for executive ability (e.g., 'Take the paper in your right hand, fold it in half, and put it on the floor.'), the total score of this dimension was five points. One for visuospatial ability (e.g., 'Please copy this picture.'), the total score of this dimension was one point. Total possible scores of MMSE range from 0-30, with higher scores corresponding to better cognitive function. The MMSE score thresholds used to define cognitive impairment varied as a function of subject educational level as follows: illiteracy <17, primary school <20, junior high school and above <24 (31–34). To facilitate a convenient decision tree analysis approach, the level of CI was treated as a binary classification variable rated in accordance with the education level-related thresholds detailed above, combining CHARLS household questionnaire and MMSE scores to stratify patients into two groups including no cognitive

impairment(no CI) coded as a 0 and cognitive impairment (CI) coded as a 1.

Measurement of other variables

The predictor variables included gender (female, male), age(60–69, 70–79,≥80 years), marital status (married, not married), education level (Junior high school and above), Living at home(Yes, No), Type of residence (Urban, Rural), Religious belief (Yes, No), Caring for grandchildren (Yes, No), Pain (Never, Occasionally, Often), Financial support (Yes, No), Live with children (Never, ≤6 months, >6months).

The marital status was categorized as married, not married. If the participants answered "Married and live with spouse" or "Married but don't living with spouse temporarily for reasons such as work" to "What is your marital status?," the marital status was defined as "married." If the answers were "Separated, don't live together as a couple anymore" or "Divorced" or "Widowed" or "Never married," the marital status was defined as "not married." The education level was categorized as illiterate, primary, and junior high school and above. If the participants answered "No formal education (illiterate)" or "Did not finish primary school" for "What's the highest level of education you have now?," the education level was defined as "illiterate." If the participants answered "Sishu/home school" or "Elementary school," the education level was defined as "primary." If the participants answered "Middle school" or "High school" or "Vocational school" or "2-/3-Year College/Associate degree" and above, the education level was defined as "junior high school and above."

The variable "living at home" was referring to a new type of care model for the elderly in China. The concept of "living at home" was highly similar to the word "community care" abroad. The definition of "living at home" was to coordinate the efforts of all social parties to jointly provide satisfactory services for the elderly at home. Convenient conditions and diversified support should be provided for the elderly at home by the family members, communities, social organizations and government departments (35). The living at home was categorized as yes and no. If the participants answered "Family housing" for "What was the type of your address," the living at home was defined as "yes." If the participants answered "Nursing home" or "Hospital" or "Other," the living at home was defined as "no."

The type of residence was categorized as town and rural for the question "Was your address in the village or city/town?." The religious belief was categorized as yes and no for the question "Do you have any religious belief? Such as Buddhism, Taosim, Christianity, etc.." The caring for grandchildren was categorized as yes and no. If the participants answered "No" or "Have no grandchild" for the question "During last year, did you/ your spouse spend time in taking care of your grandchildren?." The caring for grandchildren was defined as "no." The pain was

categorized as never, occasionally, and often. If the participants answered "None" for the question "Are you often troubled with any body pains?," The pain was defined as "no." If the participants answered "A little" or "Somewhat," the pain was defined as "occasionally." If the participants answered "Quite a bit" or "Very," the pain was defined as "often." Financial support was categorized as yes and no. If the participants answered "providing living expenses, paying for water, electricity or telephone bill, paying for mortgage/rent or other forms of regular expenses, or buying food, clothes or other stuff" for "During last year, what's the amount of financial support received from your family members?," financial support was defined as "yes." If the participants answered "nothing received" or "have no idea," financial support was defined as "no." The live with children was categorized as Never, ≤6 months, and >6months for the question "During last year, how many mouths had [X Child Name] lived with you and your spouse?"

Of the 11,153 individuals included in this study, 5422(48.6%) were male and 5731(51.4%) were female. People aged 60-69 were 6807 (61.0%), aged 70-79 were 3219 (28.9%), aged 80 and above were 1127 (10.1%). There were 8,716 people (78.1%) and 2,437 people (21.9%), respectively lived in urban and rural areas. There were 6029 people with education level of illiterate accounting for 54.0, primary 2373 people accounting for 21.3, then junior high school and above 2,751 people accounting for 24.7%. 6,059 and 5,094 were, respectively classified as no cognitive impairment (no CI) and cognitive impairment (CI).The percentage of other variables were shown in Table 1.

Statistical analysis

To test the impact of regional culture on cognitive impairment, the 11,153 elderly subjects included in this study were additionally stratified into urban and rural subgroups in accordance with their reported residence type to permit comparisons between these two groups.

All data were analyzed using SPSS 22.0. A logistic regression analysis was initially used to screen for factors influencing cognitive impairment rates among elderly Chinese individuals, after which a decision tree model was established based on the data derived from the 2018 CHARLS survey. Decision tree used a tree graph as an analysis tool based the principles of probability theory. Its basic principle was to use decision point to represent decision problem, and use plan branch to represent alternative plan, then use probability branch to represent possible result of plan, through the calculation and comparison of profit and loss value of each plan under various result conditions, provided decision basis for decision maker. This decision tree analysis utilized the Chi-square automatic interactive detection (CHAID) algorithm. Demographic characteristics were analyzed, and chi-squared tests were used to detect statistical significance at an α = 0.05 level.

Results

Univariate analyses

Chi square test was taken to each univariate analysis. There were significant differences in the incidence of cognitive impairment among older adults in urban and rural settings, and these levels also varied significantly as a function of subject age, gender, education level, whether they reported caring for grandchildren, whether they reported any physical pain or disability, and whether they reported living with their children ($P < 0.001$). There were no differences in cognitive impairment status as a function of religious belief and financial support ($P > 0.05$). For further details, see Table 1.

Logistics regression analysis

For logistic regression analyses, cognitive impairment level was defined based upon a combination of education level and MMSE scores and treated as a binary classification variable (no CI vs. CI). To analyze the factors related to cognitive impairment, chi square test was used to each univariate analysis. The nine variables in significant differences (except religious belief, financial) in the univariate analysis were used as the independent variables of the model for multiple logistic regression analysis. A logistic regression was subsequently used to identify factors associated with the incidence of cognitive impairment. Among the 9 variables included, there were no significant differences in the incidence of cognitive impairment among older adults in whether they reported "Living at home"($P > 0.05$). Compared with the elderly without pain, there was no significant differences in cognitive impairment among the elderly with "Pain Occasionally" ($P > 0.05$), but there was significant differences among the elderly with "Often pain" ($P < 0.05$). For the elderly who never lived with their children, there was no significant differences between who lived with children for ≤ 6 months ($P > 0.05$), but there was significant differences between the elderly who lived for more than 6 months ($P < 0.05$), as shown in Table 2.

Decision tree analysis

Those variables found to be significantly associated with CI in the logistic regression analyses were next used to conduct a decision tree analysis. CI was treated as the dependent variable (Y) in this model, while explanatory variables included gender (X1), age (X2), level of education (X3), marital status (X4), residence type (X5), participation in caring for grandchildren (X6), physical pain (X7), and living with children (X8). These decision tree analyses were conducted by adopting the CHAID pre-pruning method for tree pruning. The maximum tree depth

TABLE 2 Logistic regression analysis of factors correlating with cognitive impairment among elderly Chinese individuals with different characteristics.

	β	S.E.	Walsχ^2	p-value	OR(95%CI)
Gender (X1)					
Male					1.000
Female	0.365	0.038	91.187	<0.001	1.440(1.336, 1.552)
Age (X2)					
60–69					1.000
70–79	0.370	0.043	73.823	<0.001	1.448(1.331, 1.576)
≥80	1.450	0.072	405.190	<0.001	4.261(3.700, 4.907)
Education level (X3)					
Illiterate					1.000
Primary	0.231	0.013	28.531	<0.001	0.587(0.541, 0.653)
Junior high school and above	−0.353	0.045	62.350	<0.001	0.702(0.643, 0.767)
Marital status (X4)					
Married					1.000
Not married	0.646	0.046	5.864	<0.001	1.908(1.742, 2.090)
Living at home					
Yes					1.000
No	0.335	0.129	6.740	0.060	1.398(1.086, 1.801)
Type of residence (X5)					
Urban					1.000
Rural	0.490	0.046	115.169	<0.001	1.632(1.492, 1.785)
Caring for grandchildren (X6)					
Yes					1.000
No	0.528	0.047	127.579	<0.001	1.696(1.547, 1.859)
Pain (X7)					
Never					1.000
Occasionally	0.012	0.043	0.084	0.171	1.013(0.931, 1.101)
Often	0.331	0.052	40.742	<0.001	1.392(1.257, 1.541)
Live with children (X8)					
Never					1.000
≤6 months	−0.064	0.072	0.793	0.089	0.938(0.814, 1.080)
>6months	0.255	0.044	33.110	<0.001	1.291(1.183, 1.408)

of the model was set to 3, the minimum number of cases in the parent node was 100, and the minimum number of cases in the child was 50. The final decision tree (Figure 1) ultimately incorporated six explanatory variables including age (X2), type of residence (X5), gender (X1), participation in caring for grandchildren (X6), physical pain (X7), and living with children (X8), among which age (X2) had the most significant effect.

Discussion

In this study, logistic regression analyses were used to identify factors associated with cognitive impairment among
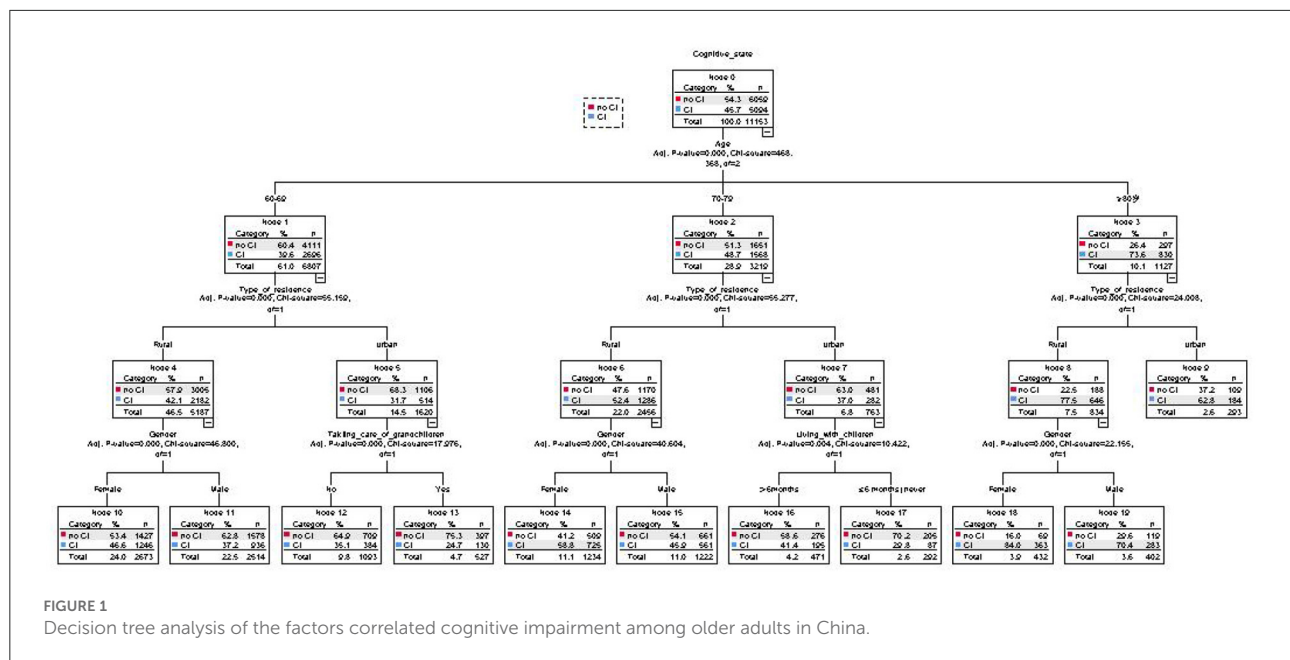
FIGURE 1
Decision tree analysis of the factors correlated cognitive impairment among older adults in China.

elderly individuals, revealing that gender, age, education level, marital status, residence type, living at home, physical pain, participation in taking care of grandchildren, and living together with children were the primary variables related to such impairment. Logistic regression analyses offer the advantage of allowing for the effective determination of the relevance of a given independent variable based on corresponding P-values, with OR values further allowing for the determination of the impact and directionality of independent variables on the dependent variable of interest. Decision tree analyses provide insight into the importance and influence of each included variable on the overall model, subdividing a given patient population based on a series of characteristics of interest. In the decision tree analysis in the present status, age, which had the greatest impact on cognitive impairment, served as the first layer of this model. Cognitive impairment rates were found to gradually rise with age, in line with prior data from other studies conducted in China and abroad (13, 36–38).

The second layer of the decision tree analysis in this study was place of residence, with cognitive impairment rates being higher in rural areas relative to urban areas. This aligns well with prior studies reporting lower levels of cognitive impairment among elderly individuals in urban environments in China relative to those in rural environments (39–41).

The third layer of this decision tree analysis model consisted of gender, participation in taking care of grandchildren, and living with children. Cognitive impairment prevalence was higher among elderly women in rural areas relative to men at any age. This may be because women exhibit a longer life expectancy than men. In addition, cognitive impairment was established based upon a combination of MMSE scores and education

level, and adults included in the 2018 CHARLS study that were over the age of 60 were thus born before 1960, corresponding to lower rates of educational attainment among women than among men. Whether cognitive impairment rates will decline with the continuing rise in female educational levels remains to be established and warrants further empirical investigation.

The variable "taking care of grandchildren" was associated with significant differences in cognitive impairment among the elderly aged 60–69 in urban areas. Further analysis found a very interesting phenomenon: the incidence of cognitive impairment among those who did not take care of their grandchildren was 35.1%, which was significantly higher than that of those who took care of grandchildren (24.7%). One possible explanation may be that participating in caring for grandchildren produces bi-generational support such that these individuals may obtain positive emotional support and other reverse intergenerational support, consistent with the importance of such support in the maintenance of mental and physical health among elderly individuals Older adults not limited by disability or pain can also better participate in social activities, and both social participation and emotional comfort were protective factors associated with lower rates of cognitive impairment (42). However, these factors did not significantly impact cognitive impairment rates among elderly individuals in rural areas.

In urban elderly populations, adults over the age of 80 that lived with their children for > 6 months exhibited higher levels of cognitive impairment than observed for adults that had never lived with their children or had lived with their children for < 6 months. This may be the result of bias introduced by the fact that individuals exhibiting cognitive impairment were more likely to need to live with their children. Alternatively, daily care

provided by these children may result in accelerated cognitive decline among older adults.

There were certain inherent limitations to the implementation of decision tree analyses. In particular, algorithm pruning can impact the accuracy with which unknown data were classified, with the difficulty of decision tree pruning rising as more factors were included in the corresponding analyses. In the present study, age was identified as the factor most closely associated with cognitive impairment in the elderly Chinese population, followed by place of residence (rural vs. urban) and gender, while caring for grandchildren and living with children were less robustly associated with this outcome variable. In China, income level was lower for individuals dwelling in rural areas relative to urban areas, and most of their children leave their hometown to work in the cities (43, 44), lack of emotional communication and financial support may affect the cognitive health status of rural elderly people lacking sufficient communication and emotional comfort. As such, health policymaking in China should focus on improving the cognitive health of elderly individuals in rural environments. While rates of cognitive impairment were found to be higher among women than men in rural areas, this same difference was not evident in urban environments, suggesting that preventative and intervention efforts in China should specifically target elderly women in rural areas.

There were other limitations in this study due to the non-independent data and cross-sectional data. Since the data analyzed in this article was based on CHARLS data (an open database), the method for selecting samples in the baseline survey was that if a household had persons older than 40, one of them was randomly selected. If the chosen person was 45 or older, then he/she became a main respondent and interviewed his or her spouse. So, the spouses were also included in the data set. If two people from the same household were both included in the data set, the data set would contain non-independent data. In addition, this study was a cross-sectional study, which only analyzed the factors correlating with cognitive impairment of the elderly and could not evaluate the causal relationship between the variables and cognitive impairment of the elderly. That was also one of the limitations of this study.

Conclusion

The present study used significant variables derived from logistic regression analyses to facilitate the development of a robust decision tree analysis model capable of assessing cognitive impairment among elderly Chinese adults. The predicted risk score of the resultant decision tree was 0.237, which was smaller than that of the decision tree analysis with all possible variables included (0.389), indicating that logistic regression analyses enabled the selection of significant variables,

optimizing the efficiency of classification and processing while minimizing associated predictive risk.

Data availability statement

Publicly available datasets were analyzed in this study. This data can be found here: http://charls.pku.edu.cn.

Ethics statement

The studies involving human participants were reviewed and approved by Ethical approval for all the CHARLS waves was granted from the Institutional Review Board at Peking University, China. The IRB approval number for the main household survey, including anthropometrics, is IRB00001052-11015. 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

Y-yW was responsible for the conception, design of the study, quality control, review of the manuscript, and was responsible for the whole manuscript. X-xW was responsible for data collection and collation. MZ, SL, and HD were responsible for the manuscript writing and revision. All authors contributed to the article 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.

Publisher's note

References

1. Ansah JP, Chiu CT, Wei-Yan AC, Min T, Matchar DB. Trends in functional disability and cognitive impairment among the older adult in china up to 2060: estimates from a dynamic multi-state population model. *BMC Geriatrics*. (2021) 21:4. doi: 10.1186/s12877-021-02309-4

2. Thies W, Bleiler L. 2020 Alzheimer's disease facts and figures. *J Alzheimer's Assoc*. (2020) 16:391–460. doi: 10.1002/alz.12068

3. Chen C, Zeng Y, Liu D, Li L, Zou MJ, Cheng GR. The association analysis between socioeconomic status and the prevalence of mild cognitive impairment in older adults. *Mod Prevent Med*. (2022) 49:103–29. doi: 10.3969/j.issn.1003-8507.2022.01.022

4. Giubilei F. Updates and new challenges in the prevention of dementia. *Minerva Med*. (2021) 112:427–9. doi: 10.23736/S0026-4806.21.07626-6

5. Yan N, Liu W, Liu DQ Li RM. Prevalence of mild cognitive impairment and its influencing factors among Community elderly in Shenyang city: a cross-sectional study. *Chin J Public Health*. (2021) 37:1410–3. doi: 10.11847/zgggws1129827

6. Tao XQ, Liao X, Li MQ, Wang NB, Li L, Yang CH, Wu L. Epidemiological study on mild cognitive impairment among the elderly in Nanchang community. *Chin J Gerontol*. (2016) 36:3283–6. doi: 10.3969/j.issn.1005-9202.2016.13.092

7. Kouloutbani K, Karteroliotis K, Politis A. The effect of physical activity on dementia. *Psychiatriki*. (2019) 30:142–55. doi: 10.22365/jpsych.2019.302.142

8. Jongsiriyanyong S, Limpawattana P. Mild cognitive impairment in clinical practice: a review article. *Am J Alzheimer's Dis Other Dement*. (2018) 33:500–7. doi: 10.1177/1533317518791401

9. Eshkoor SA, Hamid TA, Mun CY, Ng CK. Mild cognitive impairment and its management in older people. *Clin Intervent Aging*. (2015) 10:687–693. doi: 10.2147/CIA.S73922

10. Farsai PS. Cognitive impairment in older adults and oral health considerations: treatment and management. *Dent Clin North Am*. (2021) 65:345–360. doi: 10.1016/j.cden.2020.11.008

11. Wang Y, Liang J, Jia R, Xu Y. Alzheimer disease in China (2015–2050) estimated using the 1% population sampling survey in 2015. *Chin J Alzheimer's Dis Relat Disord*. (2019) 2:289–98. doi: 10.1111/ggi.13778

12. Zhang YW, Niu YH. The prevalence of cognitive impairment in the elderly in China: a systematic evaluation. *Gerontol Healthcare*. (2021) 27:375–80. doi: 10.3969/j.issn.1008-8296.2021.02.042

13. Ciarmiello A, Tartaglione A, Giovannini E, Riondato M, Giovacchini G, Ferrando O, et al. Amyloid burden identifies neuropsychological phenotypes at increased risk of progression to Alzheimer's disease in mild cognitive impairment patients. *Eu J Nuc Med Mol Imag*. (2019) 46:288–96. doi: 10.1007/s00259-018-4149-2

14. Zhou J. *The Influence of Cognitive Dysfunction in Elderly People in China*. Shenyang: Shenyang Medical College (2021).

15. Okura M, Ogita M, Arai H. Self-reported cognitive impairment predicts adverse health outcomes for community-dwelling older adults based on an analysis of sex and age. *J Nutrition Health Aging*. (2019) 23:654–64. doi: 10.1007/s12603-019-1217-7

16. Sattler C, Toro P, Schönknecht P, Schröder J. Cognitive activity education and socioeconomic status as preventive factors for mild cognitive impairment and Alzheimer's disease. *Psych Res*. (2012) 196:90–5. doi: 10.1016/j.psychres.2011.11.012

17. Lövdén M, Fratiglioni L, Glymour M. M, Lindenberger U, Tucker-Drob EM. Education and cognitive functioning across the life Span. Psychological science in the public interest. *J Am Psychol Soc*. (2020) 21:6–41. doi: 10.1177/1529100620920576

18. Ramos J, Chowdhury A. R, Caywood LJ, Prough M, Denise Fuzzell M, Fuzzell S, et al. Lower levels of education are associated with cognitive impairment in the old order amish. *J Alzheimer's Dis: JAD*. (2021) 79:451–8. doi: 10.3233/JAD-200909

19. Duan H, Sun C, Zhu Y, Liu Q, Du Y, Lin H, et al. Association of dietary habits with mild cognitive impairment among elderly in rural area of North China. *Curr Alzheimer Res*. (2021) 18:256–64. doi: 10.2174/1567205018666210617152205

20. Patrick J. Gallaway Hiroji Miyake. Physical activity: a viable way to reduce the risks of mild cognitive impairment alzheimer's disease and vascular dementia in older adults. *Brain Sci*. (2017) 2:22. doi: 10.3390/brainsci7020022

21. Zou M, Huang J, Zeng Y, Cheng G, Chen C, Li L, et al. Association between systolic blood pressure control and cognitive function in Community-living older adults 65 years and older with hypertension. *Chin J Dis Cont Prevent*. (2021) 11:1282–6. doi: 10.16462/j.cnki.zhjbkz.2021.11.008

22. Miller LM, Peralta CA, Fitzpatrick AL, Wu C, Psaty BM, Newman AB, et al. The role of functional status on the relationship between blood pressure and cognitive decline: the cardiovascular health study. *J Hypertension*. (2019) 37:1790–6. doi: 10.1097/HJH.0000000000002102

23. Abdelhafiz AH, Sinclair AJ. Cognitive impairment in older people with type 2 diabetes mellitus: the central role of hypoglycaemia and the need for prevention. *Curr Diab Rep*. (2019) 19:15. doi: 10.1007/s11892-019-1135-4

24. Liu H, Ma Y, Hu Z, Li X, Li S. Research progress on relationship between diabetes mellitus and cognition disorders. *Pract J Card Cereb Pneumal Vasc Dis*. (2019) 27:4. doi: 10.3969/j.issn.1008-5971.2019.06.001

25. Luo Y, Ye F, Song J, Shao Y, Zhou Y, Chen Y. Influential factors of cognitive dysfunction after ischemic stroke in older patients. *Int J Geriat*. (2022) 8:20–2. doi: 10.3969/j.issn.1674-7593.2022.01.005

26. Sun X. *Correlation Between Obesity and Cognitive Function Related Genes and Their Interaction With Mild Cognitive Impairment*. Yinchuan: Ningxia Medical University (2020).

27. Marengoni A, Fratiglioni L, Bandinelli S, Ferrucci L. Socioeconomic status during lifetime and cognitive impairment no-dementia in late life: the population-based aging in the Chianti Area (InCHIANTI) study. *J Alzheimer's disease JAD*. (2011) 24:559–68. doi: 10.3233/JAD-2011-101863

28. Du W, Jia X, Su C, Wang Z, Wang H, Zhang C, et al. Association between hypertension and mild cognitive impairment among people aged 55 years and above in four provinces of China. *J Environ Occupat Med*. (2021) 38:825–32. doi: 10.13213/j.cnki.jeom.2021.20596

29. Zhao Y, John S, Yang G, John G, Hu P, Hu Y, et al. *China Health and Retirement Longitudinal Study: 2011–2012 National Baseline User's Guide*. Beijing: National School of Development Peking University (2013).

30. Zhao Y, Hu Y, Smith JP, Strauss J, Yang G. Cohort profile: the China health and retirement longitudinal study (CHARLS). *Int J Epidemiol*. (2014) 43:61–8. doi: 10.1093/ije/dys203

31. Crum RM, Anthony JC, Bassett SS, Folstein MF. Population-based norms for the mini-mental state examination by age and educational level. *JAMA*. (1993) 269:2386–91. doi: 10.1001/jama.1993.03500180078038

32. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *J Psych Res*. (1975) 12:189–98. doi: 10.1016/0022-3956(75)90026-6

33. Rovner BW, Folstein MF. Mini-mental state exam in clinical practice. *Hosp Pract*. (1987) 22:99–110.

34. Tombaugh TN, McIntyre NJ. The mini-mental state examination: a comprehensive review. *J Am Geriat Soc*. (1992) 40:922–935. doi: 10.1111/j.1532-5415.1992.tb01992.x

35. Chen W. "Harmony but difference": a comparative study on the concepts of family home community and institutional elderly care. *Soc Sci Guangxi*. (2021) 09:144–50. doi: 10.3969/j.issn.1004-6917.2021.09.018

36. Hwang J, Kim S, Kim S. Gender differences in the impact of depression on cognitive decline among Korean older adults. *Asia Pacific J Public Health*. (2021). 33:67–75. doi: 10.1177/1010539520961715

37. Jia L, Du Y, Chu L, Zhang Z, Li F, Lyu D, et al. Prevalence risk factors and management of dementia and mild cognitive impairment in adults aged 60 years or older in China: a cross-sectional study. iLancet Public Health. (2020) 5:e661–71. doi: 10.1016/S2468-2667(20)30185-7

38. Kong F, Xu L, Kong M, Li S, Zhou C, Zhang J, Ai B. Association between socioeconomic status physical health and need for long-term care among the Chinese elderly. *Int J Environ Res Public Health*. (2019) 16:2124. doi: 10.3390/ijerph16122124

39. Perng CH, Chang YC, Tzang RF. The treatment of cognitive dysfunction in dementia: a multiple treatments meta-analysis. *Psychopharmacology*. (2018). 235:1571–80. doi: 10.1007/s00213-018-4867-y

40. Zhang Q, Wu Y, Han T, Liu E. Changes in cognitive function and risk factors for cognitive impairment of the elderly in China: 2005-2014. *Int J Environ Res Public Health*. (2019) 16:2847. doi: 10.3390/ijerph16162847

41. Xu S, Meng G, Chen P, Fang M, Jin A. Multidimensional intervention in individuals with mild cognitive impairment: a pilot nonrandomized study. Annals Pall Med. (2021) 10:1539–1547. doi: 10.21037/apm-20-346

42. Wang J, Xiao LD, Wang K, Luo Y, Li X. Gender differences in cognitive impairment among rural elderly in China. *Int J Environ Res Public Health*. (2020). 17:3724. doi: 10.3390/ijerph17103724

43. National Bureau of Statistics of PRC. Main Data Bulletin of the Sixth National Population Census in 2010 (No. 1). People's Daily.

44. Sun W. *Study on Labor Flow in China*. Beijing: China Renmin University Press. (2016) 12:317.

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COVID-19-related knowledge influences mental health, self-care behaviors, and quality of life among elderly with non-communicable diseases in Northern Thailand

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Background: A growing body of research shows that individuals with non-communicable diseases (NCDs), such as hypertension, diabetes, hypercholesterolemia, and heart disease, are more likely to suffer from severe COVID-19 and, subsequently, death. The purpose of this study was to assess the influence of COVID-19-related knowledge on mental health, healthcare behaviors, and quality of life among the elderly with NCDs in Northern Thailand.

Methods: In this cross-sectional study, the participants were 450 elderly people with NCDs, living in the Chiang Rai province, Northern Thailand. Random sampling was applied to select the subjects. Data collection included demographic information, COVID-19-related knowledge, healthcare behaviors, the Suanprung Stress Test-20, the Thai General Health Questionnaire (GHQ-28) for the assessment of mental health, and the Thai version of the World Health Organization Quality of Life-BREF.

Results: Almost half of the participants (45.6%) had poor knowledge about COVID-19. More than half of the sample had high stress (52.0%) and a low score in healthcare behaviors (64.9%), while approximately one-third of the participants had mental health problems (34.0%). The overall quality of life during the COVID-19 pandemic was moderate (70.7%). The score of COVID-19-related knowledge was significantly correlated with scores of stress ($r = -0.85$), mental health ($r = -0.74$), healthcare behaviors ($r = 0.50$), and quality of life ($r = 0.33$). Multiple linear regression found that history of COVID-19 detection and COVID-19-related knowledge were associated with scores of stress and quality of life ($p < 0.05$). Multiple logistic regression showed that history of COVID-19 detection (OR = 4.48, 95% CI = 1.45−13.84) and COVID-19-related knowledge (OR = 0.23, 95% CI = 0.17−0.31) were associated with mental health problem ($p < 0.05$).

Discussion: The findings emphasize the importance of COVID-19-related knowledge concerning the improvement of self-care behaviors and quality of life in the elderly population with NCDs during the pandemic, especially due to the high rate of stress and mental health problems documented in our sample. Health education interventions for this vulnerable population should be organized.

Introduction

While the world is still in the grip of Coronavirus disease (COVID-19), crucial efforts have been developed to promote learning from the pandemic response (1). The emergence of COVID-19 has had devastating impacts on the healthcare systems around the world and has become a global public health emergency (1). A large body of evidence has shown that severe morbidity and mortality are linked to COVID-19 increases with age (2). The elderly population is one of the groups most vulnerable to COVID-19 infection (3). The worldwide mortality rate from COVID-19 varies across the globe, with some representative examples being the following: 4.1% in China, 4.6% in Spain, and 2.73% in Italy (1, 4). The COVID-19 mortality rate is the highest among individuals aged 80 or more, ranging from 13 to 16.7%, followed by a rate of 7.2–8.9% among people aged 70–79 (4). If infected, people living with non-communicable diseases (NCDs) are at higher risk than those without NCDs of developing severe COVID-19-related illness and death (5). The COVID-19 mortality rate among elderly people induced changes in this population's daily life and increased the fears concerning COVID-19, causing mental health issues such as stress, anxiety, abnormal sleeping patterns, and depression (6, 7). Previous research has found that fear of COVID-19 and poor economic conditions are predictive factors for quality of life among NCDs (8).

In Thailand, the COVID-19 death rate was high among elderly people with patients with NCDs, such as heart diseases and diabetes with severe symptoms (6). According to the Department of Disease Control of the Ministry of Public Health of Thailand, as of May 14, 2022, 4,373,846 cases of COVID-19 were documented, with a total of 29,472 deaths (mortality rate: 0.67%) (9). When classifying the cumulative number of infections among the elderly Thais, 527,878 cases and 21,043 deaths (71.4%) were recorded, with this age group presenting the highest number of deaths within the general population (9). The Chiang Rai province is located in northern Thailand and has the 11th largest population of elderly in the country (237,979; 18.38%) (10). The group of elderly people has the highest mortality rate, with the cumulative number of infections reaching 1,243 (11.56%) and 114 deaths (56.16%) as of May 15, 2022 (6). In addition, the majority of the elderly people infected with COVID-19 have chronic NCDs such as diabetes, high blood pressure, obesity, chronic obstructive pulmonary disease, ischemic heart disease, stroke, and cancer (11).

NCDs represent a major health care challenge, especially in the case of COVID-19 which preferentially impacts people with underlying diseases (12). Patients with specific chronic diseases, such as diabetes, high blood pressure, cardiovascular diseases, and chronic kidney, and liver disease, are more likely to be affected by COVID-19 (9). In this context, people with NCDs infected with COVID-19 are more likely to present poor clinical outcomes than general patients (13). However, patients with NCDs who are infected with COVID-19 were more likely to develop severe illnesses and subsequently die (13). Many health reports suggest that elderly with COVID-19 present serious health complications, especially those with pre-existing diseases, leading to exacerbation of their physical condition and social isolation (7, 14). Consequently, the prevalence and severity of anxiety, stress, and poor mental health related to COVID-19 among the elderly population have increased exponentially (7). Good perception of health, health knowledge, and healthcare behaviors are important for the aging population, especially during the pandemic, since they help increase health awareness (15, 16). Research on the impact of COVID-19 on elderly people with chronic communicable diseases living in rural areas is limited. Therefore, this study aimed to assess the influence of COVID-19-related knowledge on mental health, self-care behaviors, and quality of life among elderly with NCDs living in rural areas of northern Thailand.

Methodology

Participants and sampling

The data of this cross-sectional study were collected from October to November 2021, in the Janjawa sub-district of the Chiang Rai Province. This community is located ∼30 kilometers from the nearest major urban center, where primary and secondary healthcare systems can be accessed. The population is a diverse mosaic caused by migration. Purposive sampling

was employed using the following criteria: (1) provinces located within Health Zone 1; (2) communities with a large number of elderly people, prone to NCDs including hypertension, diabetes mellitus, chronic kidney disease, and stroke; (3) areas affected by the COVID-19 pandemic, where the group of elderly people with health problems further impacted by COVID-19; and (4) local government administrators willing to cooperate with the research team.

Random sampling was employed to select the participants from the list of elderly patients with chronic NCDs registered in the sub-district of Health Promoting Hospital and the community health center program (Java Health Center Information System) during the years 2020–2022. The sample size was calculated using the unknown sample size formula (17), applying a 95% confidence interval (CI) and 5% error level. An additional 10% increase in the sample size led to the recruitment of 450 patients. The inclusion criteria were the following: (1) elderly females and males aged above 60; (2) residents of the research area for at least 1 year, registered in the municipal catalogs; (3) being diagnosed with chronic NCDs (e.g., high blood pressure, diabetes mellitus, heart diseases, and chronic kidney disease) by a medical doctor and receiving health services in the Java Health Center Information System program from 2018 to 2020; (4) being able to communicate in a local language; and (5) signing a written consent form to voluntarily participate in the research. Patients with cognitive and psychological disorders or gestational diabetes were excluded from the study. Five research assistants able to communicate in the local northern language, who served as public health scholars and village health volunteers, were recruited after a public call. A research meeting was organized to clarify the purposes of the study, the data collection technique, the interview procedures, the administration of the questionnaires, the schedule of the interviews, and the rights and privacy of the research participants. The researcher ensured that everyone understood the procedures in the same direction. The questions and interview details were translated from the official language to the local northern language for the optimal understanding of the research questions. An official request was sent to the local Public Health Office asking for permission to conduct the study that was performed during the third wave of COVID-19 in Thailand, requiring authorization by the local government agency and the village headman. All participants complied with the government prevention measures against COVID-19. The data were collected at the local care facility (sub-district Health Promoting Hospital) on the day of clinic visits for patients with chronic NCDs (Monday-Wednesday-Friday) from 9:00 a.m. to 5:00 p.m. or at any other time convenient for the patients. The questionnaires were provided during a presential interview that lasted ~30–45 min per person. A small token of appreciation was given to the participants after completing the survey.

Measurements

The first part of the questionnaire included the following socio-demographic information: general information (gender, age, marital status, education, occupation, income) and health status (NCD-related health complications, smoking status, alcohol consumption, medication, history of COVID-19, health care services, caregiver, and health information). For the 2–5 questionnaires, the questions were adapted to be suitable for elderly populations of rural contexts based on previous research. As for knowledge related to COVID-19, the questionnaire included 12 items (e.g., "COVID-19 can cause death", "all patients infected with COVID-19 will have a fever", etc.) (9, 18). Only one of the three possible answers, "Yes", "No", and "Unknown", could be chosen. The score was 1 point for each correct answer and 0 points for each wrong answer or the "Unknown" option. The scores were divided into three categories: a score range of 80–100% was considered "good knowledge", 60–79% indicated "moderate knowledge", and a score range of 0–59% percent was considered "poor knowledge".

Stress was evaluated with the Suanprung Stress Test questionnaire which consists of 20 items (19). The items assess events that occurred during the past 6 months. The scores were measured on a 5-point scale (1: "no stress"; 2: "mild stress"; 3: "moderate stress"; 4: "a lot of stress"; 5: "extreme stress"). The total scores were used to define four categories: low stress (0–24), moderate stress (25–42), high stress (43–62), and severe stress (equal to or above 63).

The Thai version of the General Health Questionnaire (GHQ-28) consists of 28 items (20) that assess the inability to live in normal conditions and distress-causing problems deriving from a personal abnormal condition (21). The questionnaire does not determine a specific psychiatric disorder (21). Four components are measured using seven items per component: somatic symptoms, anxiety and insomnia, social dysfunction, and severe depression. The participants answered the questions regarding their feelings toward the given statements (both positive and negative) on a 4-point scale, where 1 corresponded to "It doesn't represent me at all", 2 corresponded to "It represents me/happens to me sometimes", 3 corresponded to "It represents me/happens to me often", and 4 corresponded to "It happens to/represents me very often". Answers 1 and 2 were scored 0 and answers 3 and 4 were scored 1 with a total of 28 points. A total score of 6 or higher was considered representative of a mental health problem.

The self-care behaviors questionnaire was adapted to be suitable for elderly people from previous research (18, 22, 23). It consisted of 24 items about mask-wearing behavior, hand-washing behavior, and social distancing behavior. The items were rated as follows: "never" (0 times/week), "sometimes" (1–4 times/week), and "regularly" (≥5 times/week). The total score was used to define the three categories: "high scores" (≥80% or

TABLE 1 General characteristics of participants (*n* = 450).

Variables	*n* (%)
Sex	
Male	198 (44. %)
Female	252 (56. %)
Age (years)	
60–69	250 (55.6%)
70–79	144 (32.0%)
≥80	56 (12.4%)
Mean ± SD	69.42 ± 7.06
Min.–Max.	60–97
Marital status	
Married	267 (59.3%)
Single/widowed/separated	183 (40.7%)
Education	
No	156 (34.7%)
Yes	294 (65.3%)
Occupation	
No	234 (52.0%)
Yes	216 (48.0%)
Financial status	
Insufficient	177 (39.3%)
Sufficient	273 (60.7%)
Smoking	
No	420 (93.3%)
Yes	30 (6.7%)
Drinking alcohol	
No	354 (78.7 %)
Yes	96 (21.3%)
Complication	
1 disease	215 (47.8%)
2 diseases	167 (37.1%)
3 diseases	68 (15.1%)
Type of disease	
Hypertension	344 (76.4%)
Diabetes mellitus	172 (38.2%)
Dyslipidemia	194 (43.1%)
Heart disease	22 (4.9%)
Other (COPD, Tuberculosis, Gout)	21 (4.7%)
Duration of received treatment	
0–5	183 (40.7%)
6–10	183 (39.3%)
≥10	183 (20.0%)
Mean ± SD	8.34 ± 0.25
Min.–Max.	1–30
Visiting a doctor by appointment	
No	389 (86.4%)
Yes	61 (13.6%)
Visiting a doctor in case of illness	

(Continued)

TABLE 1 (Continued)

Variables	*n* (%)
No	28 (6.2%)
Yes	422 (93.8%)
Getting COVID-19 information	
Family	346 (76.9%)
Television/Radio	326 (72.4%)
Volunteer	319 (70.9%)
Social media	186 (41.3%)
Staff	164 (36.4%)
Poster/Placard	20 (4.4%)
RT-PCR test for COVID-19	
Ever with negative	240 (53.3%)
Ever with positive	138 (30.7%)
Never	72 (16.0%)
COVID-19 knowledge	
Low level (scores 0–7)	205 (45.6%)
Moderate level (scores 8–9)	157 (34.9%)
High level (scores 10–12)	88 (19.5%)
Stress level	
Mild level (scores 0–24)	75 (16.7%)
Moderate level (scores 25–42)	141 (31.3%)
High level (scores 43–62)	89 (19.8%)
Severe level (scores 63–100)	145 (32.2%)
Self-care behaviors	
Low level (scores 24–43)	292 (64.9%)
Moderate level (scores 44–56)	42 (9.3%)
High level (scores 57–72)	116 (25.8%)
Mental health problem	
No (scores < 6)	297 (66.0%)
Yes (scores ≥ 6)	153 (34.0%)
Quality of life	
Low level (scores 26–60)	98 (21.8%)
Moderate level (scores 61–95)	318 (70.7%)
High level (scores 96–130)	34 (7.5%)

≥ 57 points), "moderate scores" (60%−79% or 44–56 points), and "low scores" (<60% or ≤ 43 points).

The short version of the Quality of Life Assessment Scale developed by the World Health Organization translated to Thai (24, 25) was used. It consists of 26 items corresponding to four domains: physical health (7 items), psychological health (6 items), social relationships (3 items), and environmental health (8 items). Each item can be responded in a 1–5 scale. The total scores defined the three following categories: "poor quality of life" (score: 26–60), "moderate quality of life" (score: 61–95), and "good quality of life" (score: 96–130).

All the questionnaires were tested for content validity by three experts in their respective fields (i.e., internal medicine,

TABLE 2 Correlation between COVID-19 knowledge, stress, mental health, self-care behaviors, and quality of life among elderly patients with non-communicable diseases.

Factor	Mean ± SD	Range	1	2	3	4	5
1. COVID-19 knowledge (scores)	7.52 ± 2.20	1–12	1				
2. Stress (scores)	46.76 ± 21.48	3–96	−0.846**	1			
3. Mental health (scores)	4.54 ± 5.02	0–23	−0.743**	−0.849**	1		
4. Self-care behaviors (scores)	42.68 ± 13.67	27–71	0.500**	−0.650**	−0.581**	1	
5. Quality of life (scores)	76.92–14.86	32–112	0.332**	−0.391**	−0.419**	0.298**	1

**Significant at the 0.01 level (2-tailed).

behavioral health, and elderly nursing). The questionnaires were technically validated using the item-objective congruence score, where questions with a score ≤ 0.5 are eliminated, questions with a score of 0.5–0.69 are revised based on the experts' comments and feedback, and questions with a score equal to or above 0.7 are considered acceptable for data collection. The questionnaires passed a preliminary check with a test sample (N = 30) with similar characteristics to the study samples and the study area. The reliability of all the questionnaires except for the socio-demographic information questionnaire was tested with Cronbach's alpha coefficient, resulting in 0.77, 0.73, 0.79, 0.90, and 0.86, respectively.

Statistical analysis

Statistical analysis was performed using the SPSS software (SPSS Inc., Chicago, IL, USA). The general information was described using mean, standard deviation (SD), minimum (Min), maximum (Max), frequency, and percentage. The Pearson correlation coefficient (r) was used to examine the correlation between COVID-19 knowledge score and outcomes, including scores of stress, mental health, self-care behaviors, and quality of life among elderly with NCD. Multiple linear regression was used to investigate factors associated with stress, self-care behaviors, and quality of life. Multiple logistic regression was also used to determine the outcome of a mental health problem. The final multivariable model was presented, in which all factors were found to be significant at the 0.05 level.

Results

As for the demographic information (Table 1), the majority of the participants were women (56.0%) with a mean age of 69.42 (SD = 7.06). More than half of the sample were married (59.3%), educated (65.3%), unemployed (52.0%), and with sufficient income (60.7%). Regarding the health status data, almost all of them had never smoked (93.3%) and did not drink alcohol (78.7%). The sample had the following NCDs: hypertension (76.4%), diabetes mellitus (38.2%), dyslipidemia

(43.1%), heart disease (4.9%), or other diseases such as COPD, tuberculosis, and gout (4.7%). As for comorbidities, almost half of them (47.8%) reported having one disease, two-thirds (37.1%) reported having two diseases, and less than one-fifth of the sample (15.1%) reported suffering from more than three diseases. The average treatment duration was 8.34 years (SD = 0.25). During the COVID-19 pandemic, about 13.6% of the participants visited a doctor at a hospital or according to the scheduled appointment. On the occasion of an illness, most of them (93.8%) reported visiting a doctor despite government measures. In terms of information about COVID-19, they reported receiving information from family members (76.9%), the television/radio (72.4%), health volunteers (70.9%), social media (41.3%), staff (36.4%), and posters (4.4%). Additionally, most of them (86.0%) had had access to an RT-PCR test for COVID-19.

The mean score of COVID-19-related knowledge was 7.52 (SD = 2.2). The participants had low and moderate knowledge scores (45.6, 34.9%), followed by high scores (19.5%). Two-thirds of the sample presented severe (32.2 %) or moderate (31.3%) stress, while less than one-fifth fell into the categories of high (19.8%) or low (16.7%) stress (Mean = 46.76; SD = 21.48). According to the Thai GHQ-28, 34% of the participants presented mental health problems (Mean = 4.54, SD = 5.02). Regarding self-care behaviors, 64.9% of the sample reported a low level of self-care behaviors, followed by a high (25.8%) or moderate (9.3%) level (Mean = 42.68, SD = 13.67). As for the quality of life, 70.7% had a moderate quality of life, followed by low (21.8%) and high (7.6%) quality of life (Mean = 76.92, SD = 14.86) (Tables 1, 2). The results of the Pearson correlation analysis are presented in Table 2. Statistically significant associations were found between the knowledge score and the scores corresponding to stress (r = −0.846, p < 0.001), mental health (r = −0.743, p < 0.001), self-care behaviors (r = 0.500, p < 0.001), and quality of life (r = 0.332, p < 0.001).

Table 3 presents the variables duration of the received treatment, hypertension, RT-PCR test for COVID-19, visiting a doctor in case of illness, and COVID-19-related knowledge that were significantly associated with the stress scores (R^2 = 73.4%, $p < 0.05$). Interestingly, gender, hypertension,

TABLE 3 Association between the COVID-19 knowledge influencing stress, self-care behaviors, and quality of life among elderly with NCD by multiple linear regression.

Outcome	Factor	B	S.E.	Beta	P-value	95% CI	VIF
Stress	Constant	113.284	3.60		< 0.001	106.21, 120.35	
	Duration of received treatment (5-years)	−1.935	0.72	−0.068	0.007	−3.34, −0.52	1.051
	Hypertension (yes)	1.895	1.08	0.044	0.081	−0.24, 4.02	1.045
	RT-PCR test for COVID-19						
	Ever with negative	−0.344	1.30	−0.008	0.793	−2.91, 2.226	1.539
	Ever with positive	6.601	1.83	0.113	< 0.001	3.00, 10.19	1.628
	Never	Ref.					
	Visiting a doctor in case of illness (yes)	−4.703	2.24	−0.053	0.037	−9.11, −0.29	1.065
	COVID-19 Knowledge (score)	−8.020	0.27	−0.823	< 0.001	−8.55, −7.48	1.284
Self-care behaviors							
	(Constant)	20.537	2.75		< 0.001	15.14, 25.93	
	Gender (female)	−2.368	1.11	−0.086	0.034	−4.55, −0.18	1.017
	Hypertension (yes)	−3.007	1.34	−0.093	0.025	−5.64, −0.37	1.080
	Dyslipidemia (yes)	−3.389	1.13	−0.123	0.003	−5.61, −1.16	1.052
	Heart disease (yes)	−7.263	2.67	−0.115	0.007	−12.52, −2.00	1.111
	Duration of received treatment (5-years)	1.776	0.74	0.098	0.017	0.32, 3.23	1.034
	COVID-19 Knowledge (score)	3.243	0.25	0.523	< 0.001	2.75, 3.73	1.026
Quality of life	(Constant)	73.561	4.10		< 0.001	65.50, 81.61	1.317
	Diabetes mellitus (yes)	−4.293	1.38	−0.141	0.002	−7.01, −1.57	1.215
	Hypertension (yes)	−4.288	1.52	−0.123	0.005	−7.28, −1.30	1.130
	Dyslipidemia (yes)	−3.522	1.25	−0.118	0.005	−5.99, −1.05	1.157
	Heart disease (yes)	−5.830	2.92	−0.085	0.047	−11.58, −0.08	1.157
	RT-PCR test for COVID-19						
	Ever with negative	1.972	1.57	0.066	0.210	−1.12, 5.06	1.788
	Ever with positive	−12.639	2.16	−0.312	< 0.001	−16.90, −8.37	1.840
	Never	Ref.					
	Visiting a doctor by appointment (yes)	4.285	1.85	0.099	0.021	0.63, 7.93	1.175
	Visiting a doctor in case of illness (yes)	4.204	2.51	0.068	0.095	−0.74, 9.14	1.075
	COVID-19 knowledge (score)	1.437	0.30	0.213	< 0.001	0.85, 2.03	1.280

B, unstandardized coefficients; S.E., standard error; Beta, standardized coefficients; 95% CI, 95% confidence interval; VIF, variance inflation factor; Ref., reference group.

dyslipidemia, heart diseases, duration of the received treatment, and COVID-19-related knowledge were significantly associated with self-care behaviors ($R^2 = 28.8\%$, $p < 0.05$). Moreover, diabetes mellitus, hypertension, dyslipidemia, heart disease, RT-PCR test for COVID-19, visiting a doctor by appointment, visiting a doctor in case of illness, and COVID-19-related knowledge were significantly correlated with quality of life ($R^2 = 31.4\%$, $p < 0.05$). The logistic regression analysis revealed that married status (OR = 2.30, 95% CI = 1.14–4.64), alcohol consumption (OR = 0.30, 95% CI = 0.11–0.81), duration of the received treatment every 5 years (OR = 0.55, 95% CI = 0.36–0.86), history of COVID-19 detection (OR = 4.48, 95% CI = 1.45–13.84), and COVID-19-related knowledge (OR = 0.23, 95% CI = 0.17–0.31) were significantly associated with mental health problem ($p < 0.05$) (Table 4).

Discussion

Our results showed that the majority of the sample had low to moderate COVID-19-related knowledge scores, confirming Bandura's (26) concept that individual learning affects behavioral change. Highly believing in one's abilities results in a better prediction of the outcome (26). Additionally, environmental factors play an important role in determining individual behaviors (23). Knowledge is associated with individual behaviors (27) and is essential to healthcare since its correct and useful application leads to self-awareness of health conditions (28). Moderate knowledge related to COVID-19 is associated with prevention behaviors (23). In the context of COVID-19 prevention, elderly people with low levels of health literacy living in rural areas presented a detrimental health status (28). Similar to the present study, it has been shown that elderly

TABLE 4 Association between the COVID-19 knowledge and mental health problem by multiple logistic regression.

Factor	B	S.E.	*P*-value	OR	95% CI
Constant	10.553	1.35	< 0.001	38283.29	
Marital status (married)	0.833	0.35	0.020	2.30	1.14,4.64
Drinking alcohol (yes)	−1.197	0.50	0.018	0.30	0.11,0.81
Duration of received treatment (5-years)	−0.589	0.22	0.009	0.55	0.36,0.86
RT-PCR test for COVID-19			< 0.001		
Ever with negative	−0.523	0.44	0.239	0.59	0.25,1.41
Ever with positive	1.500	0.57	0.009	4.48	1.45,13.84
Never	Ref.				
COVID-19 knowledge (score)	−1.480	0.15	< 0.001	0.23	0.17,0.31

B, regression coefficient; S.E., standard error; OR, odds ratio; 95%CI, 95% confidence; Ref., reference group.

people with chronic diseases have a low level of knowledge regarding the spread, common symptoms, prevention, and control of COVID-19 (28). However, in China, elderly people with NCDs such as diabetes and hypertension had variable levels of knowledge, possibly due to socio-demographic factors (29, 30).

In terms of stress, we found that more than half of the participants had moderate to severe stress. One possible explanation is the experience of three pandemic waves in the area with strict government measures against COVID-19 and suspension of traveling. Consistent with our findings, during the COVID-19 pandemic, stress and anxiety levels increased, especially among NCD patients (1, 31). The COVID-19 pandemic has disrupted almost every aspect of life and presents a unique threat to the physical and emotional wellbeing of the elderly, with a major portion of them having experienced moderate or severe health effects due to COVID-19 (32). According to the 2019 Thai Mental Health Data Report, where the vast majority of Thai people reported problems originating in stressful situations, age correlated with stress and anxiety (33). In line with this, it has been shown that elderly people experience stress that affects their daily life, with subsequent negative impacts on their physical and psychological health (34).

COVID-19 has resulted in severe mental issues, especially among the elderly with chronic illnesses (35). Here, one-third of the participants presented mental health problems as evaluated with GHQ-28 (scores ≥ 6 in 34% of the sample). This is probably due to the period of the assessment, which coincided with the third wave of COVID-19. With aging, physical functions decline, causing a higher risk of NCDs among older age groups. During the first lockdown, NCD patients in Europe and the United States experienced mental health problems (36). COVID-19 survivors and 60% of the controls presented pathologies as evaluated with GHQ-28 and anxiety as evaluated with the GAS-10 scale (37). In a recent study (38), nearly 40% of the elderly participants reported having mental health problems as a result of the COVID-19 pandemic. In another report (39),

more than half of the participants (52.1%) felt fear and anxiety due to the COVID-19 outbreak. The pandemic caused long- and short-term psychological distress in the elderly population, potentially affecting their quality of life (40).

COVID-19 has become an ongoing crisis, significantly affecting the quality of life of all populations (41). Most of the participants (70.7%) obtained moderate scores in the quality of life assessment. Quality of life is negatively correlated with stress and mental health. A recent systematic review (42) indicated that quality of life deteriorated during the COVID-19 outbreak, especially among elderly people with NCDs. In another study, the majority of the participants had moderate scores of quality of life due to a decline in physical functioning and limitations concerning daily activities (43). In Turkey, at-risk populations had poorer quality of life during the pandemic, depending on their demographic background, medical condition, and psychological factors (44). Here, COVID-19-related knowledge, stress, mental health, and healthcare behaviors were associated with quality of life in elderly patients with NCDs.

The pandemic, being a global public health emergency, severely impacted the healthcare system worldwide (1), a situation that inevitably affects physical and psychological health, especially among elderly people (45). In the present study, time until receiving treatment, NCDs, RT-PCR tests for COVID-19, receiving medical services ("When you have symptoms, you can go to the doctor immediately"), and COVID-19-related knowledge were associated with stress. Moreover, this was a predictor of COVID-19-induced stress. Elderly people with underlying medical conditions experienced high levels of stress after the COVID-19 outbreak. Due to government-issued restrictions on traveling, limitation of the number of patients per day receiving health services, and social distancing, elderly people with NCDs did not receive health and medical services in time (9). Postponing such services led to the worsening of their chronic health conditions. The pandemic has hindered access to medical services and public transportation, especially for the elderly (46). Some reports described emergency

cases of chronic NCD patients that did not receive the necessary health services (46, 47). Many patients report facing difficulties to access routine medical care and receive medication or health screenings, situations that cause anxiety and stress about their health condition (31).

The variables of gender, hypertension, dyslipidemia, heart disease, time until receiving treatment, and COVID-19-related knowledge significantly correlated with self-care behaviors. Importantly, these variables were predictors of self-care behaviors during COVID-19 for ∼28% of the elderly with congenital diseases. In our study, most of the participants had low levels of self-care behaviors. This might be due to their age, when self-care behaviors are diminished, especially among chronic NCD patients, since underlying diseases affect daily life functionality (43). This is consistent with the concept that self-care behaviors arise from a learning process obtained from many components such as genetics, health status, the social environment, and individual experiences that influence self-care performance. An individual can achieve better health behaviors when relevant goals are set (26). In this context, a study with Indian populations found that moderate knowledge about COVID-19 resulted in relatively poor prophylactic behaviors (48). Additionally, the knowledge level has been linked to healthcare behaviors in hypertensive patients (49). Consistently, a systematic review suggested that knowledge affects self-care behaviors among elderly people (50). Therefore, programs that promote health-related behaviors can succeed if they include knowledge and prevention of risk factors (50).

Most of the inevitable health problems of chronic NCDs, for example, cancer, high blood pressure, osteoporosis, and diabetes, lead to reduced quality of life (51). It has been found that hypertension, dyslipidemia, and heart disease negatively correlate with self-care behaviors (52). In our study, diabetes mellitus, hypertension, dyslipidemia, heart diseases, RT-PCR tests for COVID-19, the statements "visiting a doctor to receive health services after an appointment" or "when you are sick, you immediately visit the doctor", and COVID-19-related knowledge correlated with quality of life with a coefficient of multiple determination equal to 73.561. Furthermore, these variables were predictors of quality of life during COVID-19 (31.4%). Our findings are consistent with previous studies, where elderly with comorbidities and moderate depression experienced health-related deterioration of quality of life during the COVID-19 pandemic (14), especially in places where telemedicine was not accessible (53). The presence of underlying diseases was a major factor associated with quality of life. Moreover, congenital diseases, such as high blood pressure and diabetes, worsen elderly populations' lives (49), since health problems are linked to low quality of life in old age (53).

We found that alcohol consumption, time until receiving treatment, RT-PCR tests for COVID-19, and COVID-19-related knowledge significantly correlated with mental health. The knowledge scores were negatively associated with mental health.

A person with a low level of knowledge may experience mental health disorders. Certain situations affect the commitment to practice healthcare behaviors. Thoughts and emotions (cognitive behaviors) can be adjusted to the environment that drives the motivation to perform such behaviors, depending on individual knowledge and experience (54, 55). Personal factors influence individuals' behaviors (55). It was documented that during the COVID-19 outbreak, anxiety in the elderly populations originated in pessimistic attitudes concerning mental health (56). Increased smoking and alcohol consumption during COVID-19 has been documented (57, 58).

This study has several limitations. First, the findings of this study were obtained from a cross-sectional design. Therefore, official mental health screening tests are necessary. In this context, the diagnosis of specific mental health disorders cannot be conducted through the information obtained from the questionnaires, since this requires a medical examination. Second, the third wave of COVID-19 in the area caused an increase in the number of infections, resulting in high scores of stress and mental health issues. The conclusions related to these variables should be considered with caution, taking into account the dynamics of COVID-19 and its consequences. Finally, the sample composition (elderly people with chronic NCDs, living in rural areas of northern Thailand) is very specific, and long-term studies are needed to confirm our results. In the future, research should focus on the needs of the elderly with chronic NCDs at the individual and community levels to provide solutions for the prevention and rehabilitation of mental health problems appropriate for the rural context of northern Thailand.

Conclusion

The findings of this study suggest that the COVID-19 pandemic has had detrimental effects on elderly people with chronic NCDs. COVID-19-related knowledge positively correlated with healthcare behaviors and quality of life. Interestingly, several personal factors and COVID-19-related knowledge were associated with mental health during the third wave of the pandemic in rural areas of northern Thailand. This population faces multiple challenges concerning their physical and psychological health, as well as financial problems. Therefore, educational programs focusing on the severity of the disease, health complications, infectious diseases, and other emergencies are indispensable to improve health awareness and appropriate healthcare behaviors. Additionally, mental health support, stress management, accessible scheduled check-ups, health services, and medication are essential to the treatment of elderly people with NCDs and should be considered in relevant educational programs. Community stakeholders and policymakers should collaborate to address barriers and challenges to provide a timely, high-quality mental health service system to the aging population living in rural contexts and in accordance with their social culture.

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 University of Phayao Human Ethics Committee, Thailand (UP-HEC-1.3/057/64). The patients/participants provided their written informed consent to participate in this study.

Author contributions

All authors made substantial contributions to conception and design, data analysis, interpretation, involved in data collection, drafting the manuscript, revising it critically for important intellectual content, and given final approval of the version to be published. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors contributed to the article and approved the submitted version.

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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References

1. World Health Organization. *2019-nCoV Outbreak is an Emergency of International Concern.* (2020). Available online at: http://www.euro.who.int/en/health-topics/emergencies/pages/news/news/2020/01/2019-ncov-outbreakis-an-emergency-of-international-concern (accessed January 31, 2022).

2. Bidzan-Bluma I, Bidzan M, Jurek P, Bidzan L, Knietzsch J, Stueck M, et al. A polish and German population study of quality of life, well-being, and life satisfaction in older adults during the COVID-19 pandemic. *FrontPsychiatry.* (2020) 11:585813. doi: 10.3389/fpsyt.2020.585813

3. Chen X, Wang SB, Li XL, Huang ZH, Tan WY, Lin HC, et al. Relationship between sleep duration and sociodemographic characteristics, mental health and chronic diseases in individuals aged from 18 to 85 years old in Guangdong province in China: a population-based cross-sectional study. *BMC Psychiatry.* (2020) 20:455. doi: 10.1186/s12888-020-02866-9

4. World Health Organization. *Estimating Mortality From COVID-19: Scientific Brief, 4th August 2020.* Geneva: World Health Organization. (2020). Available online at: https://www.who.int/publications/i/item/WHO-2019-nCoV-Sci-Brief-Mortality-2020.1 (accessed January 31, 2022).

5. World Health Organization. *NCDs, Mental Health and COVID-19. Departmental News.* Geneva: World Health Organization (2020).

6. Shigute Z, Mebratie AD, Alemu G, Bedi A. Containing the spread of COVID-19 in Ethiopia. *J Global Health.* (2020) 10:010369. doi: 10.7189/jogh.10.010369

7. Lebrasseur A, Fortin-Bédard N, Lettre J, Raymond E, Bussières EL, Lapierre N, et al. Impact of the COVID-19 pandemic on older adults: rapid review. *JMIR Aging.* (2021) 4:e26474. doi: 10.2196/26474

8. Khorani H, Mohammadi F, Hosseinkhani Z, Motalebi SA. Predictive factors of Quality of Life in older adults during the COVID-19 pandemic. *BMC Psychol.* (2022) 10:176. doi: 10.1186/s40359-022-00882-w

9. Department of Disease Control Ministry of Public Health. *Situation of Covid-19 in Thailand.* (2022). Available online at: https://203.157.41.186/t/sat-covid/views/SATCOVIDDashboard/7-dash-scoreboard?%3Aembed=y&%3AisGuestRedirectFromVizportal=y (accessed May 14, 2022).

10. Department of Older Persons. *Statistics of the Elderly in Thailand, 77 Provinces.* (2021). Available online at: https://www.dop.go.th/th/know/side/1/1/335 (accessed July 24, 2021).

11. Chiang Rai Provincial Public Health Office. *Covid-19 Situation in Chiang Rai Province, Thailand: Department of Disease Control Ministry of Public Health.* (2022). Available online at: https://cro.moph.go.th/moph/index.php (accessed January 31, 2022).

12. Bojola F, Taye W, Samuel H, Mulatu B, Kawza A, Mekuria A. Non-communicable diseases (NCDs) and vulnerability to COVID-19: the case of adult patients with hypertension or diabetes mellitus in Gamo, Gofa, and South Omo zones in Southern Ethiopia. *PLoS ONE.* (2022) 17:e0262642. doi: 10.1371/journal.pone.0262642

13. Nikoloski Z, Alqunaibet AM, Alfawaz RA, Almudarra SS, Herbst CH, El-Saharty S, et al. Covid-19 and non-communicable diseases: evidence from a systematic literature review. *BMC Public Health.* (2021) 21:1068. doi: 10.1186/s12889-021-11116-w

14. Levkovich I, Shinan-Altman S, Essar Schvartz N, Alperin M. Depression and health-related quality of life among elderly patients during the COVID-19 pandemic in israel: a cross-sectional study. *J Prim Care Community Health.* (2021) 12:2150132721995448. doi: 10.1177/2150132721995448

15. Chinn D. Critical health literacy: a review and critical analysis. *Soc Sci Med.* (2011) 73:60–7. doi: 10.1016/j.socscimed.2011.04.004

16. Sørensen K, Van den Broucke S, Fullam J, Doyle G, Pelikan J, Slonska Z, et al. Health literacy and public health: a systematic review and integration of definitions and models. *BMC Public Health.* (2012) 12:80. doi: 10.1186/1471-2458-12-80

17. Cochran WG. *Sampling Techniques.* 3rd ed. New York, NY: John Wiley & Sons (1977).

18. Al Ahdab S. A cross-sectional survey of knowledge, attitude and practice (KAP) towards COVID-19 pandemic among the Syrian residents. *BMC Public Health.* (2021) 21:296. doi: 10.1186/s12889-021-10353-3

19. Mahatnirunkul S, Phumphaisarn W, Thapunya P. *Suanprung Stress Test-20 (SPST-20).* (2002). Available online at: https://la.mahidol.ac.th/th/wp-content/uploads/2019/09/article_20170504171136.pdf (accessed January 31, 2022).

20. Nilchaikovit T, Sukying C, Silpakit C. Reliability and validity of the Thai version of the General Health Questionaire (in Thai). *J Psychiatr Assoc Thailand.* (1996) 41:2–1.

21. Srisatapor T, Ruamcharoencha T, Boonyapanichkul P, Srijaroentham S, Wiangnon R, Weeraphan W, et al. Prevalence of subjective health complaints among medical students, Khon Kaen University (in Thai). *Srinagarind Med J.* (2012) 27:258–66. Available online at: https://li01.tci-thaijo.org/index.php/SRIMEDJ/article/view/11144

22. Orem DE. *Nursing: Concepts of Practice.* 3rd ed. New York, NY: McGraw-hill (1985).

23. Pothisa T, Ong-Artborirak P, Seangpraw K, Tonchoy P, Kantow S, Auttama N, et al. Knowledge of COVID-19 and its relationship with preventive behaviors and vaccination among adults in Northern Thailand's Community. *Int J Environ Res Public Health.* (2022) 19:1521. doi: 10.3390/ijerph19031521

24. THE WHOQOL GROUP. Development of the World Health Organization WHOQOL-BREF quality of life assessment. *Psychol Med.* (1998) 28:551–8. doi: 10.1017/S0033291798006667

25. Mahatnirunkul S, Tuntipivatanaskul W, Pumpisanchai W. Comparison of the WHOQOL-100 and the WHOQOLBREF (26 items). *J Ment Health Thai.* (1998) 5:4–15.

26. Bandura A. Self-efficacy: towards a unifying theory of behavior change. *Psychol Rev.* (1977) 84:191–215. doi: 10.1037/0033-295X.84.2.191

27. Schwartz NE. Nutrition knowledge, attitudes and practices of Canadian public health nurses. *J Nutr Educ.* (1976) 8:28–31. doi: 10.1016/S0022-3182(76)80113-6

28. Vicerra PMM. Knowledge-behavior Gap on COVID-19 among older people in Rural Thailand. *Gerontol Geriatr Med.* (2021) 7:2333721421997207. doi: 10.1177/2333721421997207

29. Lee M, Kang BA, You M. Knowledge, attitudes, and practices (KAP) toward COVID-19: a cross-sectional study in South Korea. *BMC Public Health.* (2021) 21:295. doi: 10.1186/s12889-021-10285-y

30. de Lima Filho BF, Bessa NPOS, Fernandes ACT, da Silva Patrício ÍF, de Oliveira Alves N, da Costa Cavalcanti FA. Knowledge levels among elderly people with Diabetes Mellitus concerning COVID-19: an educational intervention via a teleservice. *Acta Diabetol.* (2021) 58:19–24. doi: 10.1007/s00592-020-01580-y

31. Devi R, Goodyear-Smith F, Subramaniam K, McCormack J, Calder A, Parag V, et al. The impact of COVID-19 on the care of patients with noncommunicable diseases in low- and middle-income countries: an online survey of patient perspectives. *J Patient Exp.* (2021) 8:23743735211034091. doi: 10.1177/23743735211034091

32. Srifuengfung M, Thana-Udom K, Ratta-Apha W, Chulakadabba S, Sanguanpanich N, Viravan N. Impact of the COVID-19 pandemic on older adults living in long-term care centers in Thailand, and risk factors for post-traumatic stress, depression, and anxiety. *J Affect Disord.* (2021) 295:353–65. doi: 10.1016/j.jad.2021.08.044

33. Department of Health. *Bureau of Elderly Health Annual Report 2020 (Thai). Bureau of Elderly Health, Ministry of Public Health 2020.* (2020). Available online at: https://eh.anamai.moph.go.th/web-upload/10x2f8665bc5c6742a30312c81435ca284e/filecenter/Annual%20report%20file/Annual%20report%202020.pdf (accessed January 31, 2022).

34. de Frias CM, Whyne E. Stress on health-related quality of life in older adults: the protective nature of mindfulness. *Aging Ment Health.* (2015) 19:201–6. doi: 10.1080/13607863.2014.924090

35. UNFPA. *Implications of COVID-19 for Older Persons: Responding to the Pandemic. UNFPA Global Technical Brief.* (2020). Available online at: https://www.unfpa.org/resources/implications-covid-19-older-persons-responding-pandemic (accessed January 31, 2022).

36. Pécout C, Pain E, Chekroun M, Champeix C, Kulak C, Prieto R, et al. Impact of the COVID-19 pandemic on patients affected by non-communicable diseases in Europe and in the USA. *Int J Environ Res Public Health.* (2021) 18:6697. doi: 10.3390/ijerph18136697

37. Mowla A, Ghaedsharaf M, Pani A. Psychopathology in elderly COVID-19 survivors and controls. *J Geriatr Psychiatry Neurol.* (2021) 35:467–71. doi: 10.1177/08919887211002664

38. Bailey L, Ward M, DiCosimo A, Baunta S, Cunningham C, Romero-Ortuno R, et al. Physical and mental health of older people while cocooning during the COVID-19 pandemic. *QJM.* (2021) 114:648–53. doi: 10.1093/qjmed/hcab015

39. Zhang Y, Ma ZF. Impact of the COVID-19 pandemic on mental health and quality of life among local residents in Liaoning Province, China: a cross-sectional study. *Int J Environ Res Public Health.* (2020) 17:2381. doi: 10.3390/ijerph17072381

40. Khan AG, Kamruzzaman M, Rahman MN, Mahmood M, Uddin MA. Quality of life in the COVID-19 outbreak: influence of psychological distress, government strategies, social distancing, and emotional recovery. *Heliyon.* (2021) 7:e06407. doi: 10.1016/j.heliyon.2021.e06407

41. Alrashed FA, Sattar K, Ahmad T, Akram A, Karim SI, Alsubiheen AM. Prevalence of insomnia and related psychological factors with coping strategies among medical students in clinical years during the COVID-19 pandemic. *Saudi J Biol Sci.* (2021) 28:6508–14. doi: 10.1016/j.sjbs.2021.07.022

42. Oliveira AKBD, Araújo MSD, Alves SFL, Rocha LDB, Da Silva ML, Rocha RSB, et al. Quality of life and social distancing: systematic review of literature. *Res Soc Dev.* (2021) 9:e318985885. doi: 10.33448/rsd-v9i8.5885

43. Ong-Artborirak P, Seangpraw K. Association between self-care behaviors and quality of life among elderly minority groups on the border of Thailand. *J Multidiscip Healthc.* (2019) 12:1049–59. doi: 10.2147/JMDH.S227617

44. Savci C, Cil Akinci A, Yildirim Usenmez S, Keles F. The effects of fear of COVID-19, loneliness, and resilience on the quality of life in older adults living in a nursing home. *Geriatr Nurs.* (2021) 42:1422–8. doi: 10.1016/j.gerinurse.2021.09.012

45. World Health Organization. *Ageing and Life Course.* (2005). Available online at: http://apps.who.int/iris/bitstream/handle/10665/186463/9789240694811_eng.pdf;jsessionid=160BDBB054F9DB6926F673E390A37A82?sequence=1 (accessed January 31, 2022).

46. Yang Y, Li W, Zhang Q, Zhang L, Cheung T, Xiang YT. Mental health services for older adults in China during the COVID-19 outbreak. *Lancet Psychiatry.* (2020) 7:e19. doi: 10.1016/S2215-0366(20)30079-1

47. Ochi S, Hodgson S, Landeg O, Mayner L, Murray V. Disaster-driven evacuation and medication loss: a systematic literature review. *PLoS Curr.* (2014). doi: 10.1371/currents.dis.fa417630b566a0c7dfdbf945910edd96

48. Roy D, Tripathy S, Kar SK, Sharma N, Verma SK, Kaushal V. Study of knowledge, attitude, anxiety & perceived mental healthcare need in Indian population during COVID-19 pandemic. *Asian J Psychiatr.* (2020) 51:102083. doi: 10.1016/j.ajp.2020.102083

49. Seangpraw K, Ong-Artborirak P. Knowledge and behaviors toward health care for elderly patients with hypertension, and quality of life among informal caregivers in Northern Thailand. *J Multidiscip Healthc.* (2020) 13:1771–80. doi: 10.2147/JMDH.S284886

50. Wood S, Harrison SE, Judd N, Bellis MA, Hughes K, Jones A. The impact of behavioural risk factors on communicable diseases: a systematic review of reviews. *BMC Public Health.* (2020) 21:2110. doi: 10.1186/s12889-021-12148-y

51. Fortin M, Bravo G, Hudon C, Lapointe L, Dubois MF, Almirall J. Psychological distress and multimorbidity in primary care. *Ann Fam Med.* (2006) 4:417–22. doi: 10.1370/afm.528

52. Sun Z, Ostrikov K. Future antiviral surfaces: lessons from COVID-19 pandemic. *Sustain Mat Technol.* (2020) 25:e00203. doi: 10.1016/j.susmat.2020.e00203

53. Al-Sofiani ME, Alyusuf EY, Alharthi S, Alguwaihes AM, Al-Khalifah R, Alfadda A. Rapid implementation of a diabetes telemedicine clinic during the coronavirus disease 2019 outbreak: our protocol, experience, and satisfaction reports in Saudi Arabia. *J Diabetes Sci Technol.* (2021) 15:329–38. doi: 10.1177/1932296820947094

54. Hongthong D, Somrongthong R, Ward P. Factors influencing the quality of life (Qol) among Thai older people in a rural area of Thailand. *Iran J Public Health.* (2015) 44:479–85.

55. Pender NJ, Murdaugh CL, Parsons MA. *Health Promotion in Nursing Practice.* 4th ed. Upper Saddle River, NJ: Pearson (2002).

56. Galić M, Mustapić L, Šimunić A, Sić L, Cipolletta S. COVID-19 related knowledge and mental health: case of croatia. *Front Psychol.* (2020) 11:567368. doi: 10.3389/fpsyg.2020.567368

57. Elovainio M, Hakulinen C, Pulkki-Raback L, Virtanen M, Josefsson K, Jokela M, et al. Contribution of risk factors to excess mortality in isolated and lonely individuals: an analysis of data from the UK Biobank cohort study. *Lancet Public Health.* (2017) 2:e260–e6. doi: 10.1016/S2468-2667(17)30075-0

58. Robb CE, de Jager CA, Ahmadi-Abhari S, Giannakopoulou P, Udeh-Momoh C, McKeand J, et al. Associations of social isolation with anxiety and depression during the early COVID-19 pandemic: a survey of older adults in London, UK. *Front Psychiatry.* (2020) 11:591120. doi: 10.3389/fpsyt.2020.591120

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Characteristics and trends in acceptance and commitment therapy research: A bibliometric analysis

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Purpose: As acceptance and commitment therapy (ACT) becomes mainstream and a growing body of literature emerges, it is critical to map the global collaborative network and a quantitative and systematic assessment of ACT, as research on this topic is still lacking. This review aims to provide a comprehensive understanding of the trajectory, key themes, and future prospects in ACT research.

Methods: Publications were extracted from the Web of Science Core Collection before 2022. Excel 2019, VOSviewer, and CiteSpace software were used to analyze the characteristics and trends of ACT research. Examples include publications trend analysis, authors' cooperation network analysis, keywords co-occurrence analysis, and citation burst analysis.

Results: A total of 799 articles in 314 journals contributed by 2,862 authors from 958 institutions in 52 countries were identified. The number of publications has increased significantly since 2015. The United States/Utah State University is the most productive country/institution; Karolinska Institute, Utah State University, and King's College of London are the most significant nodes. Twohig M.P., Hayes S.C., and Levin M.E. are the most influential authors. Keyword co-occurrence analysis found the curative mechanisms, using network technology or mobile technology as adjuvant therapy, reducing psychological diseases of cancer patients were potential trends.

Conclusion: This review is the first attempt of its kind to systematically examine the knowledge structure and draw an evidence map of ACT research. It deepens the understanding of existing research, gives many operable research directions and suggests to future ACT research.

Introduction

Acceptance and commitment therapy (ACT) is a unique, experience-based psychological intervention, and is the third wave of behavioral therapy (Fernández et al., 2020; Ruiz et al., 2020). ACT was created in the late 20th and early 21st centuries by Steven C. Hayes, Kirk D. Strosahl, and Kelly G. Wilson, utilizing the relational frame theory (RFT) as its theoretical foundation and functional contextualism as its philosophical background. The RFT is a functional contextualist theory of human language and cognition that establishes connections through human non-organic formal mechanisms, and is generally characterized by "mutual derivability," "joint derivability," and "transformation of stimulus functions." These components guide the development of ACT. Functional contextualism encompasses the understanding that psychological events are the continuous interaction between the whole and the specific situations (including history and environment). Functional contextualism also seeks to maintain the connection with the whole psychological event and its situation, analyzes psychological events in a way that maintains its integrity, aims to predict and affect the continuous interaction between the whole and the specific situations, and strives for the analysis to reach a certain accuracy, scope, and depth (Hayes, 2005; Hayes et al., 2012). In the past, patients often exhibited behaviors such as experiential avoidance, cognitive fusion, conceptualized past and fear of the future, attachment to the conceptualized self, lack of clear values, inaction, impulse or avoidance. Hayes illustrated that conflict between language/cognition and the environment is one of the root causes of dysphoria and that unwanted beliefs and suffering are associated with the response to mental illness, and that repression and avoidance not only do not free people from mental illness but lead to more pain. Subsequently, this then leads to creating, maintaining, and worsening psychological problems (Hayes et al., 2012). Compared with the previous treatment modes, the most important feature of ACT is to improve the psychological flexibility of patients, which can will enable patients to actively overcome these problems where they consciously make changes to be more aware and more fully connect with their own abilities in the moment, and actively and intentionally modify their behavior or make sustained efforts to achieve the established goals and values. Based on the ACT treatment mechanism, ACT emphasizes accepting unwanted experiences while encouraging value-driven behaviors to help individuals withstand unwanted emotions or change their understanding of and reactions to unwanted thinking and control of external actions to achieve their valued goals (Hayes et al., 2012; Houwer et al., 2016). Therefore, patients can contextualize the self with the help of ACT (Such as patients seeing themselves from an objective stance, observing everything, including their own perceptions, emotions, and will), clarify their values (through linguistically constructed aspirations and chosen direction of life), and commit to action (choosing behavior changes that are consistent

with values, taking responsibility for actions, and supporting an effective values-based life; Houwer et al., 2016).

ACT has been therapeutic effects and utilized to address and manage symptoms including chronic diseases (Hayes et al., 1996; Wang, 2017), malignancies (Vowles and Mccracken, 2008; Xu and Yang, 2017), pregnancy and childbirth (Serfaty et al., 2016; Howard et al., 2022), psychiatric-psychological disorders (Lu and Fan, 2017; Waters et al., 2020), pain, depression, mixed anxiety, obsessive–compulsive disorder, psychosis, and so on (ACBS, 2022). This indicates that the ACT has important clinical significance, and they call for further follow-up and review of the development and effectiveness of ACT in future research is needed. Several recent studies have provided evidence-based literature reviews on ACT. For example, Graaf, et al. reviewed the existing literature on the treatment of chronic pain with online ACT. They found that most studies did not provide detailed information on the choice of optimizing the matching between tasks, technologies and users, and suggested that changes and key elements of the content, design and effectiveness of ACT should be considered in the future (Graaf et al., 2021). Osaji et al. reviewed and tested all the literatures about the ACT in treating various mental disorders and substance use disorder (SUD) management. They found that ACT has achieved great success in aiding the management of SUD, but more systematic and further research is needed in the future to analyze and track the overall progress of ACT (Osaji et al., 2020). Harris and Samuel analyzed the relevant literature on ACT interventions in adolescent mental health. They found that ACT contributes to addressing adolescent mental health problems; however, more insight is needed to the progress and changes of action to determine the role of ACT in increasing psychological flexibility (Harris and Samuel, 2020). Given this recent call to action, it is necessary to continue and expand ACT research. Bibliometric analysis is a method of quantitative analysis and visual analysis that analyzes existing literature on a specific topic. Compared with previous ACT studies, bibliometric analysis can objectively determine the overall layout of research topics, discipline advantages, research centers, and leading research teams from a multi-dimensional perspective, and determine the key areas of future research (Tjak et al., 2015; Li et al., 2020; Li Z. et al., 2021; Li, 2022). Bibliometric analysis is beneficial for document tracking and analyzing the knowledge structure of certain concepts. In the case of ACT, it may not only analyze the quantitative changes of ACT research but also summarize the concepts and research experiences of ACT, as well as highlight the areas that may need further research in the future. Bibliometric analysis can also combine author information, journal information, organization information, keyword information, geographic information and others to analyze the global research basis of ACT while highlighting the highlight the cooperation opportunities of ACT research in the future. Meanwhile, bibliometric analysis as a quantitative review method minimizes selection bias in the sampling process, which is open and visible, and provides higher-level evidence based on visual reviews of completeness. Thus, it reduces the dependence on

experimental time and scope limitations (Tjak et al., 2015; Jin et al., 2021; Li, 2022; Zhang et al., 2022). Recently, bibliometric analysis has received increasing attention in various fields (Rixe et al., 2016; Kokol et al., 2020; Wg et al., 2021; You et al., 2021; Zhang et al., 2022). Therefore, it is necessary to provide an evidence-based, systematic, quantitative, transparent, and visual overview of ACT research, and this review attempts to answer the following questions.

> Q1: What are the publication trends, the top journals, articles, authors, countries and institutions that contribute to ACT research?
>
> Q2: What are the knowledge clusters in the knowledge structure of ACT research?
>
> Q3: What are the future opportunities for ACT research?

Based on the above, this paper is structured as follows: first, we count the number of current ACT research works, including publication trends, the top journals, articles, authors, countries and institutions (Q1); second, we visually map the keywords to gain insight into the theoretical structure and current status of ACT research (Q2); third, we construct a co-citation analysis of authors, journals, and references to visualize the network relationships among them(Q2); and fourth, a burst analysis of connections is used to explore dynamic changes and new knowledge turning points in ACT research (Q3).

Theoretical background

Philosophical background: Functional contextualism

ACT is developed from behavioral analysis. The core of behaviorism is environmentalism, which focuses on the changing and shaping of people that is caused by changes in the external environment. The philosophical basis of this phenomenon is contextualism (Hayes, 2005). Contextualism refers to understanding a psychological event as a continuous interaction between the whole and a specific situation (including history and environment), seeking to keep in touch with the whole psychological event and its situation, analyzing the psychological event in a way that does not destroy its integrity, and trying to predict and affect the continuous interaction between the whole and the specific situation, so as to allow the analysis to reach a certain accuracy, breadth and depth. Compared with the form of psychological events, contextualism pays more attention to the function of psychological events. As the philosophical background of ACT, functional contextualism is mainly embodied in several aspects. First, ACT operates from the belief that there is no absolute universal truth in the world and emphasizes the importance of effectiveness, considering personal values as the premise to measure effectiveness. Second, ACT's behavioral

analysis captures "prediction and influence" as the overall goal, which requires multi-dimensional contextual variables to be included in the analysis. If the context is not changed, it is impossible to have an impact on psychological events. Only context variables can be directly manipulated (Hayes et al., 2012). ACT focuses on the background and function of psychological events and not just the form and intensity of cognition and emotion. In addition, the pragmatic orientation of functional contextualism places particular importance on the goal, which is also emphasized by ACT, and thus the individual actively invests in their life in line with their own values and aims to achieve these life goals, rather than pursuing vague theories. Therefore, functional contextualism can be regarded as the extension and contextual interpretation of Skinner's radical behaviorism.

Theoretical basis: RFT

The RFT is a comprehensive functional context model for the basic research of human language and cognition, which guides the development of ACT. From this perspective, ACT integrates the basic research science of human language and cognitive attributes, which can be tested through many empirical studies and clinical empirical interventions. The RFT holds that human beings have produced language in the process of evolution. Language is everywhere, whether in real social life or the inner world. Understanding language and cognition is the key to understanding human behavior. The core of human language and advanced cognition is the ability to acquire and be controlled by context. It can artificially connect and combine events and change the function of specific events according to these relationships. The background of psychological events includes personal, physical, social, biological, and cultural characteristics. The interaction history between individuals and their living environment can affect their experience of psychological events in current situations. People's learning of the relationship between language and cognition has three main characteristics: The first is mutual entry or directionality. The second is a combinational entry. The third is that this relationship can transform the function of a related stimulus. When these three characteristics determine and form a specific relationship, we call this relationship a "relational frame" (Hayes, 2005; Hayes et al., 2012). Generally speaking, the RFT is a set of context models with functional meaning. The model's core is human language and cognitive system, which means that human language is the key to understanding human behavior. This is because human language and some advanced cognitive skills possessed by human beings need to be acquired through learning and are always controlled and influenced by the external environment.

Therapeutic mechanism of ACT

Psychotherapy often faces three issues: the universality of pain, cognitive fusion, and empirical avoidance. The universality of pain means that people can feel pain in any situation; that is, people cannot solve their own pain by simply avoiding the environment. Cognitive fusion means that because of the

establishment of relationship networks, thoughts or languages can be confused with all things involved. Experiential avoidance means that people tend to avoid their own internal experiences, including unpleasant physical feelings, emotions, thoughts, memories, and behavioral tendencies. At the core of these three issues is how to improve mental flexibility, which is also an important criterion for measuring mental health. Therefore, ACT aims to improve mental flexibility. Individuals should fully understand their abilities in this way and use their abilities to make concerted efforts to change and achieve set goals (Hayes et al., 2006). In summary, the therapeutic mechanism of ACT is divided into six processes:

1. Acceptance: In ACT, acceptance is not just tolerance but a positive, rather than a judgmental acceptance, of the experience in the moment. The aim is to make room for painful feelings, impulses, and emotions and not to try and resist, control, or escape them. The individual should aim to observe them objectively.

2. Cognitive dissociation: This refers to the separation of the self from thoughts, images, and memories and objectively observing such thought activities as a vehicle. This allows an individual to perceive thought as a language and text independently rather than something with meaning that it represents, which is entirely out of the individual's control.

3. Being present: ACT encourages participants to consciously pay attention to the environment and psychological activities in the moment, without making any evaluations, and fully accept them.

4. The self as context: Painful thoughts and feelings threaten the participant's self, and this negative feeling is particularly significant when the self is the conceptualized object. Observing the self can help participants pay attention to their own real experiences and promote cognitive dissociation and acceptance. ACT usually uses mindfulness, metaphor, and experiential processes to help visitors achieve self-observation.

5. Values: The values in ACT refer to the overall yearning and chosen life direction of participants, which are constructed through language. Values cannot be separated from people's behavior, and they consciously run through every purposeful action in life. Values-based action is constructive and not an attempt to escape painful feelings.

6. Committed action: ACT is not only a treatment strategy for acceptance, but it is also a treatment strategy for changing orientation. The purpose of ACT is to help participants choose behavior changes that conform to their own values, take responsibility for their own actions, and support an effective value-based life.

The six core processes of ACT can be divided into two parts. The first part is the process of mindfulness and acceptance: ACT aims to help participants reduce subjective control, subjective judgment, language dominance, empirical escape, and experience life in the present through unconditional acceptance, cognitive dissociation, and attention to the present. Connecting with the here and now and one's values leads to more flexible behavior. The second part is the process of commitment and behavior change: ACT helps participants mobilize and gather energy, move toward goals, and lead a valuable and meaningful life by focusing on the present, observing themselves, clarifying values, and committing to action.

Theoretical background and importance of bibliometrics

Bibliometrics is a quantitative statistical analysis tool that can quantitatively reveal the development history, research focus, and future research direction of an academic field (Tran et al., 2018). It was first proposed by famous British information scientist Allen Pritchard in 1969, marking the official birth of bibliometrics. The field has gone through three stages; germination, development, and differentiation. In the germination period (1917–1933), literature researchers pioneered the method of literature statistics, boldly aimed to conduct quantitative analysis on the literature of anatomy and chemistry in some disciplines, and achieved certain results. These studies laid the foundation for the creation and later development of bibliometrics. In the development process (1934–1960), theoretical research and legal discovery were the focus. Bradford's and Zipf's laws were one of the three basic laws of bibliometrics, which were discovered in this period. In the mature and differentiated stage, that is, the period of comprehensive development and differentiation (since 1960), bibliometrics developed from a narrow theoretical study to a wide range of applied research and indicator research involving more fields and topics (Kokol et al., 2020; Rejeb et al., 2021a,b, 2022).

The core laws of bibliometrics include Bradford's, Zipf's, and Lotka's laws which are elaborated on in the following section.

Bradford's Law: This law describes the law of document distribution. The number of papers published by a specialty is used to determine the core journals of that specialty. This law is used to guide literature and information work and scientific evaluation.

Zipf's Law: This law is used to calculate the frequency of words in documents. Through the word frequency analysis of the literature, we can determine the research "hotspots" and trends of the discipline or industry.

Lotka's Law: This law describes the relationship between the number of authors and the number of papers written. This current study discusses the law of balanced distribution of scientific paper authors. In the macro scientific writing activities, a few authors have written a large number of articles, whereas most of them have fewer works. According to this law, "the number of outstanding scientists is only the square root of the number of scientists" (Li, 2022; Yu et al., 2022).

Compared with traditional reviews, bibliometric methods can identify the importance of an article relative to other articles in the field and show how different articles are gathered together in the network. Therefore, the links between publications are visible, and

some patterns or trends hidden from meta-analysis or structural review can be found. Further advantages of bibliometric methods include the accuracy and objectivity introduced in the evaluation of scientific literature. Researchers' biases usually do not exist like in other types of review studies. Examples of this bias include excessive attention to specific authors and frequent self-reference (Wallin, 2005). Finally, when applying bibliometric methods, documents with a larger sample size can be easily carried out in hundreds of articles. Working with the same number of documents in a traditional overview can be otherwise cumbersome.

Early research and existing reviews

The existing research on ACT can be roughly divided into therapeutic mechanisms (or therapeutic processes) research and efficacy research. In terms of treatment mechanisms, several empirical studies have been carried out to explore the relationship between the core elements of ACT and the specific change processes, especially the main elements or methods involved in the psychological flexibility model. For example, with cognitive separation, a study using the time series paradigm found that when subjects were asked to quickly repeat a negative word related to themselves, they would reduce the negative emotions and beliefs related to the word. This study supports the necessity of using repetition vocabulary skills in cognitive dissociation (Masuda et al., 2008); regarding acceptance, the researchers compared the reaction of panic disorder patients with three strategies of acceptance, neutral description, and emotional repression through a strictly controlled laboratory research paradigm. The results showed that the anxiety levels and avoidance behavior of the receiving group were significantly lower than those of the depression group and the control group (Graaf et al., 2021). In terms of values, researchers discussed the impact of social psychological interventions on the behavior of disadvantaged ethnic students in real life (Cohen et al., 2006). In addition, some researchers compared ACT with Cognitive Behavioral Therapy (CBT) and found that ACT can reduce the credibility of the literal meaning of negative thinking leading to faster improvement (Bond and Bunce, 2000). In terms of efficacy research, researchers have found that ACT can effectively treat psychological health problems such as depression, obsessive–compulsive disorder, drug abuse, chronic pain, eating disorders, and work stress (Hayes et al., 1996; Wang, 2017; Graaf et al., 2021; ACBS, 2022). For example, ACT is more effective than cognitive therapy in treating depression; the effect of workplace stress management is better than that of workplace behavior adjustment training. In the treatment of social anxiety, ACT is more effective than group cognitive therapy (ACBS, 2022).

While some traditional review studies have been found and they have reviewed the role of ACT in treating of chronic pain, SUD, and adolescent mental health, and the latest systematic narrative review to study the current situation of the use of acceptance and commitment therapy (ACT) in local areas (Iran; Akbari et al., 2022), no comprehensive and timely bibliometric review has been found in the literature, which is a significant research gap this paper is aiming to fulfill. Due to the significant growth of academic literature in this field, it is necessary to apply bibliometric methods to better understand the knowledge structure of this field.

Materials and methods

We conducted a bibliometric analysis related to the ACT research, and the literature data came from the Web of Science Core Collection (WOSCC) database.

Eligibility criteria

To maximize the availability of ACT studies, we developed the following inclusion criteria with the advice of systematic evaluation experts. First, articles published between 1980 and 2021 in peer-reviewed English-language journals that included ACT-related search terms such as "acceptance and commitment therapy," "ACT," or "commitment acceptance" in context. These articles were eligible for inclusion in the citation analysis. Second, letters, conference abstracts, editorial materials, news, conference presentations, book reviews, and those without full text were excluded.

Search strategy

Retrieved articles were identified by using ACT-related search terms for the WOSCC database, one of the world's most extensive multidisciplinary repositories of scholarly information, at the same time, evidence shows that when visual analysis is conducted, the web of science database can provide better knowledge map effect (Falagas et al., 2008; Martin et al., 2018; Luo et al., 2021). Two researchers independently searched the database at the Center for Evidence-Based Medicine using the following specific strategies (Tian et al., 2017): Topic: ("Acceptance and Commitment therap*" OR "ACT*" OR "Commitment and acceptance method*" OR "Commitment Acceptance therap*"), spanning the period 1980 to January 1, 2022. "Topic" was selected to access more comprehensive relevant publications as much as possible. "Article," "Early Access," and "Review" were our target publication types because they had better and more up-to-date full-text information than other types of documents. The language was limited to English, and all retrieved studies are determined to be published before 2022.

Data extraction

Two authors independently retrieved data from the WOSCC database; studies were identified by checking titles, abstracts, keywords, and full text after duplicate articles were removed.
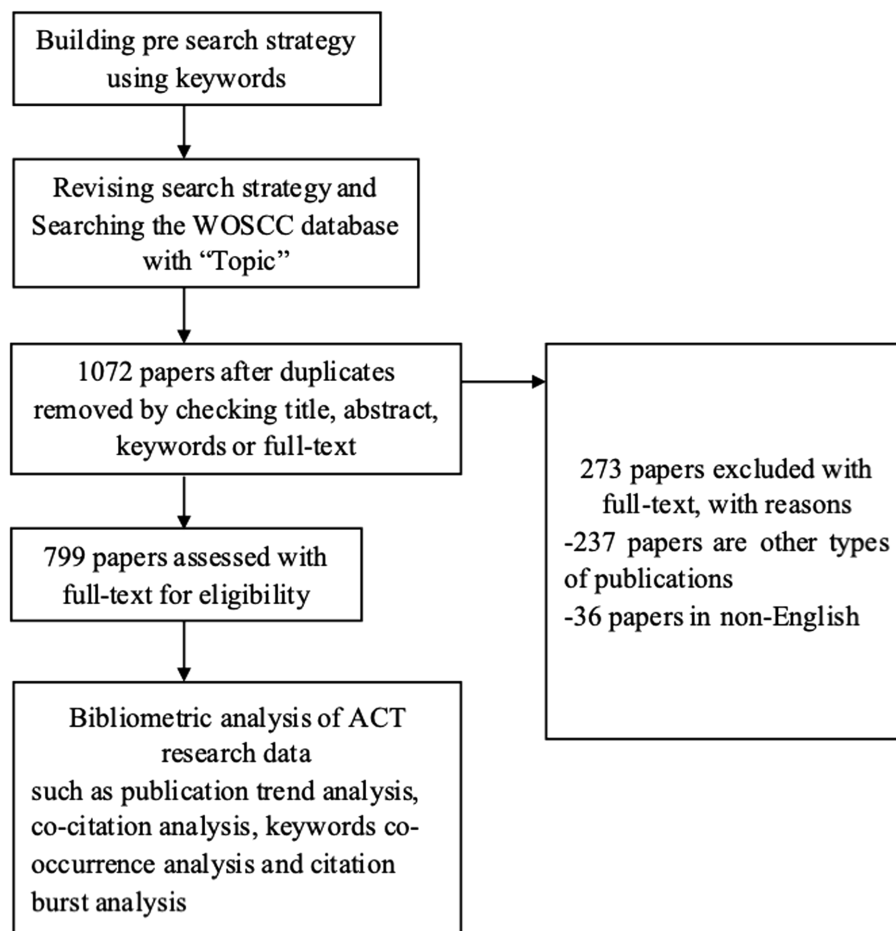
Exported records were "plain text" and "full records and citation references." Any discrepancies or disagreements during the extraction steps were discussed and/or resolved by the team. The extraction of the proposed results is not limited to the title, journal, author, number of citations, year of publication, author affiliation, author region, impact factor (IF), and so on.

Analysis method

The systematic bibliometric analysis follows the international standard process (Figure 1) and provides detailed information on each step (Page et al., 2021). The complete search strategy is shown in Appendix A. These included studies were conducted in Microsoft Excel 2019, CiteSpace, and VOSviewer. Microsoft Excel 2019 is mainly used for descriptive statistical analysis of collected article data, such as author, journal, publication year, author organization, fund source and IF, etc. VOSviewer is used to map authors, institutions, and keyword co-occurrence networks, whereas CiteSpace generates the most potent reference burst of keywords.

The data analysis resources were Excel 2020, VOSviewer (1.6.16), R (3.6.0) and CiteSpace (5.7.1.R5), and detailed parameter settings for the software are available *via* email. This computer uses a 64-bit macOS system (High Sierra 10.13.6) with a Java (1.8) environment.

Results

Overall, the study covered 799 articles in 314 journals contributed by 2,862 authors between 1980 and 2021 (due to database inclusion restrictions, only publications from 2001 to 2021 were captured). These authors belong to 958 institutions in 52 countries. The total number of citations is 20,935, with an average of 26.2 citations per year.

Annual trends in the number of publications

Figure 2 shows the number and trend of publications published each year, with changes in the number of publications
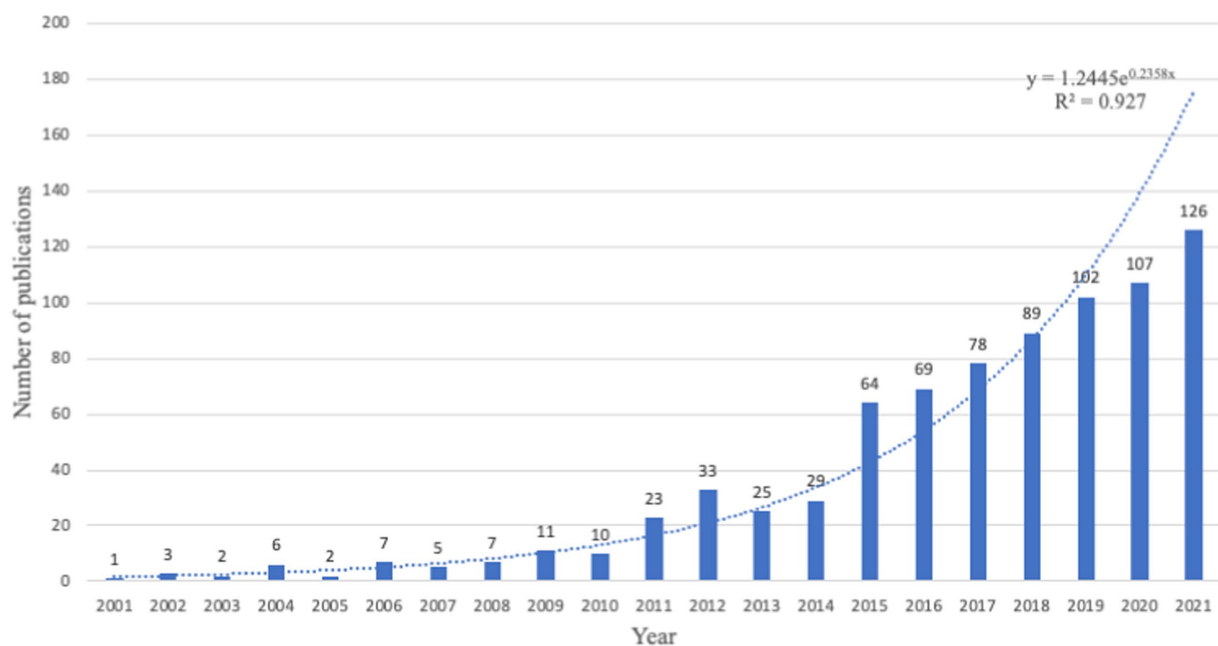
FIGURE 2
Annual output of ACT research.

in a given discipline not only reflecting its current development but also predicting future trends. ACT as a mainstream therapy, although proposed in the 1990s, was only able to be examined from 2001 onwards in the web of science database due to search limitations, so 2001 became the starting point for this research. The changes can be divided into two stages: the first phase was from 2001 to 2004, the number of articles varied from 1 to 6 every year, and the number of publications increased slowly every year, the second phase was from 2005 to the present, first experiencing a stable period (2005–2008) with publications between 2 and 7 per year, and after 2008, the number of publications per year published more than ten and had significant growth trend, especially in the last 3 years (2019-present), the number of publications per year is above 100, and the growth is very substantial, which indicates that ACT has been progressing since its introduction as a mainstream therapy and is the fastest-growing in the last 3 years, and according to the fitted trend line $y = 1.2445e^{0.2358x}$ ($R^2 = 0.927$). Thus, the number of published articles in ACT research will maintain a double-digit growth trend.

Journal distribution

A total of 799 articles were published in 314 different journals, of which 10 journals published more than 10 articles (3.2%), 106 journals published 2–9 papers (24.5%), and 198 journals published only one piece (72.3%). Table 1 lists the 10 most productive journals in ACT research, among which the "*Journal of Contextual Behavioral Science*" is the most productive journal, with 76 articles (9.5%) published and 569 citations, followed by "*Behavior*

Research and Therapy," which published 30 articles with the highest number of citations (4638), and then "*Behavior Therapy*" with 26 articles with 2,464 citations, and the last is "*Psychological Record,*" "*Trials*" and "*European Journal of Pain*" with eight or nine articles published and 54–251 citations. The 10 most productive journals' research categories are mostly from psychology, general or internal medicine, and the neurosciences; the number of papers published in the top 10 journals is 0.5 times that of all other journals. This is an interesting phenomenon since most of these representative journals are interdisciplinary journals that belong to multiple discipline categories. For example, the "Journal of Contextual Behavioral Science" includes psychology and neuroscience, the "Frontiers in Psychology" includes psychology, management and medicine, and so on. Therefore, interdisciplinary integration will become the main research direction in ACT research.

Most productive countries/institutions

A total of 52 countries and 958 institutions have participated in ACT research, with the United States (336/799, 42.1%) contributing the most. Only one country published more than 100 articles (1.9%), 16 countries published between 10 and 97 articles (30.8%), 20 countries published between 2 and 9 articles (38.5%), and 15 countries published only 1 article (28.9%). In terms of region, European countries were the most productive with 410 papers (410/799, 51.3%), followed by North America (336/799, 42.05%), Asia (85/799, 10.6%), and Oceania (83/799, 10.4%). Table 2 shows the top 10 most productive countries and

TABLE 1 The top 10 most productive journals in ACT research.

Rank	Journal	Records	% of 799	IF-5 year	Total citations
1	Journal of Contextual Behavioral Science	76	9.512	3.828	569
2	Behaviour Research and Therapy	30	3.755	6.424	4,638
3	Behavior Therapy	26	3.254	5.425	2,464
4	Cognitive and Behavioral Practice	24	3.004	3.271	720
5	Behavior Modification	23	2.879	4.092	1,121
6	Clinical Case Studies	16	2.003	1.171	68
7	BMJ Open	12	1.502	3.424	36
8	Frontiers in Psychology	11	1.377	3.62	100
8	Journal of Consulting and Clinical Psychology	11	1.377	6.844	1,453
8	Journal of Pain	11	1.377	7.061	349
9	Psychological Record	9	1.126	1.603	251
9	Trials	9	1.126	2.606	54
10	European Journal of Pain	8	1.001	4.065	238

institutions, with the United States as the most productive country with 336 publications (42.1%), followed by the United Kingdom (97, 12.1%), and finally, Australia, Sweden, Iran, the Netherlands, Spain, Canada, Finland, Ireland, Germany, and China. These nations had between 18 and 83 publications (332, 41.6%). In terms of institutions, the vast majority were from the United States, with no institution publishing more than 100 ACT studies, the most productive being Utah State University in the United States with 64 ACT studies (64/799, 8.0%), followed by the Karolinska Institute of Sweden with 50 studies (50/799, 6.3%), another eight institutions published fewer articles with 16 to 38 publications, whereas among the others, a total of 658 institutions published only one article.

To obtain a better cooperation diagram, we selected the institutions that appeared nine times and finally got the top 30 most productive institutions, forming three main clusters. In general, there is close cooperation among these institutions, especially between institutions from the United States and the United Kingdom (Figure 3). The University of Nevada (United States) was the first representative to start ACT research. Later, other top institutions from the United States, Sweden, and the United Kingdom quickly followed up. Finally, they formed the most productive institutions at Karolinska Institute in Sweden, Utah State University (United States), and King's College London (United Kingdom). However, no institutions were found in developing countries such as China. Therefore, future research on this topic requires active cooperation worldwide.

Most productive authors and their cooperation

A total of 2,862 authors contributed to ACT research. We selected authors who contributed a minimum of eight articles to complete our author network graph. Finally, the top 30 authors met the criteria and formed an overlay visual collaboration graph with four main clusters (Figure 4) that are shown as darker

bubbles representing the earliest authors, each node represents an author, the larger the node is, the more articles the author published, on the contrary, the fewer the nodes are. The lines between nodes represent the strength of the cooperation between authors, the thicker the lines are, the closer the cooperation between them is. The latter conducted ACT research, represented by thicker and more lines to represent closer collaboration. The number above the bubble represents the top 10 most productive authors and the number of articles contributed. Among the top 30 authors, the vast majority are from the United States. The first cluster (purple) is the team that first conducted ACT research, mainly in 2014, and is most represented by Hayes S.C. from the University of Nevada (41 articles, ranked 2) and Dahl J. (16 articles, ranked 8). The second cluster (green) is mainly focused on ACT research starting in 2015 and is also the most productive team, most represented by Twohig M.P. from Utah State University, United States (52 articles published, the most contributing author), Wicksell R.K. (21, rank 5), Bohlmeijer E.T. (17, ranked 6) and Afari N. (13, ranked 10). The third cluster (light green) is mainly focused on 2017. It is most represented by Mccracken L.M. (26, ranked 4) from Uppsala University, Sweden, and Vowles K.E. (14, ranked 9). The fourth cluster (yellow) is concentrated in 2018. The most represented are Levin M.E. (38, ranked 3) from Utah State University, the United States, and Lappalainen R. (17, ranked 7).

Keywords analysis

A keyword analysis is a specific association between words based on the number of keyword co-occurrences, each node represents a keyword, and the distance between keywords is determined by the density between each node. The density represents the relationship and interaction strength between the two nodes. The goal of density-based algorithm is to minimize the weighted sum of the square Euclidean distance between each pair of nodes. Therefore, the higher the density value is, the closer the

TABLE 2 The top 10 most productive countries/institutions in ACT research.

Countries/Regions	Records	% of 799	Rank	Institutions	Records	% of 799
United States (North America)	336	42.05	1	Utah State University (United States)	64	8.01
England (Europe)	97	12.14	2	Karolinska Institute (Sweden)	50	6.25
Australia (Oceania)	83	10.4	3	University of Nevada (United States)	44	5.5
Sweden (Europe)	78	9.76	4	King's College London (England)	38	4.76
Iran (Asia)	66	8.26	5	Uppsala University (Sweden)	32	4.01
Netherlands (Europe)	32	4	6	Islamic Azad University (Iran)	22	2.75
Spain (Europe)	32	4	6	University of California San Diego (United States)	22	2.75
Canada (Europe)	28	3.5	7	University of Washington (United States)	20	2.5
Finland (Europe)	20	2.5	8	University of Queensland (Australia)	19	2.38
Ireland (Europe)	20	2.5	9	Karolinska University Hospital (Sweden)	18	2.25
Germany (Europe)	19	2.38	9	University of Jyvaskyla (Finland)	18	2.25
China (Asia)	19	2.38	9	University of Twente (Netherlands)	18	2.25
Scotland (Europe)	18	2.25	10	Fred Hutchinson Cancer Research Center (United States)	16	2

distance between the two nodes is, on the contrary, the farther it is (Rejeb et al., 2022). It is used to determine the relationships between topics in the disciplines represented in this literature set, which in turn, can assist in identifying areas (clusters) for current and future research that constitute the theoretical constructs or underlying themes of the research area (Eck and Waltman, 2010; Agarwal et al., 2016).

To ensure the accuracy and completeness of the keyword classification of the articles, "All Keywords" was chosen, which includes the keywords provided by the authors (Author Keywords) and the supplementary keywords provided by the web of science (Keyword Plus), which reduces the bias and risk of researchers limiting the content associated with manual tagging and does not quickly leave out potentially critical information provided in articles, and is effective when investigating the structure of knowledge in current and future scientific fields. In the implementation, we set the keywords to occur at least 13 times, and in the end, 100 words out of 2,380 keywords constituted the most vital set of available associated terms. The ten most important keywords were: acceptance and commitment therapy (527 records), depression (210 records), mindfulness (183 records), anxiety (165 records), cognitive behavioral therapy (146 records), chronic pain (132 records), psychological flexibility (117 records), psychometric properties (106 records), meta-analysis (100 records), randomized controlled trial (100 records).

From Figure 5A, six clusters are formed, the detail is shown in Supplementary material (Appendix 1).

Cluster-1 (green) focuses on the mechanism of ACT, including 34 keywords, this cluster is by far the most influential, because it includes the theoretical core ("psychological flexibility"), measurement ("scale"), mechanism (such as "mechanisms," "mediation," "validity," "reliability"). The articles formed by these keywords constitute the basic background for understanding the concept, mechanism and relationship between ACT and other variables. It is likely to become a research point in the future to study the action mechanism of ACT on mental diseases through the action mechanism of mental illnesses (such as depression, anxiety, and panic disorder; such as psychological intelligence, emotional regulation, and psychological properties).

Cluster-2 (blue) focuses on the impact of the ACT on the psychological state (e.g., psychological distress, psychological flexibility) of cancer patients (e.g., children, parents). With the inclusion of 15 keywords, acceptance and commitment therapy has played an essential role in alleviating the mental health problems of cancer patients.

Cluster-3 (red) focuses on some ACT methods (such as models, questionnaires, and the Internet) as the primary nursing method to prevent pain (such as chronic pain, low back pain, or fibromyalgia) of patients (such as those with a disability or women), including 15 keywords.

Cluster-4 (purple) focuses on a meta-analysis to compare the effectiveness of CBT and ACT on the outcomes of schizophrenia. This included 19 keywords.

Cluster-5 (light blue) focuses on studying the mechanisms of pain, anxiety, and drug epilepsy by the ACT theory and includes 4 keywords.

Cluster-6 (yellow) compares on comparing the effects of network technology or mobile technology (such as mHealth, and web-based acceptance) on smoking, weight, PTSD, and weight loss by using an RCT test. This included 13 keywords.

In Figure 5B, keywords are determined by their frequency of occurrence and are given different colors depending on when they appear, with darker colors indicating earlier appearances in publications and lighter colors indicating more recent appearances in publications; the colors range from blue (earlier) to yellow (in recent years). The ACT research field has developed from the

FIGURE 3
The network map of institutions from countries.
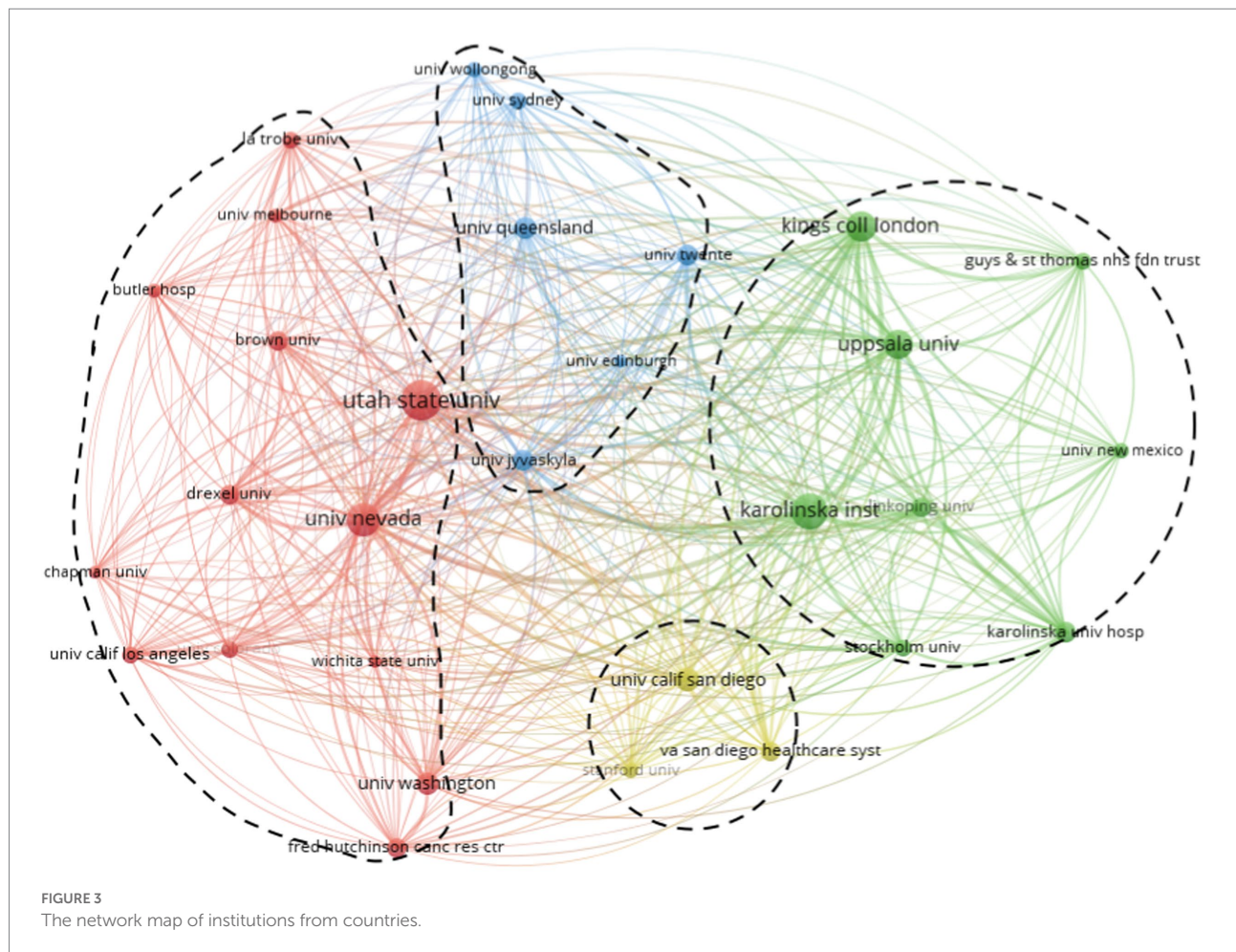
previous treatment of psychological diseases to the research on the influence mechanism of various patients' psychological disorders, the use of some new network or mobile technologies for adjuvant treatment, and the breakthrough use of ACT to provide psychological care for patients with advanced cancer.

Top cited articles and citation burst analysis of references

Table 3 shows the top 10 cited articles. These top-cited articles made outstanding contributions to ACT research, most of them published between 2002 and 2009, and three articles of them were from Hayes S.C., his article (Acceptance and commitment therapy: Model, processes, and outcomes) published in 2006 received the highest citation, with a total of 2,516 citations, ranking first and far ahead of other articles' citations, which systematically described the treatment model and work on the ACT, while other articles published in the same period focused on the use of randomized controlled trials or meta-analysis to explore the treatment effects of ACT.

Figure 6 shows the citation burst analysis of 25 references. Citation burst analysis identifies and tracks publications with strong citation growth characteristics. This surge implies that an article has been cited rapidly over the past few years, marking a dynamic change in the research field and a new turning point in knowledge. Among them, Hayes SC's "Acceptance and commitment therapy: Model, processes and outcomes," published in 2006, has the highest intensity (27.04). Notably, Tjak et al. (2015), "A meta-analysis of the efficacy of acceptance and commitment therapy for clinically relevant mental and physical health problems" (cited 339 times, ranked fourth), Hughes et al., 2017, "Acceptance and commitment therapy (ACT) for chronic pain: A systematic review and meta-analyses" (152 citations), Graham et al. (2016), "A systematic review of the use of acceptance and commitment therapy (ACT) in chronic disease and long-term conditions" (110 citations), the outbreak of these systematic evaluation articles continues to this day, suggesting that systematic evaluation is also likely to be an essential focus for the field in the future.

Discussion

This study conducted a systematic bibliometric analysis in ACT research based on the WOSCC database. It covered 799

FIGURE 4
The overlay map of authors (top 30).

articles published in 314 journals by 2,862 authors from 52 countries and 958 institutions between 2001 and 2021, with a total of 20,935 citations and an average of 26.2 citations per year. We analyzed the global ACT journal distribution, author output and collaboration, keyword co-occurrence, and a references' citation burst analysis by visualizing and summarizing the structure, development, and future trends of ACT research. This was done to help future researchers understand dynamic changes in ACT research, new knowledge turning points, and identify future research directions (Agarwal et al., 2016; Kim et al., 2021).

The number of publications of ACT research has gradually increased and the worldwide cooperation has gradually been strengthened. Especially in the last 3 years (2019 to now), papers have increased significantly, with more than 100 published every year. From 2004 to 2018, the number of documents has shown an upward trend, with an annual number of 10–100. From 2001 to 2004, it has shown slow growth, with a yearly number of 1–6. This shows that ACT as a mainstream therapy in the world has been widely concerned by researchers and gradually applied (Eck and Waltman, 2010; Li H. et al., 2021). However, through a survey of research directions, we found that most ACT studies came from the United States, and the research areas varied widely, such as 448 papers in psychology, 171 in psychiatry, and 71 in neurosciences neurology. In contrast, the other directions account for a tiny percentage. One of the reasons for this unbalanced state may be the different perspectives, experimental designs, and studies in

different directions of ACT (Barida and Widyastuti, 2019; Li H. et al., 2021; Tan et al., 2021; Reyes, 2022). Therefore, it is crucial for the evolving field of ACT to periodically review and evaluate its evolutionary pathways, and we hope to motivate future researchers to enhance interdisciplinary and integrative research to promote and coordinate ACT research.

As for journal distribution, most of them were published in medical and psychological journals. Among them, the "*Journal of Contextual Behavioral Science*" is the most productive journal, with 76 articles (9.5%) and 569 citations, followed by "*Behavior Research and Therapy,*" with 30 articles and 4,638 citations. The third is "*Behavior Therapy,*" with 26 articles and 2,464 citations. Only 10 journals published more than 10 (3.2%) articles, while 198 journals published only one article (72.3%). Although ACT has received widespread attention and research in various fields, publication quality needs to be improved. Although many articles were published in psychology, psychiatry, neurosciences neurology, general internal medicine, etc., the percentage of papers published in the top journals in these fields was meager (less than 10%). ACT is prevalent in these fields, and more different areas are starting to pay attention, but the quality of research needs to be further improved. Therefore, future researchers need to strengthen the theoretical basis, experimental design, and data analysis.

Within the most productive countries and institutions, most ACT studies came from countries and institutions in Europe and

FIGURE 5
(A) The network map of keywords (top 100). **(B)** The overlay map of keywords (top 100).

North America, with the United States being the most productive country (336/799, 42.1%) and the only country with more than 100 published articles (1.9%). The most influential institution was Utah State University in the United States, with 64 published ACT

studies (64/799, 8.0%). We found that the vast majority were from institutions in developed countries, with few from developing ones. Our quantitative analysis helps to illuminate the relative contributions of individual countries and institutions to ACT

TABLE 3 The top 10 cited articles in ACT research.

Rank	Title	Authors	Journal	Year	Cited Times
1	Acceptance and commitment therapy: Model, processes and outcomes	Hayes SC, Luoma JB, Bond FW, et al.	Behaviour Research and Therapy	2006	2,516
2	Acceptance and commitment therapy, relational frame theory, and the third wave of behavioral and cognitive therapies	Hayes SC	Behavior Therapy	2004	833
3	The use of acceptance and commitment therapy to prevent the rehospitalization of psychotic patients: A randomized controlled trial	Bach P, Hayes SC	Journal of Consulting and Clinical Psychology	2002	415
4	A meta-analysis of the efficacy of acceptance and commitment therapy for clinically relevant mental and physical health problems	A-Tjak JL, Davis ML, Morina N, et al.	Psychotherapy and Psychosomatics	2015	339
5	A randomized controlled effectiveness trial of acceptance and commitment therapy and cognitive therapy for anxiety and depression	Forman EM, Herbert JD, Moitra E, et al.	Behavior Modification	2007	331
6	Acceptance and commitment therapy: A meta-analytic review	Powers MB, Vording VS, Emmelkamp PG	Psychotherapy and Psychosomatics	2009	325
7	Acceptance and commitment therapy and contextual behavioral science: Examining the progress of a distinctive model of behavioral and cognitive therapy	Hayes SC, Levin ME, Plumb-Vilardaga J, et al.	Behavior Therapy	2013	299
8	Acceptance and commitment therapy and mindfulness for chronic pain model, process, and progress	McCracken LM, Vowles KE	American Psychologist	2014	295
9	A randomized, controlled trial of acceptance and commitment therapy and cognitive-behavioral therapy for chronic pain	Wetherell JL, Afari N, Rutledge T, et al.	Pain	2011	256
10	Acceptance and commitment therapy and the treatment of persons at risk for long-term disability resulting from stress and pain symptoms: A preliminary randomized trial	Dahl J, Wilson KG, Nilsson A	Behavior Therapy	2004	238

research. However, our analysis of country/institution collaboration revealed very few collaborative networking relationships between countries and institutions, particularly between developed and developing institutions, suggesting that ACT is unequally developed across countries/institutions (Glanzel and Moed, 2002; Balter et al., 2021; Galvez et al., 2021). Therefore, we encourage research collaboration across institutional and national boundaries to discover differences between ACT studies and thus promote ACT research.

Keyword co-occurrence analysis Can better track the research trend of ACT, provide directional guidance for future research (Glanzel and Moed, 2002; Li Z. et al., 2021; Li, 2022), and also contribute to the theoretical and application development of ACT. By analyzing the evolution of ACT keywords, we found that keywords (such as "acceptance and commitment to treatment," "depression," "anxiety," and "chronic pain") maintained a stable and growing trend. This shows that these topics still have great research potential and significance in future research. In addition, we have recently identified some new research topics. The first is to study the treatment mechanism of ACT, which is also one of the core research topics of functional contextualism. The core of ACT is to improve the psychological flexibility of patients. Future research needs to conduct more in-depth measurements of the six processes of implementation, such as keyword

co-occurrence analyses. Innovative research on the treatment mechanism and action mechanisms (such as "psychological rigidity" and "model") is called for, using more diversified perspectives and measurement models to measure each link of patients treated with ACT and to further study the treatment mechanisms and action mechanisms of ACT. Theoretical innovation is carried out based on ACT theory (such as "relational framework theory"). Although it is difficult to innovate the RFT, theoretical innovation is still a very encouraging and popular research field. Recent literature findings call for comprehensive measurement of individual and group psychological flexibility and differences, and description of their thoughts and feelings when engaging in specific activities or behaviors, exploratory measurement of their values changes, and better observation of patients' behavior changes will be more meaningful and practical. The second is to use some new network or mobile technologies for adjuvant therapy. Keyword co-occurrence analysis found that innovative research methods (such as "randomized controlled trial" and "meta-analysis") and new technological innovations (such as "mhealth" and "network-based") are frequently mentioned keywords. With the development of big data technology and mobile network technology, it will be more convenient and accurate to observe patients themselves and measure patients' psychological flexibility, value changes, and

FIGURE 6
The top 25 references with strongest citation bursts in ACT research.

action changes. The third is the breakthrough use of ACT to provide psychological care for patients with advanced cancer and explore more diseases (such as "cancer," "smoking," "overweight," "PTSD," and "weight loss"). These frequently occurring keywords indicate that ACT has been explored and used in a wider range of diseases and has achieved positive effects. These will be new trends and potential trends in ACT research. Therefore, these valuable and promising topics may attract more researchers and performers and help us understand ACT research.

Theoretical and practical contributions

Our review provides some theoretical contributions to the ACT research. First, we used systematic quantitative bibliometric techniques to explore a large number of ACT studies and identified several core themes, such as therapeutic mechanism research, auxiliary use of new technologies, exploration of new disease treatment fields, etc. The discovery of these themes will help deepen and provide new perspectives and evidence for understanding the philosophical basis of relational framework theory and functional semantics. Second, it is different from previous comments on ACT, this research adopts an objective, systematic and transparent analysis method to construct relevant research topics and reveal the future research approaches of ACT. Through the analysis of cited

journals, cited authors, cited articles and their keywords in ACT related fields, researchers can quickly understand the evolution process and knowledge structure of this field and provide new ideas for conducting new research.

Our review provides some practical contributions to the ACT research. Due to the adverse effects of drug therapy and the high requirements of physical therapy, cognitive therapy has become a hot research topic in the treatment of depression in recent years. It not only helps patients recover their standard psychological coping mechanisms but also improves their social function, which is of positive significance in preventing repeated attacks. Therapists actively guide patients to consciously accept and pay attention to the present, allow them to feel and accept love from family, nurses, and society, form a correct outlook on life and values, and offer positive psychological hints to patients. Then, through some practical activities, they consolidate effective values, promote patients to have positive coping behaviors, improve treatment confidence, effectively cooperate with nurses to conduct appropriate treatment, and help patients actively integrate into life. This reduces the psychological pressure on patients. A hospital is an organization that directly provides people-oriented treatment, services, and nursing for patients. Improving the treatment effects and nursing quality of patients, as well as reducing the psychological burden of patients, are the core implementation methods of medical, hospital, and nursing managers. In addition, nursing managers

must improve their awareness and training on ACT therapy. For medical staff and researchers, bibliometric analysis can help these professionals quickly find hot topics, potential application fields, and highly cited articles in this field, which will provide them with evidence-based references. At the same time, the results of a bibliometric analysis can help medical staff use some new technologies to improve the nursing quality of patients. For example, ACT, assisted by information technology can reduce the psychological burden of patients, which is also the core implementation method of medical, hospital, and nursing managers. It can not only help patients restore normal psychological coping mechanisms but also improve patients' social function, which is of positive significance in preventing recurrent attacks. We recommend that researchers and nursing managers use it to study other different diseases or mental patients.

Strengths and limitations

Although the bibliometric method is very effective, there are still some limitations to be recognized. Firstly, although the Web of Science is one of the most widely used databases in visualization research, it is not the source of the whole act research literature; Therefore, we search based on the title and are limited by the WOSCC database. We cannot rule out the possibility of missing some data, such as the literature before 2001. If visualization technology matures in the future, we encourage the collection of publications from as many different database sources as possible to improve our research (Yan et al., 2019; Li Z. et al., 2021). Second, the included ACT research focuses on medicine or psychology; however, this is a topic of global communication and may also exist in business, the environment, or other fields. Therefore, future research needs to expand the scope of research, which may help clarify the literature in other fields other than medicine or psychology. Third, although we describe the production situation of scholars, journals, institutions, and countries, as well as the hot and cutting-edge trend analysis in the bibliometric analysis that is based on keywords, which may make it may be difficult to obtain all key information and deeply discover the potential links of these relationships. Further work may increase their deeper cooperative relationships.

Conclusion

In summary, this study may provide a set of evidence for researchers, practitioners, and decision-makers engaged in psychotherapy to use ACT. Since 2015, the number of publications has increased significantly. The United States and Utah State University is the most productive and cooperative country and institution, respectively. Twohig M.P., Hayes S.C., and Levin M.E. are the most influential authors. The most productive core journal is the *Journal of Contextual Behavioral Science*. Research

hotspots on the mechanism of ACT and the use of network technology or mobile technology to assist in the treatment and reduce the psychological diseases of cancer patients are potential concerns of future research. The contribution of ACT research and authors' cooperation is strong in developed countries; global cooperation needs to be strengthened with developing countries to expand and deepen the understanding of ACT research.

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 authors.

Author contributions

ZL and WS are co-first authors and conducted the design, collection, analysis, and wrote the draft. ZL conceived the study. WS, CW, JG, and KY provided methodological guidance or grant support for the study. All authors contributed to the article 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.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2022.980848/full#supplementary-material

References

ACBS (2022). State of the ACT Evidence. Available at: https://contextualscience.org/state_of_the_act_evidence (Accessed October 11, 2022).

Agarwal, A., Durairajanayagam, D., Tatagari, S., Esteves, S., and Bashiri, A. (2016). Bibliometrics: tracking research impact by selecting the appropriate metrics. *Asian J. Androl.* 18, 296–309. doi: 10.4103/1008-682X.171582

Akbari, M., Seydavi, M., Davis, C., Levin, M., Twohig, M., and Zamani, E. (2022). The current status of acceptance and commitment therapy (ACT) in Iran: a systematic narrative review. *J. Contextual Behav. Sci.* 26, 85–96. doi: 10.1016/j.jcbs.2022.08.007

Balter, L., Lipsker, C., Wicksell, R., and Lekander, M. (2021). Neuropsychiatric symptoms in pediatric chronic pain and outcome of acceptance and commitment therapy. *Front. Psychol.* 12:576943. doi: 10.3389/fpsyg.2021.576943

Barida, M., and Widyastuti, D. (2019). Acceptance and commitment therapy (ACT) to improve. Educators' self-acceptance of children with special needs. *KONSELI J. Bimbingan dan Konseling* 6, 117–124. doi: 10.24042/kons.v6i2.4701

Bond, F., and Bunce, D. (2000). Mediators of change in emotion-focused and problem-focused worksite stress management interventions. *Journal of Occupational Health Psychology* 5, 156–163. doi: 10.1037/1076-8998.5.1.156

Cohen, G., Garcia, J., Apfel, N., and Master, A. (2006). Reducing the racial achievement gap: a social-psychological intervention. *Science* 313, 1307–1310. doi: 10.1126/science.1128317

Eck, N., and Waltman, L. (2010). Software survey: vosviewer, a computer program for bibliometric mapping. *Scientometrics* 84, 523–538. doi: 10.1007/s11192-009-0146-3

Falagas, M. E., Pitsouni, E. I., Malietzis, A., and Pappas, G. (2008). Comparison of PubMed, Scopus, web of science, and Google scholar: strengths and weaknesses. *FASEB J.* 22, 338–342. doi: 10.1096/fj.07-9492LSF

Fernández, C., González, S., Coto, R., Cot, R., and Pedrosa, L. (2020). Behavioral activation and acceptance and commitment therapy in the treatment of anxiety and depression in cancer survivors: a randomized clinical trial. *Behav. Modif.* 23, 232–243. doi: 10.1177/0145445520916441

Galvez, M., Montoro, C., Moreno-Padilla, M., Paso, G., and Coba, P. (2021). Clinical medicine effectiveness of acceptance and commitment therapy in central pain sensitization syndromes: a systematic review. *J. Clin. Med.* 10:2706. doi: 10.3390/jcm10122706

Glanzel, W., and Moed, H. (2002). Journal impact measures in bibliometric research. *Scientometrics* 53, 171–193. doi: 10.1023/A:1014848323806

Graaf, L., Hrt, A., Ts, A., and Fma, B. (2021). Online acceptance and commitment therapy (act) interventions for chronic pain: a systematic literature review. *Internet Interv.* 26:100465. doi: 10.1016/j.invent.2021.100465

Graham, C., Gouick, J., Krahé, C., and Gillanders, D. (2016). A systematic review of the use of Acceptance and Commitment Therapy (ACT) in chronic disease and long-term conditions. *Clinical Psychology Review* 46, 46–58. doi: 10.1016/j.cpr.2016.04.009

Harris, E., and Samuel, V. (2020). Acceptance and commitment therapy: a systematic literature review of prevention and intervention programs for mental health difficulties in children and young people. *J. Cogn. Psychother.* 34, 280–305. doi: 10.1891/JCPSY-D-20-00001

Hayes, S. (2005). Acceptance and commitment therapy, relational frame theory, and the third wave. Of behavioral and cognitive therapies. *Behav. Ther.* 35, 639–665. doi: 10.1016/S0005-7894(04)80013-3

Hayes, S., Luoma, J., Bond, F., Masuda, A., and Lillis, J. (2006). Acceptance and Commitment Therapy: Model, processes, and outcomes. *Behaviour Research and Therapy* 44, 1–25. doi: 10.1016/j.brat.2005.06.006

Hayes, S., Strosahl, K., and Wilson, K. (2012). *Acceptance and Commitment Therapy: The Process and Practice of Mindful Change* (2nd ed.). New York, NY: Guilford Press.

Hayes, S., Wilson, K., Gifford, E., Follette, V., and Strosahl, K. (1996). Experiential avoidance and. Behavioral disorders: a functional dimensional approach to diagnosis and treatment. *J. Consult. Clin. Psychol.* 64, 1152–1168. doi: 10.1037/0022-006X.64.6.1152

Houwer, J., Barnes-Holmes, Y., and Barnes-Holmes, D. (2016). Riding the waves: a functional-cognitive perspective on the relations among behaviour therapy, cognitive behaviour therapy and acceptance and commitment therapy. *Int. J. Psychol.* 51, 40–44. doi: 10.1002/ijop.12176

Howard, S., Houghton, C., White, R., Fallon, V., and Slade, P. (2022). The feasibility and acceptability of a single-session Acceptance and Commitment Therapy (ACT) intervention to support women self-reporting fear of childbirth in a first pregnancy. *Psychology and Health*. 1–22. doi: 10.1080/08870446.2021.2024190

Hughes, L., Clark, J., Colclough, J., Dale, E., and Mcmillan, D. (2017). Acceptance and Commitment Therapy (ACT) for chronic pain: a systematic review and meta-analyses. *The Clinical Journal of Pain.* 33, 552–568. doi: 10.1097/AJP.0000000000000425

Jin, X., Wong, C., Li, H., Chen, J., Chong, Y., and Bai, Y. (2021). Acceptance and commitment therapy. For psychological and behavioural changes among parents of children with chronic health conditions: a systematic review. *J. Adv. Nurs.* 77, 3020–3033. doi: 10.1111/jan.14798

Kim, S., Bae, H., and Park, S. (2021). The effectiveness of value-based Acceptance-Commitment Therapy for enhancing meaning of life in COVID-19. *Clinical Psychology In Korea: Research And Practice* 7, 219–236. doi: 10.15842/cprp.2021.7.3.219

Kokol, P., Blazun, V., and Zavrsnik, J. (2020). Application of bibliometrics in medicine: a historical bibliometrics analysis. *Health Info. Libr. J.* 1, 1–14. doi: 10.1111/hir.12295

Li, Z. (2022). Characteristics and trends in unethical pro-organizational behavior research in business and management: a Bibliometric analysis. *Front. Psychol.* 13:877419. doi: 10.3389/fpsyg.2022.877419

Li, Z., Guo, L., Sha, Y., and Yang, K. (2021). Knowledge map and global trends in extreme weather. Research from 1980 to 2019: a bibliometric analysis. *Environ. Sci. Pollut. Res.* 28, 49755–49773. doi: 10.1007/s11356-021-13825-6

Li, Z., Sha, Y., Song, X., Yang, K., Zhao, K., Jiang, Z., et al. (2020). Impact of risk perception on customer purchase behavior: a meta-analysis. *J. Bus. Ind. Mark.* 35, 76–96. doi: 10.1108/JBIM-12-2018-0381

Li, H., Wu, J., Ni, Q., Zhang, J., Wang, Y., and He, G. (2021). Systematic review and meta-analysis. Of effectiveness of acceptance and commitment therapy in patients with breast cancer. *Nurs. Res.* 70, E152–E160. doi: 10.1097/NNR.0000000000000499

Lu, D., and Fan, Q. (2017). Effect of routine nursing combined with acceptance and commitment therapy on the depression mood, self-efficacy and self-esteem ofpatients with postpartum depression. *Sichuan Ment. Health* 30, 253–255. doi: 10.11886/j.issn.1007-3256.2017.03.011

Luo, H., Cai, Z., Huang, Y., Song, J., Ma, Q., Yang, X., et al. (2021). Study on pain catastrophizing from 2010 to 2020: a Bibliometric analysis via CiteSpace. *Front. Psychol.* 12:759347. doi: 10.3389/fpsyg.2021.759347

Martin, A., Ordunaa, E., Thelwall, M., and Delgado, E. (2018). Google scholar, web of science, and scopus: a systematic comparison of citations in 252 subject categories. *J. Informet.* 12, 1160–1177. doi: 10.1016/j.joi.2018.09.002

Masuda, A., Hayes, S., Twohig, M., Drossel, C., Lillis, J., and Washio, Y. (2008). A parametric study of cognitive Defusion and the believability and discomfort of negative self-relevant thoughts. *Behav. Modif.* 33, 250–262. doi: 10.1177/0145445508326259

Osaji, J., Ojimba, C., and Ahmed, S. (2020). The use of acceptance and commitment therapy in substance use disorders: a review of literature. *J. Clin. Med. Res.* 12, 629–633. doi: 10.14740/jocmr4311

Page, J., McKenzie, E., and Bossuyt, M. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 372:n71. doi: 10.1136/bmj.n71

Rejeb, A., Rejeb, K., Simske, S., and Treiblmaier, H. (2021a). Blockchain Technologies in Logistics and Supply Chain Management: a Bibliometric review. *Logistics* 5:72. doi: 10.3390/logistics5040072

Rejeb, A., Rejeb, K., Simske, S., Treiblmaier, H., and Zailani, S. (2022). The big picture on the internet of things and the smart city: a review of what we know and what we need to know. *Internet Things* 19:100565. doi: 10.1016/j.iot.2022.100565

Rejeb, A., Treiblmaier, H., Rejeb, K., and Zailani, S. (2021b). Blockchain research in healthcare: a bibliometric review and current research trends. *J. Data Inf. Manag.* 3, 109–124. doi: 10.1007/s42488-021-00046-2

Reyes, A. (2022). The process of learning mindfulness and acceptance through the use of a Mobile App based on acceptance and commitment therapy: a grounded theory analysis. *Issues Ment. Health Nurs.* 43, 3–12. doi: 10.1080/01612840.2021.1953652

Rixe, N., Rixe, J., Glick, J., Lehman, E., and Olympia, R. (2016). Publishing trends in the field of. Pediatric emergency medicine from 2004 to 2013. *Pediatr. Emerg. Care* 32, 840–845. doi: 10.1097/PEC.0000000000000962

Ruiz, J., Luciano, C., Flórez, C., Falcón, J., and Betancourt, C. (2020). A multiple-baseline evaluation of acceptance and commitment therapy focused on repetitive negative thinking for comorbid generalized anxiety disorder and depression. *Front. Psychol.* 11:356. doi: 10.3389/fpsyg.2020.00356

Serfaty, M., Armstrong, M., Vickerstaff, V., Davis, S., and Low, J. (2016). Acceptance and commitment therapy for adults with advanced cancer (canACT): a feasibility randomised controlled trial. *Trials* 17, 1–17. doi: 10.1186/s13063-016-1169-8

Tan, H., Li, J., He, M., Li, J., Zhi, D., Qin, F., et al. (2021). Global evolution of research on green energy and environmental technologies: a bibliometric study. *J. Environ. Manag.* 297:113382. doi: 10.1016/j.jenvman.2021.113382

Tian, J., Zhang, J., Ge, L., Yang, K., and Song, F. (2017). The methodological and reporting quality of systematic reviews from China and the USA are similar. *J. Clin. Epidemiol.* 85, 50–58. doi: 10.1016/j.jclinepi.2016.12.004

Tjak, J., Davis, M., Morina, N., Powers, M., Smits, J., and Emmelkamp, P. (2015). A meta-analysis. Of the efficacy of acceptance and commitment therapy for clinically relevant mental and physical health problems. *Psychother. Psychosom.* 84, 30–36. doi: 10.1159/000365764

Tran, B., Pham, T., Ha, G., Ngo, A., Nguyen, L., Vu, T., et al. (2018). A bibliometric analysis of the global research trend in child maltreatment. *International Journal of Environmental Research and Public Health* 15:1456. doi: 10.3390/ijerph15071456

Vowles, K., and Mccracken, L. (2008). Acceptance and values-based action in chronic pain: a study of treatment effectiveness and process. *J. Consult. Clin. Psychol.* 76, 397–407. doi: 10.1037/0022-006X.76.3.397

Wallin, J. (2005). Bibliometric methods: pitfalls and possibilities. *Basic and Clinical Pharmacology and Toxicology* 97, 261–75. doi: 10.1111/j.1742-7843.2005.pto_139.x

Wang, X. (2017). Application of acceptance and commitment therapy in patients with diabetic foot amputation. *Nurs. Res. China* 31, 2885–2888. doi: 10.3969/j.issn.1009-6493.2017.23.018

Waters, C., Annear, B., Flockhart, G., Jones, I., Simmonds, J., Smith, S., et al. (2020). Acceptance and commitment therapy for perinatal mood and anxiety disorders: a feasibility and proof of concept study. *Br. J. Clin. Psychol.* 59, 461–479. doi: 10.1111/bjc.12261

Wg, A., Ly, B., and Bei, S. (2021). Mapping themes trends and knowledge structure of trophoblastic. Invasion, a bibliometric analysis from 2012–2021. *J. Reprod. Immunol.* 146:103347. doi: 10.1016/j.jri.2021.103347

Xu, C., and Yang, F. (2017). The application of acceptance and commitment therapy in patients with chronic heart failure management. *J. Clin. Nurs. Pract.* 2072, 9–12. doi: 10.3969/j.issn.2096-2479.2017.03.005

Yan, P., Yao, L., Li, H., Zhang, M., Xun, Y., Li, M., et al. (2019). The methodological quality of robotic surgical meta-analyses needed to be improved: a cross-sectional study. *J. Clin. Epidemiol.* 109, 20–29. doi: 10.1016/j.jclinepi.2018.12.013

You, Y., Wang, D., Wang, Y., Li, Z., and Ma, X. (2021). A bird's-eye view of exercise intervention in. Treating depression among teenagers in the last 20 years: a bibliometric study and visualization analysis. *Front. Psych.* 12:661108. doi: 10.3389/fpsyt.2021.661108

Yu, Q., Wang, Z., Li, Z., Liu, X., Oteng, A., and Wang, X. (2022). Hierarchical structure of depression knowledge network and co-word analysis of focus areas. *Front. Psychol.* 13:920920. doi: 10.3389/fpsyg.2022.920920

Zhang, Y., Li, Z., Sha, Y., and Yang, K. (2022). The impact of decision-making styles (effectuation logic and causation logic) on firm performance: a meta-analysis. *J. Bus. Ind. Mark.* doi: 10.1108/JBIM-08-2021-0378

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