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Insights in public health education and promotion 2022

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Insights in public health education and promotion: 2022

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Editorial: Insights in public health education and promotion: 2022

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Editorial on the Research Topic
Insights in public health education and promotion: 2022

1. Introduction

The discipline of public health received much-needed attention with the pandemic of COVID-19 (1, 2). However, current public health education still needs to be expanded to traditional teaching models that balance theory and practice. With time, public health is also trying to integrate new technologies, especially in education and promotion (3). Primary care and public health comprise the backbone of health systems, but their divergence has produced two groups of practitioners, either focused on individual health or population/public health (4). Public health education is a precursor to public health practice and essential to one's foundational knowledge and skillset. Thus, theoretical solid groundings are critical in public health education (5).

The world is now in the third decade of the 21st Century. The achievements in public health made by scientists have been exceptional, especially in the last few years, leading to significant advancements in the fast-growing field of Public Health Education and Promotion (6). It is essential to highlight the latest advancements in public health science and to shed light on the progress made in the past decade. In addition, its future challenges needs to be identified to provide a thorough overview of the status of the art of the Public Health Education and Promotion field.

For this Research Topic, we received all original research articles. They cover various topics, and each article has a unique study design. Authors were encouraged to identify the most significant challenges in the sub-disciplines and how to address those challenges. Out of 24 submitted manuscripts, 17 articles were selected for publication after a rigorous review. The majority of the articles, i.e., 10, are from China. As China's need for global health capacity grows amid a rapidly shrinking population of younger citizens, strategic investments in transnational public and global health programs may be of increasing value (7). Later, it is followed by two articles from the USA and one each from Ethiopia, Saudi Arabia, UAE, and Indonesia. One article was not country-specific though the authors were from Qatar and Australia.

The articles cover various public health-related subjects related to diseases and subjects like Reproductive issues, Thyroid diseases, Cancer, Drug abuse, Organ transplants, and others. Most article research findings have also addressed medicine/public health curricula, educational content improvement for different age groups, the performance of public health degree programs, and education to strengthen research capabilities.

Here, the author's works are summarized according to the study design.

2. Contributions according to study designs

2.1. Reviews

In Indonesian schools (both primary and secondary), reproductive health education is integrated into various subjects, including Science, Biology, Sports, and Health Education. Diarsvitri and Utomo conducted a qualitative study comparing the accuracy of the material related to reproductive health education to scientific evidence published in medical journals or medical textbooks. This study was done through a literature review and content analysis of School books of 5 to 12-year age groups. It was found that the schoolbooks were used as per Indonesia's 2006 minimum standard requirements of the subject matter curriculum. Still, the current provision for equipping young Indonesians with comprehensive reproductive health knowledge is inadequate. Schoolbooks must promote healthy lifestyles, prevent high-risk sexual behaviors, encourage openness and discussion about reproductive health in the family, improve self-confidence to refuse and avoid sexual harassment, encourage positive sexual behaviors, and increase awareness for treatment-seeking behavior.

A global video-sharing social media app—TikTok, provides information on Thyroid cancer (TC) which is becoming an increasing public health problem worldwide. However, the information quality of these videos still needs to be discovered. A search of TikTok was performed by Wang et al. with the term "thyroid neoplasm" and "thyroid cancer" in Chinese. The videos included were independently assessed using six predefined questions for content scores and DISCERN (a scale used to judge information quality). The VPI (Video Popularity Index) was calculated. Correlation analysis was performed among duration, presence of animation, VPI, DISCERN scores, and content scores. A total of 56 videos were included, of which 49 were uploaded by physicians, four by health organizations, and three by hospitals. It was seen that 43 videos were real content videos, and 13 were animated. The overall quality of the videos was satisfactory, and it varied greatly depending on the source type. Patients should take proper precautions when using TikTok as a source of TC-related information.

The USA is experiencing exponential growth in overdose fatalities over the past four decades. More than 22 million people in the USA live with a substance use disorder (SUD). The USA Cooperative Extension System (Extension) is recognized as an essential partner in addressing SUD in the communities. The scoping review by Hagaman et al. was performed to identify the range of Extension activities aimed at mediating substance misuse. The authors utilized the PRISMA-SCR model to complete this scoping review in February–July 2022. The scoping review covers a search of peer-reviewed databases, Extension websites for each state and the USA territory, and the utilization of a web search engine. Eighty-seven records meeting the inclusion criteria were included—seven peer-reviewed articles and 80 results from the gray literature. Additional 11 ROTA grantees responded to requests. It was seen that Extension had scaled multiple efforts to address SUD operating through a loose confederation of organizations. The volume of effort is significant. However, implementation at the community level has been slow, and there are significant opportunities for local adoption of evidence-based practices to mitigate SUD.

Applied practice experiences are essential to the Masters of Public Health (MPH) curriculum. The study by Pham et al. examined students' perspectives on the skills and expertise they developed in an MPH course offering applied practice opportunities. From 2008 to 2018, a total of 236 students took the course, and 104 gave their consent. The reflection essays were de-identified and analyzed using a rapid qualitative analysis approach. The essays addressed students' learning experiences and the application of the competencies for MPH programs set by the CEPH (Council for Education in Public Health). The critical lessons by each cohort of students were identified through deductive and inductive analytical lenses. Semi-structured guides and matrixes for essay analysis were created using assignment instructions and CEPH competencies. It was seen that the applied practice experience served as a valuable tool for knowledge and skills acquisition.

It also served as an opportunity for students to engage with the unique organizational cultures of their respective community partners and to deepen their understanding of the complexities of conducting meaningful community-engaged research. This study demonstrates the utility of analyzing students' critical self-reflection to explore learning experiences when training future public health professionals. The findings will be helpful to educators in designing future applied practice experiences.

2.2. Cross-sectional studies

The incidence of thyroid diseases has tripled globally in the last three decades, and the prevalence is also rising rapidly, irrespective of gender and genetics. The study by Alhazmi et al. was done to assess the knowledge, awareness of risk factors, and perceptions of thyroid disease among the Saudi Community in Saudi Arabia. An online cross-sectional study was conducted between November 2021 to January 2022 among 724 adult residents (18–50 years) living in Saudi Arabia. Saudi adults reported varying knowledge and perceptions of thyroid disease. Previous knowledge of the thyroid was found to be significantly associated with the current knowledge score. Educating people about this rising disease is essential.

Global contraceptive coverage has increased significantly. Still, high rates of unintended pregnancy are seen globally. A comparative analysis of KAP (Knowledge, Attitude, and Practice) of the Sexual and Reproductive Health (SRH) of both partners will be helpful. Liu et al. conducted a questionnaire survey of people (18–45 years age group) with unintended pregnancies, including women and their male partners (1,275 pairs) from October 2017 to October 2021. The study shows that unintended pregnancy occurs mainly in young people. The risk factors for not taking contraceptive measures are the low education background, the younger age of first sexual intercourse, and the lack of discussion of contraception between partners. Men's better knowledge and contraceptive practices than female partners, and poor male contraceptive knowledge and attitudes may lead to a higher

risk of harmful contraceptive practices. The results suggest that male KAP is vital in promoting contraceptive use and reducing unintended pregnancy.

Life form and body composition may affect the health of college students. The study by Lin and Liu explores the relationship between the effects of health behavior and sports participation on 1,200 female college students' body mass index and healthy-promoting lifestyle using the questionnaire method and bioelectrical resistance measurement. Among female college students, there is generally a lack of sleep and leisure activities, a low proportion of regular fitness habits, a high number of snacks, and a high average daily online time. The overweight and body fat rates of female college students are also generally too high, and the standard rate of muscle weight is generally too low. Their health-promoting lifestyle has the highest score of self-realization, followed by interpersonal support, and the worst behavior of sports participation. Among older college students, sports participation and overall health-promotion behavior s quite worse. Those with regular exercise habits have a lower proportion of overweight and high body fat rates.

A study by Ma H. et al. was conducted to investigate the kidney transplantation knowledge of KT (Kidney Transplant) candidates and recipients and explore the related influencing factors. 170 KT candidates and 270 KT recipients were investigated from March to July 2022 in two tertiary and Grade A hospitals in Hunan Province, China, using the Kidney Transplant Understanding Tool (K-TUT). It is seen that the knowledge level of KT candidates and recipients could be more optimistic. Healthcare providers need to pay more attention to the health education of this population.

In China, the organ transplantation sector is facing a severe shortage of donors. The study was conducted by Chen et al. to understand young people's perceptions and attitudes toward organ donation and the factors that influence them and can positively impact the promotion of organ donation. Information was obtained through 501 valid questionnaires from the target group. It is seen that the young people knew about organ donation but needed a higher depth of awareness. The household registration type, education level, and religious affiliation are significantly associated with people's willingness to donate. The correct understanding of the organ donation process, the supportive environment for organ donation in society, and laws and regulations will influence people's willingness to donate.

The need for skilled medical practitioners in outbreak investigations and public health was demonstrated during the COVID-19 pandemic. The College of Medicine and Health Sciences at the United Arab Emirates University (UAEU) introduced a clerkship in public health. This consists of theoretical and practical sessions for 5th-year medical students in 2015. The study by Rahma et al. aims to explore the students' satisfaction with the public health clerkship, which is crucial for assessing and reforming the taught curriculum. A post-evaluation cross-sectional study was conducted from 2015–2022 via an online university system, and 174 students participated. It is seen that the medical students at the UAEU were satisfied with the activities and delivery of the public health clerkship. Conducting needs assessment and proposal writing gave them the knowledge, skills, and confidence to conduct research in their career. These findings may help and support other institutes to plan and develop a clerkship in public health.

As a convenient and promising care model, the public has gradually accepted community-based senior care. However, community services developed to facilitate older adults often need to achieve the expected effect. A study by Ma W. et al. further developed an extended Anderson behavior model by incorporating social psychological factors and vertical and horizontal fairness perceptions. The study used data from a survey of 322 urban area seniors in Shaanxi Province. The results showed that factors influencing older adults' satisfaction with service categories differ. Moreover, with the addition of the social psychological factors, it is observed that the vertical fairness perception of the survey respondents affected their satisfaction with senior care services significantly more than the horizontal fairness perception.

Population knowledge and attitudes toward Obstructive Sleep Apnea syndrome (OSA) are critical to public health initiatives to overcome the disease. Healthcare education is an appropriate approach to expediting the process of building active medical practice models in the public. Pan et al. in their study, aimed to assess the level of KAP regarding OSA and healthcare education demand among the Chinese general population. A cross-sectional survey was performed online via Wenjuanxing in mainland China between February and March 2022. The study enrolled 1,507 respondents, aged 18 to 68 years old. The findings indicated that even the higher educated and urban populations in mainland China needed more knowledge about positive attitudes toward and practices regarding OSA. They showed an urgent demand for health care education. A particular emphasis should be placed on appropriating population demand for health care education and promoting the benefits of active medical practice models in sleep medicine.

2.3. Secondary data (ecological study)

Public health education is essential for managing health risks. The study by Gao et al. empirically analyzed the effect of public health education on people's demand for commercial health insurance. The research is based on panel data from 31 provinces in China from 2009 to 2019. It is observed that public health education significantly increases people's demand for commercial health insurance. This effect remains significant when considering endogeneity and robustness. It is also seen that health literacy, health risk perceptions, and health risk attitudes cause the increased demand for commercial health insurance. The effect of health education on promoting people's demand for commercial health insurance is more evident in regions with high levels of urbanization, the proportion of men, education, medical resources, economic development, and social medical insurance coverage.

2.4. Retrospective cohort study

Among PLHIV (People Living with the Human Immunodeficiency Virus), Opportunistic infections (OIs) are the leading cause of morbidity and mortality. Nevertheless, there

are few robust recent data on the rates of OIs and the risk factors contributing to their occurrence. Woldegeorgis et al. sought to determine the incidence of OIs and identify predictors among adolescents and adults after initiating Anti-Retroviral therapy (ART) in Ethiopia. A retrospective cohort study design was employed. The study population was 515 adolescents and adults who initiated ART between 1 January 2012 and 31 December 2021. The rate of OIs after the initiation of ART was relatively high. Moreover, being female, mild malnutrition, not taking ART, poor adherence to ART, and advanced HIV disease at presentation increased the hazards of developing OIs. Adherence counseling and public awareness can help improve this.

2.5. Quasi-experimental study (community trial)

The Chinese government released a national health education program in impoverished counties to promote health literacy among rural populations in 2018. Under this, an integrated health education program was implemented in Yunnan province. This included additional culturally sensitive educational components for the severely impoverished prefectures. Li et al. examined the differential effects of the health education program models on health literacy outcomes among 15-69-year-old residents in poverty-stricken areas. A quasi-experimental design was conducted with two arms. It included surveys at baseline (October 2019) and endline (June 2021) to collect individual-level health information, including the Chinese Resident Health Literacy Scale. The experimental group received the national health education program with the additional Yunnan-specific program, and the control group received only the national program. The findings highlight the importance of incorporating non-verbal visual aids and culturally-sensitive media tools in health literacy education to address healthy lifestyles and the living contexts of the populations in poverty-stricken areas.

2.6. Development of tools

The Sugar-Sweetened Media Literacy Scale (SSM-ML) has been shown to significantly assess the US population's SSB (Sugar-Sweetened Beverage) calorie intake. Long and Yoon conducted a cross-sectional study from September to November 2021 to describe the psychometric properties of the revised Chinese version of the SSB-ML (C-SSB-ML) and evaluate its validity and reliability. The results from 975 undergraduates at two of China's most prominent universities showed that the C- SSB-ML criterion-related validity was positively associated with the e-Health Literacy Scale (eHEALS). The findings provide evidence for a valid and reliable tool that can be used to assess sugar-sweetened media literacy in Chinese undergraduates. They will help organizations leverage media literacy in strategy formulation to ensure SSB intake is controlled as much as possible through practical efforts.

Selective biomedical and behavioral approaches still dominate health promotion practice. This is insufficient to reduce health inequities which are quite high due to the inequitable distribution of structural and systemic privilege and power. The RLCHPM (Red Lotus Critical Health Promotion Model) was developed to enhance critical practice. It includes values and principles that the health practitioners will be able to use to critically reflect on health promotion practice. Existing quality assessment tools primarily focus on technical aspects of practice and not on the underpinning values and principles. The purpose of the tool should be to support the reorientation of health promotion practice toward a more critical approach. A project by O'Hara and Taylor aimed to develop a quality assessment tool to support critical reflection using the values and principles of critical health promotion. Critical Systems Heuristics was used as the theoretical framework to develop the quality assessment tool. The pilot testing of the tool was done on nine graduate public health students in 2022. The Quality Assessment Tool for Critical Health Promotion Practice (QATCHEPP) includes ten values and associated principles. It provides theory-based heuristic support for practitioners to use critical reflection to assess the extent to which practice aligns with critical health promotion. The QATCHEPP can be used as part of the RLCHPM or as an independent quality assessment tool to support health promotion orientation toward critical practice. This is essential to ensure that health promotion practice enhances health equity.

3. Conclusion

The above studies provide insight into university medical and health science courses and have diverse contributions. This Research Topic is expected to inspire, inform and guide researchers in the field. The Research Topic reiterates the importance of the development of public health education considering local factors like social characteristics, demographic variables, and others. It also highlights the necessity of developing proper tools, educational material, and regular monitoring to sustain educational and promotional initiatives in the vast field of public health.

A new era of computer-assisted education has been opened by the introduction of AI in education has opened. It also brings new possibilities for teaching and learning in public health education (3). The importance of using the latest technological developments for improving public health activities is highlighted and cannot be undermined.

Author contributions

HT: Conceptualization, Writing—original draft, Writing—review and editing. AM: Conceptualization, Writing—review and editing.

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. Kang S, Goodman MS, Thakur HP, Grivna M, Zodpey SP. Editorial: an insight into university medical and health science courses. *Front Public Health.* (2022) 10:1074966. doi: 10.3389/fpubh.2022.1074966

2. Thakur H. Post-COVID-19 pandemic public health: Issues and challenges in India. *Indian J Public Health.* (2022) 66:401–2. doi: 10.4103/ijph.ijph_1430_22

3. Wang X, He X, Wei J, Liu J, Li Y, Liu X. Application of artificial intelligence to the public health education. *Front Public Health.* (2022) 10:1087174. doi: 10.3389/fpubh.2022.1087174

4. Punzalan JK, Guingona M, Punzalan MG, Cristobal F, Frahsa A, Liwanag HJ. The integration of primary care and public health in medical students' training based on social accountability and community-engaged medical education. *Int J Public Health.* (2023) 68:1605359. doi: 10.3389/ijph.2023.1605359

5. Collins SL, Smith TC, Hack G, Moorhouse MD. Exploring public health education's integration of critical race theories: a scoping review. *Front Public Health.* (2023) 11:1148959. doi: 10.3389/fpubh.2023.1148959

6. Stock C. Editorial: Experts' opinion in public health education and promotion. *Front Public Health.* (2023) 11:1211391. doi: 10.3389/fpubh.2023.1211391

7. Pan SW. Transnational public and global health education in China. *Glob Health Res Policy.* (2023) 8:21. doi: 10.1186/s41256-023-00305-2

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Psychometric properties of the Chinese version of the sugar-sweetened beverages media literacy scale for undergraduates

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Specific domains of the Sugar-Sweetened Media Literacy Scale (SSM-ML) have been shown to significantly assess sugar-sweetened beverage (SSB) calorie intake in the US population. This study aimed to describe the psychometric properties of the revised Chinese version of the SSB-ML (C-SSB-ML) and evaluate its validity and reliability. Results from 975 undergraduates at two of the largest universities in a province in southwest China showed that Cronbach's alphas for the overall scale, the three dimensions, and two-halves analysis were satisfactory (0.71–0.92). The criterion-related validity of the C-SSB-ML was positively associated with the e Health literacy scale (eHEALS). Confirmatory factor analysis showed that the three-factor model of the C-SSB-ML had adequate fit indices χ^2 (153) = 4349.93, $p < 0.001$; Comparative fit index (CFI), Tucker-Lewis index (TLI), Incremental fit index (IFI) >0.90; Standardized Root Mean Square Residual (SRMR) <0.07; and Root Mean Square Error of Approximation (RMSEA) <0.08. Our findings provide evidence for a valid and reliable tool that can be used to assess sugar-sweetened media literacy in Chinese undergraduates and will help organizations leverage media literacy in strategy formulation to ensure SSB intake is controlled as much as possible through effective efforts on all fronts.

KEYWORDS

sugar-sweetened beverages, sugar-sweetened beverages media literacy, undergraduates, psychometric properties, validation

Introduction

Consumption of liquid carbohydrates, especially sugar-sweetened beverage (SSB), is not only high but has been increasing globally to varying degrees of significance for decades (1–7). In the United States, per capita consumption of SSB more than doubled from the late 20th century to the early twenty-first century (8), as well as the increase in daily calorie consumption per capita in China of SSB sold by Coca-Cola and PepsiCo by 215 and 147%, respectively, in the decade beginning in 2000 (9).

Evidence, including prospective epidemiological studies, suggests that SSB intake is associated with obesity, both in adults and children (1, 10–16). Due to the rapid absorption of liquid carbohydrates, SSB may trigger glucose intolerance and insulin resistance and increase the risk of developing metabolic diseases such as latent autoimmune diabetes in adults, type 2 diabetes mellitus and metabolic syndrome in adults by increasing the dietary glycemic load in the presence of high consumption (1, 11–13, 17–20). SSB intake, even at low calorie levels, promotes higher triglyceride concentrations and is associated with adverse levels of inflammation and serum C-reactive protein, a biomarker of cardiovascular risk, and may lead to an increased risk of cardiovascular morbidity and mortality (13, 16, 20–24). Another issue of concern is the association between the intake of free sugars and dental caries, not only because dental caries is the most prevalent form of NCDs in the world (25–27) but also because the cost of treating dental caries accounts for 5–10% of the health budget of industrialized countries, likely exceeding the entire financial resources spent on children's health in most low-income countries (26–28). Increased SSB intake leads to poor diet quality while consuming more calories (29–31), not only a higher intake of high saturated and high trans fatty acids, but also lack of fiber, vitamins, and essential nutrients (10, 32–36). In addition, high intake of SSB has been observed to be associated with reduced bone mineral compactness and subsequent fractures (37–39).

During the transition from adolescence to adulthood, health-related behavior patterns are being established (40, 41). The transition from home to college may lead to poor choices in undergraduates' diet (40–43). They are in an obesogenic environment, have access to an all-you-can-eat cafeteria, where the food is often high in fat and sugar (17–19). In terms of promoting sound eating habits, undergraduates represent an important subgroup of young adults due to the challenges they face in making healthy choices (20). SSB make up an increasing proportion of calorie intake; during the decade beginning in 2000, SSB sales by Coca-Cola and PepsiCo witnessed an increase in per capita daily calorie consumption in China by 215 and 147%, respectively (21). A national cross-sectional survey in China in 2016 showed that 47% of adults residing in cities consumed more than one serving of SSB per day (22). The problem is that China, sandwiched between the powerful influence of the International Life Sciences Institute (ILSI) and various other SSB companies, remains decades behind in efforts to create a healthier diet for its citizens (23). Media presentations have influenced our perceptions of the foods presented, and the extent to which they now overwhelmingly present and advance foods high in sugar, fat and salt is undeniable (9, 44–48). In terms of promoting sound eating habits, undergraduates represent an important subgroup of young adults due to the challenges they face in making healthy choices (20). Media would now be able to add to this intrinsic inclination as they overwhelmingly present and advance unhealthy food options, with undeniable degrees of sugar, fat, and salt (24–27). Since the 1950s, Western scholars have been concerned about the role of mass media in consumer socialization (28). Media presentations influence our perceptions of the foods showcased and shape our perceptions of what we know, like, and how we should act (29, 30). In 2009, to explore the relationship between smoking and smoking-mediated literacy, antismoking media literacy (AML)—a theoretical framework focusing on skill sets in various domains of media literacy—was developed. Not only did the researchers find that higher smoking media literacy was significantly associated with lower current smoking prevalence, but they also found a strong independent association between higher smoking media literacy and lower susceptibility to future smoking in subsequent analyses (31, 32). Subsequently, based on AML, an ideal internal consistency assessment tool, SSB-ML, was developed (33) and validated among university students in Turkey (34). Result of a UNESCO project survey in China have shown that more than half of college students strongly believe that evaluating the information they find is difficult (49).

Based on the Antismoking Media Literacy (AML) (50, 51), Sugar-Sweetened Media Literacy Scale (SSM-ML), a theoretical framework focusing on skills in various domains of SSB media literacy was developed and validated as an ideal internal consistency assessment tool in American and Turkish populations (52, 53). Based on the gap that the impact of evolving media on eating behaviors has not received sufficient attention, this study aimed to examine the psychometric properties of the C-SSB-ML and to describe the variation in C-SSB-ML scores among undergraduate students with different demographic characteristics in a Chinese setting.

Materials and methods

Study design

A non-experimental, cross-sectional study using a survey was conducted the end of September and the beginning of November 2021 with 1,044 students from two of the largest universities located in a province in southwestern China. Participants were selected using incidental and snowball sampling, reaching the target population to the greatest extent possible through paper-based and online questionnaires.

Translation and adaptation

Before beginning the study, e-mail permission was sought from Dr. Yvonnes Chen, one of the main developers of the SSB-ML. In the first step of the translation process, two bilinguals were informed of the basic profile of the study sample population, and the original scale was translated from English to Chinese by these two individuals under the supervision of

the study leader. Afterwards, a monolingual who was not good at English was asked to test and comment on the semantic ambiguities of the Chinese version. An English-specialized researcher back-translated the resulting version into English. The bilingual team compares the original scale with the back-translated scale and adjusts it to obtain the C-SSB-ML, Chinese version of SSB-ML. In the process, the words "TV", "magazine" and "movie" in the original version were adjusted according to the media that Chinese undergraduates encounter in their daily lives and replaced by the words "Douyin (TikTok)", "short video" and "social media". The newly developed C-SSB-ML was tested in 20 participants (not included in this study) to check their understanding of the items being used in this study, this was done to assess if all 19 items were easy to provide ratings for and had no ambiguity among Chinese speakers. As the steps in Figure 1.

Data collection and measures

For the sample size calculation, we carefully considered multiple criteria, firstly in order to have an idea of the problem involved, a careful attempt at a rule of thumb suggests that the sample size should always be more than 10 times the number of free model parameters (54, 55). Based on the six rules of Raykov et al. (56), our model parametric number was determined as follows, with 18 residual variance, 3 covariances between independent variables, and 18 factor loadings connecting the potential variables and their indicators, so our total number of model parameters is 39. Then, the sample size for the first step is determined as 390. Since we want to perform an average and independent database for each of EFA and CFA, our sample size should be at least 780. Also, the criteria for the EFA sample followed Comrey and Lee's suggested size range (57). Considering the response rate and missing values, we tried to reach the maximum number of respondents. Finally, a total of 1,044 participants agreed with the contents. Another inclusion criterion was to have consumed an SSB at least once in the past month and have a clear memory of the type and volume of SSB consumed regularly. Participants had the option of completing the survey through (https://www.wjx.cn/) or through a paper-and-pencil survey provided by their classroom teacher. In the end 975 valid surveys were located, with a response rate of 92.86%. 956 participants chose to complete the survey online, and 19 completed a paper-and-pencil survey, with each one lasting approximately 15–25 minutes.

Chinese version of the SSB-ML(C-SSB-ML)

The C-SSB-ML scale was developed to assess individuals' media literacy skills in SSB (52). 19 items are included on the scale. Each item is scored on a seven-point Likert-type scale as "1" for absolutely disagree, "4" for neutral, and "7" for absolutely agree. Functional skills, interactive skills, food selection skills, and critical thinking skills are assessed by this scale (53). The first dimension of the C-SSB-ML, Authors & Audiences (AA), focuses on describing the beverage industry as highly influential and manipulative. The second dimension is Messages and Meanings (MM), which focuses on describing images, symbols, and pictures that evoke an emotional response to achieve a specific marketing purpose. The last dimension involves Representation & Reality (RR), as there is a discrepancy between the real health effects of ingesting either tobacco or SSB and what marketers portray, and this dimension is concerned with that ironic discrepancy (50, 52). The Cronbach's alphas for the entire scale in the previous study were found to be 0.89 and 0.86 (52, 53), with the three sub-dimensions ranging from 0.65 to 0.83 (52).

The eHealth literacy scale (eHEALS)

The eHEALS was developed in 2006 (58), measures individuals' multidimensional skills in accessing, understanding, and evaluating health information from electronic media and using this knowledge to solve their health problems. The eHEALS is the first electronic health literacy assessment tool to measure netizens' self-awareness of their ability to seek and apply online health knowledge. There are eight items on the scale, each scored on a five-point Likert-type scale, from "strongly disagree" to "strongly agree". Sample items include: "I know how to find helpful health resources on the Internet"; "I know how to use the Internet to answer my health questions"; and "I know what health resources are available on the Internet." The Cronbach's alpha for the overall Chinese version of eHEALS was 0.91 and factor loading coefficients were between 0.69 and 0.87 (59).

Socio-demographic questions

This part consisted of five questions about the participant's age, gender, grade, body weight, and height (to calculate the BMI), and mother's education level.

Statistical analysis

Confirmatory factor analysis (CFA) was performed with AMOS 24.0, and the rest using SPSS 24.0. Differences in demographic characteristics of C-SSB-ML (overall and the three dimensions) scores and demographic characteristics were analyzed using one-way analyses of variance (ANOVA) and independent sample *t*-tests. Database was divided into two halves, with 482 samples in the first half used to perform explanatory factor analysis (EFA) and 493 samples in the other half used to perform CFA. Substance-factor relationships were determined using EFA. The criteria for factor loading included items having values$\geq$ 0.50 on the primary factor, and no items

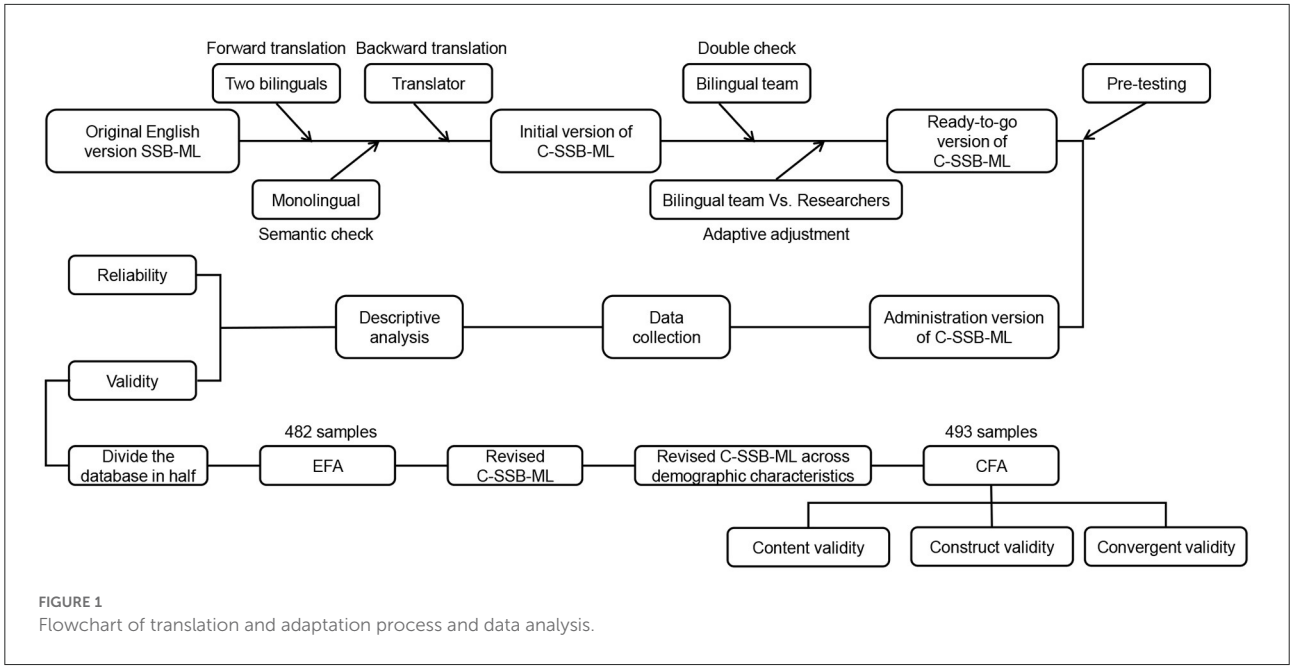

FIGURE 1
Flowchart of translation and adaptation process and data analysis.

cross loaded onto other factors. Kaiser-Meyer-Olkin (KMO) statistics and Barlett Sphericity test were used to assess the factorability of the correlation matrix. For factor extraction, the robust maximum likelihood method (RML) with correction for robust mean and variance-scaled was used. An analysis of the CFA was conducted to determine whether the items and dimensions explained the structure of the original scale. To determine whether the items and dimensions explained the structure of the original scale, CFA was performed on a second subsample using the maximum likelihood method (ML). The following criteria are used as cut-off points for ideal fits (60, 61), The goodness-of-fit was assessed by chi-square (χ^2), chi-square/degrees of freedom (χ^2/df), the Comparative fit index (CFI), the Tucker–Lewis index (TLI), Incremental fit index (IFI), the Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Square Residual (SRMR). Total score of the C-SSB-ML and discriminant validity among the three dimensions, as well as the convergent validity of eHEALS, were assessed using Pearson correlation analysis. The item-level content validity index (I-CVI) and the average of the I-CVI scores for all items on the scale (S-CVI/Ave) were used to assess the degree of relevance and representation of the elements in the instrument to the goal constructs. C-SSB-ML and three dimensions were tested for internal consistency using Cronbach's alpha coefficients (Figure 1).

Ethical considerations

This study was approved by the Human Trials Ethics Committee of Guizhou Medical University (dated 22.04.2021 and numbered 2021-LUNSHENDI-150). Respondents were informed of the content of the survey and voluntarily chose to fill out the questionnaire without any compensation, and were informed that they could withdraw at any time without penalty, and that all respondents signed an informed consent form (those who chose to fill out the online questionnaire received an electronic version of the informed consent form).

Results

Participant characteristics

The average age of the participants was 19.60 years (SD = 1.44, range = 17–24). Most of the participants were in their first year (74.40%), with the majority being female (61.40%). In terms of their mothers' education, most of participants reported as primary school/below (50.70%), followed by junior high school (27.80%), high school (11%), junior college/above (8.60%), and unaware (1.90%). Using the Working Group on Obesity in China (WGOC) Body Mass Index (BMI) standards (62), the sample was 87.80% underweight or normal (BMI from the lowest to 23.99) and 12.20% overweight or obese (BMI from 24 to 27.99).

Revised C-SSB-ML across socio-demographic characteristics

First, regarding the mean scores of the dimensions of C-SSB-ML, participants scored the highest on the MM dimension (*M*

TABLE 1 Revised C-SSB-ML across socio-demographic characteristics.

	All participants *n* (%)	Overall SSB-ML, mean (*SD*)	Authors and audiences, mean (SD)	Messages and meanings, mean (SD)	Representation and reality, mean (SD)
Gender					
Male	376 (38.6)	4.84 (0.91)	4.44 (1.02)	5.09 (1.02)	4.86 (1.15)
Female	599 (61.4)	4.96 (0.83)	4.41 (0.95)	5.35 (0.97)	4.89 (1.11)
Statistic		$t = -2.15$,	$t = 0.59$, ($p = 0.56$)	$t = -3.99$,	$t = -0.40$, ($p = 0.69$)
(p-value)		($p = 0.03$)		($p = 0.00$)	
Age					
≤19	566 (58.1)	4.93 (0.79)	4.38 (0.93)	5.3 (0.91)	4.9 (1.14)
20–21	288 (29.5)	4.95 (0.93)	4.51 (1.02)	5.26 (1.06)	4.91 (1.1)
≥22	121 (12.4)	4.76 (1.01)	4.36 (1)	5 (1.17)	4.7 (1.06)
Statistic		$F = 3.13$,	$F = 1.66$, ($p = 0.19$)	$F = 4.71$,	$F = 2.84$, ($p = 0.06$)
(p-value)		($p = 0.04$)		($p = 0.01$)	
Grade					
1	725 (74.4)	4.92 (0.84)	4.42 (0.96)	5.26 (0.96)	4.91 (1.14)
2	80 (8.2)	4.82 (0.92)	4.3 (1.03)	5.18 (1.1)	4.81 (1.13)
3	129 (13.2)	4.82 (0.96)	4.32 (1.01)	5.17 (1.13)	4.74 (1.05)
4	41 (4.2)	5.22 (0.9)	4.89 (1.06)	5.5 (1.04)	4.99 (1.02)
Statistic		$F = 2.50$,	$F = 4.06$, ($p = 0.01$)	$F = 1.30$,	$F = 1.00$, ($p = 0.39$)
(p-value)		($p = 0.06$)		($p = 0.27$)	
BMI	856 (87.8)	4.88 (0.85)	4.37 (0.96)	5.24 (1)	4.85 (1.11)
≤23.99					
≥24-27.99	119 (12.2)	5.11 (0.95)	4.8 (1.06)	5.33 (1)	5.09 (1.21)
Statistic		$t = -2.70$,	$t = -4.52$, ($p = 0.00$)	$t = -0.914$,	$t = -2.21$, ($p = 0.03$)
(p-value)		($p = 0.01$)		($p = 0.36$)	
Mother's education level[a]					
Primary school/below	494 (50.7)	4.86 (0.87)	4.38 (0.99)	5.2 (1)	4.8 (1.11)
Junior high school	271 (27.8)	4.96 (0.84)	4.43 (0.96)	5.29 (0.96)	5.03 (1.08)
High school	107 (11)	5.03 (0.92)	4.53 (0.99)	5.4 (1.07)	4.93 (1.21)
Junior college/ above	84 (8.6)	4.92 (0.87)	4.48 (0.98)	5.24 (1.04)	4.8 (1.11)
Statistic		$F = 1.58$,	$F = 0.88$, ($p = 0.45$)	$F = 1.38$,	$F = 2.62$, ($p = 0.05$)
(p value)		($p = 0.19$)		($p = 0.25$)	

[a]Missing data = 19 (A total of 19 reported they did not know their mother's level of education).

= 5.25, SD = 1) followed by RR ($M = 4.88$, SD = 1.12) the lowest was AA ($M = 4.42$, SD = 1). The mean score of C-SSB-ML overall was 4.91 (SD = 0.87). Out of a total of 18 items, the highest scoring item was "Two people may see the same short video on Douyin (TikTok) and get very different ideas about it" in the MM dimension ($M = 5.57$, SD = 1.30) and the lowest scoring item was "Certain sugary drink brands are designed to appeal to people like me" in the AA dimension ($M = 3.94$, SD = 1.61). Second, females had significantly higher mean scores than males in both the overall scale and MM dimension, and males had slightly higher mean score than females in the RR dimension but the difference was not statistically significant. Similarly, the three age groups showed statistically significant differences in overall scale and MM dimension score, with the middle age group scoring higher than the other two groups. However, the same pattern was not shown in terms of grade, not only is the difference presented in the scores of the AA dimension, but the highest scores are for 4th year undergraduates. Statistically differences due to BMI were shown in the overall scale, AA dimension and RR dimension, with the most prominent pattern being the coexistence of high BMI and high C-SSB-ML scores (see Table 1).

Psychometric properties

Content validity

A panel of nine experts with extensive research experience in the field of health care, comprising three professors/associate professor, one graduate student and one practicing physician, and four PhD candidates. These experts were invited to rate the relevance of the scale's 18 items on a 4-point Likert scale (where 1 = not related, 2 = slightly related, 3 = quite related, and 4 =strongly related). I-CVI is calculated by the percentage of relevance ratings given to items 3 or 4 by content experts, and the average of the proportional correlations of all expert judgments was used to calculate the S-CVI/Ave. The S-CVI/Ave was 0.88 and I-CVI for all questions was equal to or higher than 0.78, and the revised C-SSB-ML had good content validity considering the number of experts (63, 64).

Construct validity

According to KMO, sampling adequacy measure was 0.93. The statistical significance of Barlett Sphericity test was χ^2 (153) = 4349.93 ($p < 0.001$), suggesting that factor analysis can be applied to the data.

In order to further optimize the application model of SSB-ML in the Chinese context, the item with factor loading <0.5, that is, "sugary drink ads show a healthy lifestyle to make people forget about the health risks, such as weight gain and diabetes" was removed. Subsequently, "wearing a shirt with a sugary drink logo on it makes you a walking advertisement" and "sugary drink in social media link drinking these beverages to things people want, like joy, good looks, and health" were moved to the first dimension. "When designing an advertisement campaign, sugary drink companies think very carefully about the people they want to buy their beverages" and "most social media information shows people drinking sugary drinks make it look more attractive than it really is" were moved to the second dimension. There are two reasons why this alignment was acceptable. First, there was a degree of overlap between the various constructs of media literacy (50, 51). Second, the first two items fit into the original theoretical frameworks of "authors of media messages target specific audiences," and the latter two also fit into "media messages convey particular values and/or points-of-view" and "producers carefully construct media messages" (50). As Table 2 shows, factor loadings in the AA dimension ranged from 0.51 to 0.68; MM dimension, from 0.56 to 0.80; and RR dimension, from 0.71 to 0.81. In total, 58.94% of the total variance was explained, the first eigenvalue explained 29.40% of the total variance, and the ratio of the first to the second eigenvalue was 1.78, and the ratio of the first to the third eigenvalue reached 2.26, indicating that the scale has the potential to be two-dimensional when used as a survey instrument for Chinese populations.

According to the CFA results, loadings of 18 items were medium to high (with values of 0.47–0.87) and the three-factor model for the 18 items exhibited a satisfactory fit as presented in Table 2. Fit indices indicated that three dimensions of C-SSB-ML represented the item responses in Chinese undergraduates with the following values: χ^2/df = 3.63 ($p < 0.001$), CFI = 0.92, TLI = 0.91, IFI = 0.92, and these values are also considered acceptable (65–68). In addition, this study examined the two model fit indices from an absolute perspective: SRMR and RMSEA. Considering the total sample SRMR value of this study should be close to 0.08 (69, 70), the RMSEA value should be lower than 0.08 for acceptable model fit (60, 69, 70). The results of our study, SRMR of 0.06 and RMSEA of 0.07, are acceptable. Average variance extracted (AVE) and composite reliability (CR) were calculated for each domain, and although the CR values were excellent, one AVE did not reach 0.5, but the results were acceptable because it was higher than 0.3 (71).

Convergent validity

The convergent validity of the C-SSB-ML with one external measurement tool. As shown in Table 3, the convergent validity of the C-SSB-ML was also assessed in comparison with the eHEALS score. The eHEALS scores were significantly correlated with the total C-SSB-ML scores, as well as the scores of the three dimensions.

Reliability

The Cronbach's alpha was 0.92 for the overall scale. The Cronbach's alpha of the subdimensions were 0.75, 0.92, and 0.82, for AA, MM, and RR, respectively. Based on the two-halves analysis, the Cronbach's alpha for the first and second halves, respectively, were 0.82 and 0.90. The Spearmen Brown coefficient was 0.83, the Guttman split-half coefficient was 0.83, and the correlation coefficient between the two halves was 0.71, which shows the high internal consistency of the scale.

Discussion

When looking at the C-SSB-ML across demographic characteristics, the first finding was that there was much room for improvement in the C-SSB-ML levels of Chinese undergraduate students. The mean (SD) for SSB-ML overall and across subdomains ranged from 5.83 (0.89) to 6.28 (0.57) for participants of similar age in the study by Chen et al., and were significantly higher than that in our study. However, the similarity between the results of the two studies was that respondents had the highest scores in the MM, followed by the RR, and the lowest in the AA (52).

TABLE 2 Results of the exploratory and confirmatory factor analyses.

Items	EFA			CFA		
	Factor 1	Factor 2	Factor 3	Factor loading	AVE	CR
Domain 1: "authors and audiences"						
Grocery store or convenient store deals on sugary drinks, like buy-one-get-one free and other sales, are designed to get people addicted to sugar (1).	0.66			0.55	0.32	0.74
Sugary drink companies are very powerful, even outside of the beverage business (2).	0.66			0.55		
Sugary drink companies only care about making money (3).	0.68			0.57		
Certain sugary drink brands are designed to appeal to people like me (4).	0.68			0.47		
Wearing a shirt with a sugary drink logo on it makes you a walking advertisement (6).	0.51			0.58		
Sugary drink in social media link drinking these beverages to things people want, like joy, good looks, and health (7).	0.54			0.65		
Domain 2: "messages and meanings"						
When designing an advertisement campaign, sugary drink companies think very carefully about the people they want to buy their beverages (5)		0.56		0.65	0.53	0.91
Most social media information shows people drinking sugary drinks make it look more attractive than it really is (15).		0.73		0.75		
Two people may see the same short video on Douyin (TikTok) and get very different ideas about it (8).		0.79		0.78		
Different people can see the same sugary drink on Douyin (TikTok) and feel completely different about it (9).		0.75		0.75		
A sugary drink advertisement may catch one person's attention but not even be noticed by another (10).		0.78		0.77		
People are influenced by social media, whether they realize it or not (11).		0.80		0.75		
People are influenced by advertising (12).		0.77		0.68		
When people make short videos, every camera shot is very carefully planned (13).		0.64		0.69		
There are hidden messages in sugary drink advertisements (14).		0.63		0.73		
Domain 3: "representation and reality"						
When you see a buy-one-get-one-free or other type of sugary drink sale, it's usually not actually a good deal in the long run (17).			0.81	0.62	0.58	0.80
When you see a sugary drink advertisement, it is very important to think about what was left out of it (18).			0.72	0.79		
Short videos usually leave out a lot of important information (19).			0.71	0.86		
Eigenvalue	7.71	1.78	1.12			
Explained Variance (%)	29.40	16.52	13.02			

The item numbers of the original English version of the scale are indicated in parentheses; *EFA*, exploratory factor analysis; *CFA*, confirmatory factor analysis; AVE, Average variance extracted; *CR*, Composite reliability.

TABLE 3 Correlation between continuous variables of the revised C-SSB-ML and eHEALS.

	Authors and audiences	Messages and meanings	Representation and reality	SSB-ML	eHEALS
Authors and audiences	1				
Messages and meanings	0.53***	1			
Representation and reality	0.54***	0.66***	1		
SSB-ML	0.80***	0.92***	0.80***	1	
eHEALS	0.19***	0.31***	0.26***	0.31***	1

***$p < 0.001$.

Our primary finding showed that the relationship between gender and overall score of C-SSB-ML was in line with previous studies stating that females scored higher on the RR, MM, and the scale overall, but only the latter two differences were statistically significant. This suggests that the female participants tended to endorse the pluralistic structure of media literacy as a whole and SSB' critical attitude toward advertising intentions. This is consistent with previous studies in which females scored higher than males in media literacy sets or certain media literacy subdomains (72, 73). Participants with a BMI of 24–27.99 had significantly higher scores on the C-SSB-ML total scale, AA, and RR than those with a BMI less than or equal to 23.99. First, this suggests that higher BMI and higher media literacy scores can co-exist, which is consistent with the findings of a 2020 study (72). Furthermore, combined with the idea that larger female college students are more likely to have critical attitudes toward media images because they are less likely to be identified in them (74), our findings may suggest that such attitudes may be generalized to other media message areas. Second, this result implies that participants with a higher BMI are more sensitive to the marketing motives and techniques of media authors. In addition, fourth-year undergraduates scored significantly higher than freshman to junior undergraduates on all three subdomains and the overall scale, but no difference was significant, implying that fourth-year undergraduates were more willing to take a critical view of marketing techniques in the SSB industry.

Although the EFA results cannot be compared with the original study's findings (52), in a subsequent study, the factor loadings for the three dimensions were reported to be between 0.30 and 0.92, and a total of 49.90% of the variance can be explained by the sum of the three dimensions of the scale (53). Therefore, the current study indicates that the interpretation of factor loadings and scale variances is highly desirable.

In the initial study, Cronbach's alphas >0.65 were reported for the scale (52). In the Turkish version of the study, Cronbach's alphas were reported >0.65 in both the total scale and subdimensions, as well as in the two-halves (53). Our study is slightly higher than these two prior studies in terms of these values, indicating that the C-SSB-ML and previous studies are similar and has strong internal consistency.

In the literature, it is recommended to use CFA to study the structure determined by EFA, and a good fit is indicated if the model fit indicators are >0.90, the χ^2/df is <5, RMSEA is <0.08, and SRMR is <0.07 (61, 75). The coefficient loadings in CFA in our study also showed satisfactory results between 0.47 and 0.86 (significantly higher than 0.3), and the model fit indicators were consistent with literature criteria.

Regarding convergent validity, the C-SSB-ML was highly correlated with eHEALS scores, a result that further confirmed the validity of the C-SSB-ML due to the highly established study of the applicability of eHEALS in the Chinese sample population.

Although we did our best to make the present study comparable to the initial study (52), there were still some context-based differences, such as we cannot completely exclude the effect due to the small range of BMI in the current sample population. Finally, it is worth noting that Guizhou province is an economically underdeveloped province in southwestern China, and our participants were representative of the undergraduate students in Guizhou. This representation can therefore not be extended to other provinces in China where the situation is quite different. Future investigations should be conducted in more diverse populations, as whether the SSB-ML subdomains are sensitive to different levels of media literacy needs to be further validated; similarly, the association between BMI and caloric intake of SSB in different populations should be further explored. As well as the association of SSB intake with media literacy, should be compared with the association of many other factors considered to be important predictors of this behavior.

Conclusions

Identifying which part of the media literacy skill set is most closely related to undergraduate students' SSB intake or motivation can help us design specific SSB control interventions. To our knowledge, this is the first study to validate the C-SSB-ML in a Chinese setting. We examined the psychometric properties of the C-SSB-ML and the results of the study point

to the C-SSB-ML as a valid and reliable instrument and it may be an important component of SSB control interventions with Chinese undergraduates or young adults, especially because it is feasible and teachable.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by the Human Trials Ethics Committee of Guizhou Medical University (numbered 2021-LUNSHENDI-150). The patients/participants provided their written informed consent to participate in this study.

Author contributions

CL and MY conceptualized this study, and they were also responsible for the data analysis. MY directed the study. CL was responsible for data gathering and the initial draft of the manuscript. Both authors contributed to this paper 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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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.1009838/full#supplementary-material

References

1. Haque M, McKimm J, Sartelli M, Samad N, Haque SZ, Bakar MA, et al. Narrative review of the effects of sugar-sweetened beverages on human health: a key global health issue. *J Popul Ther Clin Ph.* (2020) 27:e76–e103. doi: 10.15586/jptcp.v27i1.666

2. Singh GM, Micha R, Khatibzadeh S, Shi P, Lim S, Andrews KG, et al. Correction: global, regional, and national consumption of sugar-sweetened beverages, fruit juices, and milk: a systematic assessment of beverage intake in 187 countries. *PLoS ONE.* (2019) 14:e0214344. doi: 10.1371/journal.pone.0214344

3. Vorster HH, Kruger A, Wentzel-Viljoen E, Kruger HS, Margetts BM. Added sugar intake in South Africa: findings from the adult prospective urban and rural epidemiology cohort study. *Am J Clin Nutr.* (2014) 99:1479–86. doi: 10.3945/ajcn.113.069005

4. Nielsen SJ, Popkin BM. Changes in beverage intake between 1977 and 2001. *Am J Prev Med.* (2004) 27:205–10. doi: 10.1016/j.amepre.2004.05.005

5. Zhang N, Morin C, Guelinckx I, Moreno LA, Kavouras SA, Gandy J, et al. Fluid Intake in Urban China: results of the 2016 Liq. In 7 national cross-sectional surveys. *Eur J Nutr.* (2018) 57:77–88. doi: 10.1007/s00394-018-1755-5

6. Greenhalgh S. Soda industry influence on obesity science and policy in China. *J Public Health Pol.* (2019) 40:5–16. doi: 10.1057/s41271-018-00158-x

7. Gulati S, Misra A. Sugar intake, obesity, and diabetes in India. *Nutrients.* (2014) 6:5955–74. doi: 10.3390/nu6125955

8. Popkin BM. Patterns of beverage use across the lifecycle. *Physiol Behav.* (2010) 100:4–9. doi: 10.1016/j.physbeh.2009.12.022

9. Naderer B, Matthes J, Spielvogel I. How brands appear in children's Movies. A Systematic Content Analysis of the Past 25 Years. *Int J Advert.* (2019) 38:237–57. doi: 10.1080/02650487.2017.1410000

10. Malik VS, Schulze MB, Hu FB. Intake of sugar-sweetened beverages and weight gain: a systematic review. *Am J Clin Nutr.* (2006) 84:274–88. doi: 10.1093/ajcn/84.2.274

11. Malik VS, Popkin BM, Bray GA, Després J-P, Hu FB. Sugar-sweetened beverages, obesity, type 2 diabetes mellitus, and cardiovascular disease risk. *Circulation.* (2010) 121:1356–64. doi: 10.1161/CIRCULATIONAHA.109.876185

12. Malik VS, Popkin BM, Bray GA, Després J-P, Willett WC, Hu FB. Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes: a meta-analysis. *Diabetes Care.* (2010) 33:2477–83. doi: 10.2337/dc10-1079

13. Hauner H, Bechthold A, Boeing H, Brönstrup A, Buyken A, Leschik-Bonnet E, et al. Evidence-based guideline of the German nutrition society: carbohydrate intake and prevention of nutrition-related diseases. *Ann Nutr Metab.* (2012) 60:1–58. doi: 10.1159/000335326

14. Nishida C, Uauy R, Kumanyika S, Shetty P. The joint who/Fao expert consultation on diet, nutrition and the prevention of chronic diseases: process, product and policy implications. *Public Health Nutr.* (2004) 7:245–50. Epub 2007/01/02. doi: 10.1079/PHN2003592

15. Raben A, Vasilaras TH, Møller AC, Astrup A. Sucrose compared with artificial sweeteners: different effects on ad libitum food intake and body weight after 10 week of supplementation in overweight subjects. *Am J Clin Nutr.* (2002) 76:721–9. doi: 10.1093/ajcn/76.4.721

16. Malik VS, Hu FB. The role of sugar-sweetened beverages in the global epidemics of obesity and chronic diseases. *Nat Rev Endocrinol.* (2022) 18:205–18. doi: 10.1038/s41574-021-00627-6

17. El-Malky AM, Naik RG, Elnouman AA. Sugary beverages consumption and latent autoimmune diabetes in adults: systematic review and meta-analysis. *Clin Diabetol.* (2020) 9:118–27. doi: 10.5603/DK.2020.0007

18. Janssens JP, Shapira N, Debeuf P, Michiels L, Putman R, Bruckers L, et al. Effects of soft drink and table beer consumption on insulin response in normal teenagers and carbohydrate drink in youngsters. *Eur J Cancer Prev.* (1999) 8:289–95. doi: 10.1097/00008469-199908000-00004

19. Schulze MB, Liu S, Rimm EB, Manson JE, Willett WC, Hu FB. Glycemic index, glycemic load, and dietary fiber intake and incidence of type 2 diabetes in younger and middle-aged women. *Am J Clin Nutr.* (2004) 80:348–56. doi: 10.1093/ajcn/80.2.348

20. Neelakantan N, Park SH, Chen G-C, van Dam RM. Sugar-sweetened beverage consumption, weight gain, and risk of type 2 diabetes and cardiovascular diseases in Asia: a systematic review. *Nutr Rev.* (2021) 80:50–67. doi: 10.1093/nutrit/nuab010

21. Liu S, Manson JE, Buring JE, Stampfer MJ, Willett WC, Ridker PM. Relation between a diet with a high glycemic load and plasma concentrations of high-sensitivity c-reactive protein in middle-aged women. *Am J Clin Nutr.* (2002) 75:492–8. doi: 10.1093/ajcn/75.3.492

22. Huang C, Huang J, Tian Y, Yang X, Gu D. Sugar sweetened beverages consumption and risk of coronary heart disease: a meta-analysis of prospective studies. *Atherosclerosis.* (2014) 234:11–6. doi: 10.1016/j.atherosclerosis.2014.01.037

23. Fung TT, Malik V, Rexrode KM, Manson JE, Willett WC, Hu FB. Sweetened beverage consumption and risk of coronary heart disease in women. *Am J Clin Nutr.* (2009) 89:1037–42. doi: 10.3945/ajcn.2008.27140

24. Yin J, Zhu Y, Malik V, Li X, Peng X, Zhang FF, et al. Intake of sugar-sweetened and low-calorie sweetened beverages and risk of cardiovascular disease: a meta-analysis and systematic review. *Adv Nutr.* (2020) 12:89–101. doi: 10.1093/advances/nmaa084

25. Marcenes W, Kassebaum NJ, Bernabé E, Flaxman A, Naghavi M, Lopez A, et al. Global burden of oral conditions in 1990–2010: a systematic analysis. *J Dent Res.* (2013) 92:592–7. doi: 10.1177/0022034513490168

26. Petersen PE. The world oral health report 2003: continuous improvement of oral health in the 21st century—the approach of the who global oral health programme. *Commun Dent Oral.* (2003) 31 Suppl 1:3–23.

27. Moynihan P. "The role of diet in the prevention of dental diseases". In: Limeback H, editor. *Comprehensive Preventive Dentistry.* Amsterdam: John Wiley & Sons (2012). p. 99–114. doi: 10.1002/9781118703762.ch6

28. Petersen PE, Bourgeois D, Ogawa H, Estupinan-Day S, Ndiaye C. the global burden of oral diseases and risks to oral health. *B World Health Organ.* (2005) 83:661–9.

29. Almiron-Roig E, Palla L, Guest K, Ricchiuti C, Vint N, Jebb SA, et al. Factors that determine energy compensation: a systematic review of preload studies. *Nutr Rev.* (2013) 71:458–73. doi: 10.1111/nure.12048

30. DeSalvo KB, Olson R, Casavale KO. Dietary guidelines for Americans. *JAMA.* (2016) 315:457–8. doi: 10.1001/jama.2015.18396

31. Mattes RD. Dietary compensation by humans or supplemental energy provided as ethanol or carbohydrate in fluids. *Physiol Behav.* (1996) 59:179–87. doi: 10.1016/0031-9384(95)02007-1

32. Pundziute-Lyckå A. Persson L-Ak, Cedermark G, Jansson-Roth A, Nilsson U, Westin V, et al. Diet, growth, and the risk for type 1 diabetes in childhood: a matched case-referent study. *Diabetes Care.* (2004) 27:2784–9. doi: 10.2337/diacare.27.12.2784

33. Mullie P, Deliens T, Clarys P. Relation between sugar-sweetened beverage consumption, nutrition, and lifestyle in a military population. *Mil Med.* (2016) 181:1335–9. doi: 10.7205/MILMED-D-15-00453

34. Yoshino F, Yoshida A, Umigai N, Kubo K, Lee M-C-I. Crocetin reduces the oxidative stress induced reactive oxygen species in the stroke-prone spontaneously hypertensive rats (Shrsps) brain. *J Clin Biochem Nutr.* (2011) 49:182–7. doi: 10.3164/jcbn.11-01

35. Bonnefont-Rousselot D. Glucose and reactive oxygen species. *Curr Opin Clin Nutr.* (2002) 5:561–8. doi: 10.1097/00075197-200209000-00016

36. Prasad K, Dhar I. Oxidative stress as a mechanism of added sugar-induced cardiovascular disease. *Int J Angiol.* (2014) 23:217–26. doi: 10.1055/s-0034-1387169

37. Ahn H, Park YK. Sugar-sweetened beverage consumption and bone health: a systematic review and meta-analysis. *Nutr J.* (2021) 20:41. doi: 10.1186/s12937-021-00698-1

38. Wyshak G. Teenaged girls, carbonated beverage consumption, and bone fractures. *Arch Pediat Adol Med.* (2000) 154:610–3. doi: 10.1001/archpedi.154.6.610

39. Whiting SJ, Healey A, Psiuk S, Mirwald R, Kowalski K, Bailey DA. Relationship between carbonated and other low nutrient dense beverages and bone mineral content of adolescents. *Nutr Res.* (2001) 21:1107–15. doi: 10.1016/S0271-5317(01)00324-4

40. Greene GW, White AA, Hoerr SL, Lohse B, Schembre SM, Riebe D, et al. Impact of an online healthful eating and physical activity program for college students. *Am J Health Promot.* (2012) 27:e47–58. doi: 10.4278/ajhp.110606-QUAN-239

41. Nelson MC, Story M, Larson NI, Neumark-Sztainer D, Lytle LA. Emerging adulthood and college-aged youth: an overlooked age for weight-related behavior change. *Obesity.* (2008) 16:2205–11. doi: 10.1038/oby.2008.365

42. Frehlich LC, Eller LK, Parnell JA, Fung TS, Reimer RA. Dietary intake and associated body weight in canadian undergraduate students enrolled in nutrition education. *Ecol Food Nutr.* (2017) 56:205–17. doi: 10.1080/03670244.2017.1284066

43. Nelson MC, Kocos R, Lytle LA, Perry CL. Understanding the perceived determinants of weight-related behaviors in late adolescence: a qualitative analysis among college youth. *J Nutr Educ Behav.* (2009) 41:287–92. doi: 10.1016/j.jneb.2008.05.005

44. Annala M, Vinnari M. Content analysis of Tv food advertising using climate impact and a nutritional impact index. *Ecol Econ.* (2019) 159:68–74. doi: 10.1016/j.ecolecon.2019.01.017

45. Coates AE, Hardman CA, Halford JC, Christiansen P, Boyland EJ. Food and beverage cues featured in Youtube videos of social media influencers popular with children: an exploratory study. *Front Psychol.* (2019) 10:2142. doi: 10.3389/fpsyg.2019.02142

46. Vilaro MJ, Barnett TE, Watson AM, Merten JW, Mathews AE. Weekday and weekend food advertising varies on children's television in the usa but persuasive techniques and unhealthy items still dominate. *Public Health.* (2017) 142:22–30. doi: 10.1016/j.puhe.2016.10.011

47. Bandura A. Social cognitive theory of mass communication. *Media Psychol.* (2001) 3:265–99. doi: 10.1207/S1532785XMEP0303_03

48. Birch LL, Fisher JO. Development of eating behaviors among children and adolescents. *Pediatrics.* (1998) 101:539–49. doi: 10.1542/peds.101.S2.539

49. Zhang X, Li S, Zhang H. Media and information literacy of university students in china: status quo, issues, and improvement. *J Am Inf Sci Tec.* (2018) 2:83–92.

50. Primack BA, Sidani J, Carroll MV, Fine MJ. Associations between smoking and media literacy in college students. *J Health Commun.* (2009) 14:541–55. doi: 10.1080/10810730903089598

51. Primack BA, Hobbs R. Association of various components of media literacy and adolescent smoking. *Am J Health Behav.* (2009) 33:192–201. doi: 10.5993/AJHB.33.2.8

52. Chen Y, Porter KJ, Estabrooks PA, Zoellner J. Development and evaluation of the sugar-sweetened beverages media literacy (Ssb-Ml) scale and its relationship with SSB consumption. *Health Commun.* (2017) 32:1310–7. doi: 10.1080/10410236.2016.1220041

53. Demir D, Bektas M, Demir S, Bektas I. Psychometric properties of the Turkish version of the sugar-sweetened beverages media literacy scale for university students. *Curr Psychol.* (2021) 40:2561–9. doi: 10.1007/s12144-019-00325-7

54. Bentler PM. *Eqs Structural Equations Program Manual.* Encino, CA: Multivariate software (1995).

55. Hu L-t, Bentler PM, Kano Y. Can test statistics in covariance structure analysis be trusted? *Psychol Bull.* (1992) 112:351. doi: 10.1037/0033-2909.112.2.351

56. Raykov T, Marcoulides GA. *A First Course in Structural Equation Modeling.* New York, NY**:** Routledge (2000).

57. Comrey AL, Lee HB. *A First Course in Factor Analysis.* London: Psychology press (2013). doi: 10.4324/9781315827506

58. Norman CD, Skinner HA. Ehealth literacy: essential skills for consumer health in a networked world. *J Med Internet Res.* (2006) 8:e506. doi: 10.2196/jmir.8.2.e9

59. Jun-Shuai G, Xiao-Peng Y, Yu-Ying S, Dan N, Xue-Min L, Lu W. Adaptation and evaluation of chinese version of eheals and its usage among senior high school students. *Ch J Health Educ.* (2013) 29:106–8. doi: 10.16168/j.cnki.issn.1002-9982.2013.02.019

60. van de Schoot R, Lugtig P, Hox J, A checklist for testing measurement invariance. *Eur J Dev Psychol.* (2012) 9:486–92. doi: 10.1080/17405629.2012.686740

61. Yu C-Y. *Evaluating Cutoff Criteria of Model Fit Indices for Latent Variable Models with Binary and Continuous Outcomes.* Los Angeles, CA: University of California (2002).

62. Zhou B-F. Cooperative meta-analysis group of the working group on obesity in C. predictive values of body mass index and waist circumference for risk factors of certain related diseases in Chinese adults—study on optimal cut-off points of

body mass index and waist circumference in Chinese Adults. *Biomed Environ Sci.* (2002) 15:83–96. doi: 10.1046/j.1440-6047.11.s8.9.x

63. Lynn MR. Determination and quantification of content validity. *Nurs Res.* (1986) 35:382–6. doi: 10.1097/00006199-198611000-00017

64. Polit DF, Beck CT, Owen SV. Is the cvi an acceptable indicator of content validity? Appraisal and recommendations. *Res Nurs Health.* (2007) 30:459–67. doi: 10.1002/nur.20199

65. Tabachnick BG, Fidell LS, Ullman JB. *Using Multivariate Statistics, 5th edn.* Boston, MA: Pearson (2007).

66. Bentler PM, Bonett DG. Significance tests and goodness of fit in the analysis of covariance structures. *Psychol Bull.* (1980) 88:588–606. doi: 10.1037/0033-2909.88.3.588

67. Brown TA. *Confirmatory factor analysis for applied research.* New York, NY: Guilford publications (2015).

68. Browne MW, Cudeck R. single sample cross-validation indices for covariance structures. *Multivar Behav Res.* (1989) 24:445–55. doi: 10.1207/s15327906mbr2404_4

69. Hu Lt, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria vs. new alternatives. *Struct Equ Model.* (1999) 6:1–55. doi: 10.1080/10705519909540118

70. Hu L-t, Bentler PM. Fit indices in covariance structure modeling: sensitivity to underparameterized model misspecification. *Psychol Methods.* (1998) 3:424. doi: 10.1037/1082-989X.3.4.424

71. Fornell C, Larcker DF. Evaluating structural equation models with unobservable variables and measurement error. *J Marketing Res.* (1981) 18:39–50. doi: 10.1177/002224378101800104

72. Kes D, Aydin Yildirim T. The relation between levels of media literacy and attitudes and beliefs concerning obesity in university students. *Soc Work Public Health.* (2020) 35:645–54. doi: 10.1080/19371918.2020.1810192

73. Levin-Zamir D, Lemish D, Gofin R. Media health literacy (Mhl): development and measurement of the concept among adolescents. *Health Educ Res.* (2011) 26:323–35. doi: 10.1093/her/cyr007

74. Irving LM, Berel SR. Comparison of media-literacy programs to strengthen college women's resistance to media images. *Psychol Women Q.* (2001) 25:103–11. doi: 10.1111/1471-6402.00012

75. Hooper D, Coughlan J, Mullen MR. Structural equation modelling: guidelines for determining model fit. *Electron J Bus Res Methods. [Internet].* (2008) 6:53–60. Available online at: https://academic-publishing.org/index.php/ejbrm/article/view/1224/1187

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The impact of public health education on people's demand for commercial health insurance: Empirical evidence from China

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Public health education is gaining significance globally, and it is important for managing health risks. This study empirically analyzed the effect of public health education on people's demand for commercial health insurance. And we used the fixed effects and the mediating effect models, and instrumental variables regression in our research based on panel data of 31 provinces (including municipalities and autonomous regions) in China from year 2009 to 2019. The findings show that public health education significantly increases people's demand for commercial health insurance, and this effect remains significant when considering endogeneity and robustness. We further analyzed and found that the increased demand for commercial health insurance is caused by health literacy, health risk perceptions and health risk attitudes. Through heterogeneity analysis, we found that there were significant differences in the effects of public health education in regions with different demographic and socioeconomic characteristics. We found that the effect of health education on promoting people's demand for commercial health insurance is more obvious in regions with high levels of urbanization, proportion of men, education, economic development, medical resources, and social medical insurance coverage. Governments are supposed to take further measures to enhance the effectiveness of public health education, develop high-quality commercial health insurance, and continuously improve health risk coverage.

KEYWORDS

public health education, commercial health insurance, health literacy, health risk perception, health risk attitude

Introduction

Health is an important form of human capital and the foundation of socioeconomic development (1). However, the current industrialized and information-oriented society contains risks, ecological and food safety problems. And the accelerating pace of life as well as work have significantly increased health risks. In recent years, the spectrum of

human diseases is changing, and "civilization diseases" such as cardiovascular diseases, tumors, diabetes and mental disorders are gradually replacing infectious diseases as major threats to people's life and health. According to the latest statistics from the World Health Organization (WHO), 17.9 million people worldwide die from cardiovascular disease each year, accounting for 32% of all deaths (2). Over 422 million people suffer from diabetes around the world, and the number of cases and its prevalence are increasing every year (3). As to mental disorder, over 5% of adults worldwide suffer from the depression and more than 75% of people suffering from mental disorders in low- and middle-income countries do not receive treatment (4). According to latest research, there were 23.6 million new global cancer cases and 10 million cancer deaths in 2019 (5). However, people are often "overconfident" about health risks (6). They usually have an optimistic bias in their perception of health risks, believing that they are less susceptible to diseases than others (7, 8). They misperceive health risks and underestimate the impact of diseases on health (9, 10). Subjective perception of health risks may lead people to adopt health-hazardous behaviors or prevent them from taking effective health risk prevention measures (9). Therefore, they are reluctant to manage health risks. This leads to suppressed demand for commercial health insurance (6).

Public health education is a planned, organized, and systematic social education activity. Health education can effectively improve people's health literacy, thereby encouraging them to prevent and alleviate most "civilization diseases" by improving their living habits, strengthening physical exercise, and actively seeking medical care (11). Health education is essential for health awareness, disease prevention, and health promotion (12). Public health education can improve health risk perceptions (13), influence health risk attitudes, and increase health risk aversion (14). Theoretically, the improvement of health literacy, risk perception, and risk aversion can facilitate people taking measures to manage risks, such as diversifying health analysis by purchasing commercial insurance (15). Hence, public health education can promote active access to health care and increase the burden of health care expenditure, which would increase the demand for commercial health insurance. Generally, commercial health insurance is an effective tool for managing health risks. To the best of our knowledge, whether public health education encourages people to manage their health risks by purchasing commercial health insurance is an issue that remains unexplored.

As health risks to residents are increasing, the World Health Organization attaches great importance to health education and has held a global health promotion conference every 4 years since 1986, with health education as a core part of the conference (16). The Chinese government also highly values public health education. In terms of policy, China released the "Health China 2030" planning outline in 2016, which aims to strengthen health education and improve health literacy of the entire population. Regarding legislation, China introduced the Basic Medical Sanitation and Health Promotion Law in 2020, which clearly stipulates that "the state should establish a health education system, guarantee citizens' right to health education, and improve their health literacy." In terms of professional institutions, China established the China Health Education Center in 2021, a professional institution dedicated to providing theoretical research and technical guidance for health education. According to the China Health Statistical Yearbook, by the end of 2020, China has held 792,300 public activities, provided training for 15,671,200 people both online and offline, and built 1,015 websites related to health education.

Years of public health education practices in China provide important support for our study. We focus on two core issues: (1) whether public health education significantly promotes health risk management by purchasing commercial insurance and (2) how public health education affects people's demand for commercial health insurance. This study uses provincial panel data from 2009 to 2019 to analyze the relationship between public health education and regional commercial health insurance development using a fixed effects model. Our findings suggest that public health education significantly increases the demand for commercial health insurance by improving health literacy, health risk perceptions, and changing health risk attitudes. This study makes three theoretical contributions: (1) we extend the literature by exploring the relationship between public health education and residents' demand for commercial insurance at the macro level; (2) we recommend further studies about the internal mechanism of public health education on residents' commercial insurance demand and unveil the "black box" between public health education and residents' health risk management behavior; (3) this study provides significant theoretical guidance for the government to strengthen health education, enhance the development of commercial health insurance, and improve residents' health risk protection.

The remainder of this manuscript is arranged as follows: The literature review section presents the theoretical background relevant to this study; the data, variables, and methods section describes the data source, variable selection, and model setting; the results section reports the basic regression results as well as endogeneity, robustness, mediating effects, and heterogeneity analysis; the discussion section includes discussion, limitations of the study and future outlook, along with research conclusions and policy implications.

Literature review

Public health education, health literacy, and demand for commercial health insurance

Public health education aims to improve residents' health literacy (17), encourage people to change bad habits, and

actively seek medical care. It is effective in increasing health literacy (12, 18), changing hygiene habits (19, 20), improving personal hygiene for protection from infectious diseases, and further reducing the risk of acute illness (21). Seeking medical treatment is an effective measure to treat diseases and improve health at the cost of increasing medical expenses. Despite the existence of some social security systems in countries around the world, the level of healthcare coverage remains limited and residents face the burden of health costs, which greatly reduces access to health care (22). Health education enables people to recognize the significance of health, promote their active access to healthcare, and seek ways to relieve pressure on healthcare spending (11). Commercial health insurance is an effective way to manage health risk. As an effective supplement to social medical insurance, commercial health insurance can effectively relieve the pressure on residents' medical expenses by paying out insurance benefits and reimbursing medical expenses (23). Previous studies have found that residents' willingness to purchase commercial health insurance significantly increases when there is increased healthcare spending expected in the future (24, 25).

Public health education, health risk perception, and demand for commercial health insurance

Health risk perception is essential for managing health risks. It reflects how an individual perceives and recognizes the possibility and impact of health risks based on their knowledge and experience (26), that is essential for managing health risks. However, people usually have inadequate knowledge about health risks (7, 27), which hinders people from effectively managing health risks. Public health education remedies these tendencies (28), and improves health risk perception (29, 30). It also informs the public about the probability and severity of diseases, enabling timely risk identification and enhanced health-risk management (13, 30). In terms of public health education, targeted and personalized public health education can be more effective in improving health risk perception (18). Owing to the impact of the Corona Virus Disease 2019 pandemic (COVID-19), people worldwide have received extensive health education related to COVID-19. The level of risk perception regarding the COVID-19 pandemic has significantly increased due to public health education, and people are managing their own health risks by wearing masks and washing their hands regularly (15, 31). Commercial health insurance is an important tool for health risk management. Through health education, people's health risk awareness level is enhanced, which in turn promotes residents to strengthen health risk management, thereby enhancing their willingness to purchase commercial health insurance (23, 32). Previous studies have found that residents are more likely to purchase commercial health insurance when they are fully aware of the health effects of haze (23). Low perception of long-term care risks predominantly causes the low demand for long-term care insurance in many countries (33). There is a significant increase in residents' willingness to purchase long-term care insurance after being informed of the probability of long-term care risks and cost of care (34). Adequate health risk communication can increase the level of health risk perception of the population, which consequently promotes the purchase of commercial health insurance (35).

Public health education, health risk attitudes, and demand for commercial health insurance

Health risk attitudes are highly correlated with an individual's overall risk appetite, reflecting their aversion to health risks related to certain behaviors, and have an important influence on the demand for commercial health insurance (26). The occurrence of events such as severe weather, natural disasters, and epidemics can increase the risk aversion of the population (36, 37). Health education has a similar effect; for example, ongoing health education about the dangers of mad cow disease may increase risk aversion and even make residents pay higher prices to ensure food safety (14). Owing to the global spread of the COVID-19 pandemic, countries have intensified health education on epidemic protection for their populations, and their risk aversion has considerably increased (31, 36). According to the insurance demand theory, risk-averse people prefer to obtain protection by purchasing insurance (38, 39); the higher the risk aversion, the stronger the residents' willingness to purchase (40). The fact that a deepening risk-averse attitude promotes insurance has been proven for various types of insurance such as earthquake insurance (37, 41), technology insurance (42), agricultural insurance (43), social health insurance (44), and commercial health insurance (28, 39).

According to the literature, public health education can improve residents' health literacy and encourage people to actively seek medical care to improve their health. The increasing pressure on medical expenditures tends to encourage individuals to reduce financial risks by purchasing commercial health insurance. As public health education enhances health risk perception and reduces health risk perception bias, individuals who have adequate health risk perception may manage their health risks by purchasing commercial health insurance. Additionally, public health education affects people's health risk attitude and further accelerates the purchase of commercial health insurance. Theoretically, public health education can encourage residents to purchase commercial health insurance through health literacy, health risk perception

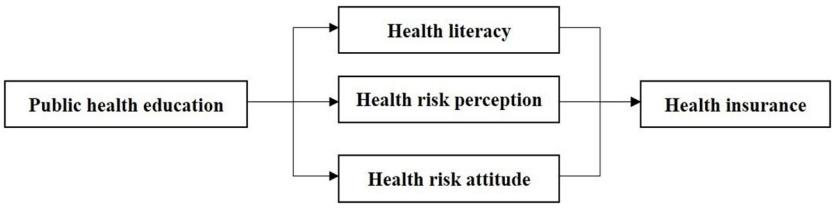

FIGURE 1
Theoretical framework.

and health risk attitudes (Figure 1). Although there are some studies on the relationship between healthcare expenditures, health risk perception, health risk attitudes, and demand for commercial health insurance, few studies have focused on the relationship between public health education and residents' demand for commercial health insurance.

Materials and methods

Data sources

We constructed provincial panel data based on public data, which covered information on 31 provincial administrative regions in China from 2009 to 2019. The data on commercial health insurance, the data on public health education, and the rest of the data are from the Yearbook of China's Insurance (45), the China Health Statistical Yearbook (46) and the China Statistical Yearbook (47), respectively.

Variables

Explanatory variable

The core explanatory variable was public health education. According to previous studies, the most effective methods of public health education are face-to-face public health education and Internet public health education (11). They also suggest that the use of the Internet can effectively promote the purchase of commercial health insurance (48). A comprehensive health education score (Public health education) was constructed using the entropy value method to measure public health education in each region. Two offline health education indicators (public health education activities and training attendance) and one online health education indicator (health education websites), were used to develop a composite indicator for public health education. Considered as an objective assignment method, the entropy method can effectively overcome the shortcomings of information superposition among variables and the subjectivity of artificially determined weights and is now widely used in socioeconomic research. Referring to existing studies, our study uses the entropy value method to obtain the weights and calculates the status of public health education in 31 provinces (including autonomous regions and municipalities) of China from 2009 to 2019 based on these weights, as detailed in Table 1.

TABLE 1 Comprehensive evaluation index system for health education.

Index	Comentropy	Redundancy	Weight
Health education activities	0.946	0.054	0.454
Health education Websites	0.938	0.062	0.521
Health education activities attendance	0.997	0.003	0.025

Explained variable

The variable explained in our study is the demand for commercial health insurance. We used the commercial health insurance density indicator which shows per capita commercial health insurance premium expenditure to measure the demand for commercial health insurance among regional residents. Compared to regional commercial health insurance premium income, commercial health insurance density indicators are more comparable across regions (49). Additionally, to prevent non-stationary data from affecting the results, we used the logarithm of commercial health insurance density to measure the demand for commercial health insurance.

Control variables

According to previous studies, economic development (50, 51), medical resources (52–54), education (55–57), urbanization (51, 58), population dependency (59), health (24), gender (53, 57), social health insurance participation (20, 60), and air pollution may influence people's demand for commercial health insurance. We control for these factors in our study to ensure the reliability of our findings. Economic development is measured as the logarithm of GDP per capita. The medical resources are measured considering the number of staff of medical and health institutions per 1,000 people. The percentage of the population with a college diploma or above is used to indicate

TABLE 2 Descriptive statistics of variables.

Variable		Mean	Standard deviation	Min	Max
Explained variable	Health insurance density (RMB per person)	4.66	1.09	1.28	7.51
Explanatory variable	Public health education	0.24	0.17	0.01	0.77
Control variables	Economic development (RMB per person)	10.69	0.50	9.24	12.01
	Urbanization ratio (%)	56.09	13.75	22.3	89.6
	Gender ratio (%)	104.89	3.99	95.77	123.17
	Health Status (%)	6.02	0.78	4.21	7.57
	Dependency ratio (%)	36.41	6.67	19.27	51.45
	Education (%)	12.79	7.21	1.68	50.49
	Social health insurance coverage (%)	0.54	0.30	0.12	1.11
	Medical resources (per 1,000 persons)	5.83	1.79	2.37	15.46
	Air pollution (tons)	437,944	363,875	880	1,628,647

the education level of the region (Education). Urbanization ratio was calculated as the proportion of the urban resident population to the total resident population. The dependency ratio is measured by the ratio of the population aged 65 and over and 14 and below to the resident population. We used the mortality rate as a proxy for the health status of the regional population. The gender ratio of the resident population was used to represent the gender profile of the study population. The proportion of the population covered by social health insurance to the total population was used to express the regional level of social health insurance coverage (23). The regional air pollution status is indicated by industrial sulfur dioxide emissions.

Methods

This study examines the effect of public health education on demand for commercial health insurance at the macro level. Considering the interference of unobservable factors in each province and special policy releases in particular years on the empirical results, we use a panel fixed-effects model to control for features that do not vary with individuals and time. Therefore, we constructed the following model:

$$\begin{aligned} \boldsymbol{lndensity_{it}} &= \alpha+\beta(\boldsymbol{health\ education})_{it}+\gamma \cdot \boldsymbol{control_{it}} \\ &+ \mu_i+\lambda_t+\varepsilon_{it} \end{aligned}$$

where $lndensity_{it}$ denotes the natural logarithm of health insurance density in province i in year t, $(health\ education)_{it}$ denotes the level of public health education in province i in year t, $control_{it}$ denotes a series of control variables, $\mu_i$and λ_t represent individual effects and time effects, and ε_{it} is a random disturbance term. Moreover, the Hausman test results show that it is appropriate to use a fixed effects model in this study.

Statistical analysis

Descriptive statistical analysis

Descriptive statistics were used to demonstrate the statistical characteristics of the explained, explanatory, and control variables. The results of the descriptive statistics for each variable are presented in detail in Table 2.

Spatio-temporal evolution analysis

To better visualize the demand for commercial health insurance and public health education in each region of China, we used ArcGIS10.5, a geographic analysis software with version 10.5, to plot quadrature chart of health insurance density and public health education in 2009 and 2019, as shown in Figures 2–5. In terms of health insurance density, there was a significant increase in all regions in 2019 compared with 2009. Figures 2, 3 show that the provinces with higher demand for health insurance are mainly located in the eastern coastal region such as Beijing, Shanghai and Jiangsu, and the level of demand for commercial health insurance in the western region is generally lower. In terms of the level of public health education, after 10 years of development, the level of public health education in the central and western regions improved significantly. According to Figure 5, the overall level of public health education is now more balanced across the nation in 2019. According to Figures 2–5, provinces with high health insurance density tend to have higher levels of health education, which is somehow consistent with our expectations.

Panel regression analysis

We studied the effect of public health education on residents' demand for commercial health insurance using panel fixed-effects model, and the regression results are presented in Table 3. Column (1) shows the regression results without control

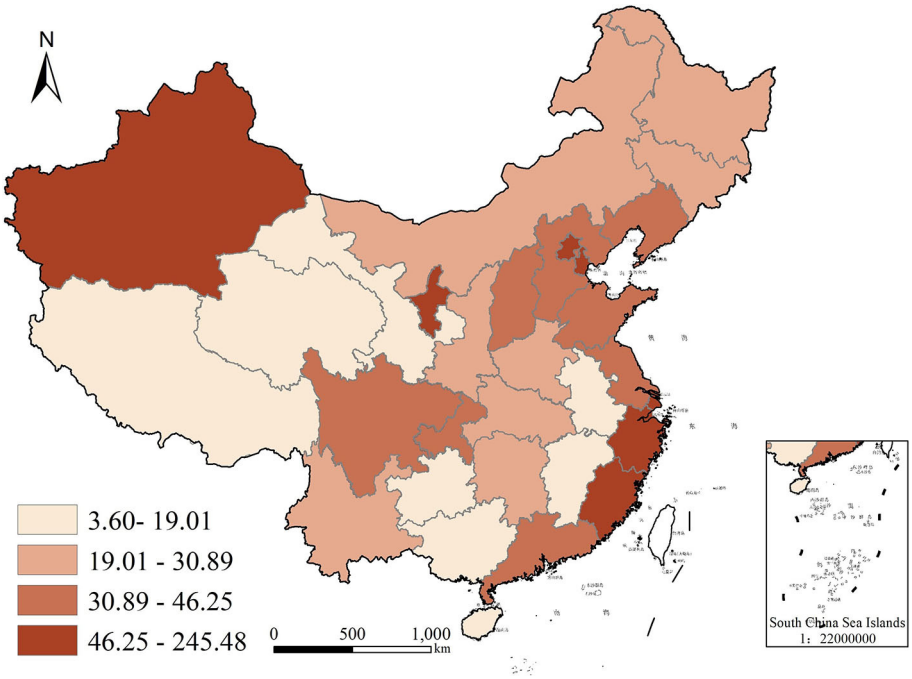

FIGURE 2
Commercial health insurance density in China in 2009.

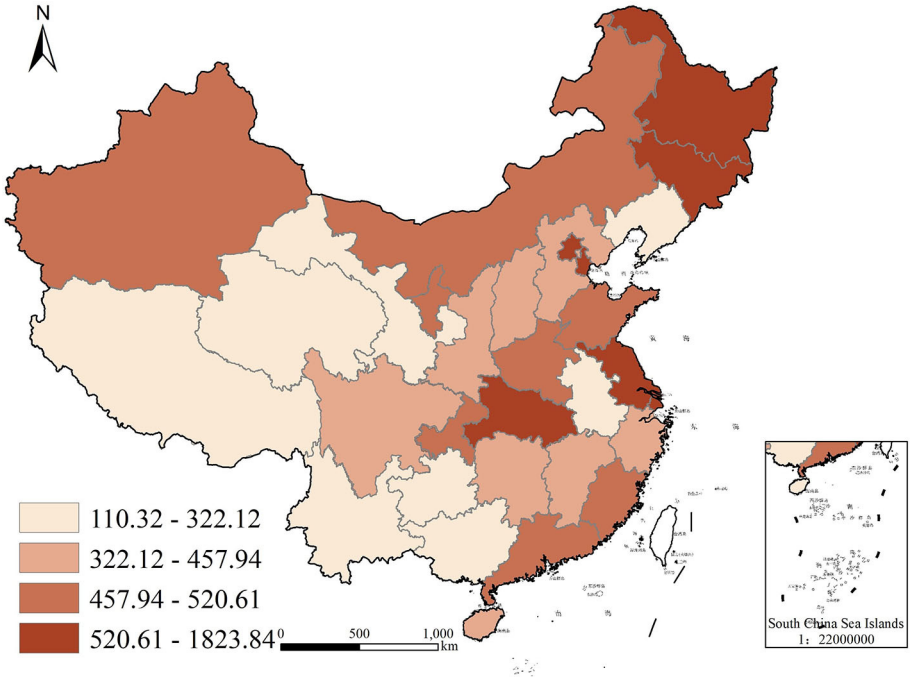

FIGURE 3
Commercial health insurance density in China in 2019.

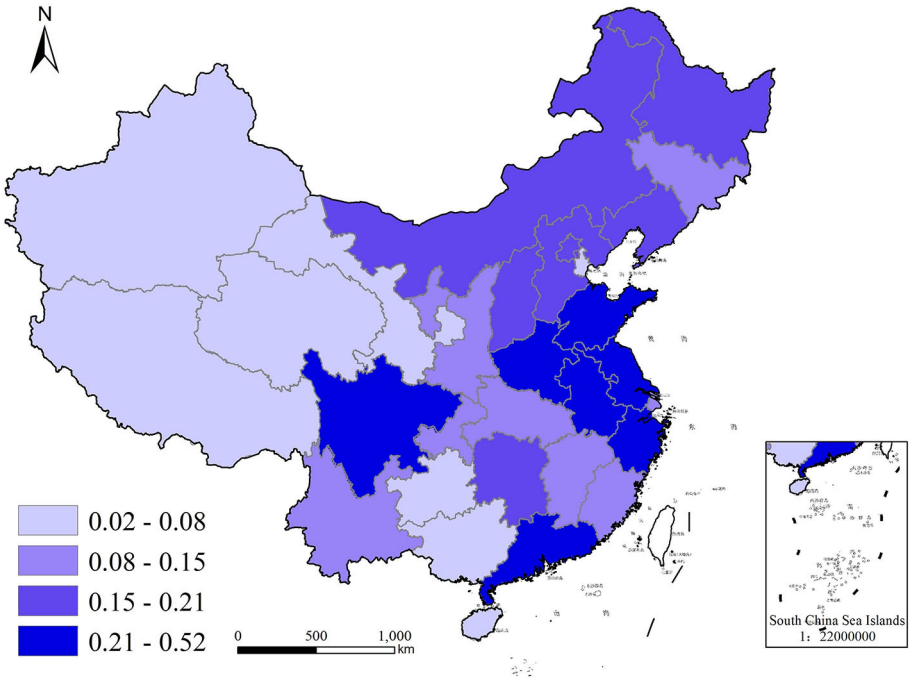

FIGURE 4
Public health education in China in 2009.

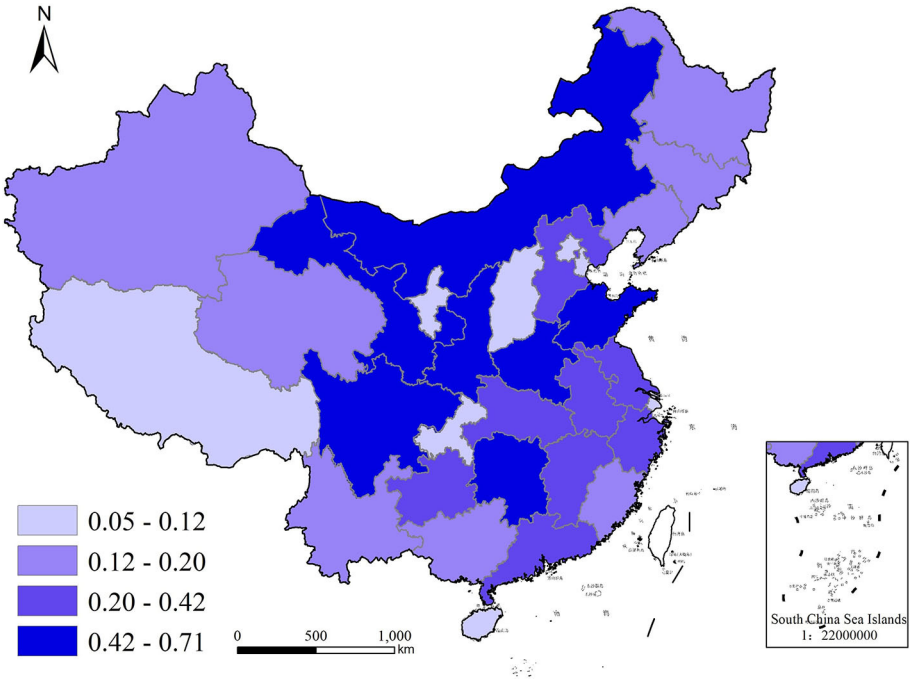

FIGURE 5
Public health education in China in 2019.

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TABLE 3 The impact of public health education on the demand for commercial health insurance.

Variables	Health insurance density		Public health education	Health insurance density
	(1)	(2)	(3)	(4)
			First stage	Second stage
Public health education	0.494***	0.348*		1.383*
	(2.90)	(1.96)		(1.72)
IV			0.822***	
			(3.96)	
Economic development		0.109	−0.040	0.160
		(0.62)	(−0.71)	(0.87)
Urbanization ratio		−0.002	0.006	−0.014
		(−0.14)	(1.24)	(−0.83)
Gender ratio		−0.003	−0.001	−0.001
		(−0.59)	(−0.59)	(−0.14)
Dependency ratio		−0.003	0.002	−0.003
		(−0.40)	(0.71)	(−0.41)
Health status		0.069	−0.009	0.079
		(1.44)	(−0.61)	(1.59)
Education		−0.020**	0.001	−0.021**
		(−2.15)	(0.18)	(−2.16)
Social health insurance coverage		0.115	−0.215	0.120
		(1.14)	(−0.66)	(1.15)
Medical resources		0.008	0.012	−0.005
		(0.30)	(1.35)	(−0.16)
Air pollution		−0.000*	−0.000**	−0.000
		(−1.90)	(−2.00)	(−1.37)
Time effect	Yes	Yes	Yes	Yes
Individual effect	Yes	Yes	Yes	Yes
observations	341	341	341	341
R-squared	0.938	0.941	-	-

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$; Standard errors are shown in parentheses.

variables, where public health education is significant at the 1% level. Column (2) shows the regression results after adding control variables. The effect of public health education is still significant, and the goodness of fit is above 0.9 in all cases, which indicates that the model is well fitted. The above regression results indicate that public health education can effectively increase residents' demand for commercial health insurance. For every single unit increase in the level of public health education, the density of commercial health insurance is increased by 34.84%.

Endogeneity analysis

The relationship between public health education and demand for commercial health insurance is influenced by multiple factors. Although we has taken the economy, population, medical resources, education level, and other factors into consideration, there may be endogeneity problems in the model, such as omitted variables. To overcome the endogeneity issues, we used public health education at the regional level as an instrumental variable for public health education at the provincial level. Referring to previous studies (61), the former is highly correlated with the latter, and it is not directly related to the demand for health insurance (62, 63). According to the criteria of the China Health Statistical Yearbook, we classify the 31 provincial administrative regions into three regions: east, middle, and west. Public health education on the three regional levels is used as an instrumental variable in a two-stage least squares regression.

Columns (3) and (4) in Table 3 report the results of the first- and second-stage regressions. The coefficient for public health education at the regional level in the first-stage regression results was 0.822 and significant at the 1% level. Moreover, the F-statistic in the one-stage regression was 15.691, which

TABLE 4 Robust test results.

Variables	Premium	Density	
	(1)	(2)	(3)
Health education	0.297*		0.404**
	(1.70)		(2.04)
Health education dummy		0.090*	
		(1.88)	
Time effect	Yes	Yes	Yes
Individual effect	Yes	Yes	Yes
Observations	341	341	310
R-squared	0.946	0.941	0.943

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; Standard errors are shown in parentheses.

was > 10. According to the relevant criterion (64), weak instrumental variable hypothesis is rejected, which indicates that the instrumental variable is valid. The regression results of the second stage show that the coefficient of public health education level remains significantly positive, indicating that our results are reliable.

Robustness analysis

We used three methods to test robustness of our results: replacing the explained variable, changing the explanatory variable, and deleting data for the year of significant policy implementation. And panel fixed effect models were used to test robustness.

Replacing explained variable

Although commercial health insurance premium income cannot measure commercial health insurance demand at the individual level as insurance density does, it considerably reflects the level of commercial health insurance demand of the total population in a region. Therefore, we used commercial health insurance premium income as the explanatory variable to test the robustness of our model. Column (1) of Table 4 shows the regression results, which indicate that the effect of public health education remains significantly positive.

Replacing explanatory variable

Furthermore, we constructed a binary variable to indicate public health education. When a province's health education in a year is greater than or equal to the median value of the provinces in that year, the value is assigned as 1, otherwise, it is assigned as 0. As presented in Column (2) of Table 4, public health education is statistically significant, which means that our findings are robust.

Deleting data in special year

The implementation of significant policies affects the development of the industry and people's behavior. To exclude the effect of policy implementation, we sorted through the commercial health insurance policies during the sample period. We found that "Several Opinions on Accelerating the Development of Commercial Health Insurance" was issued by the state council in October 2014, specifically addressing the development of the commercial health insurance industry, and it has promoted the development of commercial health insurance in China. There is a lag in the policy's effect since it was released at the end of the year. Hence, we regarded 2015 as the year of the policy shock and estimated the basic model after dropping data in 2015. Column (3) of Table 4 shows that after deleting the data on the special year, the effect of public health education is still significant.

The results of the three robustness tests indicate that the findings of this study are robust. Hence, the conclusion that public health education can increase people's demand for commercial health insurance is reliable.

Mechanism analysis

Public health education significantly increases people's demand for commercial health insurance, however, what is the mechanism of this influence? The mediating effect model can help us to find out the answer. Mediating effect model has been widely used as a primary tool for testing this mechanism (65). Bootstrap testing is an increasingly popular method for testing mediating effects. The bootstrap method, as a nonparametric repeated sampling method, has no strict restrictions on the distribution of the mediating variables. Compared to the Sobel test, it can be applied in cases where the samples are not normally distributed, making the research results more reliable. To answer the above question, we used the bootstrap method to test the mediating effects of three indicators: health literacy, health risk perception, and health risk attitudes. Table 5 reports the results of the mediating-effects test.

Health literacy

According to the theoretical analysis, public health education can effectively improve people's health literacy making them actively seeking medical treatment (11, 66). Hence, people's pressure on medical expenditure increases, which may encourage them to transfer their medical expenses to insurance companies through commercial health insurance. Therefore, to explore whether public health education increases the demand for commercial health insurance through health literacy, we obtained the average outpatient visits of residents from the China Health Statistical Yearbook as a proxy variable for health literacy. According to the regression results in Table 5, both the direct and indirect effects of health literacy were significantly positive, and the 95% confidence interval did not contain zero. The results demonstrate that health literacy plays a partially mediating role.

TABLE 5 The result of the mediating effect model.

Mediating variable		Effect	Coefficient	Standard error	95% confidence interval	
					Lower limit	Upper limit
Health literacy	Outpatient visits	Indirect	0.071**	(0.03)	0.007	0.136
		Direct	0.384***	(0.11)	0.171	0.597
Health risk perception	Physical examination	Indirect	0.131**	(0.07)	0.002	0.260
		Direct	0.334***	(0.13)	0.080	0.589
	Smog Baidu index	Indirect	0.122***	(0.05)	0.030	0.214
		Direct	0.343***	(0.12)	0.116	0.570

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; Standard errors are shown in parentheses.

Health risk perception

Public health education can increase residents' health risk perceptions, which encourages them to better manage health risks using tools such as commercial health insurance (28, 32). Hence, the higher the perception of health risks, the more people can recognize the dangers and importance of health risks. Residents identify their health risks through medical checkups. Therefore, we obtain the physical examination data of residents in each province from the China Health Statistics Yearbook as a proxy for health risk perception. The long-standing haze problem in China is a serious threat to human health. People with higher levels of health risk perception would be more concerned about haze and better understand its hazards and protective measures. Baidu is the largest search engine in China, people usually search for relevant information from Baidu; thus, the Baidu index can truly reflect people's attention to a certain topic. Hence, we obtained the Baidu index for the term "haze" from its website (https://index.baidu.com) and used it as another proxy for health risk perception. According to the results in Table 5, the direct and indirect effects of both proxies are significantly positive, and zero is not included in the 95% confidence interval. These results indicate that health risk perception plays a partially mediating role.

Health risk attitudes

Public health education can change people's attitude toward health risks, making them more averse to health risks, thereby, promoting the purchase of commercial health insurance (14, 28). Individual health behaviors have been commonly used in previous studies to represent individual risk attitude (39). There is a global consensus that smoking is hazardous to health and that the act of quitting can represent a change in one's attitude toward health risks. Generally, it is difficult to quit smoking, and it requires the help of certain methods. People who intend to quit smoking often search for knowledge and methods about it. Therefore, we obtained the Baidu index for "quit smoking" from its website as a proxy variable for health risk attitudes. According to the regression results in Table 5, both the direct and indirect effects of the Baidu index of smoking cessation were significantly positive, and the 95% confidence interval did not contain zero, indicating that health risk attitudes played a partially mediating role.

Heterogeneity analysis

Given that the effects of the demand for commercial health insurance is influenced by demographic and socioeconomic characteristics, including urbanization ratio, gender ratio, education level, economic development, medical resources, and social medical insurance coverage, the research samples were further divided into subgroups based on these six variables. The panel fixed effects models were conducted, and the results were displayed in Table 6. Overall, in terms of demographic characteristics, public health education in areas with high levels of urbanization, high proportion of men, and high levels of education is more likely to significantly increase people's demand for commercial health insurance. Regarding economic and social development, public health education may significantly increase the demand for commercial health insurance among people in areas with high economic development level, abundant medical resources, and high social medical insurance coverage.

Discussion

In the contemporary society, people are exposed to a wide range of risks, especially increasing health risks that pose a great threat to human health and life (67). Despite this critical situation, people tend to under-perceive health risks and are overoptimistic about it (68), which is not conducive to scientific and effective health risk management. Health risks challenge the stable development of the economy and society, particularly the increased pressure on the Social Medical Insurance Fund. Governments are actively engaged in public health education to alleviate problems associated with health risks (69). The core goal of health education is improving people's health by changing their health awareness and health behaviors (70).

TABLE 6 Heterogeneity analysis of the impact of health education on health insurance.

Variables	Gender ratio		Education		Urbanization ratio	
	High	Low	High	Low	High	Low
Health education	0.519***	0.280	0.602***	0.068	0.570***	0.089
	(3.00)	(0.84)	(3.26)	(0.21)	(3.27)	(0.25)
Variables	**Economic development**		**Medical resources**		**Social medical insurance coverage**	
	High	**Low**	**High**	**Low**	**High**	**Low**
Health education	0.309**	0.167	0.496***	0.173	0.548***	0.165
	(2.13)	(0.50)	(3.08)	(0.48)	(2.86)	(0.48)

*p < 0.1, ** p < 0.05, *** p < 0.01; Standard errors are shown in parentheses.

Public health education affects people in several ways. According to previous theories, public health education can improve people's health literacy, increase their health risk perceptions, and influence their health risk attitude, all of which may further promote the management of health risks through the purchase of commercial health insurance.

We focus on a vital question in this study: can public health education influence people's demand for commercial health insurance? Our research finds that the level of public health education significantly increases the density of commercial health insurance in a region, and this facilitation effect remains significant after overcoming endogeneity bias and conducting robustness tests. As the relationship between public health education and residents' demand for commercial health insurance remains underexplored, this original study can address this gap.

Furthermore, we uncover the "black box" of public health education to promote the purchase of commercial health insurance. We confirmed that health education can promote the purchase of commercial health insurance through three mediating variables: health literacy, health risk perception, and health risk attitudes (12, 28, 39). Through public health education, the health literacy of residents is improved, therefore, they may actively seek medical care (71, 72). Consequently, increased pressure on healthcare spending significantly promotes risk diversification through the purchase of commercial health insurance (9, 10, 21, 22). Due to the implementation of public health education, resident's health risk awareness has increased (22, 24). Consequently, they are more likely to purchase commercial health insurance to actively manage their health risks (23, 32). Through continued implementation of public health education, residents may become more averse to the risk of diseases, and more inclined to purchase insurance (7, 33, 36).

We also find significant differences in the impact of public health education on the development of commercial health insurance among regions with different demographic and socioeconomic characteristics. In terms of demographic characteristics, the impact of public health education on regional commercial health insurance development is greater in regions with a higher proportion of men, level of education, and urbanization rate. Men tend to prefer risks, and may have a greater change in risk attitude and manage health risks through commercial health insurance after receiving public health education (53). In areas with high education levels, residents are more likely to participate in health education and gain a better understanding about it, which leads them to actively manage their health risks by purchasing commercial health insurance (73). Additionally, a social welfare gap exists between urban and rural areas in China, which can affect the level of residents' participation in health education (74, 75). Rural residents are generally less aware of health education, which can further affect the development of commercial health insurance (45, 63). In terms of socioeconomic development, the promotion of health education for commercial health insurance is more evident in regions with high levels of economic development (75–77), abundant medical resources, and high social medical insurance coverage. After receiving health education, people with high income levels have more willingness and purchasing power to diversify their health risks by purchasing commercial health insurance (50, 51). In areas with abundant medical resources, people are more willing to purchase commercial health insurance to diversify the risk of medical costs because of the high accessibility of medical resources and willingness to seek medical care (53, 60). In areas with high rates of social medical insurance coverage, people have stronger health insurance awareness and cognition; therefore, they are more willing to purchase commercial health insurance (20).

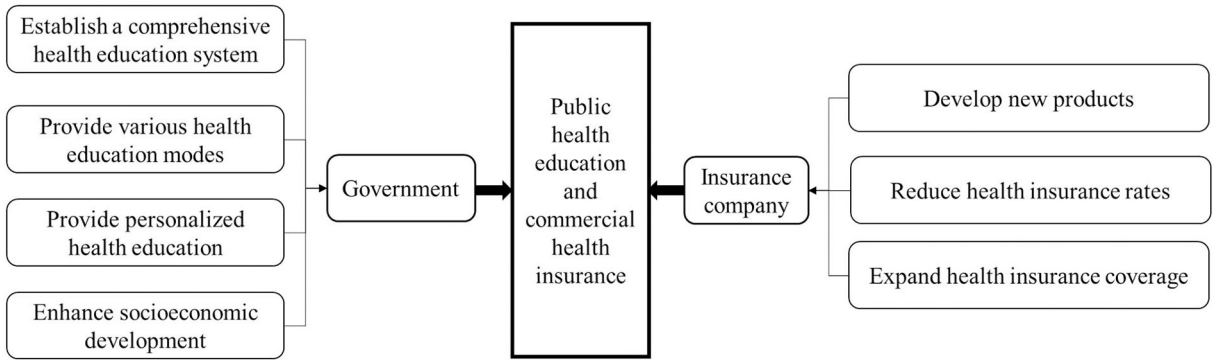

FIGURE 6
Measures to improve public health education and commercial health insurance.

Limitations and future directions

This study has some limitations. First, this study examines the impact of public health education on residents' demand for commercial health insurance. However, our data resources do not provide individual data of public health education and commercial health insurance demand. Hence, we used provincial data instead. Second, commercial health insurance includes various types, such as medical insurance, long-term care insurance and major illness insurance. Each type of insurance has its own specific functions. However, we could only study the impact of public health education on the demand for residents' commercial health insurance from the overall level. In the future, we can further obtain data at the micro level through questionnaires and other tools and use it for further research. We may also concentrate on the impact of public health education on demand for different types of commercial health insurance. Additionally, previous studies have found different effects for different forms of public health education. Therefore, we can also study the effects of different forms of public health education on residents' demand for commercial health insurance in future.

Conclusions and policy implications

Using panel data from the 2009–2019 period for 31 provinces (including municipalities and autonomous regions) in China, our study found that public health education can promote people's demand for commercial health insurance using a fixed effects model. This conclusion remains relevant after solving the endogeneity problem and conducting the robustness tests. Further, by conducting a mechanism analysis, we found that public health education can increase people's demand for commercial health insurance in three ways: improving health literacy and health risk perceptions, and changing health risk attitudes. Through heterogeneity analysis, we found that the effect of health education on promoting people's demand for commercial health insurance is more obvious in regions with high levels of urbanization, proportion of men, education, economic development, medical resources, and social medical insurance coverage.

Our findings provide important theoretical support and empirical evidence for countries managing residents' health risks through public health education. Countries should focus on health education and establish a set of scientific and complete public health education programs based on the disease spectrum. Additionally, they can improve the effectiveness of public health education implementation by enriching public health education modes, improving personalization, and increasing relevant financial input.

Second, countries are supposed to improve the quality of commercial health insurance. Improvements need to be made in the insurance industry by exploring new products and services, optimizing the structure of health insurance products, appropriately reducing health insurance rates, and improving the security of health insurance. High-quality development of the health insurance industry is significant in public health education for improving people's health risk protection.

Finally, countries should take various measures to improve the level of health risk protection for residents. This study found that the effect of public health education on people's demand for commercial health insurance is dependent on many factors, including demographic socioeconomic characteristics. Therefore, governments should continuously improve the education level of the population, further improve the urbanization level, promote sustainable and healthy economic development, increase the input of health funds, and enrich medical resources in all provinces. And Figure 6 shows measures that can be taken by government and insurance companies. These measures can comprehensively improve the effect of public health education to promote the purchase of commercial

health insurance and effectively improve the level of residents' health risk protection.

Data availability statement

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

Author contributions

LG conceived the conception and design of this research. LG and YN carried out the preparation of writing-original draft, including data extraction, and statistical analysis. GW funded this research. All authors read, revised, and approved the submitted manuscript.

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Conflict of interest

Author FL was employed by China Life Reinsurance Company Ltd.

The remaining 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. Grossman M. *The Demand for Health: A Theoretical and Empirical Investigation*. New York, NY: Columbia University Press (2017). doi: 10.7312/gros17900

2. World Health Organization. *Cardiovasc Dis.* (2022). Available online at: https://www.who.int/health-topics/cardiovascular-diseases#tab=tab_1 (accessed July 13, 2022).

3. World Health Organization. *Diabetes.* (2022). Available online at: https://www.who.int/health-topics/diabetes#tab=tab_1 (accessed July 13, 2022).

4. World Health Organization. *Depression.* (2022). Available online at: https://www.who.int/health-topics/depression#tab=tab_1 (accessed Oct 13, 2022).

5. Cancer Incidence M. Years of life lost, years lived with disability, and disability-adjusted life years for 29 cancer groups from 2010 to 2019: a systematic analysis for the global burden of disease study 2019. *Jama Oncol.* (2022) 8:420–44. doi: 10.1001/Jamaoncol.2021.6987

6. Wei H, Li W. Research on health insurance needs in three central cities. *China Ins.* (2007) 29—31.

7. Walker EA, Mertz C, Kalten MR, Flynn J. Risk perception for developing diabetes: comparative risk judgments of physicians. *Diabetes Care.* (2003) 26:2543–8. doi: 10.2337/diacare.26.9.2543

8. Wang W, Liu L, Zhou J, Zhou N. Optimism bias of college students about aids. *Psychol Dev Educ.* (2006) 47—51.

9. Bränström R, Kristjansson S, Ullen H. Risk perception, optimistic bias, and readiness to change sun related behaviour. *Eur J Public Health.* (2006) 16:492–7. doi: 10.1093/eurpub/cki193

10. De Lima Jr MM, Da Silva GR, Jensem Filho SS, Granja F. Association between perceived lifetime risk of cardiovascular disease and calculated risk in a male population in Brazil. *Vas Health Risk Manag.* (2016) 12:279. doi: 10.2147/VHRM.S107874

11. Wang C, Yin J. Public health education and medical seeking behavior of infectious diseases of internal migrants in China. *China Econ Q.* (2022) 22:569–90. doi: 10.13821/j.cnki.ceq.2022.02.11

12. Xu X, Zhang Q, You H, Wu Q. Awareness, Utilization and Health Outcomes of National Essential Public Health Service among Migrants in China. *Front Public Health.* (2022) 10:936275. doi: 10.3389/fpubh.2022.936275

13. Skolarus LE, Zimmerman MA, Bailey S, Dome M, Murphy JB, Kobrossi C, et al. Stroke ready intervention: community engagement to decrease prehospital delay. *J Am Heart Assoc.* (2016) 5:e003331. doi: 10.1161/JAHA.116.003331

14. Schroeder TC, Tonsor GT, Pennings J, Mintert J. Consumer food safety risk perceptions and attitudes: impacts on beef consumption across countries. *B E J Econ Anal Policy.* (2007) 7:1848. doi: 10.2202/1935-1682.1848

15. Mahmood S, Hussain T, Mahmood F, Ahmad M, Majeed A, Beg BM, et al. Attitude, perception, and knowledge of covid-19 among general public in Pakistan. *Front Public Health.* (2020) 8:602434. doi: 10.3389/fpubh.2020.602434

16. World Health Organization. *Health Promotion.* (2022). Available online at: https://www.who.int/health-topics/health-promotion#tab=tab_1 (accessed Oct 13, 2022).

17. Nutbeam D. Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health Promot Int.* (2000) 15:259–67. doi: 10.1093/heapro/15.3.259

18. Zhong B-L, Luo W, Li H-M, Zhang Q-Q, Liu X-G, Li W-T, et al. Knowledge, attitudes, and practices towards covid-19 among chinese residents during the rapid rise period of the covid-19 outbreak: a quick online cross-sectional survey. *Int J Biol Sci.* (2020) 16:1745. doi: 10.7150/ijbs.45221

19. Savolainen-Kopra C, Haapakoski J, Peltola PA, Ziegler T, Korpela T, Anttila P, et al. Hand washing with soap and water together with behavioural recommendations prevents infections in common work environment: an open cluster-randomized trial. *Trials.* (2012) 13:10. doi: 10.1186/1745-6215-13-10

20. Liu H, Gao S, Rizzo JA. The expansion of public health insurance and the demand for private health insurance in rural China. *China Econ Rev.* (2011) 22:28–41. doi: 10.1016/j.chieco.2010.08.006

21. Zivich PN, Gancz AS, Aiello AE. Effect of hand hygiene on infectious diseases in the office workplace: a systematic review. *Am J Infect Control.* (2018) 46:448–55. doi: 10.1016/j.ajic.2017.10.006

22. Wang J, Chang Z, Liu H. Health care demand and choice of medical treatment. *Econ Res J.* (2008) 105–17.

23. Chang TY, Huang W, Wang YX. Something in the air: pollution and the demand for health insurance. *Rev Econ Stud.* (2018) 85:1609–34. doi: 10.1093/restud/rdy016

24. Long SH. Prescription drugs and the elderly: issues and options. *Health Aff.* (1994) 13:157–74. doi: 10.1377/hlthaff.13.2.157

25. Browne MJ, Doerpinghaus HI. Information asymmetries and adverse selection in the market for individual medical expense insurance. *J Risk Ins*. (1993) 60:300–12. doi: 10.2307/252909

26. Pennings JME, Wansink B, Meulenberg MTG. A note on modeling consumer reactions to a crisis: the case of the mad cow disease. *Int J Res Mark.* (2002) 19:91–100. doi: 10.1016/S0167-8116(02)00050-2

27. Riddel M, Hales D. Risk misperceptions and selection in insurance markets: an application to demand for cancer insurance. *J Risk Ins.* (2018) 85:749–85. doi: 10.1111/jori.12180

28. Wang Y, Chen X, Sun R. The effect of health risk perception bias on commercial health insurance purchase decision–based on behavioral economics perspective. *China Soft Sci.* (2021) 66—74.

29. Truong M, Paradies Y, Priest N. Interventions to improve cultural competency in healthcare: a systematic review of reviews. *BMC Health Serv Res.* (2014) 14:1–17. doi: 10.1186/1472-6963-14-99

30. Ajilore K, Atakiti I, Onyenankeya K. College students' knowledge, attitudes and adherence to public service announcements on ebola in nigeria: suggestions for improving future ebola prevention education programmes. *Health Educ J.* (2017) 76:648–60. doi: 10.1177/0017896917710969

31. Motta Zanin G, Gentile E, Parisi A, Spasiano D. A preliminary evaluation of the public risk perception related to the covid-19 health emergency in Italy. *Int J Environ Res Public Health.* (2020) 17:3024. doi: 10.3390/ijerph17093024

32. Yuan C, Liu S. Air pullution, risk perception and commercial health insurance consumption in China. *Ins Stud.* (2020) 88—102. doi: 10.13497/j.cnki.is.2020.08.007

33. Bacon PW, Gitman LJ, Ahmad K, Ainina MF. Long-term catastrophic care: a financial planning perspective. *J Risk Ins.* (1989) 60:146–54. doi: 10.2307/253022

34. Zhou-Richter T, Browne MJ, Gründl H. Don't they care? or, are they just unaware? risk perception and the demand for long-term care insurance. *J Risk Ins.* (2010) 77:715–47. doi: 10.1111/j.1539-6975.2010.01362.x

35. Gao L, Guan J, Wang G. Does media-based health risk communication affect commercial health insurance demand? *Evidence from China Appl Econ.* (2022) 54:2122–34. doi: 10.1080/00036846.2021.1985071

36. Wang C, Pan R, Wan X, Tan Y, Xu L, Ho CS, et al. 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.* (2020) 17:1729. doi: 10.3390/ijerph17051729

37. Zhu W, Chen B. The identification of factors affecting residents' catastrophe insurance demand—the evidence from earthquake risks in China. *Ins Stud.* (2015) 14—23. doi: 10.13497/j.cnki.is.2015.02.002

38. Jullien B, Salanie B, Salanie F. Screening risk-averse agents under moral hazard: single-crossing and the cara case. *Econ Theory.* (2007) 30:151–69. doi: 10.1007/s00199-005-0040-z

39. Doiron D, Jones G, Savage E. Healthy, wealthy and insured? the role of self-assessed health in the demand for private health insurance. *Health Econ.* (2008) 17:317–34. doi: 10.1002/hec.1267

40. Sang L. Residents' happiness, subjective attitude and commercial insurance market participation. *Econ Manag.* (2019) 33:45–53.

41. Zhang Y, Liu Q, Duan B. Effects of earthquake shocks and risk preference: evidence from urban household in China. *J World Econ.* (2022) 45:213–36. doi: 10.19985/j.cnki.cassjwe.2022.02.002

42. Lv W. Executive risk appetite, risk perception and the willingness to purchase science and technology insurance. *China Soft Sci.* (2014) 128—38.

43. Shang Y, Xiong T, Li C. Risk perception, risk attitude and farmers' willingness to adopt risk management strategies: a case study of crop insurance and "insurance + futures". *China Rural Surv.* (2020) 52—72.

44. Yang N, Su Z. The risk attitude and participation in social insurance of residents: evidence from CHFS. *J Harbin Univ Com.* (2015) 11–8.

45. China National Knowledge Infrastructure. Yearbook of China's Insurance (2022). Available online at: https://data.cnki.net/yearbook/Single/N2017030254 (accessed October 3, 2022).

46. China National Knowledge Infrastructure. China Health Statistical Yearbook (2022). Available online at: https://data.cnki.net/yearbook/single/n2022010155 (accessed October 3, 2022).

47. National Bureau of Statistics of China. China Statistical Yearbook (2022). Available online at: https://data.stats.gov.cn/publish.htm?sort=1 (accessed October 3, 2022).

48. Shi H, Gao L, Wang G. How does media use promote the purchase of private medical insurance? a moderated mediation model. *Front Psychol.* (2022) 13:894195. doi: 10.3389/fpsyg.2022.894195

49. Patrick M L. What's Insurance to a Modern Economy? *Geneva Pap Risk Insur Issues Pract.* (2007) 32:211–21. doi: 10.1057/palgrave.gpp.2510128

50. Li H, Liu GG, Glaetzer C. Financing innovative medicines in mainland china: the role of commercial health insurance. *Chin Stud.* (2013) 2:128. doi: 10.4236/chnstd.2013.23020

51. Thorsten B, Ian W. Economic, demographic, and institutional determinants of life insurance consumption across countries. *World Bank Econ Rev.* (2003) 51—88. doi: 10.1093/wber/lhg011

52. Levin N, Willis K. Recent K/Doqi guidelines: applications in peritoneal dialysis patients. *Contrib Nephrol.* (2003) 140:151–62. doi: 10.1159/000071435

53. Höfter RH. Private health insurance and utilization of health services in chile. *Appl Econ.* (2006) 38:423–39. doi: 10.1080/00036840500392797

54. Suo L, Wan Y, Chen T. A research on the uneven development of health insurance and its reasons. *Ins Stud.* (2015) 42—53. doi: 10.13497/j.cnki.is.2015.01.05

55. Shi L. Vulnerable populations and health insurance. *Med Care Res Rev.* (2000) 57:110–34. doi: 10.1177/107755870005700107

56. Saver BG, Doescher MP. To buy, or not to buy: factors associated with the purchase of nongroup, private health insurance. *Med Care.* (2000) 141–51. doi: 10.1097/00005650-200002000-00004

57. Wu J, Wang H, Chu D, Nie F. Effect of haze pollution on the development of commercial health insurance. *China Popul Resour Environ.* (2019) 29:103–11.

58. Qi Z, Xu Y, Hu J. An analysis on commercial health insurance demands based on demographic structure. *Ins Stud.* (2018) 45–55. doi: 10.13497/j.cnki.is.2018.05.004

59. Lewis FD. Dependents and the demand for life insurance. *Am Econ Rev.* (1989) 79:452–67.

60. Liu H, Wang J. An empirical analysis of private health insurance ownership in China. *China Econ Q.* (2012) 11:1525–48. doi: 10.13821/j.cnki.ceq.2012.04.017

61. Yue W, Wang X, Zhang Q. Health risk, medical insurance and household financial vulnerability. *China Ind Econ.* (2021) 175–92. doi: 10.19581/j.cnki.ciejournal.2021.10.009

62. Lei X, Lin W. The new cooperative medical scheme in rural China: does more coverage mean more service and better health? *Health Econ.* (2009) 18:S25–46. doi: 10.1002/hec.1501

63. Zhou Q, Yuan Y, Zang W. The study of health insurance on households' portfolio choice in urban and rural China. *China Econ Q.* (2015) 30. doi: 10.13821/j.cnki.ceq.2015.03.005

64. Staiger DO, Stock JH. *Instrumental Variables Regression with Weak Instruments*. USA: National Bureau of Economic Research Cambridge Mass (1994). doi: 10.3386/t0151

65. Yang H, Wu Y, Lin X, Lin X, Zhang S, Zhang S, et al. Internet use, life satisfaction, and subjective well-being among the elderly: evidence from 2017 China general social survey. *Fron Public Health.* (2021) 9:677643. doi: 10.3389/fpubh.2021.677643

66. Zhao X, Yang S. Health literacy and its improving mechanism for floating population: a research based on dynamic monitoring data in Jiangsu Province. *Northwest Popul.* (2019) 40:38–47.

67. Stock C. Grand challenges for public health education and promotion. *Front Public Health.* (2022) 10:917685. doi: 10.3389/fpubh.2022.917685

68. Boo S FE, Yun JH, Kim YW, Jung JY, Suh CH. Perceived and actual risk of cardiovascular disease in patients with rheumatoid arthritis in Korea: a cross-sectional study. *Med.* (2016) 95:e5117. doi: 10.1097/MD.0000000000005117

69. World Health Organisation. *Promoting Health in the Sdgs. Report on the 9th Global Conference for Health Promotion, Shanghai, China, 21–24 November 2016: All for Health, Health for All*. Geneva: World Health Organisation (2017).

70. World Health Organisation. *Ottawa Charter for Health Promotion*. Geneva: World Health Organisation (1986). Available online at: https://www.healthpromotion.org.au/images/ottawa_charter_hp.pdf

71. Howard DH, Sentell T, Gazmararian JA. Impact of health literacy on socioeconomic and racial differences in health in an elderly population. *J Gen Int Med.* (2006) 21:857–61. doi: 10.1111/j.1525-1497.2006.00530.x

72. Lee SYD, Tsai TI, Tsai YW. Health literacy, health status, and healthcare utilization of taiwanese adults: results from a national survey. *BMC Public Health.* (2010) 10:614. doi: 10.1186/1471-2458-10-614

73. Wang J, Zhu J, Wang X, Che Y, Bai Y, Liu J. Sociodemographic disparities in the establishment of health records among 0.5 million migrants from 2014 to 2017 in China: a nationwide cross-sectional study. *Int J Equity Health.* (2021) 20:1–10. doi: 10.1186/s12939-021-01584-2

74. Pu X, Gen S, Cao Z, Wu S. A study of the effect of basic public health services. *Health Econ Res.* (2018) 3:17–20.

75. Zhang J, Lin S, Liang D, Qian Y, Zhang D, Hou Z. Public health services utilization and its determinants among internal migrants in China: evidence from a nationally representative survey. *Int J Environ Res Public Health.* (2017) 14:1002. doi: 10.3390/ijerph14091002

76. Lam KK, Johnston JM. Health insurance and healthcare utilisation for shenzhen residents: a tale of registrants and migrants? *BMC Public Health.* (2012) 12:868. doi: 10.1186/1471-2458-12-868

77. Flegar V, Dalli M, Toebes B. Access to preventive health care for undocumented migrants: a comparative study of germany, the Netherlands and Spain from a human rights perspective. *Laws.* (2016) 5:9. doi: 10.3390/laws5010009

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Medical perspective of reproductive health education in Indonesian schoolbooks

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The current provision for equipping young Indonesians with a comprehensive knowledge of reproductive health is inadequate. In Indonesian primary and secondary schools, reproductive health education is integrated into various subjects, including Science, Biology, Sport, and Health Education. In this paper, we compared the accuracy of the material related to reproductive health education to scientific evidence published in medical scientific journals or medical textbooks. Even though the schoolbooks were used in Indonesia's 2006 minimum standard requirements of subject matter (KTSP) curriculum, we found much inaccurate information that is not based on the scientific literature and unnecessarily detailed information on therapy and technology. Schoolbooks should emphasize promoting a healthy lifestyle, preventing high-risk sexual behaviors, encouraging openness and discussion about reproductive health in the family, improving self-confidence to refuse and avoid sexual harassment, encouraging positive sexual behaviors, and increasing awareness for treatment-seeking behavior.

KEYWORDS

medical perspective, reproductive health education, Indonesia, schoolbooks, inaccurate information

Introduction

Studies conducted on more than 19,000 never-married women and men aged 15–24 years in all 33 provinces of Indonesia revealed that young Indonesians had not had enough knowledge of reproductive health. Overall, less than 60 percent of respondents completely understood physical changes at puberty. Less than 26 percent of male respondents knew that a woman's fertile period is halfway between periods. Less than 56 percent of respondents knew that a woman can become pregnant after one instance of unprotected sexual intercourse (1, 2).

A study on 1,762 year 6 primary school students in four provinces in Indonesia showed variability in the student's understanding of how pregnancy can occur (3). In addition, a study conducted on 1,082 senior high school students in Papua and West Papua Provinces found that around 38.3 percent of students reported having had sexual intercourse, and 36.5 percent of them had had their first sexual intercourse before they were 15 years old (4).

Below is the confession of a young Indonesian female who got pregnant when she was 15 years old and still in her first year at a high school in Bandung, West Java. To terminate her pregnancy, her boyfriend asked her to drink grated young pineapple mixed with soda drinks and arak (homemade distilled alcohol). In addition, she also consumed large amounts of herbal medicines to abort the fetus. Despite her efforts, her pregnancy got more extensive, and with her parent's support, she finally gave birth to a healthy baby boy (5).

"I had been grappling with feelings of guilt, shame, isolation, and desperation for years. If I had been able to get information and access to information on reproductive health and youth-friendly health services earlier, my life would have been different," said Nindya (not her real name), who is now an active youth advocate and a peer educator (5).

The formal education system in Indonesia consists of early childhood education; primary, secondary, and tertiary level. a 12-year compulsory education in primary (6 years) and secondary Indonesia, consisting of 6 years of primary school, 3 years of junior high school, and 3 years of senior high school. In 2006, the Indonesian government introduced the education unit level curriculum (*KTSP*) for elementary, junior high, and senior high schools. *KTSP* was a decentralized school-based curriculum, a replacement of the earlier curriculum called competency-based curriculum (*KBK*). In the *KTSP* system that could be used until 2020, the government acknowledged the diversity of local context, therefore each provincial or district government might design its own curriculum based on its context, as well as referring to curriculum policy and guidelines issued by the National Education Standard Board (NESB) (6). With increasing net enrollment ratios of primary to senior high schools in Indonesia (7), formal education has an excellent opportunity to reach large numbers of young people. Moreover, schoolbooks used in formal education have significant contributions to preparing young people with essential knowledge, attitude, and skills needed to make the responsible choice of healthy behavior and sexual practices.

This study presented the medical perspective of reproductive health education in the primary and secondary schoolbooks used in Indonesia's 2006 *KTSP* curriculum. In the *KTSP* curriculum, reproductive health education in Indonesia was integrated into four compulsory related subject matters: Biology (Science), Social Science *(IPS)*, Religion, and Sport and Health Education *(Penjaskes)* (8). The analysis was part of the 2008 Indonesian Gender and Reproductive Health Book Analysis Study.

Methods

This study adopted a qualitative approach by employing a literature review and content analysis (9, 10). In the data collection step, descriptions or vital words relating directly or indirectly to reproductive health were recorded. Books corresponding to elementary, junior high, and senior high school grades, as well as subjects from various publishers, were purchased. In the data analysis step, a total of 172 books of Biology (Science), Social Science *(IPS)*, Religion, and Sport and Health Education *(Penjaskes)* produced by more than 15 publishers were intensively analyzed. We compared the accuracy of the contents in the books to scientific evidence-based literature published in medical scientific journals or medical textbooks. In this article, we presented the analysis of 51 schoolbooks of years 5-12, consisting of 23 biology and science books and 28 sports and health education books. This study covered four areas of reproductive health: genital hygiene, sexually transmitted infections (STIs), pregnancy and delivery, violence, and sexual crimes.

TABLE 1 Some inaccurate information about genital hygiene.

Year and book	Inaccurate information
Year 5 sport and health education *(Penjaskes)* Books	1. Reproductive organs are external genitals. Clean genital after urination and defecation with clean water [(11), p. 47]. 2. Reproductive organs can be infected because they also serve as urinary tracts. Testis functions to get the urine out from the bladder. The vagina functions as an organ to get offspring and a urinary tract [(12), p. 61].
Year 6 science book	Genital should be washed after urination. Some ways to keep female genital hygiene include regular exercise. [(13), p. 18].

Results

Genital hygiene

In general, some schoolbooks provided inaccurate information related to the anatomy and physiology of urinary and reproductive systems, as well as genital hygiene, as depicted in Table 1.

Some schoolbooks provided overlapped understanding related to reproductive and urinary systems, which are two different biological systems of human bodies that carry out specific functions. In females, the urethra is the end part of the urinary system, and it is not connected to the vagina. In males, the urethra extends from the urinary bladder to the distal end of the penis, and the testis is not part of the urinary system. The urethra is the passageway for both urine and male reproductive fluids. The two, however, do not exit the urethra at the same time. While seminal fluid passes through the urethra, a reflex causes the urinary sphincter muscles to contract tightly to keep urine from passing the urinary bladder through the urethra (14).

One of the female genital hygiene practices that are important for schoolgirls but are not covered in reproductive health education at schools in Indonesia is menstrual hygiene. Lack of adequate knowledge and misbelieves related to menstruation were found in a study conducted on 1,402 adolescent schoolgirls aged 12-19 years from 16 schools in four provinces of Indonesia (East Java, South Sulawesi, Papua, and East Nusa Tenggara). Around 97 percent of girls reported that they had heard about menstruation before menarche; however, many stated they were still unprepared and confused when they first menstruated and lacked adequate knowledge to deal with menstruation. Misbeliefs surrounding menstruation was still common among girls in the study, including they could not do physical activity during menstruation, they should avoid particular food during menstruation, menstrual blood contained dangerous substances, a girl was dirty or unclean during menstruation, and washing hair during menstruation could block the menstrual flow, caused headache or death (15).

Sexually transmitted infections

Much of the inaccurate information in the year 7, 9, and 11 books were about the cause and transmission of syphilis, HIV, and trachoma, as depicted in Table 2.

Regarding sexually transmitted infections (STIs), it should be explained that T. pallidum, a spirochaete bacterium, causes syphilis. The disease may be congenital or acquired. Congenital syphilis is transmitted from mother to child during pregnancy. Acquired syphilis is classified as early syphilis and late syphilis. Primary syphilis, the first stage of early syphilis, is characterized by the occurrence of a sore (called a chancre) that is usually firm, round, small, and painless. It appears at the spot where syphilis entered the body. Regarding HIV, the virus attacks the immune system, specifically the CD4-T cells, part of the white blood cells. About trachoma, it is the world's leading cause of preventable blindness caused by *Chlamydia trachomatis*, the same bacterium that causes Chlamydiosis, a common sexually transmitted infection among teenagers (26).

Some year six books explained that around 53 percent of HIV/AIDS transmission in Indonesia is due to sharing needles by drug users (27), which was not valid. From 1987 to March 2017, the majority (68 percent) of HIV cases in Indonesia were transmitted by heterosexual contact, followed by blood transfusion (13 percent), and sharing needles among injecting drug users (11 percent). Moreover, most HIV-infected people in Indonesia were from 25-49 and 20-24 age groups (28), who were sexually active.

Some schoolbooks gave detailed information on gonorrhea therapy, such as ceftriaxone, cefixime, ciprofloxacin, and ofloxacin (16). Other books explained antiretroviral treatment (ART) for HIV/AIDS globally, their composition, how they work, and their side effects (20). It is enough that elementary to senior high school students know there is an available treatment for STIs, but they do not have to know the type and name of treatment or even the mechanism of how a particular drug works.

Further, few schoolbooks in Indonesia provided photographs of STIs, but the pictures showed the effect of STIs on the skin. Gonorrhea was depicted as congenital blindness; the symptom of syphilis was shown as a rash on the

TABLE 2 Some inaccurate information about STIs.

Year and book	Inaccurate information
Year 7 Sport and Health Education *(Penjaskes)* Books	1. The cause of STIs is a virus that emerges because of infection (acute wound) on the human genital [(16), p. 142]. 2. Blindness (trachoma) is caused by vitamin A deficiency [(17), p. 93]. 3. STIs can only be transmitted *via* sexual relationships (sexual organs) [(17), p. 176]. 4. STI prevention includes exercise and a healthy diet [(17), p. 179]. 5. STIs induce infection on several organs, including the digestive tract and liver [(18), p. 237]. 6. Syphilis can be transmitted by contact with contaminated vomit [(18), p. 240]. 7. Painful on the hip bone and inflammation on the hip bone are gonorrhea's symptoms [(18), p. 241]. 8. Untreated STIs will cause chronic diarrhea [(19), p. 226] 9. Syphilis causes painful ulceration called a chancre. The pain is felt around the genitals, mouth, tongue, and other body parts [(19), p. 227]. 10. Husband and wife should use a contraception device when having sexual intercourse [(19), p. 230].
Year 11 sport and health education *(Penjaskes)* books	1. CIV (Ciuman Immunodeficiency Virus) was known to be identical with HIV (Human Immunodeficiency Virus) [(20), p. 106]. 2. HIV attacks the red blood cells [(20), p. 107]. 3. HIV/AIDS can be prevented by being aware of safe sex (sexual contact without mixing genital fluid as a way of HIV transmission) [(20), p. 108]. 4. Some ways to prevent HIV infection include avoiding stress (21).
Year 9 science books	1. Gonorrhea and syphilis are caused by fungi [(22), p. 23].
Year 11 biology book	1. Symptoms of STIs in men: severe itching and genital, hot, swelling, and pain on the hip, which then become ulcers. Symptoms of STIs in women: spotting after sexual intercourse [(23), p. 314]. 2. There are five stages of syphilis. The fifth stage is congenital syphilis [(24), p. 216]. 3. Herpes simplex is caused by the Varicella zoster virus [(25), p. 223].

FIGURE 1
Rash on the palm **(left)** as a symptom of syphilis (29), and inflammation on the skin **(right)** (18) as a symptom of HIV Infection.

palm or plantar surface. AIDS was often depicted as having a rash on the skin, as depicted in Figure 1 (18). The use of photographs showing the effect of STIs on the skin may create a misperception that STIs are skin diseases and have minimal impact on sexual practices. Further, students who read the non-explicit materials may not perceive a threat, susceptibility, and severity, as highlighted in the Health Belief Model (30). Due to the sensitive nature of explicit material, an essential element of any plan related to this matter in Indonesian schools must also consider the importance of teachers' training so that they feel comfortable teaching the materials (31).

The critical messages related to STIs that should be delivered to the schoolers, for example, are: (1) STIs can be transmitted in various ways, and not exclusively through sexual intercourse. Early diagnosis and prompt treatment are needed to prevent serious complications. (26); (2) The ABC of prevention should be known by students with abstinence as the best choice to prevent STIs. It has to be emphasized that using a condom in ABC prevention is regarded as "safer sex," but not "safe sex" (32), so teenagers are not encouraged to have sexual relations that seem safe and problem-free; (3) An effective prevention strategy across multiple sectors should be implemented, including the health care system, educational, social, and policy (33).

Pregnancy and delivery

Some schoolbooks for years 6, 9, and 11 gave inaccurate information about fetal growth during pregnancy and the delivery process, as depicted in Table 3.

Pregnancy is, for most women, a time of great happiness. However, during pregnancy, both the woman and her developing fetus face various health risks. Therefore, the message that should be delivered to the students is the importance of all pregnancies to be well prepared and monitored by skilled care providers. To achieve a healthy pregnancy, an expectant mother should have a good nutritional status, proper antenatal care, regular physical activity, preventive measures against various infections, and an excellent psychological condition (37).

TABLE 3 Some inaccurate information about pregnancy and delivery.

Year and book	Inaccurate information
Year 6 science book	A baby will be born by external pushing and contraction of the uterus [(13), p. 19].
Year 8 science book	1. Placenta and umbilical cord will be cut during delivery [(34), p. 9]. 2. The first stage of delivery is dilation of the cervix, and the second stage is a contraction of the uterus [(35), p. 13].
Year 9 science book	The delivery process starts with dilation of the cervix, followed by contraction of the uterus [(36), p. 26].
Year 11 biology book	In the ninth month, the length of the fetus is 950 mm = 95 cm [(25), pp. 217–218].

Labor is the physiologic process by which a fetus is expelled from the uterus. Normal labor is divided into three stages. In the first stage, biochemical connective tissue changes in the cervix precede progressive rhythmic uterine contractions and lead to cervical dilatation. All of these events culminate in spontaneous rupture of the fetal membranes. The second stage of labor is the time between complete cervical dilation and delivery of the neonate. The delivery of the placenta is the third and final stage of labor; it usually occurs within 30 min of delivery of the newborn (38). The length of the fetus in the ninth month of pregnancy is around 48-53 cm, in opposition to the size of 95 cm written in the year 11 Biology book (25).

The second stage of labor comprises the passive phase, with passive descent of the fetal head, and the active phase or expulsive phase, which starts when contraction becomes expulsive or when the pregnant mother actively pushes. Optimal obstetric management of the second stage is an ongoing challenge to reduce emergency cesarean delivery rates and avoid adverse maternal and neonatal outcomes (39). The fundal pressure (Kristeller maneuver), an application of external manual pressure to assist spontaneous vaginal delivery during the second stage of labor, is a common practice conducted at home by birth attendants or at hospitals by health workers, even though the course is often not documented in the medical record (40). Contrary to the written explanation in the schoolbook (13), the maneuver was ineffective in shortening the second stage of labor and added riskier than beneficial, which leads to vaginal, cervical, and third-degree perineal laceration; uterine prolapse, retained placenta, postpartum hemorrhage, increases the rate of episiotomy and Cesarean delivery (41).

Many Indonesian female teenagers did not know that they could be pregnant after having one sexual intercourse (1, 2). The withdrawal method is not a safe method for pregnancy prevention. Most female teenagers are not ready to become pregnant. Students should know that pregnancy could happen when a girl reaches puberty and has sex with a man who can

produce sperm. However, reaching puberty does not mean that a girl is ready for pregnancy. Complications from pregnancy and childbirth are the leading cause of death among adolescent girls aged 15–19 years in low and middle-income countries. Infants of adolescent mothers are more likely to have a preterm delivery, low birth weight, and severe neonatal condition, which can long-term impact their health and development. Therefore, students should avoid having sex at a young age (42).

High school students should know that Indonesia is one of the high-burden countries related to maternal mortality (43). To reduce the maternal mortality rate, Indonesia had several efforts, including increasing services in some public health centers (*Puskesmas*) as primary health care service providers to provide essential obstetric and neonatology emergency services (PONED) (44), and in hospitals as a secondary health care provider to provide comprehensive obstetric and neonatology emergency services (PONEK) that are available for 24 h (45).

However, students should be aware that there are many potential barriers to accessing emergency obstetric care that is conceptualized in the "three delays model" of Thaddeus and Maine: delays in (i) deciding to seek care; (ii) reaching a health facility; and (iii) receiving appropriate health care (46, 47). Either a single delay or a sequence of delays can be fatal. There are also common causes of high-risk maternal mortality that should be recognized in the community: too old for having a child, too young for having a child, too many children, and too close spacing of each child. Public health efforts to reduce maternal mortality in Indonesia include the use of a mother and child health book (*Buku KIA*) for every pregnant mother, as well as delivery planning and prevention of complication stickers (P4K sticker) that will be put on the house door of every high-risk expectant mother. The sticker is meant to let the neighborhood know about the presence of high-risk pregnancy mothers, so they are ready to help whenever needed (48).

In addition, some year 8-11 schoolbooks explained various techniques used in reproductive technology, including *in vitro* fertilization (IVF), partial zona dissection (PZD), subzonal sperm intersection (SUZI), and intra cytoplasm sperm injection (ISIS). The books also explained about two techniques used to obtain sperm, including microsurgical sperm aspiration (MESA) and testicular sperm extraction (TESE) (36, 49). Do high school students need to know the detail of the sophisticated technology of *in vitro* fertilization?

Violence and sexual crime

Some schoolbooks gave inaccurate information about the causes of violence and sexual crimes, as depicted in Table 4.

Violence is "the intentional use of physical force or power, threatened or actual, against oneself, or a group or community that either result in or have a high likelihood of resulting in injury, death, psychological harm, maldevelopment, or deprivation" (52). Violence-related problems can be depicted as a pyramid, with violent death representing the pyramid's apex, the victims that need care in the middle of the pyramid, and acts of violence that are often not reported are in the bottom (53).

TABLE 4 Some inaccurate information about violence and sexual crimes.

Year and book	Inaccurate information
Year 5 sport and health education *(Penjaskes)* books	1. Going out with an adult can lead to sexual harassment [(50), p. 68]. 2. Some physical signs of sexual harassment are urinary tract inflammation and throat infection. Some non-physical signs of sexual harassment are growth retardation and isolation [(12), p. 62]. 3. The victims of sexual harassment are women and men under 18 years old [(12), p. 63].
Year 6 sport and health education *(Penjaskes)* books	1. Children should not allow other people to see or touch their bodies to avoid sexual harassment [(51), p. 124]. 2. Students should avoid sexual harassment by choosing a seat beside the window when taking public transportation [(50), p. 136]. 3. Victims of sexual harassment are boys and girls under 18 years old [(27), p. 143]. 4. Female students should wear decent clothes and avoid "excessive" cosmetics to prevent sexual harassment [(27), p. 142].

Indonesia has ratified the United Nations Convention on the Rights of the Child (UNCRC) 1989 (54) and published a Presidential Decree No. 36/1990 (55). Thirteen years after the launch of UNCRC, Indonesia issued Law No. 23/2002 on the protection of the child (56), which was followed by the establishment of the Indonesian Child Protection Commission (KPAI) as one of three independent national institutions that guard the implementation of human rights in Indonesia. In 2014, Law No. 23/2002 was revised by Law No. 35/2014 to protect the child (57). Yet, there have been weaknesses and gaps in protection afforded to children against all forms of violence.

A survey conducted in 25 provinces, 108 districts, and 125 subdistricts revealed that 47.45 percent of men (1 of 2 men) and 35.05 percent of women (1 of 3 women) aged 18-24 years reported having had sexual, physical, and emotional violence (s) when they were < 18 years. Approximately 30 percent of boys and girls aged 13-17 years reported having had sexual, physical, and emotional violence (s) in the last 12 months. However, the majority of those who experienced violence (62.6 percent of men and 86.87 percent of women aged 18-24; and 75 percent of boys and 85.4 percent of girls aged 13–17 years) did not know any available child protection services and did not ask for help when they experienced violence (58). As of 2015, the KPAI received 289 reported cases related to children as victims of trafficking (48 cases), online prostitution (96 points), commercial sex (61 patients), and child labor (84 cases)

(40b). Despite the available protection, children should have knowledge and skills on preventing sexual violence, including tips for partying, avoidance strategies, and crime prevention tips (59–61).

Related to body-revealing cloth, several year 5 and 6 Sport and Health Education books reminded female students to wear 'decent' clothes as a preventive measure against sexual harassment. The information in these books implied a gender bias. Further, there could be various interpretations of the term "decent" clothes, depending on the different cultural contexts. Of five books that suggested students wear decent clothes, three books explained proper meaning. One book described decent clothes as clothes that accentuated the body shape. This book also prohibited female students from using "excessive" cosmetics (27). Another book suggested that students should not wear short skirts or tight clothes (62). Another book described decent clothes as clothes that did not show the thighs, breasts, or bellies (63). These suggestions on female clothing were written in sections on preventing sexual harassment.

A study explored the reasons for the allegation that female victims of sexual violence precipitate their assaults by wearing provocative, body-revealing clothes. The survey of 193 female and 128 male undergraduate students aged 18–24 years revealed a gender-based attribution gap. Men perceived the sexualized look as indicating an interest in sex and intent to seduce. Women reported wearing sexy clothes to feel and look attractive (64). Women's attractiveness was also connected with color, and a study found that men reported higher sexual intent in women wearing red clothing (65).

Discussion

This study found much inaccurate information related to genital hygiene, STIs, pregnancy, delivery, and sexual violence in the school books of primary, junior high, and senior high school books. Belief in inaccurate or false information may lead to poor judgments, decision-making, and an enduring impact on people's thoughts that results in resistance to correction (66). Accurate and reproducible SRH knowledge is crucial because it may facilitate students' decision-making process. The process may be explained by the "mindsponge" theory, "a metaphor that the mind is analogized to a sponge that absorbs new compatible values and squeezes out incompatible values with its core values." The core values are highly trusted values or beliefs, that are used as points of reference for assessing the suitability of newly absorbed values (or information) that influences an individual's perceptions, attitudes, and behaviors, as well as making decisions or responses [(67), p. 5].

Prior studies have examined the impact of health literacy and reproductive health education on students and the results showed that students receiving reproductive health education were more responsible for their sexual practices (68). High-quality schoolbooks are an essential part of learning materials and are intended as one of the students' primary sources of information. If left to the students' own devices to find information and draw up their own perception of reproductive health, adolescents may have poor knowledge of reproductive health and may be at risk of practicing unsafe sex (69). Therefore, the schoolbooks" crucial health information and skills must be scientific-based and reliable (70).

At the 1994 International Conference on Population and Development (ICPD), governments from 179 countries including Indonesia affirmed that adolescents need and have a fundamental right to obtain sexual and reproductive health (SRH) information and services to help them develop positive values, attitudes, and informed decision practices (71). Prior studies reported that the majority of school students in Indonesia obtained SRH knowledge from the media (4, 72). As of 2021, the timely school participation rate in elementary, junior high, and senior high schools in Indonesia were 97.8%, 80.6, and 61.7%, respectively. These data were inclusive of female and male school-age children, in urban and rural areas, and children with and without special needs (73). As the majority of children and youth in Indonesia attend formal education, schools have an important role to promote SRH as part of fundamental aspects of life. Therefore, we recommend that schoolbooks should provide age-appropriate, accurate, culturally relevant, and non-judgmental SRH information, for example, related to genital hygiene, high-risk sexual behaviors, how pregnancy can occur; as well as putting emphasis on the prevention of risky sexual behaviors, STIs, reproductive health problems, and sexual violence in adolescence that may have long-lasting consequences. Moreover, the development of schoolbooks that contain SRH materials can be carried out in collaboration with university lecturers from medical or health-related schools, based on the scientific references, such as medical textbooks or journals.

The advancement of information technology allows anyone to access various information, including SRH. To prevent misinformation, we recommend that scientific-based SRH information should be made available and can be accessed by vulnerable or marginalized adolescents, those who cannot attend formal education, and the community. In addition to scientific-based SRH information, effective SRH services should also be available for adolescents (74). In Indonesia, youth-friendly healthcare facilities at primary and secondary levels, as well as school-based healthcare services and various community-based health programs for adolescence are available, but their quality should be improved.

Conclusion

The current provision for equipping young Indonesians with a comprehensive knowledge of reproductive health is inadequate. The existing reproductive health materials in the primary to senior high schoolbooks contain incomplete

and inaccurate information in the schoolbooks that are not based on the scientific literature and are presented in a complex language. They have unnecessarily detailed information on the therapy and technology. Primary to high school students do not need thorough treatment for HIV and other sexually transmitted infections and detailed assisted reproductive technology such as medical students. Moreover, some schoolbooks explain the harmful use of external pushing in delivery and lead to many adverse effects.

Students have the right to obtain all the relevant and scientifically grounded information on reproductive health to decide their steps. During the review, we found that many references in the schoolbooks were from personal blogs or websites that were not based on scientific evidence. We recommend that the contents and illustrations of the books should be based on scientific evidence, such as articles in scientific journals or textbooks. The schoolbooks should emphasize promoting a healthy lifestyle; preventing high-risk sexual behaviors (i.e., early sexual debut, having multiple sexual partners, using substance abuse); encouraging openness and discussion about reproductive health in the family, improving self-confidence to refuse and avoid sexual harassment, encouraging positive sexual behaviors, and increasing awareness for treatment-seeking behavior.

Data availability statement

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

Author contributions

IDU designed and directed the project. WD performed the analysis and drafted the manuscript. WD and IDU discussed the results and commented on the manuscript. Both 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.

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References

1. BPS-Statistics Indonesia and Macro International. Indonesia Young Adult Reproductive Health Survey. (2008). Calverton: BPS-Statistics Indonesia and Macro International. Available online at: https://dhsprogram.com/pubs/pdf/fr219/fr219.pdf (accessed, February 14, 2009).

2. Statistics Indonesia, National Population and Family Planning Board, Ministry of Health of the Republic of Indonesia and ICF International. Indonesia Demographic and Health Survey 2012. (2013). Jakarta: BPS, BKKBN, Kemenkes, and ICF International. Available online at: https://dhsprogram.com/pubs/pdf/fr275/fr275.pdf (accessed February 12, 2020).

3. Utomo ID, McDonald P, Reimondos A, Utomo A, Hull TH. Do primary students understand how pregnancy can occur? A comparison of students in Jakarta, West Java, West Nusa Tenggara and South Sulawesi, Indonesia .*Sex Educ.* (2014) 14:95–109. doi: 10.1080/14681811.2013.833503

4. Diarsvitri W, Utomo IDU, Neeman T, Oktavian A. Beyond sexual desire and curiosity: sexuality among senior high school students in Papua and West Papua Provinces (Indonesia) and implications for HIV prevention. *Cult Health Sex.* (2011) 13:1047–60. doi: 10.1080/13691058.2011.599862

5. Widiadana, R., and Muryanto, B. *Granting Indonesian Youth Access to Reproductive Health Rights*. (2017). Jakarta: The Jakarta Post. Available online at: https://www.thejakartapost.com/life/2017/06/07/granting-indonesian-youth-access-to-reproductive-health-rights.html (accessed June 20, 2020).

6. Sulfasyah. *Investigating the implementation of the Indonesian KTSP (school-based curriculum) in the teaching of writing in year two.* (2013). Theses: Doctorates and Masters. Edith Cowan University. Available online at: https://ro.ecu.edu.au/theses/602 (accessed September 11, 2022).

7. BPS-Statistics Indonesia. *Laporan Bulanan Data Sosial Ekonomi*. 93rd edn. (2018). Jakarta: BPS-Statistics Indonesia. Available online at: https://www.bps.go.id/publication/2018/06/05/3a877931dac5ddb743b54c6d/laporan-bulanan-data-sosial-ekonomi-juni-2018.html (accessed January 20, 2021).

8. Irwanto Tambunan R, Kamil O, Lenggogeni S, Emmy, Natalia S, et al. *Education Sector Response to HIV, Drugs and Sexuality in Indonesia: An Assessment on the Integration of HIV and AIDS, Reproductive Health, and Drug Abuse Issues in Junior and Senior Secondary Schools in Riau Islands, DKI Jakarta, West Kalimantan, Bali, Maluku and Papua.* (2010). Jakarta: UNESCO. Available online at: https://www.researchgate.net/publication/316459767_Education_sector_response_to_HIV_Drugs_and_Sexuality_in_Indonesia/link/58ff5312a6fdcc8ed50da0ed/download (accessed January 20, 2021).

9. Johnson RB, Christensen LB. *Educational Research: Quantitative, Qualitative, and Mixed Approaches*. 5th edn, editor, Hester R. Thousand Oaks, CA: SAGE Publications, Inc (2014).

10. Sutton J, Austin Z. Qualitative research: data collection, analysis, and management. *Can J Hosp Pharm*. (2015) 68:226–31. doi: 10.4212/cjhp.v68 i3.1456

11. Sumarya M, Suwarso E. *Sport and Health Education (Pendidikan jasmani, olah raga dan kesehatan) for Year 5*. Depok: Arya Duta. (2007).

12. Supriyanto J. *Happy sport for Year 5 (Gembira berolahraga untuk kelas 5)*. Solo: PT. Tiga Serangkai Pustaka Mandiri. (2008).

13. Prabandari E, Dewi M, Kamari. *Science (Ilmu Pengetahuan Alam) for Year 6*. Jakarta: Bumi Aksara. (2007)

14. Moore KL, Agur AMR, Dailey AF. Essential clinical anatomy fifth edition. In: *Journal of Chemical Information and Modeling*. 5th edn. Surabaya: Lippincott Williams and Wilkins (2013).

15. Burnet Institute, SurveyMETER, WaterAid Australia and Aliansi Remaja Independen. *Menstrual Hygiene Management in Indonesia. Understanding Practices, Determinants and Impacts Among Adolescent School Girls*. (2015). Available online at: https://www.burnet.edu.au/system/asset/file/2034/2015_Menstrual_hygiene_management_Indonesia_FINAL_REPORT_February_2015_low_res.pdf (accessed January 23, 2016).

16. Hudaya, Chandra S, Riyadi S, Sugianto, Sukarno. *Sport and health education (Pendidikan jasmani, olah raga dan kesehatan) for Year 7*. Depok: Arya Duta (2007).

17. Nenggala. *Sport and health education (Pendidikan jasmani, olah raga dan kesehatan) for Year 7*. Bandung: Grafindo Media Pratama (2008).

18. Karyadi I, Sujar CA, Rozak N, Nor S. Chandra, Abdurrahman AH. *Sport and health education for Year 7 (Pendidikan jasmani, olah raga dan kesehatan untuk kelas 7)*. Jakarta: Widya Utama (2006).

19. Muhajir. *Sport and health education (Pendidikan jasmani, olah raga dan kesehatan) for Year 7*. Jakarta: Yudhistira. (2007)

20. Muhajir. *Sport and Health Education (Pendidikan jasmani, olah raga dan kesehatan) for Year 11*. Jakarta: Erlangga (2007).

21. Mukholid A. *Pendidikan jasmani, olah raga dan kesehatan untuk kelas 11 (Sport and health education for Year 11)*. Jakarta: Yudhistira. (2007).

22. Arisworo D, Yusa. *Science for Year 9 (Ilmu Pengetahuan Alam untuk kelas 9)*. Bandung: Grafindo Media Pratama (2008).

23. Prawirohartono S, Hidayati S. *Science Biology (Sains Biologi) for Year 11*. Jakarta: Bumi Aksara. (2007).

24. Nur EH, Rubeka T. *Science Biology (Sains Biologi) for Year 11*. Bekasi: Galaxy Puspa Mega. (2007).

25. Jati W. *Biology active (Aktif Biologi) for Year 11*. Jakarta: Ganeca. (2007).

26. World Health Organizaton (WHO). *Guidelines for the Management of Symptomatic Sexually Transmitted Infections*. Geneva: WHO. (2021). Available online at: https://www.who.int/publications/i/item/9789240024168 (accessed February 15, 2022).

27. Supriyanto J. *Happy Sport for Year 6 (Gembira berolahraga untuk kelas 6)*. Solo: Tiga Serangkai Pustaka Mandiri. (2008).

28. Kementerian Kesehatan RI. *Report on the Development of HIV-AIDS and Sexually Transmitted InfectiousDiseases (STIs) in the FirstQuarter of 2017 (Laporan Perkembangan HIV-AIDS dan Penyakit Infeksi Menular Seksual (PIMS) TriwulanI Tahun 2017)*. Jakarta: Kementerian Kesehatan RI. (2017). Available online at: https://siha.kemkes.go.id/portal/perkembangan-kasus-hiv-aids_pims# (accessed February 28, 2020).

29. Irwansyah. *Sport and health education for Year 11 (Pendidikan jasmani, olah raga dan kesehatan untuk kelas 11)*. Edited by Somad AA and Mulyani D. Vol. 2. Bandung: Grafindo Media Pratama (2008).

30. Rosenstock IM. Why people use health services. *Milbank Mem Fund Q Health Soc*. (1966) 44:94–124. doi: 10.2307/3348967

31. Smith G, Kippax S, Aggleton P, Tyrer P. HIV/AIDS school-based education in selected Asia-Pacific Countries. *Sex Educ*. (2003) 3:1–21. doi: 10.1080/1468181032000052126

32. Iralade J, Alonso A. Changes in sexual behaviours to prevent HIV. *Lancet*. (2006) 368:1749–50. doi: 10.1016/S0140-6736(06)6 9712-2

33. Mkumba LS, Nassali M, Benner J, Ritchwood TD. Sexual and reproductive health needs of young people living with HIV in low- and middle-income countries: a scoping review. *Reprod Health*. (2021) 18:219. doi: 10.1186/s12978-021-0 1269-7

34. Sumarwan, Sumartini, Kusmayadi S, Sulastri, and Priambodo BA. *Science (Ilmu Pengetahuan Alam) for Year 8*. Jakarta: Erlangga. (2007).

35. Arini, N. Silvianita, Taufiq A, Suryana, Budi K, Santosa E. *Science (Ilmu Pengetahuan Alam) for Year 8*. Jakarta: Widya Utama. (2008).

36. Prawirohartono S, Hidayati, S. *Science (Ilmu Pengetahuan Alam) for Year 9*. Jakarta: Bumi Aksara. (2007).

37. World Health Organization (WHO). *Who Recommendation on Antenatal Care for Positive Pregnancy Experience, Who Recommendation on Antenatal Care for Positive Pregnancy Experience*. Geneva: WHO (2016).

38. Cunningham FG, Leveno KJ, Bloom SL, Dashe JS, Hoffman BL, Casey BM, et al. *Williams Obstetrics*. 25th edn. NewYork: The McGraw-Hill / Medical (2018).

39. Sandström A, Altman M, Cnattingius S, Johansson S, Ahlberg M, Stephansson O, et al. Durations of second stage of labor and pushing, and adverse neonatal outcomes: a population-based cohort study. *J Perinatol*. (2017) 37:236–42. doi: 10.1038/jp. 2016.214

40. Mahendru R, Malik S, Anand T. Age old practice of uterine fundal pressure in labor - more risky than beneficial. *Biomed Res J*. (2010) 21:295–6.

41. Mohamed HS, Elkheshen SA. Effect of manual fundal pressure during the second stage of labor on maternal outcomes among parturient women. *Am J Nurs Res*. (2017) 5:109–14. doi: 10.12691/ajnr-5-4-2

42. Leftwich HK, Alves MVO. Adolescent pregnancy. *Pediat Clin N*. (2017) 64:381–8. doi: 10.1016/j.pcl.2016.11.007

43. WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division. *Maternal Mortality in 1990-2015 Country Profile: Indonesia. Geneva: WHO, UNICEF*, UNFPA, World Bank Group and the United Nations Population Division (2015).

44. Ministry of Health of the Republic of Indonesia. *Guideline for public health center with basic emergency obstetric and neonatal services (Pedoman penyelenggaraan Puskesmas mampu PONED*. Jakarta: Kemenkes RI (2013). Available online at: https://www.academia.edu/10947236/PEDOMAN_PENYELENGGARAAN_PUSKESMAS_MAMPU_PONED (accessed June 10, 2020).

45. Ministry of Health of the Republic of Indonesia. *(Ministry of Health Decree on comprehensive obstetrics neonatal emergency services 24 hours in hospital Keputusan Menteri Kesehatan RI No. 1051/MENKES/SK/XI/2008 tentang Pedoman penyelenggaraan pelayanan obstetri neonatal emergensi komprehensif (PONEK))*. (2008). Available online at: https://rsnas.kulonprogokab.go.id/detil/356/peraturan-menteri (accessed November 6, 2020).

46. Penchansky R, Thomas JW. The concept of access: definition and relationship to consumer satisfaction. *Med Care*. (1981) 19:127–40. doi: 10.1097/00005650-198102000-00001

47. Myers BA, Fisher RP, Nelson N, Belton S. Defining remoteness from health care: integrated research on accessing emergency maternal care in Indonesia. *AIMS Public Health*. (2015) 2:256–73. doi: 10.3934/publichealth.2015.3.256

48. Kementerian Kesehatan RI. Buku KIA Kesehatan Ibu dan Anak. *Jakarta: Kementerian Kesehatan RI*. (2021). Available online at: https://gizi.kemkes.go.id/katalog/buku-kia.pdf (accessed January 10, 2021).

49. Kadaryanto, Jati W, Mukido, Chalsum U, Sarmini S, Harsono. Biology. *Revealing the Secret of Life for Year 8 (Biologi. Mengungkap rahasia alam kehidupan untuk kelas 8)*. Jakarta: Yudhistira (2008).

50. Harianja KO, Riva'i H, Triwiyata. *Sport and health education for Year 6 (Pendidikan jasmani, olah raga dan kesehatan untuk kelas 6)*. Bekasi: Galaxy Puspa Mega. (2007).

51. Sumarya M, Suwarso E. *Sport and Health Education for Year 6 (Pendidikan jasmani, olah raga dan kesehatan)*. Depok: Arya Duta. (2007).

52. Krug EG, Dahlberg LL, Mercy JA, Zwi AB, Lozano R. *World Report on Violence and Health*. (2002). Geneva: WHO. Available online at: https://apps.who.int/iris/bitstream/handle/10665/42495/9241545615_eng.pdf (accessed June 10, 2020).

53. WHO, UNODC and UNDP. *Global Status Report on Violence Prevention 2014*. (2014). Geneva: WHO. Available online at: https://www.who.int/publications/i/item/9789241564793 (accessed May 14,2020).

54. United Nations. *Convention on the Rights of the Child*. New York (1989). Available online at: https://www.ohchr.org/en/instruments-mechanisms/instruments/convention-rights-child (accessed March 12, 2021).

55. President of the Republic of Indonesia. Presidential Decree No. *36/1990 on the ratification of the Convention on the Rights of the Child (Keppres tentang pengesahan Konvensi tentang Hak-hak Anak)*. (1990). Available online at: https://peraturan.bpk.go.id/Home/Details/63923/

keppres-no-36-tahun-1990#:\sim:text=KEPPRES%20No.%2036%20Tahun%201990,Anak%20%5BJDIH%20BPK%20RI%5D (accessed January 10, 2020).

56. President of the Republic of Indonesia. Law of the Republic of Indonesia No. 23/2002 on the Child Protection (UU RI No. 23 tahun 2002 tentang Perlindungan Anak). (2002). Available online at: https://peraturan.bpk.go.id/Home/Details/44473/uu-no-23-tahun-2002 (accessed January 10, 2020).

57. Komisi Perlindungan Anak Indonesia. *Child protection data tabulation (Tabulasi data perlindungan anak)*. Jakarta: KPAI. (2016). Available online at: https://bankdata.kpai.go.id/tabulasi-data/data-kasus-perlindungan-anak-2016-2020 (accessed February 16, 2020).

58. Kurniasari A, Wismaayanti YF, Husmiati I, Widodo N, Susantyo B, et al. *Summary Results of Survey on Violence Against Indonesian Ahildren 2013 (Ringkasan hasil survey kekerasan terhadap anak Indonesia tahun 2013)*. (2013) Jakarta: Kemensos, KPPPA, Bapenas, BPS, UNICEF Indonesia. Available online at: https://kemenpppa.go.id/index.php/page/read/38/2477/survey-kekerasan-terhadap-anak-indonesia-tahun-2013 (accessed July 24, 2020).

59. Daigneault I, Hébert M, McDuff P, Michaud F, Vézina-Gagnon P, Henry A, et al. Effectiveness of a sexual assault awareness and prevention workshop for youth: A 3-month follow-up pragmatic cluster randomization study. *Can J Hum Sex*. (2015) 24:19–30. doi: 10.3138/cjhs.2626

60. Jozkowski KN. Beyond the dyad: an assessment of sexual assault prevention education focused on social determinants of sexual assault among college students. *Violence Against Women*. (2015) 21:848–74. doi: 10.1177/1077801215584069

61. Streng TK, Kamimura A. Sexual assault prevention and reporting on college campuses in the US: a review of policies and recommendations. *J Educ Pract*. (2015) 6:65–72.

62. Suryatmo B, Rohenda, T, Abdollah S. *Sport and health education for Year 6 (Pendidikan jasmani, olah raga dan kesehatan untuk Kelas 6)*. Jakarta: Widya Utama (2006)

63. Tim Penjas SD, Santoso THB, Christiana I, Sutisna A, Pribadi E, Sudiana O, et al. *Sport and Health Education for Year 6 (Pendidikan jasmani, olah raga dan kesehatan untuk Kelas 6)*. Jakarta: Yudhistira (2007).

64. Moor A. She dresses to attract, he perceives seduction: a gender gap in attribution of intent to women's revealing style of dress and its relation to blaming the victims of sexual violence. *J Int Women's Stud*. (2010) 11:115–27.

65. Guéguen N. Color and women attractiveness: when red clothed women are perceived to have more intense sexual intent. *J Soc Psychol*. (2012) 152:261–5. doi: 10.1080/00224545.2011.605398

66. Ecker UKH, Lewandowsky S, Cook J, Schmid P, Fazio LK, Brashier N, et al. The psychological drivers of misinformation belief and its resistance to correction. *Nat Rev Psychol*. (2022) 1:13–29. doi: 10.1038/s44159-021-00006-y

67. Nguyen MH, La VP, Le TT, Vuong QH. Introduction to Bayesian mindsponge framework analytics: an innovative method for social and psychological research. *MethodsX*. (2022) 9:101808. doi: 10.1016/j.mex.2022.101808

68. Kirby D. *The Impact of Sex Education on the Sexual Behaviour of Young People, United Nations. Department of Economic and Social Affairs*. New York: United Nations. Department of Economic and Social Affairs. Population Division. (2011).

69. Harding, C. *The Influence of the'Decadent West': Discourses of the Mass Media on Youth Sexuality in Indonesia. Intersections: Gender and Sexuality in Asia and the Pacific*. (2008). Available online at: http://intersections.anu.edu.au/issue18/harding.htm (accessed January 18, 2010).

70. UNESCO. Textbooks and learning resources. In: *Guidelines for Developers and Users*. (2014). Paris: UNESCO. Available online at: https://unesdoc.unesco.org/ark:/48223/pf0000226135_eng (accessed January 20, 2021).

71. United Nations. *Report of the International Conference on Population and Development*. (1995). New York. Available online at: https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/a_conf.171_13_rev.1.pdf (accessed September 24, 2022).

72. Utomo ID, McDonald P. Adolescent reproductive health in Indonesia: Contested values and policy inaction. *Stud Fam Plann*. (2009) 40:133–46. doi: 10.1111/j.1728-4465.2009.00196.x

73. Central Bureau of Statistics of the Republic of Indonesia. *Education Statistics 2021*. (2021). Jakarta: Badan Pusat Statistik Republik Indonesia,. Available online at: https://www.bps.go.id/publication/2021/11/26/d077e67ada9a93c99131bcde/statistik-pendidikan-2021.html (accessed September 24, 2022).

74. Denno DM, Hoopes AJ. and Chandra-Mouli, V. Effective strategies to provide adolescent sexual and reproductive health services and to increase demand and community support. *J Adolesc Health*. (2015) 56:S22–41. doi: 10.1016/j.jadohealth.2014.09.012

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A cross-sectional assessment of knowledge, awareness of risk factors, and perceptions of thyroid disease (TD) among adults living in Saudi Arabia – A community based study

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Background: The incidence of thyroid diseases has tripled in the last three decades, and the prevalence is rising rapidly irrespective of gender and genetics. This study aimed to assess the Knowledge, awareness of risk factors, and perceptions of thyroid disease among the Saudi Community in Saudi Arabia.

Methods: A cross-sectional, online web-based, survey type study was conducted between November 2021 to January 2022 among residents living in Saudi Arabia. Individuals aged ≥ 18 years who expressed a willingness to complete the survey were included. Descriptive and bivariate analyses were carried out to determine the factors associated with knowledge of thyroid using SPSS version 26.0 software (SPSS Inc., Chicago, IL, U.S.).

Results: Among the participants, the majority of them were females than males (77.5 vs. 22.5%). A total of 78.2% (n = 566) of them were aware of the thyroid. Nearly 44% (n = 312) of respondents are aware that a lump in the neck or swelling is a sign of thyroid disease, followed by pain in the neck 24.6% (n = 178), and difficulty in swallowing 23.8% (n = 172). The mean knowledge score of the thyroid was 4.1 (SD = 3.09), while the score of the mean perception was 33.02 (SD = 6.41). The mean knowledge scores were significantly associated with having previous knowledge of thyroid disease (t = 5.08; p = 0.0001). The gender of the participant and the presence of chronic diseases were found to have no impact on the knowledge score of the thyroid disease (t = −1.18; p = 0.235; t = 1.005; p = 0.315). Additionally, the perceptions score was not significantly associated with the demographics of the participants (p = 0.05).

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Conclusion: In this study, Saudi adults reported varying levels of knowledge and perceptions of thyroid disease. Having previous knowledge of the thyroid was significantly associated with the knowledge score. It is necessary to educate people about this rising disease.

KEYWORDS

thyroid disease, neck pain, awareness, risk factors, treatment, Saudi Arabia

Introduction

The thyroid gland is a butterfly-shaped gland situated in the neck that regulates many metabolic processes and physiological functions in the body (1, 2). In recent years, abnormal thyroid function has been a major problem in clinical practice, raising health concerns among patients (3). Thyroid illness is caused by a deficiency in iodine or by autoimmune diseases (4, 5). Other studies have shown that thyroid disease is caused by inflammation or particular medical operations such as radiation or thyroid surgery or by a hereditary factor (1, 2). Thyroid diseases are caused by excessive or insufficient thyroid hormone secretion, as well as thyroid gland hypertrophy. It is estimated that one-third of the world's population suffers from iodine deficiency, with 1.6 billion people at risk of developing thyroid disorders (6). Furthermore, previous studies discovered that physical stress is a possible cause of thyroid gland dysfunction. The most prevalent indications and symptoms of an underactive thyroid gland were fatigue, dry skin, weight gain or loss, changes in bowel movement and menstruation cycle, hair loss and abnormal metabolism and growth, and myalgia (7).

Internationally, the prevalence of thyroid is on the rise, and incidence were more in females than males. The prevalence of thyroid among middle-aged women was 7% (8), the most common form of the disease is the thyroid nodule, accounting for 19–68% of the general population, more commonly found in women (9). According to recent estimates in Saudi Arabia, the prevalence of thyroid dysfunction was 49.76%, and subclinical hypothyroidism was the most prevalent type at 39.2% among Saudis, while primary hypothyroidism was reported at 5.3% (5). The clinical signs of thyroid are primarily determined by the type of thyroid (hypothyroidism or hyperthyroidism or thyroid nodules) and can alter multiple physiological functions in the body including metabolism. Thyroid diseases are also often neglected or mistaken for other medical conditions because most of the symptoms are non-specific (10).

There were previous studies that estimated knowledge, attitudes, and practice toward influenza and diabetes nationally (11, 12), while international studies assessed the knowledge of thyroid cancer (13), and only a few studies evaluated the knowledge, practice, and prevalence of thyroid diseases in Saudi Arabia (1, 5, 6, 14, 15). Although the majority of earlier studies were carried out in other parts of Saudi Arabia, our study stands out for its original design and sample, complete attention to the thyroid, clinical information related to it, manifestations, symptoms, and other factors. As a result, it raises public awareness of the hidden thyroid. Since thyroid disorders are one of the most under-diagnosed and neglected medical conditions, and the lack of general knowledge among patients may be of considerable concern, posing adequate knowledge about the disease is likely an important element in curtailing the prevalence (15). There are only limited studies that evaluated the awareness and knowledge on preventive practices toward thyroid disease in Saudi Arabia from community perspectives. Previously published studies in Saudi Arabia reported a lack of knowledge despite the increased prevalence of disease, which would greatly influence the morbidity and mortality rates. Therefore, this study aimed to assess the knowledge, awareness of risk factors, and perceptions of thyroid disease among the Saudi community in Saudi Arabia.

Methods

Study design, settings, and population

This was a cross-sectional study conducted using an online self-reporting questionnaire among the Saudi Community in Saudi Arabia over 3 months, from November 2021 to January 2022. Saudi adults aged between 18 and 50 years and above, currently living in Saudi Arabia, and willing to provide informed consent were included in the study. We excluded Non-Arabic speakers or those who were outside of the country during the study period. Before data collection, the study protocol was reviewed and approved by the Institutional Review Board (E-21-6371), College of medicine, king Saud University, Riyadh Saudi Arabia.

Study questionnaire, data collection, and source

The questionnaires were prepared after an extensive literature review using previously published similar studies (1,

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5, 13–15). The questionnaire used in this study is divided into four categories. Category one includes 7-items that assess demographic characteristics and certain clinical information of participants such as disease history. The second category contains questions about the knowledge of thyroid disease (4 items), assessed using multiple-choice questions. The third category contains questions about the knowledge of warning signs of the thyroid with a total of 11 items, measured on a three-point scale (Yes/No/I do not know). The fourth category contains questions about the awareness and perception regarding a person's chance of developing thyroid (10 items). The responses of the last section were recorded on a 5-point Likert scale ranging from strongly agree to strongly disagree. A score of 5 was given to strongly disagree, 4 to disagree, 3 to neutral, 2 to agree, and 1 to strongly agree. The knowledge scores were calculated by assigning each correct answer a score of 1 and a wrong answer a score of 0, then all the knowledge items were computed to the obtained overall knowledge. The total knowledge was further divided into good, who scored >50% in the knowledge, while poor considered as individuals who scored <50% in the knowledge items.

We decided to use a non-probability sampling strategy to gather the data from the intended audience. The final study questionnaire was created using Google forms and distributed *via* social media applications using the "snowball" technique, in which each person who signs up for the survey refers to several other people. Participants were given the assurance that their information would only be used for research purposes and would be kept confidential throughout the study. To assure greater reliability and prevent lower response rates, we targeted at least 1,000 people for the data collection process. A statement outlining the importance of participating in the study was made at the beginning. Filling out the survey provided as both an indication of agreement and verbal informed consent. The data was checked to see if it met the inclusion criteria after being obtained. The study did not include any responses that were missing or incomplete.

The designed questionnaire was validated in two steps. First, the initial draft is evaluated by a research expert in the related field, to check the accuracy of the content and flow of the questionnaire. Second, a pilot study was conducted among a randomly selected sample of ($n = 20$) individuals to give their opinions. Reliability was determined using Cronbach's alpha, which was found to be 0.85. The data from the pilot study was not included in the final analysis. The final questionnaire was then distributed using online survey tools.

Statistical analysis

The data were recorded and analyzed using the Statistical Package for the Social Sciences (SPSS) Version 26 for Windows (SPSS Inc., Chicago, Illinois). Frequencies were reported in numbers and percentages (for categorical variables) and as means and standard deviation (for continuous variables). The association between demographics and knowledge and perception scores of the thyroid were measured using parametric tests. The association between the mean scores and demographics with two groups was assessed using the student's *t*-test, while demographics with more than two groups were assessed by ANOVA. All statistical tests were performed at a significance level of $\alpha = 0.05$ and a 95 % confidence interval (CI).

TABLE 1 Socio-demographic characteristics and clinical profile of the study sample.

Demographics	Frequency (*n*)	Percentage (%)
Gender		
Male	163	22.5
Female	561	77.5
Age (full years)		
18–22	492	68.0
23–25	83	11.5
26–30	48	6.6
31–44	70	9.7
45–50	31	4.3
Schooling		
Primary school/ lower	264	36.5
Secondary school	148	20.4
University degree	312	43.1
Professional class		
Working	200	27.6
Self-employed/business	157	21.7
Housewife	210	29.0
Students	34	4.7
Looking for employment	123	17.0
Family income		
Excellent	221	30.5
Good	283	39.1
Average	191	26.4
Poor	29	4.0
Presence of chronic disease?		
Yes	77	10.6
No	647	89.4
Nationality		
Saudi	692	95.6
Non-Saudi	32	4.4
Did you hear about thyroid disease?		
Yes	566	78.2
No	158	21.8

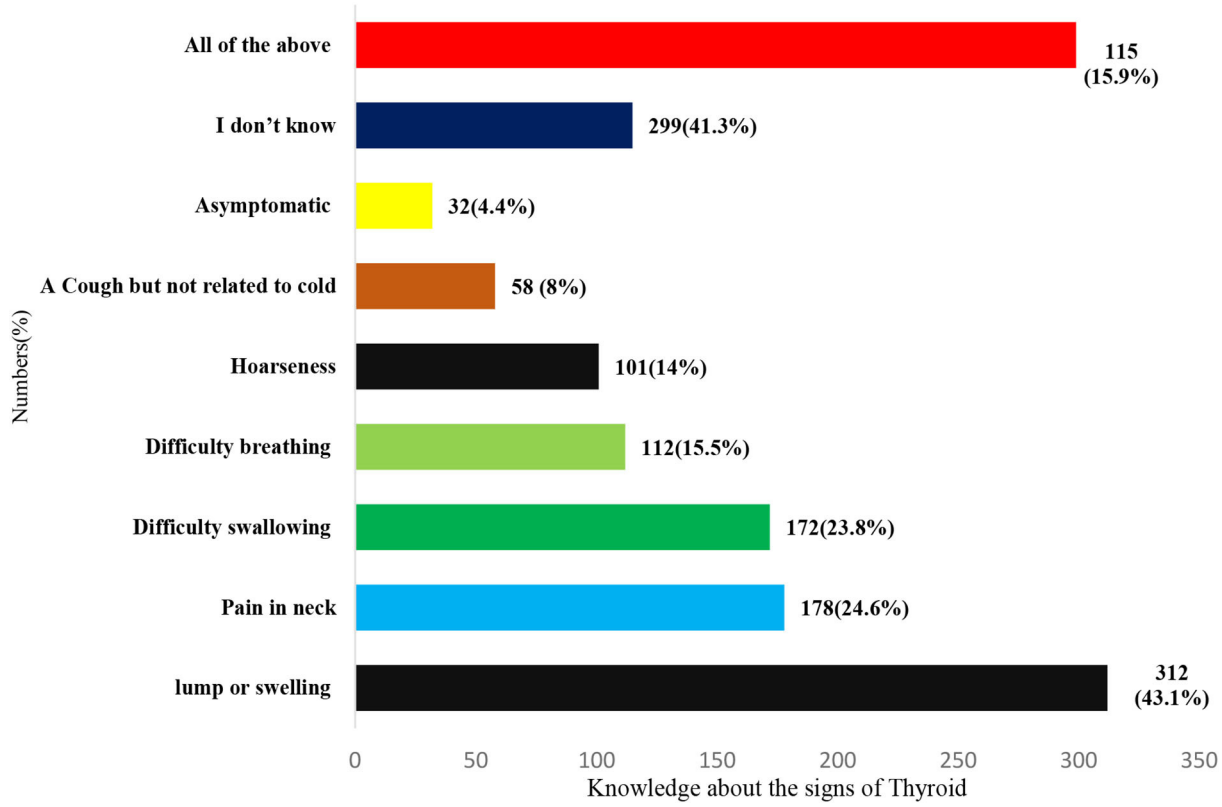

FIGURE 1
Knowledge about early signs of thyroid cancer.

Results

Demographics and clinical characters of the participants

The study included a total of 724 Saudi adults who responded to the online survey, yielding a response rate of 72.4%. There were 561 (77.5%) women, and 68% (n = 492) of them were aged between 18 and 22. About 29% of the 210 participants were housewives, in contrast to 27.6% of the employed participants (n = 200). About 40% (n = 283) of them claimed to have a decent family income, while 30% (n = 221) had an excellent monthly income. The majority of the 647 (89.4%) participants in the study had no history of chronic disease and 78.2% (n = 566) were aware of thyroid cancer. Of the total number of participants, 345 (47.7%) belonged to the central region of Saudi Arabia, while 190 (26.2%) were from the west of Saudi Arabia. Detailed information on the demographic characteristics and clinical profiles of the participants is summarized in Table 1.

Knowledge about early signs of thyroid cancer

Figure 1 demonstrates knowledge about the early signs of thyroid cancer. Findings show that roughly 43.1% (n = 312) of respondents knew that a lump or swelling in the neck is an indication of thyroid disease, followed by neck pain at a rate of 24.6% (n = 178), and difficulty swallowing at a rate of 23.8% (n = 172). However, 42% (n = 299) of people are unaware of the symptoms and indicators of thyroid disease (Figure 1).

Participant's responses toward knowledge of thyroid cancer

Table 2 describes the participant's responses regarding the knowledge of thyroid cancer. The majority of participants (39.4%) reported that they had no idea which gender was most affected by the thyroid, while 33.6% reported being female. Only 41.2% (n = 291) of the participants in this study gave a favorable response, claiming that thyroid function affects the menstrual

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TABLE 2 Participant's responses toward knowledge of thyroid cancer.

Variables	Frequency (*n*)	Percentage (%)
Most common diagnostic methods for screening for thyroid cancer		
Neck palpation and thyroid	242	33.4
ultrasonography	114	15.7
Blood smear	241	33.3
Biopsy	139	19.2
Hormonal level testing	286	39.5
Don't know		
Desirable candidate for a thyroid cancer screen		
Old age	71	9.8
High radiation exposure	74	11.4
Family history	203	28
All of the above	300	41.4
I don't know	234	32.3
Gender most affected by thyroid dysfunction		
Male	45	6.2
Female	243	33.6
Both	151	20.9
I don't know	285	39.4

cycle, as opposed to 54.1% (n = 329) who answered that thyroid function does not affect the menstrual cycle. Over two-thirds of the participants were unaware that thyroid hormone is synthesized using iodine. Knowledge regarding diagnostic methods for screening of thyroid cancer was as follows: 33.4% (n = 242) identified neck palpation and thyroid ultrasonography, followed by biopsy by 33.3% (n = 241), and hormonal testing by 19.2%(139). When asked about the desirable candidate for the thyroid, most of the participants about 28% (203) reported family history, while high radiation exposure by 11.4% (n = 74) (Table 2).

Frequency of correct answers regarding the Knowledge of warning signs for thyroid

Table 3 describes the participant's responses regarding the knowledge of warning signs for thyroid. In this study, slightly more than half of about 55.9% of participants believed that an unexplained lump or swelling might be a sign of cancer. Two-thirds said unexplained weight loss could be a sign of cancer, while 40.9% were uncertain. As for the symptoms such as a persistent change in the bowel, a sore that does not heal, a

TABLE 3 Frequency of correct answers regarding the knowledge of warning signs for thyroid.

Characteristics	Correct answer Frequency (*n*)	Correct answer Percentage (%)
Iodine is required for the synthesis of thyroid hormones	205	28.3
Thyroid function impacts the menstrual cycle	298	41.2
Unexplained lump or swelling could be a sign of cancer	405	55.9
Persistent unexplained pain could be a sign of cancer	260	35.9
Unexplained bleeding could be a sign of cancer	303	41.9
A persistent cough or hoarseness could be a sign of cancer	260	35.9
A persistent change in bowel or bladder habits could be a sign of cancer	160	22.1
Persistent difficulty swallowing could be a sign of cancer	309	42.7
A change in the appearance of a mole could be a sign of cancer	228	31.5
A sore that does not heal could be a sign of cancer	207	28.6
Unexplained weight loss could be a sign of cancer	283	39.1

change in the appearance of a mole, and a persistent difficulty in swallowing, the responses recorded were 57.7% did not know and 22.1% yes; 56.1% did not know and 28.6% yes; 50.0% did not know and 31.5 % yes; 44.1% did not know and 42.7% yes, respectively (Table 3). In this study, 43.9% of the participants were found to have good knowledge, while 56% reported poor knowledge of warning signs for the thyroid (Figure 2).

Perception regarding chances of developing thyroid

Table 4 describes the participant's perceptions about developing thyroid. In terms of the perception of developing cancer, the highest percentage of participants (81.3%) believed that smoking increases the risk. A total of 73.3% of participants expressed that exposure to cigarette smoke from others increases cancer risk and 35.4% of participants were neutral about the statement that eating less than five portions of fruit and vegetables a day increases the risk of cancer. In total, 39.5 % of

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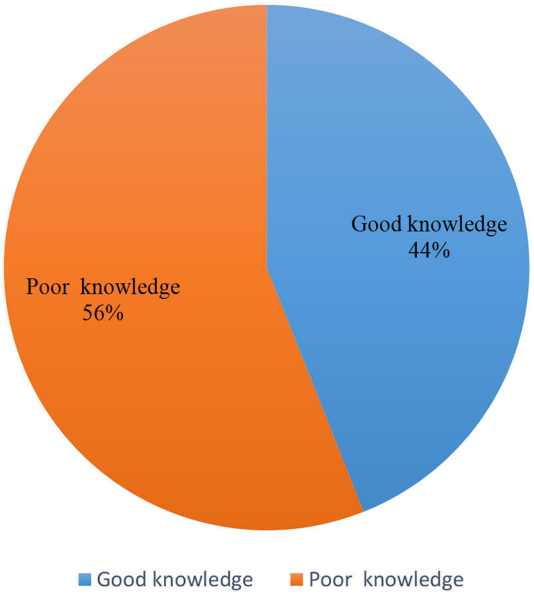

FIGURE 2
The levels of knowledge of thyroid.

the participants positively responded that <30 min of moderate physical activity five times a week can lead to cancer. Over two-thirds of the participants opted for neutral when it came to infection with HPV (Human Papillomavirus). More than 40% of the participants were neutral regarding statements like being overweight (BMI over 25), getting sunburnt as a child twice, and being over 70 years old for the possibility of developing cancer (Table 4).

Differences between knowledge and perception scores and participant characteristics

Table 5 describes the differences between knowledge and perception scores and participant characteristics. According to findings, more than one-third of the Saudis about 43.9% ($n = 318$) have good knowledge, while 405(55.9%) of them were found to have poor knowledge. The mean knowledge score of the thyroid was found to be 4.1(SD=3.09), (Range 0–11) while the score of the mean perception was 33.02(SD = 6.41) (Range 0–41). Previous knowledge of thyroid disease has significantly affected the mean knowledge scores of Saudi adults ($t = 5.08$; $p = 0.0001$). The gender of the participant and the presence of chronic diseases were found to have no impact on the knowledge score of the thyroid disease ($t = -1.18$; $p = 0.235$; $t = 1.005$; $p = 0.315$) as shown in Table 5. Additionally, the perceptions score was not significantly different concerning the demographics of the participants ($p = 0.05$). Similarly, the education of participants is not significantly different concerning the knowledge or perception scores of the thyroid, while employment status is different with knowledge of the thyroid as shown in Table 2.

Discussion

The incidence of metabolic disease has been increasing in recent years, which has made individuals pay more attention (16, 17). In particular, the prevalence of obesity, thyroid, and diabetes are on the rise in both Saudi Arabia and other international countries (16–19), which are significantly associated with multiple comorbidities, which in turn raise the mortality and disability rates over the world. There is not much literature available nationally and internationally about the knowledge and perceptions of individuals toward thyroid disease; however, most of the literature reported was identified in other regions of Saudi Arabia and neighboring countries (1, 5, 10). This study adds a significant contribution to identifying factors, which could contribute to the prevalence of thyroid among the young population in Saudi Arabia. It will serve as a baseline study for further studies looking at developing targeted interventions and services to reduce the risk of predisposing factors or help in the management of diseases to lead a healthy lifestyle.

In this study, 43.9% of the individuals reported having good knowledge of the thyroid. A similar study by Almuzaini et al. reported that 57.32% of Saudi adults reported having good knowledge of the thyroid (20). On the contrary, another recent study reported moderate knowledge of the thyroid (56%) (20). Although Alqahtani in 2021 reported moderate knowledge of 41.5% of the thyroid (5), Alyahya et al. (1) conducted a similar study in 2021 to assess the general knowledge about thyroid disease among the general population of eastern provenience of the same country and reported that 14.2% of the Saudis were knowledgeable about the disease. Therefore, poor knowledge of the thyroid is more common and is reported in many studies internationally (1, 10, 21, 22). This might be because the thyroid is most prevalent and typically has no apparent symptoms. If this condition is left untreated, severe complications may occur, in both males and females (23, 24).

The most common early signs of thyroid in this study were a lump in the neck or swelling (43.1%), followed by pain in the neck (24.6%), and difficulty in swallowing (23.8%). Similar results were reported by Almousa and Alotaibi on symptoms of thyroid disease as a neck swelling, constipation, and diarrhea (10). Another study by Alyahya et al. (1) identified fatigue (81.7%), neck swelling (70.6%), followed by weight gain (68.9%), and constipation and diarrhea (28.2%) (1). In comparison, the study by Rai et al. (22) reported weight gain or weight loss fatigue (61%). This variation in the findings might be due to the

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TABLE 4 Perception regarding chances of developing thyroid.

Variables	Strongly agree *n* (%)	Agree *n* (%)	Neutral *n* (%)	Strongly disagree *n* (%)	Disagree *n* (%)	Mean ± (SD)
Smoking any cigarettes at all	436(60.2)	153(21.1)	100(13.8)	14(1.9)	21(2.9)	2.81 ± (1.23)
Exposure to another person's smoking	276(38.1)	255(35.2)	141(19.5)	17(2.3)	35(4.8)	3.32 ± (1.35)
Eating less than five portions of fruits and vegetables a day	85(11.7)	143(19.8)	256(35.4)	94(13.0)	146(20.2)	3.42 ± (1.57)
Eating red or proceed meat and junk food	111(15.3)	195(26.9)	264(36.5)	68(9.4)	86(11.9)	3.58 ± (1.65)
Being overweight	103(14.2)	164(22.7)	330(45.6)	49(6.8)	78(10.8)	3.51 ± (1.52)
Getting sunburnt	92(12.7)	142(19.6)	318(43.9)	79(10.9)	93(12.8)	3.37 ± (1.52)
Being over 70-year old	98(13.5)	165(22.8)	301(41.6)	57(7.9)	103(14.2)	3.53 ± (1.53)
Having a close relative with cancer	132(18.2)	169(23.3)	284(39.2)	58(8.0)	81(11.2)	3.23 ± (1.22)
Infection with HPV (Human Papillomavirus)	87(12.0)	81(11.2)	462(63.8)	39(5.4)	55(7.6)	3.07 ± (0.92)
Doing <30 min of moderate physical activity five times a week	139(19.2)	147(20.3)	240(33.1)	86(11.9)	112(15.5)	3.13 ± (1.27)

study design, questionnaire, living habits of the individuals, race, and ethnicity.

The most common justification among the participants in this study for the desirable candidate for thyroid was old age, followed by high radiation exposure, and family history, while the gender most affected by thyroid dysfunction was identified to be female (33.6%). These results were similar to a previously published study by Alqahtani in 2021, who reported that being female (58.4%), genetics (53.1%), and frequent exposure to radiation in childhood (37.5%) contributed to the thyroid (5). Similarly, another recent study reported that being female gender and a smoker is an important risk factor for thyroid diseases (1). Additionally, an earlier study reported that the antiarrhythmic medication, amiodarone, is another significant risk factor to induce thyroid dysfunction among the elderly (25).

In this study, the majority of the individuals agreed that smoking cigarettes or exposure to other smoke is positively effects the thyroid dysfunction. Similar results were reported by previous studies around the world (1, 5, 10, 13, 26). In addition, there was evidence that smoking leads to a decrease in the levels of thyrotropin and higher levels of thyroid hormones, which in turn causes the development of Graves' disease and hyperthyroidism (27). These findings necessitate additional awareness and knowledge programs among individuals about the harmful outcomes of smoking suggesting that smoking cessation, on the other hand, may lower the incidence and adverse events not only in the thyroid but also in multiple cancers associated with smoking implying that the effects of smoking may be reversed in persons who quit (27). Thus, current findings suggested that in order to prevent the morbidity and mortality linked to thyroid cancer and to limit the prevalence of thyroid, it is obligatory to create awareness among the public and should focus on educating people and raising mass knowledge of the disease's earliest symptoms and risk factors.

This study has some limitations. The first limitation is that it was an online web-based study, some elderly people or people who are technologically illiterate or lack access to the internet might find it difficult to participate, and this limited the response rate. According to earlier studies, the majority of people who suffer from chronic diseases such as thyroid are often young adults, thus it is still a useful strategy. The second is the study's self-reported design may have made our results less trustworthy. However, one can presume that thyroid-related clinical condition was accurately captured because the survey was anonymous and entirely voluntary. Despite the previous potential limitations, this study had a large sample size and sufficient response rates (>60%), which may be one of its strengths.

Conclusion

These findings indicate that Saudi adults in Saudi Arabia are lacking some aspects of sufficient knowledge of thyroid diseases

TABLE 5 Differences between knowledge and perception scores and participant characteristics.

Participants characteristics	Knowledge score				Perception score			
	Mean (SD)	*F* value	*t*-value*	*p*-value	Mean (SD)	*F* value**	*t*-value	*p*-value
Gender								
Male	3.85(3.28)		−1.18	0.235*	32.6(6.68)		−889	0.374*
Female	4.18(3.03)				33.1(6.33)			
Age (full years)								
18–22	3.91(3.03)	1.71		0.130**	32.8(6.28)	2.05		0.069**
23–25	4.52(3.26)				32.7(6.33)			
26–30	4.02(3.04)				32.2(7.10)			
31–34	4.46(2.97)				32.8(5.60)			
35–40	4.69(2.95)				35.9(6.78)			
45 and more	5.09(3.71)				33.3(7.10)			
Presence of chronic disease?								
Yes	4.44(3.23)		1.005	0.315*	32.6(6.68)		−0.562	0.574*
No	4.06(3.07)				33.0(6.38)			
Did you hear about thyroid disease?								
Yes	4.41(3.08)		5.08*	0.0001	32.9(6.64)		−0.303	0.7628*
No	3.01(2.88)				33.1(5.54)			
Place of residence								
Central	4.13(3.12)	0.51		0.729**	32.7(6.37)	1.21		0.304**
East	4.61(3.18)				31.0(6.89)			
West	4.05(3.11)				33.5(5.97)			
North	4.62(3.30)				34.2(7.32)			
South	3.90(2.95)				32.8(6.78)			
Professional class								
Working	3.77(2.9)	5.41		0.0001	32.6(5.8)	0.788		0.533
Self-employed	4.78(3.1)				33.5(7.0)			
Housewife	3.56(2.9)				33.2(6.3)			
Students	4.08(3.6)				32.0(6.5)			
Unemployed	4.71(3.1)				32.8(6.5)			
Schooling								
Primary or below	4.08(3.03)	0.056		0.946	32.5(6.13)	1.691		0.185
Secondary	4.18(3.30)				32.8(6.25)			
University	4.08(3.04)				33.5(6.69)			

*t-test; **ANOVA.

and their manifestation. More importantly, the prevalence of thyroid is on the rise compared with both national and international studies, which potentially predict an increase in negative consequences in the everyday life. The present results could serve as a support for healthcare facilities and providers to improve their patient counseling to encourage adherence to prescribed medications and to support the various strategies to control the thyroid. Therefore, we advocate the implementation of educational programs that teach patients and individuals about how to avoid the complications and incidence of thyroid diseases.

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 studies involving human participants were reviewed and approved by IRB Approval of Research Project No. E-21-6371. The patients/participants provided their written informed consent to participate in this study.

Author contributions

RA and AA designed the work and wrote this paper. WS, SA, and MA-R extracted and analyzed the datasets. S, SA, and MA-R interpreted the results and helped to revise the manuscript. 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.

Publisher's note

References

1. Alyahya A, AlNaim A, AlBahr AW, Almansour F, Elshebiny A. Knowledge of thyroid disease manifestations and risk factors among residents of the Eastern Province, Saudi Arabia. *Cureus.* (2021) 13:e13035. doi: 10.7759/cureus.13035

2. Meng Z, Liu M, Zhang Q, Liu L, Song K, Tan J, et al. Gender and age impacts on the association between thyroid function and metabolic syndrome in Chinese. *Medicine.* (2015) 94:e2193. doi: 10.1097/MD.0000000000002193

3. Taylor PN, Albrecht D, Scholz A, Gutierrez-Buey G, Lazarus JH, Dayan CM, et al. Global epidemiology of hyperthyroidism and hypothyroidism. *Nat Rev Endocrinol.* (2018) 14:301–16. doi: 10.1038/nrendo.2018.18

4. Garmendia Madariaga A, Santos Palacios S, Guillén-Grima F, Galofré J. The incidence and prevalence of thyroid dysfunction in Europe: a meta-analysis. *J Clin Endocrinol Metab.* (2014) 99:923–31. doi: 10.1210/jc.2013-2409

5. Alqahtani SA. Prevalence and characteristics of thyroid abnormalities and its association with anemia in ASIR Region of Saudi Arabia: a cross-sectional study. *Clinics and practice.* (2021) 11:494–504. doi: 10.3390/clinpract11030065

6. Alam Khan V, Khan MA, Akhtar S. Thyroid disorders, etiology and prevalence. *J Med Sci.* (2002) 2:89–94. doi: 10.3923/jms.2002.89.94

7. NHS. Symptoms of underactive thyroid. Available online at: https://www.nhs.uk/conditions/underactive-thyroid-hypothyroidism/symptoms/ (accessed January 12, 2022).

8. Poppe K, Bisschop P, Fugazzola L, Mintziori G, Unuane D, Weghofer A. Erratum: 2021 European thyroid association guideline on thyroid disorders prior to and during assisted reproduction. *Eu Thyroid J.* (2020) 9:281–95. *Eur Thyroid J.* (2021) 10:268. doi: 10.1159/000512790

9. Haugen BR, Alexander EK, Bible KC, Doherty GM, Mandel SJ, Nikiforov YE, et al. American thyroid association management guidelines for adult patients with thyroid nodules and differentiated thyroid cancer: the American thyroid association guidelines task force on thyroid nodules and differentiated thyroid cancer. *Thyroid.* (2016) 26:1–133.: 10.1089/thy.2015.0020

10. Abdulrahman Ibrahim AM: Survey of awareness of thyroid disorders among the Riyadh population, Central Region of Saudi Arabia. *Egypt J Hosp Med.* (2018) 72:4039–44. doi: 10.21608/ejhm.2018.9095

11. Sales IA, Syed W, Almutairi MF, Al Ruthia Y. Public Knowledge, Attitudes, and Practices Toward Seasonal Influenza Vaccine in Saudi Arabia: a Cross-Sectional Study. *Int J Environ Res Public Health.* (2021) 18:479. doi: 10.3390/ijerph18020479

12. Wajid S, Al-Arifi MN, Babelghaith SD, Naqvi AA, Althagfan SS, Mahmoud MA. Pharmacy students' knowledge and attitudes towards diabetes: a cross-sectional study. *Biomed Res.* (2018) 29:3638–42. doi: 10.4066/biomedicalresearch.29-18-1074

13. Iqbal A, Azhar S, Ibrahim NA, Kharaba ZJ, Iqbal MM, Khan SA, et al. Thyroid cancer risk factors and Pakistani University students' awareness towards its preventive practice. *J Oncol Pharm Pract.* (2021) 27:570–8. doi: 10.1177/1078155220925166

14. Khalifa A, Alotaibi A, Albahlal A, General public awareness about symptoms and risk factors of cardiovascular diseases in Riyadh city, Saudi Arabia. *IJMDC.* (2019) 3:44-51. doi: 10.24911/IJMDC.51-1563109418

15. Syed W, Samarkandi OA, Alsadoun A, Harbi MKA, Al-Rawi MBA. Evaluation of clinical knowledge and perceptions about the development of thyroid cancer-An observational study of healthcare undergraduates in Saudi Arabia. *Front Public Health.* (2022) 10:912424. doi: 10.3389/fpubh.2022.912424

16. Awad AS, Alshahrni FMM, Alhawyan FS, Ghazwani EY, Alasmary MY, Alshahrani MY, et al. Inference of link among diabetes, obesity, and thyroid dysfunction in data from a clinic at Saudi Arabia. *Bioinformation.* (2021) 17:119–25. doi: 10.6026/97320630017119

17. Althumiri NA, Basyouni MH, AlMousa N, AlJuwaysim MF, Almubark RA, BinDhim NF, et al. Obesity in Saudi Arabia in 2020: prevalence, distribution, and its current association with various health conditions. *Healthcare.* (2021) 9:311. doi: 10.3390/healthcare9030311

18. Biondi B, Kahaly GJ, Robertson RP. Thyroid dysfunction and diabetes mellitus: two closely associated disorders. *Endocr Rev.* (2019) 40:789–824. doi: 10.1210/er.2018-00163

19. Huang X, Zhang X, Zhou X, Han X, Fu Z, Li Y, et al. Prevalence of thyroid dysfunction in a Chinese population with different glucose intolerance status: a community-based cross-sectional study. Diabetes, metabolic syndrome, and obesity. *Targ Therapy.* (2020) 13:4361. doi: 10.2147/DMSO.S271328

20. Almuzaini A, Alshareef B, Alghamdi S, Munshy AA, Aljarallah AK, Salman SA, et al. Assessment of knowledge and awareness

regarding thyroid disorders among Saudi people. *IJDMC.* (2019) 3:1070–6. doi: 10.24911/IJMDC.51-1568037206

21. Alotaibi FM, Alotaibi AM, Alotaibi FA, Awaji AM, Alotaibi FR, Aldajani KA, et al. General public awareness about symptoms and risk factors of some thyroid diseases in KSA, Riyadh 2019. *IJMDC.* (2019) 3:739–45.

22. Rai S, Sirohi S, Khatri AK, Dixit S, Saroshe S. Assessment of knowledge and awareness regarding thyroid disorders among women of a cosmopolitan city of central India. *Natl J Community Med.* (2016) 7:7–10. Available online at: https://www.bibliomed.org/mnsfulltext/159/159-1461647943.pdf?1667218355

23. Alzahrani AS, Al Mourad M, Hafez K, Almaghamsy AM, Alamri FA, Al Juhani NR, et al. Diagnosis and management of hypothyroidism in gulf cooperation council (GCC) countries. *Adv Ther.* (2020) 37:3097–311. doi: 10.1007/s12325-020-01382-2

24. Cooper DS. Subclinical hypothyroidism. *NEJM.* (2001) 345:260–5. doi: 10.1056/NEJM200107263450406

25. Takeuchi D, Honda K, Shinohara T, Inai K, Toyohara K, Nakanishi T. Incidence, clinical course, and risk factors of amiodarone-induced thyroid dysfunction in Japanese adults with congenital heart disease. *Circ J.* (2015) 3:CJ−15. doi: 10.1253/circj.CJ-15-0042

26. Wiersinga WM. Smoking and thyroid. *Clin Endocrinol.* (2013) 79:145–51. doi: 10.1111/cen.12222

27. Åsvold BO, Bjøro T, Nilsen TI, Vatten LJ. Tobacco smoking and thyroid function: a population-based study. *Arch Int Med.* (2007) 167:1428–32. doi: 10.1001/archinte.167.13.1428

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Incidence and predictors of opportunistic infections in adolescents and adults after the initiation of antiretroviral therapy: A 10-year retrospective cohort study in Ethiopia

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Background: Opportunistic infections (OIs) are the leading cause of morbidity and mortality in people living with the human immunodeficiency virus (PLHIV). However, there are few robust recent data on the rates of OIs and the risk factors that contribute to their occurrence. Therefore, the current study sought to determine the incidence of OIs and identify predictors among adolescents and adults after the initiation of antiretroviral therapy (ART) at Wolaita Sodo University Comprehensive Specialized Hospital (WSUCSH), Southern Ethiopia.

Methods: A retrospective cohort study design was employed. The study population was adolescents and adults who initiated ART between 1 January 2012 and 31 December 2021. A simple random sampling technique was used to select 537 participants' records. We reviewed the medical records of the sampled individuals from 1 May 2022 to 15 June 2022. KoboCollect version 2021.2.4 and STATA version 14.0 software were used for data collection and analysis, respectively. We calculated the incidence rate per 100 person-years of observation (PYO) with 95% confidence intervals (CIs) for the occurrence of any OIs. The Weibull regression model was fitted after the goodness-of-fit test for the Cox proportional hazard model was deemed inadequate. An adjusted hazard ratio (AHR) with 95% CI was used to identify a significant predictor of OIs. The statistical significance was made at a 5% significance level.

Results: A total of 515 participants contributed to 1,829 person-years of risk, of whom 164 (31.84%) exhibited at least one OI. The overall incidence rate of OIs was 8.97 cases (95% CI: 7.69, 10.44) per 100 PYO. The independent predictors of OIs were being female [AHR: 1.65 (95% CI (1.15, 2.36), $P = 0.007$)], individuals classified as World Health Organization (WHO) HIV clinical stage III [AHR: 1.98 (95% CI (1.12, 3.51), $P = 0.019$)], individuals who did not take cotrimoxazole preventive therapy (CPT) [AHR: 2.58 (95% CI (1.62, 4.11), $P < 0.001$)], mild malnutrition [AHR: 1.62 (95% CI (1.06, 2.54), $P = 0.035$)], and poor adherence to ART [AHR: 4.21 (95% CI (2.39, 7.44), $P < 0.001$)].

Conclusion: The rate of OIs after the initiation of ART was still high**.** Moreover, being female, not taking CPT, poor adherence to ART, mild malnutrition, and advanced HIV disease at presentation were found to increase the hazards of developing OIs.

KEYWORDS

opportunistic infections, Ethiopia, incidence, antiretroviral therapy, HIV/AIDS

Background

Human immunodeficiency virus (HIV) causes progressive immune cell depletion and reduces a person's ability to combat opportunistic infections (OIs) (1). Over 20 specific OIs have been linked to HIV (2), and people living with human immunodeficiency virus (PLHIV) are frequently exposed to co-infections during the disease (3). Moreover, HIV-related OIs affect PLHIV more frequently and severely, causing significant morbidity and mortality, and necessitating lifelong antiretroviral therapy (ART) (4, 5).

Recent global estimates suggest that 79.3 million people have become infected with HIV since the first evidence of the epidemic. In addition, 36.3 million people have died from acquired immune deficiency syndrome (AIDS)-related illnesses (6). High levels of early morbidity and mortality following ART initiation continue to be a distinctive feature of ART programs in Sub-Saharan Africa, although the introduction and scaling-up of ART have decreased overall mortality (7, 8). The World Health Organization (WHO) recommends a range of medical interventions to reduce the occurrence of OIs among PLHIV. These include, but are not limited to the reduction of exposure, chemoprophylaxis, immunization, and rapid initiation of ART (9).

In concert with these, Ethiopia has adopted several strategies to improve the HIV care continuum, including (a) launching ART services in 2003, (b) declaring universal access to free ART in 2005 which is reflected in part in the increased ART coverage from 5% in 2010 to 9.5% in 2013, (c) treating all policies since 2016 to improve the survival of HIV, (d) endorsement of the national HIV prevention 2020 road maps, and (e) rollout of dolutegravir (DTG) and third-line ART regimen; optimization of pediatric and adult ART, and phase out of nevirapine (NVP) (1, 10). OIs are the leading cause of hospitalization and death in patients with HIV and still present formidable challenges for meager healthcare systems endeavoring to provide effective and efficient HIV care (11, 12).

In resource-poor settings, HIV-related OIs occupy between 20 and 52% of hospital beds (13). Furthermore, 90% of HIV-related morbidity and mortality are attributed to OIs (14, 15). Between 2000 and 2019, US $170.79 billion in development assistance for health was spent on HIV globally and most of this aid went toward care and treatment for patients with HIV (16). Moreover, OIs have significantly contributed to poverty among PLHIV, impeding the achievement of sustainable development goal III on health in resource-poor settings (17). Since the advent of ART, a drastic decrease in rates of OIs was observed, but still, the incidence rate of OIs in industrialized countries differs markedly from those countries in Africa (18). In Poland, for instance, the rate of OIs was 6.8 in 2000, 6.5 in 2001, and 4.8 in 2002 per 100 person-years of observation (PYO) (19). Furthermore, the rate of OIs per 100 PYO was 4.67 in Vietnam (20); 2.27 in the US and Canada (2000–2010) (21); 6.9 in London (22); and 7.7 at 3 months, 2.6 at 6 months, and 2.2 at between 9 and 15 months in Swiss HIV cohort study (23).

A few studies demonstrated that the OIs in low and middle-income countries remain the major driver of HIV-associated morbidity and mortality (24). In Uganda, the rate of OIs was 5.9 cases per 100 PYO (25). In the Senegalese cohort, the rates of AIDS-defining illness decreased from 20.5 to 4.3 per 100 PYO between the first and fourth year (26). According to previous studies, but limited studies conducted in Ethiopia, the incidence of OIs was 13.5 cases per 100 PYO in Dessie, Northern Ethiopia (27), and 3.4 cases per 100 PYO in Arba Minch, Southern Ethiopia (28). Although ART has been proven to be impactful in halting immune system impairment and preventing disease progression, studies showed that OIs have not ended (1, 29) either due to the unmasking of subclinical infection that occurs with immune recovery, drug toxicities and interactions, initial acquisition of a drug-resistant strain, or high exposure to infectious agents (10, 30).

A study in the United Kingdom (UK) reported that late presentation to health facilities increases the risk of developing OIs and remains a significant problem in developed countries, with over 20% of patients in the UK suffering from OIs (31). In addition, baseline NVP-based regimens, time-varying higher viral load, treatment failure, and time-varying lower hemoglobin

Abbreviations: AHR, adjusted hazard ratio; AIDS, acquired immunodeficiency syndrome; ART, antiretroviral therapy; CI, confidence interval; CPT, cotrimoxazole preventive therapy; DTG, dolutegravir; EFV, efavirenz; HIV, human immunodeficiency virus; HR, hazard ratio; IPT, isoniazid preventive therapy; IQR, interquartile range; NVP, nevirapine; OIs, opportunistic infections; PLHIV, people living with HIV; TDF, tenofovir; WHO, World Health Organization.

levels were risk factors associated with the development of OIs at any given time, while the patient is taking ART (25, 32, 33).

Furthermore, adherence to ART, nutritional status, isoniazid preventive therapy (IPT) and cotrimoxazole preventive therapy (CPT), place of residence, functional status, gender, age of the PLHIV, CD4 T lymphocytes count, and disclosure status have been associated with the occurrence of OIs among adolescent and adult PLHIV after the initiation of ART (27, 28, 32, 34). Reliable data on the burden of OIs after ART initiation are critical for planning health services and reducing OI-related morbidity and mortality. Nevertheless, information on the rates of OIs is scarce nationally and non-existent in the study setting.

In this study, we sought to determine the incidence of OIs and identify potential risk factors correlated with the acquisition of OIs among adolescent and adult participants in HIV care. A follow-up study, like the current study, would make difference to healthcare professionals, who are caring for patients infected with HIV receiving ART at Wolaita Sodo University Comprehensive Specialized Hospital (WSUCSH), in two regards. In the first instance, to predict potential risk factors for the acquisition OIs. Second, it enables healthcare professionals to remain knowledgeable about the estimated time of OI occurrence after ART initiations which in turn helps design the optimal strategies for the prevention and management of OIs and provide comprehensive and high-quality care to patients with HIV. Furthermore, the results obtained from this study will enable administration bodies to define local priorities in HIV care and inform targeted expenditures on the prophylaxis and treatment of HIV-related OIs. In addition, evidence is expected to be used by policymakers and program managers mainstreaming HIV/AIDS activities. Finally, the current study calls for researchers to conduct a multi-centered prospective follow-up study.

Methods

Study design

An institution-based retrospective cohort study design was employed.

Study setting

The study was conducted at WSUCSH, which is located in Wolaita Zone, Sodo town, 325 km south of Ethiopia's capital, Addis Ababa. A total of 28 public health facilities, including one specialized hospital, were available in the town. The hospital provides inpatient and outpatient services for an estimated five million people, including patients visiting from neighboring zones and regions of Ethiopia. Comprehensive HIV care and treatment were launched in September 2005 at the hospital. A total of 26 staff, comprising four ART physicians, four ART nurses, two data clerks, two porters, two cleaners, two case managers, four ART adherence supporters, two ART pharmacists, two clinical officers, and two ART laboratory technologists, were providing healthcare services at the hospital's ART clinic. A total of 1,897 (male participants-−828; female participants-−1,069) PLHIV were initiated on ART from 1 January 2012 to 31 December 2021, at the center. Of these, 60 individuals were younger than 15 years. We reviewed the medical records of the sampled individuals from 1 May 2022 to 15 June 2022. This study was reported following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (available online at https://www.strobe-statement.org/).

Participants

Eligible PLHIV were individuals whose age was at least 15 years old (adolescents and adults) and who initiated ART at WSUCSH between 1 January 2012 and 31 December 2021. Records of PLHIV with missing information, such as an unknown ART start date, OIs that were not documented, or an incomplete diagnosis, were excluded from data extraction.

Sample size and sampling procedure

We computed the required sample size directly using OpenEpi version 3.0.1 (Open Source Epidemiologic Statistics for Public Health) software designed for cohort studies based on the following assumptions: The frequency of outcome in the unexposed was 50%; the frequency of outcome in the exposed was 63%; absolute precision of 5%; $Z\alpha/2 = 1.96$ at 95% confidence interval (CI), and a power of 80%. The variable that resulted in a larger sample size from the previous study conducted in Ethiopia was the body mass index (BMI) of the participants (35). Considering a 10% contingency for incomplete information, the final sample size for this study turned out to be 537. Between 1 January 2012 and 31 December 2021, a total of 1,897 patients initiated ART. Of which, records of 60 PLHIV under the age of 15 years were excluded (Figure 1). Medical records of 537 participants were selected from the remaining 1,837 using the simple random sampling method. To prepare the sampling frame, sequential numerical codes starting with 1 and ending with 1,837 were assigned to the eligible charts found on the shelves. Microsoft Excel 2010 was used to create random sampling. When the "RAND function ()" was entered, random numbers were created. After sorting them, the required 537 samples of random numbers were selected for data extraction.

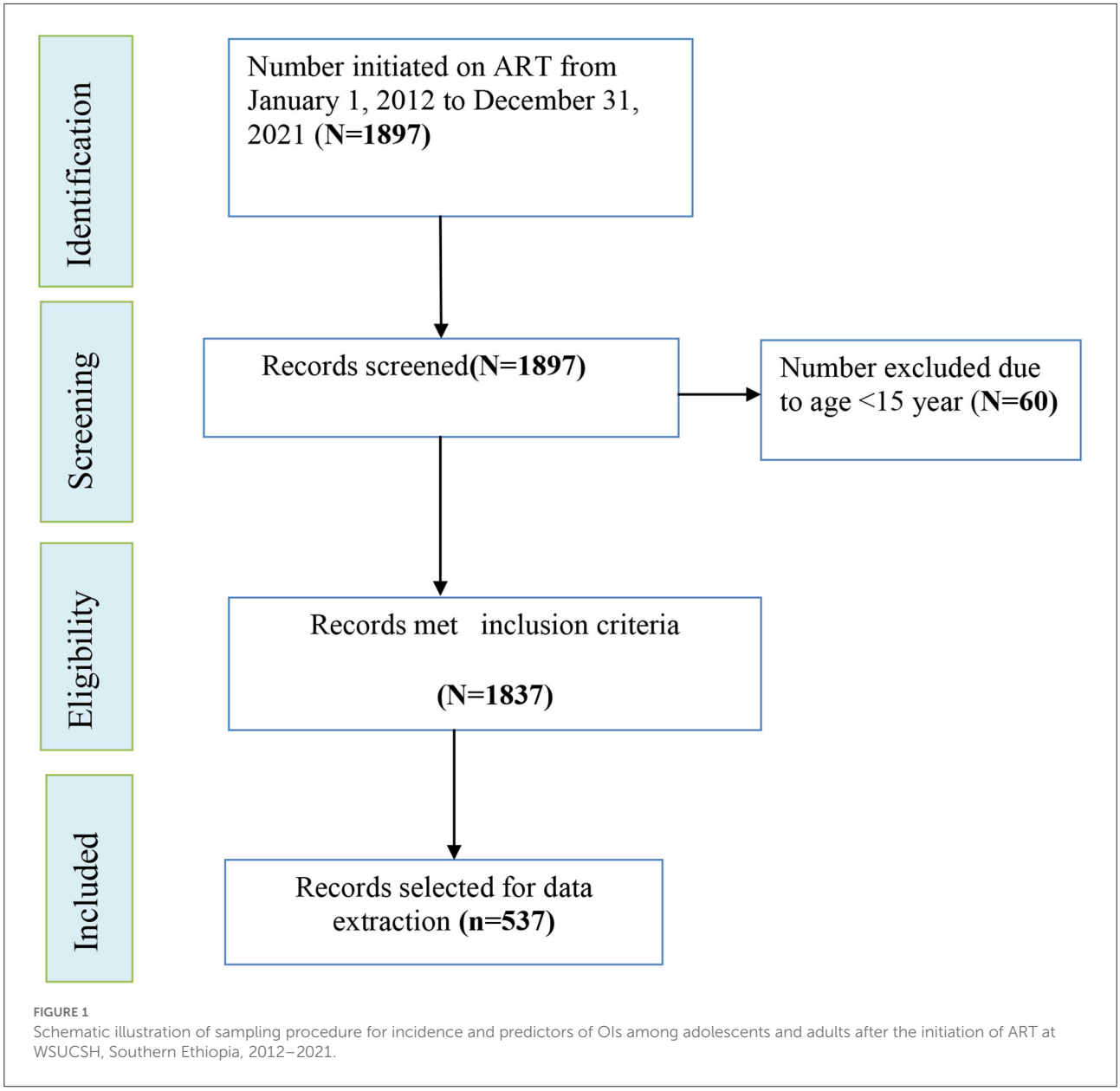

FIGURE 1
Schematic illustration of sampling procedure for incidence and predictors of OIs among adolescents and adults after the initiation of ART at WSUCSH, Southern Ethiopia, 2012–2021.

Study variables

The outcome variable of this study was time to the acquisition of OIs. The time was estimated in years, and it was from the date when the patient was initiated on ART to the date when OI was diagnosed. Opportunistic infections are infections that occur more frequently and severely among PLHIV with weakened immune systems (5). Participants with any of the following infections, herpes zoster, candidiasis (oral or vaginal), cryptococcal meningitis, chronic diarrhea, encephalopathy, herpes simplex, PCP, pneumonia, pulmonary tuberculosis, extrapulmonary tuberculosis, intestinal parasitosis, acute diarrhea, toxoplasmosis, and upper respiratory tract infection, were considered as having OIs (event) only if diagnosed and documented by ART physician (10) and therefore coded as "1," whereas those who dropped, lost to follow-up, transferred out, died, or were still on active ART follow-up but did not develop any OIs until the end of the follow-up were considered censored and coded as "0." The information on the outcome variable was obtained by reviewing the patient chart documented by the ART physician. The explanatory variables were categorized into the following themes: socio-demographic variables: age, gender, marital status, level of education, residence, religion, occupation, and catchment area; clinical, treatment, and laboratory-related variables: WHO HIV clinical stage, BMI, baseline hemoglobin, ART adherence,

functional status, IPT, CPT, type of first-line ARV regimen, prior history of OIs, and disclosure status.

Measurements

An electronic data collection system using KoBoCollect version 2021.2.4 software was employed to retrospectively abstract data on exposure and outcome variables that had been filled in properly by medical staff at enrollment and each visit of the patients. Published studies (27, 28, 32), patient cards, and the national HIV care/ART intake and follow-up forms, which are available in the ART clinic, were sources of information to create the XLSForm Online. The XLSForm uploaded to the server contains socio-demographic variables such as age, sex, residence, educational background, marital status, and occupation; clinical and laboratory-related variables such as weight, height, WHO HIV clinical stage, baseline hemoglobin, comorbidity, ART adherence, and functional status. Treatment-related variables such as IPT, CPT, and baseline ART regimen were all factors to be considered. The quality of the data was ensured by using pre-tested and refined checklists. Before the actual data collection, a pre-test was conducted to prove its internal validity.

The levels of reliability agreements among the data collectors were analyzed using statistical packages for the social sciences (SPSS) version 25 after retrieving data on a selected variable from 5% ($n = 26$) of the patient records and were verified by using Cohan's kappa coefficient. The standard for the strength of agreement for the kappa coefficient was categorized as poor ($\leq$0.20), fair (0.21–0.40), moderate (0.41–0.60), good (0.61–0.80), and almost perfect agreement (0.81–1). A kappa statistic value of $\geq$0.5 was considered congruent and accepted (64).

The reliability analysis revealed that there was a statistically significant similarity between the two data extractors (Cohen's kappa = 87.4%, $P < 0.001$). Data collectors and supervisors were trained intensively for 1 day which emphasized the relevance of the study, the objective of the study, how to use KoBoCollect software, and the overall data extraction procedure. Meetings between supervisors and data collectors were held to address preemptive problems. The overall data collection process was monitored by the principal investigator and the supervisors.

Definition of terms

Censored

Censored was recorded if patients were dropped, lost to follow-up, transferred out, died, or were still on active ART follow-up but did not develop any OIs until the end of the follow-up (36). Transferred out was recorded when patients with HIV-positive on follow-up care in one health institution were transferred to another to continue their follow-up there; loss to follow-up occurred when PLHIV on HIV care was not seen for at least 1 month, and drop-out occurred when PLHIV on HIV care was not seen for at least 3 months as recorded by ART clinic personnel (10).

Event

Event, also usually known as a failure, was entertained if patients infected with HIV on ART developed any form of OI during the follow-up period (37).

Time

Time, also known as survival time, was the time in years/months/days between the start of ART for PLHIV and the occurrence of the outcome. It refers to the time variable as survival time, and it indicates how long a patient infected with HIV on ART "survived" during the follow-up period (37).

ART adherence

It was classified as good, fair, or poor, according to the percentage of drug dosage calculated from the total monthly dose of ART drugs. Good ART adherence was reported with compliance $\geq$95% or $\leq$3 missed doses per month; fair adherence to ART reflects 85–94% compliance or between 4 and 8 missing doses per month, and poor adherence reflects <85% compliance or $\geq$ 9 missed dose per month (10).

Functional status

It was classified as "working" if the individual was able to perform usual work in or out of the house; "ambulatory" can perform activities for daily living, and "bedridden" if unable to perform activities of daily living (10).

WHO HIV clinical staging

It is the way to categorize HIV disease severity based on new or recurrent clinical events. There are four WHO clinical stages ranging from asymptomatic (WHO stage I) to severe symptoms (WHO clinical stage IV) (9).

Body mass index (BMI)

Body mass index was computed as per WHO adopted national ART guideline, that is, weight (kg)/height $(m)^2$. Thus, patients were grouped based on their baseline BMI into six categories: 18.5–24.99 (normal), 17–18.49 (mild malnutrition), 16–16.99 (moderate malnutrition), <16 (severe malnutrition), 25–29.99 (overweight), and $\geq$30 (obese) (10). Anemia is defined as having a hemoglobin level of <10 gm/dl (38).

Statistical methods

Data collected and entered simultaneously *via* electronic systems were downloaded as an XLS and exported to STATA Version 14.0 (Stata Corp. LP, College Station, Texas) for statistical analysis. Before analysis, the data were arranged, edited, and cleaned by running simple frequencies and cross-tabulations. Furthermore, distributional plots and tests and categorization for quantitative variables (age, baseline weight, and hemoglobin) were performed; data were declared to be survival-time data. The incidence rate of OIs was calculated by dividing the number of events experienced by the person-years at risk.

The overall Kaplan–Meier (KM) survival curves (product limit estimate) with 95% CI, stratified by categorical covariates, were plotted to demonstrate how the survival experience varied, and the equivalence of KM survival curves was tested using the generalized log-rank (Mantel–Cox). Mathematical assumptions associated with the cox proportional hazards model were explicitly validated which include the independence of observation and proportional hazards. Thus, there were no multicollinearity problems (mean VIF = 1.71) attesting that observations were independent.

The proportional hazards assumptions for each variable and globally for all predictors were tested using the Schoenfeld residuals. Thus, when fitted, the global test was insignificant ($P = 0.0001$), indicating a violation of the assumption that hazards are proportional (assumptions not satisfied). This model finding was further confirmed by the Cox–Snell Residual Nelson–Aalen Cumulative hazard graph. The proportional hazard assumptions were also graphically evaluated for different categories of variables being investigated using log–log survival curves, comparison of "observed" with "expected" survival curves, and time-dependent covariates, all of which failed to satisfy this assumption.

The lowest value of Akaike's information criterion and Bayesian information criterion was used to determine which best fit model from the parametric distributions is selected. Accordingly, the Weibull regression model was fitted. Before multivariable regression analyses, the data were fitted to check the adequacy of the Weibull model by stratified KM curves.

The Weibull regression diagnostic plot revealed that the lines for stratified covariates are generally parallel and linear in their scale attesting that the model was fit. In the bi-variable Weibull regression analysis, variables with $p \leq 0.25$ were selected and fitted in the multivariable Weibull regression model to control for possible confounding effects.

In the final model, variables with $p < 0.05$ were considered statistically significant predictors of OIs. The effect of each variable was estimated using adjusted hazard ratios (AHRs) with a 95% CI.

Results

Characteristics of the study participants

We analyzed data extracted from the charts of 515 (95.9%) HIV-infected adolescents and adults who initiated ART between 1 January 2012 and 31 December 2021. Among the censored individuals, 276 (78.63%) were as a result of the end of the follow-up period; 40 (11.43%) were due to transfer to another health facility; 21 (5.99%) were as a result of dropping out; and 13 (3.7%) were due to being lost to follow-up. The majority of those studied, 295 (57.3%), were female subjects. The median age at baseline was 30 years [interquartile range (IQR), 27–38 years], 311 (60.4%) were married, 106 (20.6%) were merchants, and 432 (83.9%) were living within the catchment area (Table 1).

The baseline clinical, laboratory, and treatment-related characteristics of the participants are presented below. A total of 187 (36.3%) patients were enrolled in chronic ART after the test and treatment WHO recommendation. Isoniazid preventive therapy and CPT were initiated in 334 (64.85%) and 466 (90.49%) patients, respectively. The median body weight at baseline was 56 kg (IQR, 48–63 kg), 413 (80 %) were able to perform their usual work, 220 (44%) were in WHO HIV clinical stage I at presentation, and 330 (64.1%) were started on tenofovir (TDF) + lamivudine (3TC) + efavirenz (EFV) regimen (Table 2).

Person-times at risk for the development of OIs

Participants were followed until they were censored or experienced an event after the initiation of ART was identified. The median duration of follow-up time was 36.9 months (IQR, 12.5–69.6 months). During 10 years (2012–2021), 515 persons contributed 1,829 PYO or 22,252.833 person-months at risk and 164 (31.84%) exhibited at least one OI.

Incidence and type of opportunistic infections

The overall person-time incidence rate of OIs among adolescents and adults after the initiation of ART was found to be 8.97% (95% CI: 7.69, 10.44) per 100 PYO. Community-acquired pneumonia was the predominant, 68 (41.5%) OIs assessed during the follow-up period, followed by pulmonary tuberculosis, 36 (22%), and oral thrush, 16 (9.5%) (Figure 2). Furthermore, chronic diarrhea (6.1%), herpes zoster (5.5%), esophageal candidiasis (4.9%), cryptococcal meningitis (3.7%),

TABLE 1 Baseline socio-demographic characteristics of participants at the initiation of ART at WSUCSH, Southern Ethiopia, 2012–2021 ($n = 515$).

Characteristics	Category	Frequency	Percentage
Age (years)	15–24	63	12.2
	25–34	246	47.8
	35–44	150	29.1
	45–54	43	8.3
	≥55	13	2.5
Gender	Female	295	57.3
	Male	220	42.7
Marital status	Married	311	60.4
	Never married	93	18.1
	Divorced	68	13.2
	Widowed	34	6.6
	Separated	9	1.7
Educational level	No education	106	20.6
	Primary	201	39.0
	Secondary	126	24.5
	Tertiary and above	82	12.9
Occupation	Housewife	139	27.0
	Merchant	106	20.6
	Government employee	87	16.9
	Daily laborer	57	11.1
	Farmer	49	9.5
	No work	50	9.7
	Other	26	5.0
Residence	Urban	406	78.8
	Rural	109	21.2
Living within the catchment area	Yes	432	83.9
	No	83	16.1

and tinea capitis (0.6%) were also retrieved from the records. In the majority of the PLHIV, 140 (85.4%) developed a single OI, while 15 (9%) and 10 (6%) developed two and at least three OIs.

Comparison of opportunistic infection-free survival time

The Kaplan–Meier estimation method was used to determine the overall survival time. As such, the median OI-free survival time after the initiation of ART was ∼95.8 months (7.87 years) (Figure 3). The survival probability past 6, 12, and 24 months was 93.74% (95% CI: 91.27, 95.53%), 87.74% (95% CI: 84.51, 90.33%), and 79.01% (95% CI: 79.73, 86.44%), respectively. Furthermore, tests for survival function equality were conducted to compare the OI-free survival probability at each point in time between categories of covariates of OIs predictor variables, and the existence of a difference was determined using the Mantel–Cox (log-rank) test at $p < 0.05$. Thus, there was a statistically significant difference in developing OIs across the gender, adherence to ART, WHO HIV clinical stages, and history of taking CPT (Figures 4A–D).

Predictors of opportunistic infections

The multivariable Weibull regression model revealed that being female, not taking CPT, poor ART adherence, mild malnutrition, and WHO HIV clinical stage III turned out to be independent predictors of OI acquisition. To begin with, compared to male subjects, female subjects had a 65% [AHR: 1.65 (95% CI (1.15, 2.36), $P = 0.007$)] higher hazard of developing OIs. In addition, the hazards of developing OIs were 98% higher in adolescent and adult PLHIV with WHO HIV clinical stage III defining illnesses than in adult PLHIV with WHO HIV clinical stage I [AHR: 1.98 (95% CI (1.12, 3.51), $P = 0.019$)]. In this study, we also found

TABLE 2 Clinical, laboratory, and treatment-related characteristics of participants on ART at WSUCSH, Southern Ethiopia, 2012–2021 ($n = 515$).

Characteristics	Category	Frequency	Percentages
Ever initiated on CPT	Yes	466	90.5
	No	49	9.5
Ever initiated on IPT	Yes	334	64.9
	No	181	35.2
Hemoglobin	<10 gm/dl	126	24.5
	≥10 gm /dl	389	75.5
Nutritional status	Normal	306	59.4
	Mild malnutrition	80	15.5
	Moderate malnutrition	33	6.4
	Severe malnutrition	46	8.9
	Overweight	42	8.2
	Obese	8	1.6
Functional status	Working	413	80.2
	Ambulatory	92	17.9
	Bedridden	10	1.9
WHO HIV clinical stage	Stage I	226	43.9
	Stage II	109	21.2
	Stage III	152	29.5
	Stage IV	28	5.4
ART adherence	Good	450	87.4
	Fair	39	7.6
	Poor	26	5.1
Baseline ARV regimen	AZT + 3TC + NVP	29	5.6
	AZT + 3TC + EFV	15	2.9
	TDF + 3TC + EFV	330	64.1
	TDF + 3TC + NVP	21	4.1
	TDF + 3TC + DTG	120	23.3
Comorbidity	No	500	97.1
	Yes	15	2.9
Presence of OI at enrollment	Yes	303	58.8
	No	212	41.2

that the hazards of OIs occurring at any given time were three times higher in PLHIV who had not initiated CPT than in their counterparts [AHR: 2.58 (95% CI (1.62, 4.11), $P < 0.001$)].

Furthermore, a correlation between malnutrition and OIs was identified. Adolescents and adults with mild malnutrition had a 62 % higher hazard of developing OIs [AHR: 1.62 (95% CI (1.06, 2.54), $P = 0.035$)] than PLHIV with no malnutrition. The level of ART adherence was also found to be an independent predictor of OIs in the multivariable analysis. Thus, the hazards of developing OIs were four times higher in adolescents and adults with poor ART adherence compared to those with good ART adherence [AHR: 4.21 (95% CI (2.39, 7.44), $P < 0.001$); Table 3].

Discussion

This retrospective cohort study sought to determine the incidences of OIs and identify potential predictors among adolescents and adults after the initiation of ART at Wolaita Sodo University Comprehensive Specialized Hospital. During the 10 years of follow-up periods, the overall incidence rate of OIs after ART initiation was 8.97 cases (95% CI: 7.69, 10.44) per 100 PYO.

The rate of OIs in our study was higher than that found in other cohort studies' findings from the northern parts of Ethiopia, the Tigray region, Mekelle (7.5 cases per 100 PYO) (32); Arba Minch town, South Ethiopia (3.4 cases per 100 PYO) (28); Uganda (5.9 cases per 100 PYO) (25); a collaborative observational cohort study involving 15 sites in the Asia and

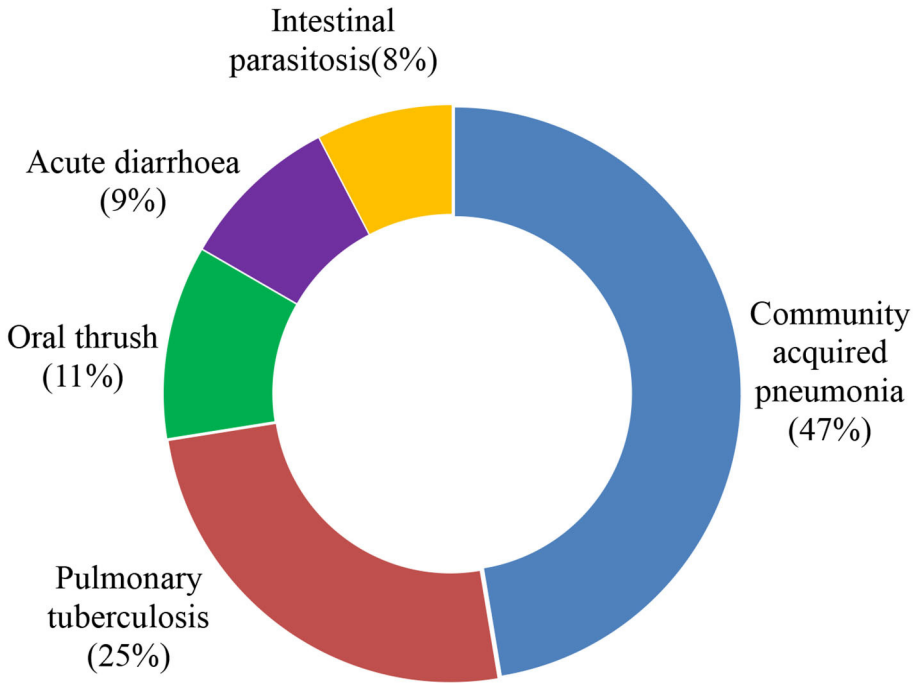

FIGURE 2
Common type of OIs identified among adolescents and adults after the initiation of ART at WSUCSH, Southern Ethiopia, 2012–2021.

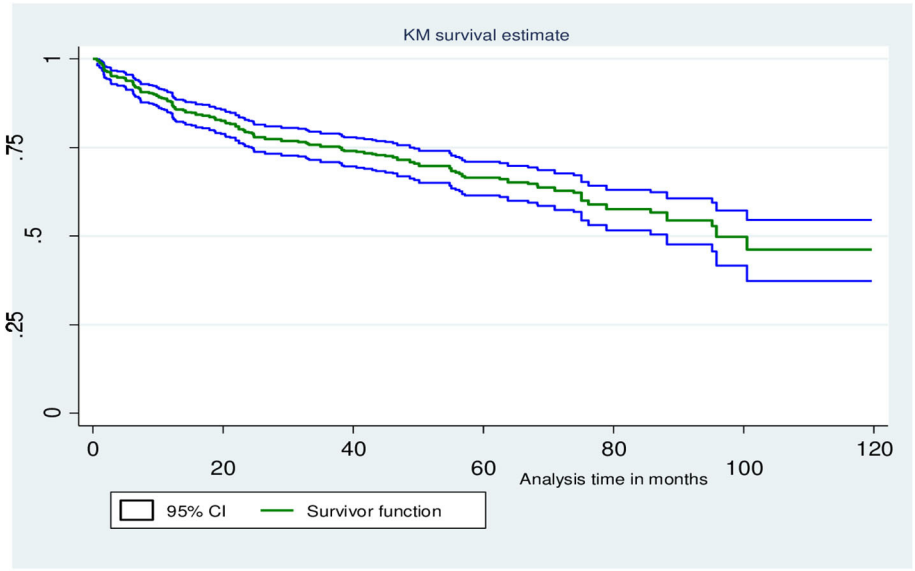

FIGURE 3
KM survival curves illustrate the probability of OI-free survival over follow-up time for the cohort after the initiation of ART at WSUCSH, 2012–2021.

Pacific region (7.3 cases per 100 PYO) (34); multicohort analysis of persons infected with HIV in the United States and Canada, 2000–2010 (2.3 cases per 100 PYO) (21).

The observed difference in the rates of OIs across these studies could be due to sample size and a short follow-up period in some studies. In the Mekelle study, for instance, the cohort

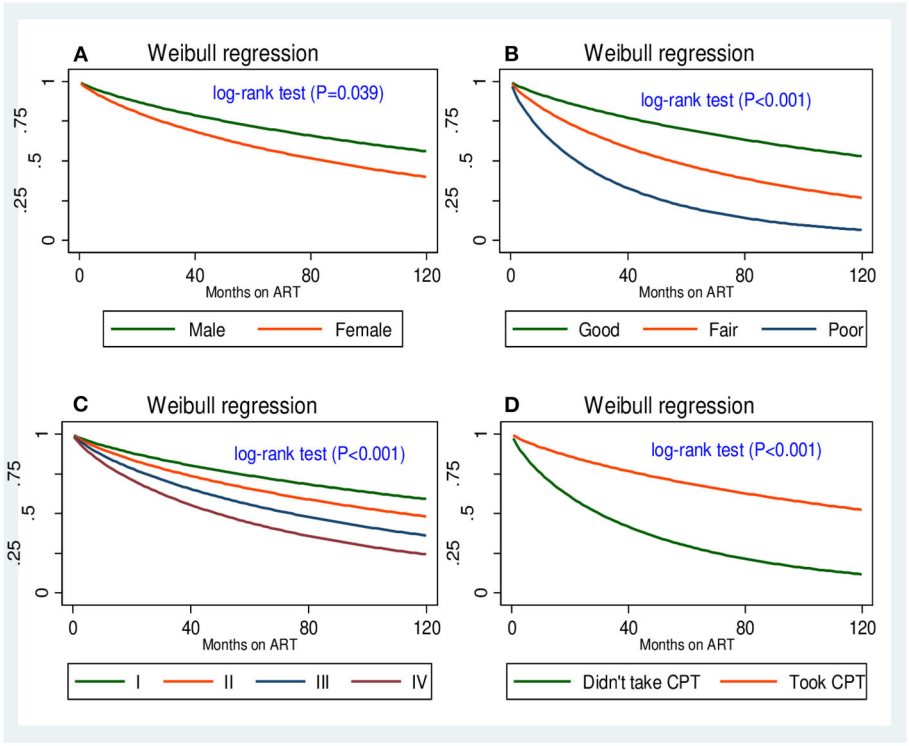

FIGURE 4
Four survival functions corresponding to **(A)** gender, **(B)** adherence to ART, **(C)** WHO HIV clinical stage, and **(D)** CPT.

was followed for 36 months only. Another possible explanation could be due to a disparity in the level of engagement in HIV care in low-income countries and western countries. Furthermore, the incidence of OIs in the current study was also higher than study findings in Poland, with 6.8, 6.5, and 4.8 cases per 100 PYO in 2000, 2001, and 2002, respectively (19). In contrast, the current study's findings are lower than previous studies in Dessie, north Ethiopia (13.5 cases per 100 PYO) (27), Taiwan (17.88 cases per 100 PYO) (39), and Pune, India (35.7 cases per 100 PYO) (40). The potential explanation is that the majority of PLHIV at ART enrollment were younger age groups, where individuals infected with HIV at a younger age may remain free of clinical AIDS for more than 20 years.

In this study, community-acquired pneumonia (41.5%) was the most common OI, followed by pulmonary tuberculosis (22.2%). In contrast, pulmonary tuberculosis was the most common OI compared to other studies conducted in Ethiopia including St. Hospital, Paul's Millennium Medical College, Addis Ababa (43.49%) (41), and Ayder Referral Hospital, Mekelle (32.3%) (32). The fact that the incidence of tuberculosis was lower just after community-acquired pneumonia may be attributable to the intensified tuberculosis screening program and the provision of IPT, which was more than 80% in this study. Furthermore, about 73% of patients who were not initiated on CPT exhibited OI, which might have contributed to the higher proportion of pneumococcal infection.

In this analysis, we found that participants who were not initiated on CPT, poor ART adherence, WHO HIV clinical stage III, mild malnutrition, and female PLHIV were independent predictors of OIs after ART commencement. To begin with, the hazards of developing OIs were 4-fold greater in PLHIV with poor ART adherence compared to those who had good ART adherence. This finding was congruent with previous research findings in Ethiopia (27, 32) and Ilorin, Nigeria (42). This is because poor adherence to ART reduces the effectiveness of ARV drugs while also accelerating viral replication and immune suppression, creating a favorable environment for the development of OIs. Suppression of HIV replication is an important component in prolonging and improving the quality of life for the patient and minimizing the risk of transmission of HIV to others. Adequate suppression of HIV replication requires strict adherence to prescribed regimens of antiretroviral drugs.

Furthermore, WHO HIV clinical stage at presentation was an independent predictor of OIs. The hazards of developing OIs were 98% higher in PLHIV who presented for medical treatment at a chronic HIV care and treatment center with advanced

TABLE 3 Bivariable and multivariable Weibull regression analyses of OI predictors among adolescents and adults after the initiation of ART at WSUCSH, Southern Ethiopia, 2012–2021 ($n = 515$).

Characteristics	Status		Bivariable analysis	Multivariable analysis	
	Censored *n* (%)	Event *n* (%)	CHR (95% CI)	AHR (95% CI)	*P*-value
Age (years)					
15–24	39 (61.9)	24 (38.1)	1	1	1
25–34	178 (72.4)	68 (27.6)	0.65 (0.41, 1.03)	0.75 (0.45, 1.26)	0.277
35–44	90 (60.0)	60 (40.0)	1.00 (0.62, 1.61)	1.15 (0.68, 1.97)	0.592
45–54	36 (83.7)	7 (16.3)	0.40 (0.17, 0.93)	0.77 (0.31, 1.89)	0.564
≥55	8 (61.5)	5 (38.5)	0.78 (0.30, 2.05)	2.02 (0.71, 5.78)	0.188
Educational level					
No education	72 (67.9)	34 (32.1)	1.44 (0.79, 2.61)	0.94 (0.50, 1.78)	0.861
Primary	129 (64.2)	72 (35.84)	2.03 (1.18, 3.50)	1.90 (0.60, 1.99)	0.778
Secondary	84 (66.7)	42 (33.3)	1.66 (0.93, 2.95)	1.44 (0.78, 2.64)	0.245
Tertiary and above	66 (80.5)	16 (19.5)	1	1	1
Gender					
Male	163 (74.1)	57 (25.9)	1	1	1
Female	188 (63.7)	107 (36.3)	1.59 (1.150, 2.19)	1.65 (1.15, 2.36)	0.007*
Isoniazid preventive therapy					
No	87 (48.1)	94 (51.9)	2.26 (1.66, 3.08)	1.21 (0.83, 1.76)	0.312
Yes	264 (79.0)	70 (21.0)	1		
Cotrimoxazole preventive therapy					
No	13 (26.5)	36 (73.4)	3.30 (2.27, 4.77)	2.58 (1.62, 4.11)	<0.001*
Yes	338 (72.5)	128 (27.4)	1	1	1
Nutritional status					
Normal	218 (71.2)	88 (28.8)	1		
Mild malnutrition	52 (65.0)	28 (35.0)	1.61 (1.05, 2.47)	1.62 (1.06, 2.54)	0.035*
Moderate malnutrition	18 (54.6)	15 (45.5)	2.09 (1.21, 3.62)	1.45 (0.79, 2.67)	0.228
Severe malnutrition	24 (52.2)	22 (47.8)	2.52 (1.58, 4.03)	1.30 (0.75, 2.25)	0.353
Overweight	33 (78.6)	9 (21.4)	0.70 (0.35, 1.40)	0.63 (0.31, 1.29)	0.206
Obese	6 (75)	2 (25)	1.20 (0.30, 4.88)	1.43 (0.34, 6.08)	0.627
WHO HIV clinical stage					
Stage I	186 (82.3)	40 (17.7)	1	1	1
Stage II	66 (60.6)	43 (39.5)	1.91 (1.24, 2.95)	1.21 (0.68, 2.15)	0.528
Stage III	75 (49.3)	77 (50.7)	3.43 (2.34, 5.02)	1.98 (1.12, 3.51)	0.019*
Stage IV	24 (85.2)	4 (14.3)	0.66 (0.24, 1.86)	0.41 (0.12, 1.43)	0.161
ART adherence					
Good	332 (73.8)	118 (26.2)	1	1	1
Fair	13 (33.3)	26 (66.7)	2.24 (1.46, 3.42)	1.45 (0.86, 2.46)	0.163
Poor	6 (23.1)	20 (76.9)	4.14 (2.57, 6.67)	4.21 (2.39, 7.44)	<0.001*
Baseline ART regimen					
AZT + 3TC + NVP	12 (41.4)	17 (58.6)	1.55 (0.77, 3.11)	1.08 (0.49, 2.37)	0.842
AZT + 3TC + EFV	5 (33.3)	10 (66.7)	2.46 (1.11, 5.46)	1.05 (0.39, 2.81)	0.927
TDF + 3TC + EFV	219 (66.4)	111 (33.6)	1.06 (0.62, 1.81)	0.95 (0.53, 1.71)	0.876
TDF + 3TC + NVP	11 (53.4)	10 (47.6)	1.99 (0.90, 4.41)	0.70 (0.28, 1.74)	0.445
TDF + 3TC + DTG	104 (86.7)	16 (13.3)	1	1	1

(Continued)

TABLE 3 (Continued)

Characteristics	Status		Bivariable analysis	Multivariable analysis	
	Censored *n* (%)	Event *n* (%)	CHR (95% CI)	AHR (95% CI)	*P*-value
Comorbidity					
No	344 (68.8)	156 (31.2)	1	1	1
Yes	7 (46.7)	8 (53.3)	1.63 (0.80, 3.31)	1.06 (0.49, 2.32)	0.884
Functional status					
Working	302 (73.1)	111 (26.9)	1	1	1
Ambulatory	40 (43.5)	52 (56.5)	2.22 (1.59, 3.08)	0.87 (0.55, 1.37)	0.535
Bedridden	9 (90.0)	1 (10.0)	0.37 (0.52, 2.66)	0.62 (0.69, 5.63)	0.674
Presence of OIs at enrollment					
Yes	173 (57.1)	34 (16.0)	2.53 (1.74, 3.69)	1.62 (0.94, 2.80)	0.083
No	178 (84.0)	130 (42.9)	1	1	1

Reference category-1; * statistically significant at $P < 0.05$.

WHO clinical stage of the disease. This finding is consistent with a study in Dessie Comprehensive Specialized Hospital, North Ethiopia (27). This can be explained by the fact that the progression of HIV from infection through subtle symptoms to advanced HIV disease is correlated with prolonged immune suppression, which is partly a reflection of late presentation to health facilities. In addition, individuals with advanced HIV diseases are prone to acquiring multiple other OIs.

Our study also identified that adult PLHIV who did not take CPT had three times higher hazards of developing OIs compared to their counterparts. Compelling evidence supporting the current finding was reported in other studies (43–46). In addition, a retrospective cohort study by Bizuayehu et al. revealed that the hazards of OIs were reduced by 69% in adult patients with HIV who took CPT (44). The Ethiopian ART guideline recommends initiating trimethoprim–sulfamethoxazole as the primary prevention of PCP, toxoplasmosis, bacterial infections, malaria, and diarrhea caused by Isospora belli or Cyclospora species. This recommendation was made as part of a package of HIV-related services (10). Moreover, on top of the appropriate use of potent ART, the prophylactic use of cotrimoxazole is of critical importance in providing each patient with the best opportunity to live a long and healthy life with HIV infection. Nevertheless, the reverse is valid if patients infected with HIV did not receive CPT.

Malnutrition was also identified as an independent predictor of OI acquisition in this cohort study. Adolescents and adults with mild malnutrition had 62% higher adjusted hazards of developing OIs compared to those who had normal BMI, holding other factors constant. This finding was in agreement with previous studies in KwaZulu-Natal, South Africa, where low BMI was associated with morbidity and mortality among patients with HIV (47). This could be due to a complex and mutually reinforcing relationship between malnutrition and HIV infection. Furthermore, malnutrition can result from HIV-induced immune impairment, and the resulting OIs can cause poor appetite and nutrition absorption from the gastrointestinal.

Finally, statistical analysis of this result revealed a positive relationship between gender and OIs. Female PLHIV had a 65% higher hazard of developing OIs than male PLHIV. This finding was in contrast to a cohort study in Arba Minch, Southern Ethiopia, where the adjusted hazard of OI acquisition was two times greater in men (28). Moreover, in our study, a higher proportion of female PLHIV (53.85%) was poorly adherent to prescribed ART drugs, and studies in Ethiopia (48) and Nigeria (49, 50) reported that being female was associated with non-adherence to ART compared to men, which may partly explain the correlation of being female with the occurrence of OIs.

The strength and limitations of this study

This study provides important information regarding the role of clinical, laboratory, and treatment-related variables in the acquisition of OIs. It could identify the lacunae in the existing data and missing data points because of the use of data collection software. Furthermore, the proportion of losses to follow-up was low (<3%). No study addressed current issues in the study setting. In addition, the study design was efficient for ascertaining temporal relations. We also acknowledged that the current study has some limitations that should be interpreted with caution. First, as is common in resource-limited settings, some of the OIs were diagnosed clinically only, which may overestimate or underestimate some morbidity. Second, due to the study's retrospective nature, we were unable to investigate the behavioral and environmental-related independent factors that may influence OI acquisition. Third, because of the "test and treat" policy implemented following 2016 WHO recommendation, the baseline CD4+ T lymphocyte count was

not recorded for a total of 187 (36.3%) patients, resulting in non-random missing data.

Conclusion and recommendations

We found that the rate of OIs after the initiation of ART was still high. Moreover, poor adherence to ART, mild malnutrition, advanced HIV disease at presentation, being female, and not taking CPT were independent predictors of OIs. We recommend that health workers caring for PLHIV assess and provide intensified care for patients presenting with advanced HIV disease and malnutrition to avoid the risk of developing OIs after ART initiation. Furthermore, enhanced adherence counseling should be provided by the ART team based on the patient's adherence track records. Prescription of CPT for patients with ART should be instituted as indicated in the guidelines for the ART program and should be readily accessible to increase survival among patients with HIV. The Wolaita zone health department should strengthen public awareness to foster early presentation to health facilities before advanced HIV disease supervenes, which in turn curbs the frequent development of OIs that follow marked immune compromise at HIV diagnosis. Moreover, national HIV program mainstreaming managers and policymakers should intensify comprehensive HIV care and support activities. Finally, prospective observational studies are required to assess the role of personal, social, or environmental factors in the occurrence of OIs.

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 studies involving human participants were reviewed and approved by Institutional Review Board of Wolaita Sodo University. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

BW: conceptualization, project administration, software, formal analysis, visualization, and writing—original draft. BW, CD, BY, and YA: data curation and validation. BW, CD, BY, AK, and YA: methodology and writing—reviewing and editing. AK: supervision. 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.

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References

1. MoH. *Guidelines Formanagement of Opportunistic Infections and Anti Retroviral Treatment in Adolescents and Adults in Ethiopia.* Federal HIV/AIDS Prevention and Control Office (2008). Available online at: https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---ilo_aids/documents/legaldocument/wcms_125386.pdf

2. World Health Organization. *WHO Case Definitions of HIV for Surveillance and Revised Clinical Staging and Immunological Classification of HIV-Related Disease in Adults and Children*. World Health Organization (2007).

3. Losina E, Freedberg KA. *Life Expectancy in HIV*. British Medical Journal Publishing Group (2011). doi: 10.1136/bmj.d6015

4. Goud T, Ramesh K. Opportunistic infections among HIV patients attending tertiary care hospital, Karnataka, India. *Int J Curr Microbiol Appl Sci.* (2014) 3:824–9.

5. Masur H. Recurring and emerging questions related to management of HIV-related opportunistic infections. *Top Antiviral Med.* (2018) 26:79.

6. UNAIDS. *Global HIV Statistics.* UNAIDS (2021). Available online at: https://www.unaids.org/en/resources/fact-sheet

7. Marshall CS, Curtis AJ, Spelman T, O'Brien DP, Greig J, Shanks L, et al. Impact of HIV-associated conditions on mortality in people

commencing anti-retroviral therapy in resource limited settings. *PLoS ONE.* (2013) 8:e68445. doi: 10.1371/journal.pone.0068445

8. Antiretroviral Therapy in Lower Income Countries Collaboration, ART Cohort Collaboration. Mortality of HIV-1-infected patients in the first year of antiretroviral therapy: comparison between low-income and high-income countries. *Lancet*. (2006) 367:817–24. doi: 10.1016/S0140-6736(06)68337-2

9. WHO. *Guidelines for Managing Advanced HIV Disease and Rapid Initiation of Antiretroviral Therapy*. Geneva: WHO (2017).

10. FMOH. *National Guidelines for Comprehensive HIV Prevention, Care And Treatment*. FMOH (2018). Available online at: https://www.humanitarianresponse.info/en/operations/ethiopia/document/national-comprehensive-hiv-care-guideline-2018

11. Mirani G, Williams PL, Chernoff M, Abzug MJ, Levin MJ, Seage III GR, et al. Changing trends in complications and mortality rates among US youth and young adults with HIV infection in the era of combination antiretroviral therapy. *Clin Infect Dis.* (2015) 61:1850–61. doi: 10.1093/cid/civ687

12. Palella FJ Jr, Baker RK, Moorman AC, Chmiel JS, Wood KC, Brooks JT, et al. Mortality in the highly active antiretroviral therapy era: changing causes of death and disease in the HIV outpatient study. *J Acquir Immune Defic Syndr.* (2006) 43:27–34. doi: 10.1097/01.qai.0000233310.90484.16

13. Krentz H, Dean S, Gill M. Longitudinal assessment (1995–2003) of hospitalizations of HIV-infected patients within a geographical population in Canada. *HIV Med.* (2006) 7:457–66. doi: 10.1111/j.1468-1293.2006.00408.x

14. Benson CA, Brooks JT, Holmes KK, Kaplan JE, Masur H, Pau A. *Guidelines for Prevention and Treatment Opportunistic Infections in HIV-Infected Adults and Adolescents; Recommendations From CDC, the National Institutes of Health, and the HIV Medicine Association/Infectious Diseases Society of America* (2009). Centers for Disease Control and Prevention (CDC). Available online at: https://stacks.cdc.gov/view/cdc/5236

15. Rubaihayo J, Tumwesigye NM, Konde-Lule J, Wamani H, Nakku-Joloba E, Makumbi F. Frequency and distribution patterns of opportunistic infections associated with HIV/AIDS in Uganda. *BMC Res Notes.* (2016) 9:501. doi: 10.1186/s13104-016-2317-7

16. Micah AE, Cogswell IE, Cunningham B, Ezoe S, Harle AC, Maddison ER, et al. Tracking development assistance for health and for COVID-19: a review of development assistance, government, out-of-pocket, and other private spending on health for 204 countries and territories, 1990–2050. *Lancet.* (2021) 398:1317–43. doi: 10.1016/S0140-6736(21)01258-7

17. Harries AD, Suthar AB, Takarinda KC, Tweya H, Kyaw NT, Tayler-Smith K, et al. Ending the HIV/AIDS epidemic in low-and middle-income countries by 2030: is it possible? *F1000Research.* (2016) 5:2328. doi: 10.12688/f1000research.9247.1

18. Maartens G. Opportunistic infections associated with HIV infection in Africa. *Oral Dis.* (2002) 8:76–9. doi: 10.1034/j.1601-0825.2002.00016.x

19. Podlasin RB, Wiercinska-Drapalo A, Olczak A, Beniowski M, Smiatacz T, Malolepsza E, et al. Opportunistic infections and other AIDS-defining illnesses in Poland in 2000–2002. *Infection.* (2006) 34:196–200. doi: 10.1007/s15010-006-5030-y

20. Tanuma J, Lee KH, Haneuse S, Matsumoto S, Nguyen DT, Nguyen DT, et al. Incidence of AIDS-defining opportunistic infections and mortality during antiretroviral therapy in a cohort of adult HIV-infected individuals in Hanoi, 2007-2014. *PLoS ONE.* (2016) 11:e0150781. doi: 10.1371/journal.pone.0150781

21. Buchacz K, Lau B, Jing Y, Bosch R, Abraham AG, Gill MJ, et al. Incidence of AIDS-defining opportunistic infections in a multicohort analysis of HIV-infected persons in the United States and Canada, 2000-2010. *J Infect Dis.* (2016) 214:862–72. doi: 10.1093/infdis/jiw085

22. Mocroft A, Sabin CA, Youle M, Madge S, Tyrer M, Devereux H, et al. Changes in AIDS-defining illnesses in a London Clinic, 1987-1998. *J Acquir Immune Defic Syndr.* (1999) 21:401–7. doi: 10.1097/00042560-199908150-00007

23. Ledergerber B, Egger M, Erard V, Weber R, Hirschel B, Furrer H, et al. AIDS-related opportunistic illnesses occurring after initiation of potent antiretroviral therapy: the Swiss HIV cohort study. *JAMA.* (1999) 282:2220–6. doi: 10.1001/jama.282.23.2220

24. Low A, Gavriilidis G, Larke N, B-Lajoie MR, Drouin O, Stover J, et al. Incidence of opportunistic infections and the impact of antiretroviral therapy among HIV-infected adults in low- and middle-income countries: a systematic review and meta-analysis. *Clin Infect Dis.* (2016) 62:1595–603. doi: 10.1093/cid/ciw125

25. Weissberg D, Mubiru F, Kambugu A, Fehr J, Kiragga A, von Braun A, et al. Ten years of antiretroviral therapy: incidences, patterns and risk factors of opportunistic infections in an urban Ugandan cohort. *PLoS ONE.* (2018) 13:e0206796. doi: 10.1371/journal.pone.0206796

26. De Beaudrap P, Etard JF, Diouf A, Ndiaye I, Ndèye GF, Sow PS, et al. Incidence and determinants of new AIDS-defining illnesses after HAART initiation in a Senegalese cohort. *BMC Infect Dis.* (2010) 10:179. doi: 10.1186/1471-2334-10-179

27. Tegegne KD, Cherie N, Tadesse F, Tilahun L, Kassaw MW, Biset G. Incidence and predictors of opportunistic infections among adult HIV infected patients on anti-retroviral therapy at dessie comprehensive specialized hospital, ethiopia: a retrospective follow-up study. *HIV AIDS.* (2022) 14:195–206. doi: 10.2147/HIV.S346182

28. Misker D, Demissie M, Mellie H. Effect of highly active antiretroviral therapy on incidence of opportunistic infections among HIV positive adults in public health facilities of arba minch town, south ethiopia: retrospective cohort study. *J AIDS Clin Res.* (2014) 5:1–6. doi: 10.4172/2155-6113.1000330

29. Brooks JT, Kaplan JE, Holmes KK, Benson C, Pau A, Masur H. HIV-associated opportunistic infections—going, going, but not gone: the continued need for prevention and treatment guidelines. *Clin Infect Dis.* (2009) 48:609–11. doi: 10.1086/596756

30. Bariha PK, Mohapatra MK, Kullu BK, Karua PC, Biswal SB, Thakur A. Prospective study of opportunistic infections among HIV infected patients in VSS institute of medical science and research, Burla, Sambalpur, Odisha, India. *Int J Adv Med.* (2018) 5:566. doi: 10.18203/2349-3933.ijam20181980

31. Sabin CA, Schwenk A, Johnson MA, Gazzard B, Fisher M, Walsh J, et al. Late diagnosis in the HAART era: proposed common definitions and associations with mortality. *AIDS.* (2010) 24:723–7. doi: 10.1097/QAD.0b013e328333fa0f

32. Arefaine ZG, Abebe S, Bekele E, Adem A, Adama Y, Brockmeyer HN, et al. Incidence and predictors of HIV related opportunistic infections after initiation of highly active antiretroviral therapy at Ayder Referral Hospital, Mekelle, Ethiopia: a retrospective single centered cohort study. *PLoS ONE.* (2020) 15:e0229757. doi: 10.1371/journal.pone.0229757

33. Solomon FB, Angore BN, Koyra HC, Tufa EG, Berheto TM, Admasu M. Spectrum of opportunistic infections and associated factors among people living with HIV/AIDS in the era of highly active anti-retroviral treatment in Dawro Zone hospital: a retrospective study. *BMC Res Notes.* (2018) 11:604. doi: 10.1186/s13104-018-3707-9

34. Zhou J, Paton NI, Ditangco R, TREAT Asia HIV Observational Database. AIDS-defining illness diagnosed within 90 days after starting highly active antiretroviral therapy among patients from the TREAT Asia HIV Observational Database. *Int J STD AIDS.* (2007) 18:446–52. doi: 10.1258/095646207781147283

35. Tewachew AS, Mekonnen WN, Mekuria AD, Amare YE. Determinants of opportunistic infections among HIV-positive patients on HAART in debre berhan referral Hospital, North Shoa Zone, Ethiopia, 2020: a case-control study. *HIV AIDS.* (2021) 13:337–347. doi: 10.2147/HIV.S298661

36. Melkamu MW, Gebeyehu MT, Afenigus AD, Hibstie YT, Temesgen B, Petrucka P, et al. Incidence of common opportunistic infections among HIV-infected children on ART at Debre Markos referral hospital, Northwest Ethiopia: a retrospective cohort study. *BMC Infect Dis.* (2020) 20:50. doi: 10.1186/s12879-020-4772-y

37. Kleinbaum DG, Klein M. *Survival Analysis: A Self-Learning Text.* Vol. 3. Springer (2012).

38. Tettamanti M, Lucca U, Gandini F, Recchia A, Mosconi P, Apolone G, et al. Prevalence, incidence and types of mild anemia in the elderly: the "health and anemia" population-based study. *Haematologica.* (2010) 95:1849–56. doi: 10.3324/haematol.2010.023101

39. Lee CY, Tseng YT, Lin WR, Chen YH, Tsai JJ, Wang WH, et al. AIDS-related opportunistic illnesses and early initiation of HIV care remain critical in the contemporary HAART era: a retrospective cohort study in Taiwan. *BMC Infect Dis.* (2018) 18:352. doi: 10.1186/s12879-018-3251-1

40. Ghate M, Deshpande S, Tripathy S, Nene M, Gedam P, Godbole S, et al. Incidence of common opportunistic infections in HIV-infected individuals in Pune, India: analysis by stages of immunosuppression represented by CD4 counts. *Int J Infect Dis.* (2009) 13:e1–8. doi: 10.1016/j.ijid.2008.03.029

41. Addisu Deribe WE. Magnitude and determinants of opportunistic infections among HIV/AIDS patients in sphmmc, Addis Ababa, Ethiopia: retrospective study. *JOJ Pub Health.* (2018) 4:555627. doi: 10.19080/JOJPH.2018.04.555627

42. Salami A, Olatunji P, Oluboyo P. Spectrum and prognostic significance of opportunistic diseases in HIV/AIDS patients in Ilorin, Nigeria. *West Afr J Med.* (2006) 25:52–6. doi: 10.4314/wajm.v25i1.28245

43. Seddon J, Bhagani S. Antimicrobial therapy for the treatment of opportunistic infections in HIV/AIDS patients: a critical appraisal. *HIV/AIDS.* (2011) 3:19. doi: 10.2147/HIV.S9274

44. Bizuayehu HM, Abyu DM, Aweke AM. Assessment of duration of staying free from acquiring rehappening opportunistic infections among pre-ART people living with HIV/AIDS between 2008 and 2013. *Biomed Res Int.* (2015) 2015:146306. doi: 10.1155/2015/146306

45. Campbell JD, Moore D, Degerman R, Kaharuza F, Were W, Muramuzi E, et al. HIV-infected Ugandan adults taking antiretroviral therapy with CD4 counts> 200 cells/μL who discontinue cotrimoxazole prophylaxis have increased risk of malaria and diarrhea. *Clin Infect Dis.* (2012) 54:1204–11. doi: 10.1093/cid/cis013

46. Aberg J, Powderly W. HIV: primary and secondary prophylaxis for opportunistic infections. *BMJ Clin Evid.* (2010) 2010:1–82. doi: 10.1016/B978-0-323-04579-7.00091-5

47. Naidoo K, Yende-Zuma N, Augustine S. A retrospective cohort study of body mass index and survival in HIV infected patients with and without TB co-infection. *Infect Dis Poverty.* (2018) 7:35. doi: 10.1186/s40249-018-0418-3

48. Alemu H, Haile Mariam D, Tsui AO, Shewamare A. Correlates of highly active antiretroviral therapy adherence among urban Ethiopian clients. *Afr J AIDS Res.* (2011) 10:263–70. doi: 10.2989/16085906.2011.626297

49. Uzochukwu BS, Onwujekwe OE, Onoka AC, Okoli C, Uguru NP, Chukwuogo OI. Determinants of non-adherence to subsidized anti-retroviral treatment in southeast Nigeria. *Health Policy Plan.* (2009) 24:189–96. doi: 10.1093/heapol/czp006

50. Salami AK, Fadeyi A, Ogunmodede JA, Desalu O. Factors influencing adherence to antiretroviral medication in Ilorin, Nigeria. *J Int Associ Phys AIDS Care.* (2010) 9:191–5. doi: 10.1177/1545109710368722

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A study on the effects of health behavior and sports participation on female college students' body mass index and healthy promoting lifestyle

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Objective: Life form and body composition may affect the health of college students. This study will explore the relationship between the demographic variables of female college students and their body composition and health promoting lifestyle, so as to provide useful reference for the future design and planning of college students' physical and mental health courses and improving their physical activity level.

Methods: Using the method of questionnaire and bioelectrical resistance measurement, a questionnaire on healthy lifestyle of college students was constructed on the basis of consulting a large number of relevant research literature. Relevant survey samples were obtained through random sampling, and their body composition was measured; use SPSS21.0 statistical analysis software to conduct statistical analysis on relevant indicators.

Results and conclusions: (1) at present, female college students generally lack leisure activities and sleep, the proportion of regular fitness habits is low, and the number of snacks and average daily online time are generally too high; The overweight rate and body fat rate of female college students are generally too high, while the standard rate of muscle weight is generally too low. (2) Female college students' health promoting lifestyle has the highest score of self-realization, followed by interpersonal support and the worst behavior of sports participation; The older the college students, the worse their sports participation and overall health promotion behavior; The better the Conscious health status, the better the self-realization, exercise participation and nutritional behavior; The more exercise time per day, the higher their participation in sports and the stronger their health responsibility; The more time spent on the Internet every day, the worse the health responsibility and sports participation. (3) The more time female college students spend on the Internet every day, the higher the probability of overweight. Those with regular exercise habits have a lower proportion of overweight and high body fat rate, while the better their sleep and night snack behavior, the lower their body fat rate. The older college students are, the larger their visceral fat area is, the

better their exercise habits and sleep behavior are, the smaller their visceral fat area is, and the lower their visceral fat level is.

KEYWORDS

demographic variables, socio economic background, body shape, health promoting lifestyle, abdominal obesity

1. Introduction

Modern technology and network facilitation have changed the eating habits of modern people, increased the pressure of life, reduced leisure time and physical activity time, resulted in the deterioration of physical activity and lack of exercise, thereby affecting health, increasing the risk of chronic diseases (such as hypertension, diabetes, etc.) and degenerative diseases of body function (such as back pain, joint lesions, etc.) (1–3). The outline of healthy the China 2030 plan is a strategic deployment formulated to promote the construction of a healthy China and improve people's health. The outline pays more attention to the active promotion rather than negative maintenance of people's health (4). Contemporary college students should shoulder the important task of building socialism with Chinese characteristics, but according to relevant domestic research reports, the score of overall health promoting lifestyle of college students in China is only limited to the medium level, while the performance of health responsibility and sports behavior is very poor (5–8). In relevant foreign studies, the lifestyle of college students also has the phenomenon of insufficient physical activity, but the intervention of health promoting lifestyle (such as diet and health education, exercise, improving static behavior, etc.) can effectively control and improve the physique, BMI, cortical thickness and hip circumference of obese adolescents (9, 10). The compound intervention of healthy eating habits and sports education program can significantly reduce the incidence of BMI and obesity in 62% of school children (11). The health promotion exercise program has significant positive effects on improving the risk factors (triglycerides, total cholesterol, glycosylated hemoglobin, etc.) of high-risk groups of metabolic diseases, and can promote the formation of regular exercise habits (12, 13).

Body composition refers to the percentage of body adipose tissue and non-adipose tissue (bone and muscle) in body weight, which is often used as the basis for evaluating health, exercise ability and healthy physical fitness (14). The body composition of adolescents (especially college students) is affected by gender. Among them, boys are significantly higher than girls in muscle mass, waist hip ratio and visceral fat, while the amount and percentage of body fat are significantly lower than girls (15). At the same time, different departments, schoolwork pressure and participation in leisure activities will also affect body composition (16). Studies have shown that high body fat, insufficient muscle mass and physical weakness can induce the risk of juvenile sarcopenia and obesity (17). Obesity can be caused by excessive body fat and obesity can cause comorbidify such as diabetes, hypertension, hyperlipidemia and mental disorders (such as social impairment and depression) (18). The 4 years of college life is an important and critical period for teenagers to enter adulthood. If they can cultivate their good and healthy lifestyle in this period, they will greatly reduce their risk of chronic diseases in the future. However, according to the latest domestic research literature, there are few related studies on college students' health promotion lifestyle and body composition. This study combines cross-sectional survey and body composition measurement to reveal the relationship between demographic variables, health promoting lifestyle and body composition of college students in China, so as to provide a useful reference for designing and planning college students' physical and mental health courses and improving their physical activity levels in the future.

2. Research object and method

2.1. Research object

This study adopts a cross-sectional study design. Taking the freshman girls of a comprehensive university in the central region as the survey and test objects, 100 people were selected from 12 disciplines such as philosophy, economics, law, education, literature, history, science, engineering, agriculture, medicine, management and art, and a total of 1,200 samples were obtained. Taking the opportunity of physical fitness test for freshmen in colleges and universities, questionnaires and corresponding physical fitness monitoring were conducted for these subjects from October 2021 to November 2021.

2.2. Data collections and research ethics

This study was approved by the human trial ethics committee. Before the questionnaire survey, the researcher explained the purpose and method of the study to the participants, and the data would not to be used for purposes other than the study. The questionnaire was issued after obtaining the informed consent of the subjects, and the physical composition test was arranged.

2.3. Research methods

2.3.1. Questionnaire survey method

The questionnaire structure consists of three parts:

- Personal basic data include gender, age, health status, working hours, regular participation in sport or leisure community activities, regular exercise habits, sleep habits, Internet hours and night snack habits.
- Health Promoting Lifestyle scale for college students. The "adolescent health promoting lifestyle scale" of Chen et al. (19) was modified to evaluate the performance of health promoting lifestyle of participants in this study (see Table 1).

This scale contains 40 questions and can extract six common factors (KMO = 0.77 and Bartlett spherical test value is significant ($P < 0.001$), and the cumulative explained variation of six common factors is 67.59%. The first common factor contains five items, and its contribution rate is 20.76%. The content is related to teenagers' daily diet and food choice, so it is named "nutritional behavior" factor; The second common factor contains eight items, with a contribution rate of 16.43%, which mainly involves teenagers' attention to health, such as routine physical examination, self-health topic discussion, health education and training and daily food choice, so it is named "health responsibility" factor; The third public factor contains eight items, with a contribution rate of 12.76%, which involves teenagers' cherishing of life, growth mentality, knowing their strengths and weaknesses, and how to face achievements and challenges, so it is named "self realization" factor; The fourth common factor contains six items, with a contribution rate of 8.42%. The content mainly involves the interpersonal relationships that teenagers have and the related support they can get from them, so it is named "interpersonal support" factor. The fifth common factor contains four items, with a contribution rate of 5.86%, which mainly involves teenagers' sports and fitness problems, such as exercise time, intensity and frequency, so it is named "sports participation" factor; The sixth common factor contains nine items, with a contribution rate of 3.36%, which mainly involves how teenagers face pressure, mitigation methods and countermeasures, so it is named "stress response" factor. The internal consistency test results of six common factors show that Cronbach's α the coefficients are 0.73, 0.76, 0.75, 0.81, 0.79 and 0.77 respectively, indicating that the adolescent health promotion lifestyle scale has good measurement validity (see Table 1).

2.3.2. Measurement method

The body composition analyzer (IOI353; origin: Korea) was used to measure the body composition of participants, including body weight, body mass index, body fat weight, body fat percentage, muscle weight, visceral fat degree, visceral fat area, abdominal obesity rate, waist circumference ratio, visceral fat weight and subcutaneous fat weight.

2.3.3. Mathematical statistics

SPSS 21.0 statistical software package was used for data processing, and descriptive statistics were used to explore the subjects' basic attributes, health promoting lifestyle, body composition and abdominal obesity indicators; Independent sample *t*-test, chi square test, one-way ANOVA and Pearson correlation analysis were used for inferential statistical analysis. The significance level of all indicators is set as $\alpha = 0.05$.

3. Results

3.1 Descriptive analyses of demographic variables of college students

Table 2 shows:

- among 1,200 subjects, the average age is 21.69±2.61 years. In "Compared with people of the same age, I think my health status is...", the score is 6.91 ± 1.78; 42.8% of them have fixed leisure community activities, Regular exercise habits accounted for 34.2%, 55.0% were lack of sleep, The average daily online time is about 5.58 ± 3.75 h, Only 43.6% of them had no habit of eating snacks.
- From the physical state of the subjects, the average weight of the students was 56.59 ± 8.52 kg, the overweight rate was 21.4%, the lean accounted for 24.7%, and the weight standard accounted for 53.9%. The mean value of body mass index (BMI) is 22.35 ± 3.08 kg/m^2, of which 28.6% is too high, 13.6% are too low and 57.8% is standard. The average body fat weight was 14.55 ± 5.32 kg and the average percentage of body fat was 25.23 ± 5.17%. The percentage of body fat that was too high accounted for 18.3%, the percentage of body fat that was too low accounted for 10.3%, and the standard accounted for 71.4%. The average muscle weight was 36.06 ± 3.87 kg, 13.6% were too high, 27.5% were insufficient and 58.9% were standard.
- From the abdominal condition of the subjects, the average area of visceral fat was about 11.09 ± 5.47 cm^2, with visceral obesity accounting for 15.0%, subcutaneous type accounting for 60.8%, and balanced type accounting for only 24.2%. The mean value of visceral fat was 5.22 ± 2.84 kg. Based on this, it was judged that visceral obesity accounted for 19.2%, subcutaneous type accounted for 56.6%, and balanced type only accounted for 34.2%. The average abdominal obesity rate (waist circumference ratio) was 0.76 ± 0.12. According to this, 11.7% were judged to be too high, 9.4% were lower, and 78.9% were judged to

TABLE 1 Common factor extraction and reliability analysis of college students' health promoting lifestyle scale.

KMO Bartlett spherical test	Factor naming	Number of items	Eigenvalue	Explained variation%	Progressive variation%	Cronbach α coefficient
KMO = 0.77						
$P = 0.000$	Nutritional behavior	5	9.15	20.76	20.76	0.73
	Health responsibility	8	7.24	16.43	37.19	0.76
	Self-realization	8	5.62	12.76	49.95	0.75
	Interpersonal support	6	3.71	8.42	58.37	0.81
	Sports participation	4	2.58	5.86	64.23	0.79
	Stress response	9	1.48	3.36	67.59	0.77

Nutritional behavior (5 items): A1, eating breakfast; A2. The time and quantity of three meals per day is normal; A3. The diet contains fiber rich food; A4. Drinking at least 1500 cc of water every day; A5. Daily meals include five categories of food. Health responsibility (8 items): A6. Check cholesterol and know the results; A7. Take blood pressure and know the results; A8. Discuss health-related issues with medical staff; A9. Observe whether your body has changed or abnormal; A10. Participation in education course on personal health knowledge; A11. Do not eat food containing preservatives or artificial additives; A12. Take your pulse when doing exercise; A13. Looking at the nutritional composition of the food. Self realization (8 items): A14. Appreciate yourself; A15. Full of confidence and optimism in life; A16. Growth and change in a positive direction; A17. Know my own advantages and disadvantages; What is important in life; A19. Value your achievements; A20. Every day is full of fun and challenges; A21. Feeling that your life is meaningful. Social support (6 items): A22. Be willing to keep in touching with closing people; A23. Maintain use interpersonal relationships; A24. Staying with closing friends; A25. Showing concern, love and warmth to others; A26. Keeping in touching with the people I care about; A27. Discuss personal issues and concerns. Exercise behavior (4 items): A28. Do stretching exercises at least 3 times / week; A29, 3 times / week, 20-30 minutes of exercise each time; A30. Participate in sport courses or activities guided by others; A31. Participate in recreational sports. Stress management (9 items): A32. Find some time to relax every day; A33. Practice relaxation for 15-20 minutes every day; A34. Know the source of stress in life; A35. Pay attention to control your weight; A36 will pay attention to their unpleasant emotions; A37. Sleep 6 to 8 hours a day; A38. Arrange work and rest time in a planned way; A39. My response to unreasonable requests is appropriate; A40. Reading health promoting newspapers, magazines or books.

be standard. The mean weight of visceral fat was 1.58 ± 0.69 kg, and the mean weight of subcutaneous fat was 12.97 ± 4.09 kg.

3.2. Influence of demographic variables on health promoting lifestyle of female college students

Table 3 data display:

- The average score of female college students' overall health promoting lifestyle was 3.72 ± 0.55, among which the score of self realization was the highest (4.09 ± 0.58), followed by interpersonal support (4.02 ± 0.68), stress coping (3.81 ± 0.73), health responsibility (3.61 ± 0.74), nutritional behavior (3.59 ± 0.81) and sports participation (3.24 ± 0.89).
- From the factors affecting the health promotion lifestyle of female college students, their age is negatively correlated with sport participation (−0.25*) and the total score of health promotion (-0.15*). The older the students are, the worse their sports participation and overall health promotion behavior are: The conscious health status of female college students is significantly positively correlated with self realization (0.23*), exercise participation (0.27**), nutritional behavior (0.27**) and the total score of health promotion (0.21*). Similarly, daily exercise time of female college students is positively correlated with health responsibility (0.21*), exercise participation (0.20*) and the total score of health promotion (0.19*). It means that more female college students exercise every day, the higher their degree of exercise participation and the stronger their health responsibility, the more positive the overall health promotion behavior. In addition, female college students' daily online time is negatively correlated with health responsibility (−0.18*) and sports participation (-0.17*), which means that the more female college students spend online time every day, the worse their health responsibility and sports participation.
- "Whether there are fixed leisure community activities" has a positive impact on the scores of interpersonal support ($t = -2.81$, $P < 0.05$), sports participation ($t = -3.70$, $P < 0.05$) and health promotion ($t = -2.16$, $P < 0.05$). Female college students "regular exercise habits" positively affect their sports participation scores ($t = -5.29$, $P < 0.01$), nutritional behavior scores ($t = -3.63$, $P < 0.05$) and total health promotion scores ($t = -2.68$, $P < 0.05$). Scores of "regular exercise habits" is higher.
- Sleep behavior and snack behavior of female college students had no significant effect on the six dimensions of health promotion behavior and the total score of health promotion behavior (the corresponding F value was between 0.37 and 2.43, $P > 0.05$).

TABLE 2 Statistical table of basic information and physical condition of respondents ($N = 1,200$).

Variable name	Frequency	%	Variable name	Frequency	%	Variable name	Frequency	%
Weight (KG)			**Muscle weight (KG)**			**Waist circumference ratio**		
Thin	296	24.7	Low	330	27.5	Low	113	9.4
Standard	647	53.9	Standard	707	58.9	Standard	947	78.9
Overweight	257	21.4	Overtop	163	13.6	Overtop	140	11.7
Mean value	56.59±8.52		Mean value	36.06±3.87		Mean value	0.76±0.12	
Body mass index			**Visceral fat area(cm^2)**			**Fixed leisure activities**		
Low	163	13.6	Subcutaneous type	730	60.8	None	686	57.2
Standard	695	57.8	Balanced type	290	24.2	Have	514	42.8
Overtop	342	28.6	Visceral obesity	180	15.0	**Exercise habits**		
Mean value	22.35±3.08		Mean value	11.09±5.47		None	790	65.8
Body fat %			**Visceral fat level (Kg)**			Have	410	34.2
Low	124	10.3	Subcutaneous type	679	56.6			
Standard	857	71.4	Balanced type	410	34.2			
Overtop	219	18.3	Visceral obesity	111	19.2	Age	21.69±2.61	
Mean value	25.23 ± 5.17		Mean value	5.22 ± 2.84		Body fat weight (kg)	14.55 ± 5.32	
Night snack habit			**Sleep quality**			Visceral fat weight (kg)	1.58 ± 0.69	
None	523	43.6	Enough sleep	514	42.8	Subcutaneous fat weight (kg)	12.97 ± 4.09	
1–3 time/week	536	44.7	Sleep debt	660	55.0	Conscious health status	6.91 ± 1.78	
≥4 time/week	141	11.7	Often insomnia	260	2.2	Online time / day (H)	5.58 ± 3.75	

3.3. Influence of demographic variables on body shape (body weight, BMI, body fat weight, muscle mass) of college students

Table 4 data display:

- Female college students' age, Conscious health status and daily exercise time had no significant effects on their body weight, body mass index (BMI), percentage of body fat (%) and muscle mass; However, the time spent on the Internet every day significantly affected their weight ($F = 4.72$, $P = 0.033 < 0.05$), which showed that the people with high weight spent the most time on the Internet every day.
- Whether female college students participate in fixed leisure community activities has nothing to do with their physical state, but whether they have regular exercise habits has a significant impact on their body weight ($x^2 = 5.89$, $P = 0.024 < 0.05$) and body fat percentage (%) ($x^2 = 5.01$, $P = 0.037 < 0.05$), which shows that the rate of overweight and excessive body fat percentage of regular exercise habits is lower; The sleep behavior and night snack behavior of college students also affect their body fat percentage. More sufficient sleep ($x^2 = 7.12$, $P=0.014<0.05$) and the fewer

TABLE 3 Statistical table of the influence of College Students' demographic variables on their health promoting lifestyle.

		Self realization		Health responsibility		Interpersonal support		Sports participation		Stress response		Nutritional behavior		Total score of health promotion	
		Mean	t/F/r	Mean	t/F/r	Mean	t/F/r	Mean	t/F/r	Mean	t/F/r	MEAN	t/F/r	Mean	t/F/r
Age (years)		4.09	−0.12	3.61	−0.08	4.02	−0.12	3.24	**−0.25***	3.81	−0.05	3.59	−0.04	3.72	**−0.15***
Conscious health status		4.09	**0.23***	3.61	−0.07	4.02	0.13	3.24	**0.27****	3.81	0.09	3.59	**0.27****	3.72	**0.21***
Exercise time/day		4.09	−0.12	3.61	**0.21***	4.02	−0.10	3.24	**0.20***	3.81	−0.07	3.59	−0.05	3.72	**0.19***
Online time/day		4.09	−0.04	3.61	**−0.18***	4.02	0.06	3.24	**−0.17***	3.81	0.08	3.59	0.06	3.72	−0.09
Leisure participation		4.12	−1.39	3.72	−0.51	4.23	**−2.81***	3.45	**−3.70***	3.84	−1.40	3.62	−1.42	3.85	**−2.16***
Regular exercise habits		4.11	−1.26	3.66	−0.29	4.07	−1.29	3.51	**−5.29***	3.90	−1.66	3.674	**−3.63***	3.89	**−2.68***
Sleep	Enough sleep	4.12	0.37	3.55	1.49	3.90	2.43	3.32	1.88	3.83	1.61	3.63	1.82	3.79	1.63
	Sleep debt	4.16		3.61		4.07		3.27		3.81		3.60		3.72	
	Often insomnia	3.98		3.67		4.10		3.15		3.80		3.55		3.65	
Night snack	None	3.98	0.39	3.54	0.47	3.88	2.09	3.30	1.48	3.77	0.99	3.53	1.26	3.68	0.57
	1–3 time/week	4.11		3.57		4.12		3.24		3.82		3.61		3.70	
	≥4 time/week	4.17		3.41		4.06		3.19		3.90		3.64		3.77	
Mean		4.09 ± 0.58		3.61 ± 0.74		4.02 ± 0.68		3.24 ± 0.89		3.81 ± 0.73		3.59 ± 0.81		3.72 ± 0.55	

*P <0.05, **P <0.01. Among the influencing factors, the relationship between age, Conscious health status, daily exercise time and daily online time on health promotion behavior was analyzed by correlation analysis (the statistic is the correlation coefficient r); The effects of leisure community participation and regular exercise habits on health promotion behavior were tested by independent sample t–test (the statistic was t); The effects of sleep habits and night snack habits on health promotion behavior were analyzed by one–way ANOVA (the statistic is F value)?

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TABLE 4 Statistical table of the influence of College Students' demographic variables on their body shape.

		Weight (KG)			BMI			Body fat weight (KG)			Body fat (%)			Muscle weight (KG)		
		In sufficient	Standard	Over weight	In sufficient	Standard	Over weight	In sufficient	Standard	over weight	In sufficient	Standard	over weight	In sufficient	Standard	Over weight
		M	X^2/F	P	M	X^2/F	P	M	X^2/F	P	M	X^2/F	P	M	X^2/F	P
Age (years)		56.59	0.84	0.57	22.35	0.57	0.56	14.55	0.73	0.64	25.23	0.58	0.64	36.06	1.26	0.37
Conscious health status		56.59	1.56	0.39	22.35	1.34	0.33	14.55	−0.16	0.51	25.23	1.49	0.26	36.06	0.75	0.48
Exercise time/day		56.59	1.89	0.15	22.35	0.76	0.48	14.55	−0.11	0.77	25.23	0.22	0.62	36.06	0.61	0.54
Online time/day		56.59	**4.72***	**0.033**	22.35	0.46	0.71	14.55	−0.18	0.50	25.23	0.17	0.81	36.06	1.25	0.23
Leisure participation		56.01	1.49	0.36	21.82	1.65	−0.53	14.63			25.69	0.28	0.75	36.97	1.87	0.33
Regular exercise habits		54.74	**5.89***	**0.024**	22.39	1.67	0.94	15.57			26.51	**5.01***	**0.037**	37.31	0.86	0.79
Sleep	Enough sleep	56.32	2.04	0.41	22.25	2.21	1.21	14.89	1.21	0.38	23.18	**7.12***	**0.014**	35.87	0.92	0.63
	Sleep debt	56.48			22.37			14.37			26.06			36.57		
	Often insomnia	56.97			22.44			14.38			26.46			35.75		
Night snack	None	56.22	1.63	0.87	22.35	1.85	0.32	14.77	0.58	0.65	23.46	**6.45***	**0.034**	35.57	1.43	0.80
	1–3 time/week	56.46			22.19			14.20			25.95			36.02		
	≥4 time/week	57.10			22.52			14.69			26.27			36.59		

*$P < 0.05$, **$P < 0.01$,***$P < 0.001$. The effects of age, Conscious health status, daily exercise time and daily Internet time on body shape indexes were analyzed by one–way ANOVA (the statistic is F value); The effects of leisure community participation, regular exercise habits, sleep habits and night snack habits on body shape indexes were analyzed by R × C contingency analysis (chi square x^2 value).

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TABLE 5 Statistical table of the influence of College Students' demographic variables on their abdominal obesity.

		Visceral fat area (cm^2)			Visceral fat grade			Abdominal obesity rate			Visceral fat weight (KG)			Subcutaneous fat weight (KG)		
	M	X^2/F	*P*	M	X^2/F	*P*	M	X^2/F	*P*	M	X^2/F	*P*	M	X^2/F	*P*	
Age (years)	11.09	**6.23***	0.001	5.22	**3.49***	0.041	0.76	0.55	0.59	1.58	0.08	0.55	12.92	0.61	0.54	
Conscious health status	11.09	0.51	0.48	5.22	1.34	0.36	0.76	0.28	0.73	1.58	−0.13	0.34	12.92	−0.13	0.33	
Exercise time/day	11.09	0.65	0.81	5.22	0.26	0.54	0.76	1.26	0.25	1.58	−0.06	0.83	12.92	−0.05	0.72	
Online time/day	11.09	0.78	0.43	5.22	0.59	0.47	0.76	0.08	0.81	1.58	−0.05	0.58	12.92	−0.08	0.48	
Leisure participation	12.25	1.37	0.59	6.58	1.76	0.67	0.79	0.29	0.91	1.73	−0.25	0.80	14.11	−0.65	0.52	
Regular exercise habits	13.69	**6.59***	0.037	8.11	**9.47***	0.033	0.81	1.32	0.31	1.68	1.48	0.14	14.88	0.80	0.43	
Sleep	Enough sleep	9.52	**26.11***	**0.000**	3.48	**14.3***	0.046	0.73	2.68	0.61	1.46	1.48	0.14	12.12	1.02	0.34
	Sleep debt	11.08			5.20			0.76			1.63			13.32		
	Often insomnia	12.68			6.99			0.78			1.66			13.31		
Night snack	None	8.95	2.47	0.16	5.33	2.45	0.96	0.75	0.89	0.19	1.48	0.41	0.67	12.00	0.74	0.72
	1–3 time/week	11.20			4.52			0.75			1.62			13.91		
	≥4 time/week	13.13			5.81			0.79			1.63			13.84		

*$P < 0.05$, **$P < 0.01$. The effects of age, Conscious health status, daily exercise time and daily Internet time on abdominal obesity were analyzed by one–way ANOVA (the statistic is F value); The effects of leisure community participation, regular exercise habits, sleep habits and night snack habits on body shape indexes were analyzed by R × C contingency analysis (chi square x^2 value). Bold* means statistically significant, with no other meaning.

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night snack time ($x^2 = 6.45$, $P = 0.034 .< 0.05$), the lower the rate of excessive body fat percentage.

3.4. Analysis of related factors affecting abdominal obesity of college students

Table 5 data display:

- The age of female college students had a significant effect on their visceral fat area (F=6.23, P=0.001< 0.05), but had no effect on visceral fat grade, abdominal obesity rate (waist circumference ratio), visceral fat weight (kg) and subcutaneous fat weight (kg): conscious health status, daily exercise time and daily Internet time had no effect on the indexes of abdominal obesity.
- Regular exercise habits had a significant effect on visceral fat area (cm^2) and visceral fat grade of female college students ($x^2 = 6.59$, $P = 0.0\,7 < 0.05$; $x^2 = 9.47$, $P = 0.033 < 0.05$). It shows that the area of visceral fat is significantly smaller and the grade of visceral fat is significantly lower in those who have exercise habits: the sleep behavior of college students had a significant effect on their visceral fat area (cm^2) and visceral fat grade ($x^2 = 26.11$, $P = 0.000 < 0.001$; $x^2 = 14.3$, $P = 0.046 < 0.05$). It showed that the better the sleep behavior, the smaller the visceral fat area and the lower the visceral fat grade.

4. Discussion

This study found that among the dimensions of health promoting lifestyle of female college students, self realization score was the highest, sport participation was the worst, followed by nutritional behavior. Wenwen et al. (20) conducted a survey of the current situation of health promoting lifestyle of nursing college students, which showed that the score of self realization was the highest, but the score of interpersonal support was the worst, followed by nutritional behavior. Fengcheng et al. (21) investigated the health promoting lifestyle of college students and found that interpersonal support scored the highest and sport or health responsibility scored the lowest. Lingyan et al. (22) investigated the health promoting lifestyle of college students with hypertension in Shanghai and found that the scores of interpersonal relationship were the highest and the score of sport behavior and health responsibility was the lowest. The research results of Guanghui et al. (23) show that the total score of healthy lifestyle of medical students is higher than that of other majors, so they believe that the healthy lifestyle of medical students is more ideal (24), but some scholars have reached the opposite conclusion (25). It can be seen that the findings of this study are basically consistent with the results of previous scholars, indicating that at present, Chinese college students may pay more attention to self realization in their health promotion lifestyle, and ignore sports participation, nutrition and health responsibility, indicating that college students still have a lot of room to improve their regular sports behavior and health care responsibility.

This study found that college students' self-health status was significantly positively correlated with their total score of self realization, sport participation, nutritional behavior and health promotion, which was also consistent with the research results of domestic scholar Guanghui (23). College students' self-health status can predict college students' healthy lifestyle, that is, the higher the score of self-health status, the better the healthy lifestyle. According to the cognitive behavior theory (26), positive cognition of health responsibility and health management will be embedded in individual health decision-making and practice as a continuous driving force, and further correct or improve their own health-related behaviors. In other words, college students can improve their exercise, nutrition and health responsible behavior by strengthening their awareness of self-health, so as to inhibit health dangerous behaviors such as smoking, drinking and Internet addiction (27). Jeong et al. (8) found that the health promoting lifestyle of college students is closely related to their age, major, leisure needs, students' personal characteristics and experience. The higher the grade, the lower the score of health promoting lifestyle, and the score of health promoting lifestyle of information college students is higher than that of other majors. This study did not analyze the differences in the scores of health promoting lifestyle among college students of different majors, but found that senior female college students' sports participation is poor, and the total score of health promoting lifestyle is the lowest, that is, the older they are, the worse their sports participation and overall health promoting behavior are. This finding confirms the views of Jeong et al. (8) and other scholars. Ting survey found that (28), college students' sports participation may decrease due to the increase of age, grade, school work and working time, that is, students' age has a significant negative correlation with sports dimensions, and it is speculated that the reason may be related to school work pressure.

This study found that those who did not participate in fixed leisure community activities and lack regular fitness habits had poor interpersonal support, inactive sport participation, improper nutrition and low total score of health promotion. With the increasing trend of adolescent obesity and maintaining a stationary posture for a long time, it is becoming more and more important to promote adolescent health, nutrition and exercise participation. The higher the pleasure value of participating in leisure activities, the better the health promoting lifestyle of college students (29, 30). Schwarz et al. (29) systematically reviewed the impact of leisure game on teenagers' health promoting lifestyle, indicating that teenagers'

participation in leisure tourism has a significant predictive effect on their self realization, interpersonal support and stress coping. According to research of Guoxin and Xiaojuan (31), pleasant sport experience is conducive to the participation of associations. The more attention paid to lifestyle (such as interpersonal relationship and schoolwork orientation), the higher the demand for leisure and entertainment. The views of these scholars are very consistent with the findings of this study, that is, college students with fixed art and sport activity organizations or fixed leisure associations may affect college students' overall health promotion lifestyle, interpersonal support and sport performance.

This study found that college students' online hours affect college students' weight, which is likely to be related to students' lack of exercise due to too much online time. According to research of Guozai and Sanren (32), Internet addiction is one of the important risk factors for the damage of college students' health behavior. The longer you use the Internet, the lower your exercise participation and the worse your health quality of life. This study also found that regular exercise habits may affect the degree of visceral fat of college students. Relevant studies have reported that regular exercise is related to body fat content. The intervention of physical activities can effectively control the body fat rate and waist circumference of obese students (33, 34). Joseph et al. (35) found that the weight, body fat weight and BMI of male students in engineering colleges decreased after 12 aerobic exercise intervention training; Women who received 12 weeks of circular training can effectively reduce BMI, body fat rate, increase muscle mass, and significantly improve sleep quality (36). Rosa et al. (37) reviewed the improvement of health-related variables by independent physical activity intervention and reducing sedentary behavior, which showed that the results of the two interventions were similar, both had a significant degradation effect on the body fat percentage and body fat weight of various obese people and overweight people, and there was a significant upward trend in physical index, which could effectively improve body composition and cardiopulmonary fitness.

This study found that female college students' sleep behavior and regular exercise habits have a significant impact on their visceral fat area and visceral fat level, which is the same as that found in Theorell-Haglow et al. (38), that is, sleep habits may affect college students' visceral fat area. Krittanawong et al. (39) found that shorter sleep time is a risk factor for cardiovascular disease and increased mortality. Sleep time less than seven <7 h (short sleep) and >9 hohurs (long sleep) will increase the risk of cardiovascular disease death, especially in the Asian population and the elderly. Wheaton et al. (40) found that the daily sleep time of middle school students was negatively correlated with waist circumference, abdominal diameter and BMI. At the same time, less sleep time leads to reduced leptin secretion, increased brain intestinal hormone secretion, and increased appetite, all of which lead to obesity (41, 42).

5. Conclusions and suggestions

5.1. Conclusions

- Female college students pay more attention to self-realization in health promotion lifestyle, but ignore sports participation, nutrition and health responsibility. However, college students' self-health statuses can predict their healthy lifestyles, so college students can enhance their exercise, nutrition and health responsibility behavior by strengthening their awareness of self-health.
- Female college students' participation in leisure activities and regular fitness habits can significantly predict their self-realization, interpersonal support and stress coping. Regular exercise habits may affect the degree of visceral fat, while Internet hours negatively affect college students' weight and health quality of life.
- The age of female college students has a significant impact on their visceral fat area. Regular exercise habits affect their visceral fat area and visceral fat level, while the better their sleep behavior, the lower their visceral fat area and visceral fat level.

5.2. Suggestions

- This study adopts a cross-sectional research design and lacks long-term follow-up investigation. It may not be possible to make causal inference on the related factors affecting health promoting lifestyle and body composition (state and abdominal obesity). It suggests that future research can be tracked sustainably.
- This study only takes the students of a comprehensive university in Central China as the research object, so the research results cannot be inferred to the female college students in the whole central region. There may be regional differences between different regions. It is suggested that future research can increase the scope of sample size and expand to the comparison between different schools, so as to improve the representativeness and value of the 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.

Ethics statement

This study was approved by the Ethics Committee of School of Physical Education, Southwest Medical University (Approval

No.: swmu-ty2022002). The patients/participants provided their written informed consent to participate in this study.

Author contributions

XL contributed to the conception or design of the paper and drafted the manuscript. HL contributed to the acquisition, analysis, or interpretation of data for the work. XL and HL have read and agreed to the published version of the manuscript. 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.

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References

1. Shiyan W, XuXi Z, Kaige S, Kang H, Sijia L, Xinyi S. Multi group structural equation model analysis of health belief model of leisure physical activities in high-risk groups of chronic diseases and healthy groups. *J Peking University (Medical Edition)*. (2017) 50:711–6. doi: 10.3969/j.issn.1671-167X.2018.04.024

2. Xueli Y, Xuejiao Z, Yamin B, Wenqing N, Yingzhou Y, Xiaoli L, et al. Analysis of physical activity status and influencing factors in high-risk groups of chronic diseases. *Prevent Control Chronic Dis China*. (2016) 2:107–10. doi: 10.16386/j.cjpccd.issn.1004-6194.2016.02.007

3. Loef B, de Hollander E, Boot CRL, Proper KI. Physical activity of workers with and without chronic diseases. *Prev Med Rep*. (2015) 3:30–5. doi: 10.1016/j.pmedr.2015.11.008

4. Chinese American Professor Expert Network. *China First Released the Outline of "healthy China 2030": the Next 15 Years Will be an Era of Great Health*. Available online at: http://scholarsupdate.hi2net.com/news.asp?NewsID=25921.

5. Xueqin L, Lin M. Analysis on the relationship between health promoting lifestyle and depression of college students in Zhengzhou. *Chin J Health Educ*. (2018) 34:793–6. doi: 10.16168/j.cnki.issn.1002-9982.2018.09.006

6. Sujun L, Xuena Y. Relationship between health promoting lifestyle and depression of Uighur college students. *Chinese School Health*. (2018) 39:871–3. doi: 10.16835/j.cnki.1000-9817.2018.06.020

7. Nho JH, Chae SW. Effects of a lifestyle intervention on health-promoting behavior, psychological distress and reproductive health of overweight and obese female college students. *Healthcare*. (2021) 9:309. doi: 10.3390/healthcare9030309

8. Jeong GC. Influence of health promoting lifestyle on academic procrastinationin college students: mediating effect of grit moderated by gender. *J Korean Acad Nurs*. (2020) 20:611–22.

9. Aceijas C, Waldhausl S, Lambert N, Cassar S, Bello-Corassa R. Determinants of health-related lifestyles among university students. *Perspect Public Health*. (2017) 137:227–36. doi: 10.1177/1757913916666875

10. Giovanni P. Motivation, health-related lifestyles and depression among university students: a longitudinal analysis. *Psychiatry Res*. (2018) 260:412–7. doi: 10.1016/j.psychres.2017.12.009

11. Anton-Paduraru DT, Gotca I, Mocanu V, Popescu V, Iliescu ML, Miftode EG, et al. Assessment of eating habits and perceived benefits of physical activity and body attractiveness among adolescents from Northeastern Romania. *Appl Sci-Base*. (2021) 11:11042. doi: 10.3390/app112211042

12. Justamente I, Raudeniece J, Ozolina-Moll L, Guadalupe-Grau A, Reihmane D. Comparative analysis of the effects of daily eating habits and physical activity on anthropometric parameters in elementary school children in latvia: pach study. *Nutrients*. (2020) 12:3818. doi: 10.3390/nu12123818

13. Munoz GAD, Hoyos AKP, Liberato DPC, Renteria LMM, Sanchez MCQ. Difference in levels of physical activity, sedentary lifestyle, and eating habits among university students from different health programs at a private university in Bogota, Colombia. *Revista Espanola DE Nutricion Humanay Dietetica*. (2021) 25:8–17. doi: 10.14306/renhyd.25.1.1007

14. Aars NA, Beldo S, Jacobsen BK, Horsch A, Morseth B, Emaus N, et al. Association between objectively measured physical activity and longitudinal changes in body composition in adolescents: the Tromso study fit futures cohort. *BMJ Open*. (2020) 10:e036991. doi: 10.1136/bmjopen-2020-036991

15. Cuenca-Garcia M, Huybrechts I, Ruiz JR, Ortega FB, Ottevaere C, Gonzalez-Gross M, et al. Clustering of multiple lifestyle behaviors and health-related fitness in european adolescents. *J Nutr Educ Behav*. (2013) 45:549–57. doi: 10.1016/j.jneb.2013.02.006

16. Toselli S, Grigoletto A, Zaccagni L, Rinaldo N, Badicu G, Grosz WR, et al. Body image perception and body composition in early adolescents: a longitudinal study of an Italian cohort. *BMC Public Health*. (2021) 21:1381. doi: 10.1186/s12889-021-11458-5

17. Harmouche-Karaki M, Mahfouz M, Mahfouz Y, Fakhoury-Sayegh N, Helou K. Combined effect of physical activity and sedentary behavior on body composition in university students. *Clin Nutr*. (2020) 39:1517–24. doi: 10.1016/j.clnu.2019.06.015

18. Smith TJ, White A, Hadden L, Young AJ, Marriott BP. Associations between mental health disorders and body mass index among military personnel. *Am J Health Behav*. (2014) 38:529–40. doi: 10.5993/AJHB.38.4.6

19. Chen MY, Wang EK, Yang RJ, Liou YM. Adolescent health promotion scale: development and psychometric testing. *Public Health Nurs*. (2003) 20:104–10. doi: 10.1046/j.1525-1446.2003.20204.x

20. Wenwen P, Wenjing T, Hanyu L. Analysis on the current situation and related factors of College Students' health promoting lifestyle. *General nursing*. (2020) 18:2182–7. doi: 10.12104/j.issn.1674-4748.2020.18.002

21. Fengcheng T, Wenling S, Shuling H. Discussion on the implementation of health promoting lifestyle of college students and its related factors. *J Hum Factors*. (2015) 17:27–38. doi: 10.6273/JES.2015.17(01).03

22. Lingyan T, Youqing P. Analysis on the current situation and influencing factors of health promoting lifestyle of college students with hypertension in Shanghai. *Prev Med*. (2020) 1:1–4. doi: 10.12183/j.scjpm.2020.0001

23. Guanghui C, Yongtian Y, Mingzhou W, Kexin Y, Jiaqin L. Relationship between electronic health literacy and healthy lifestyle of medical students. *Chinese School Health.* (2020) 41:936–8. doi: 10.16835/j.cnki.1000-9817.2020.06.037

24. Yuzhou L, Jixin Y, Ge Z. "Physique" to "health promotion": the hot evolution of students' Physique Research in China. *J Shenyang Sport Uni.* (2019) 38:94–100. doi: 10.3969/j.issn.1004-0560.2019.01.015

25. Guowei J, Yinghui J, Xue B, Huiying L, Ying X. Research progress on the current situation of College Students' lifestyle and its influencing factors. *Health Edu China*. (2015) 31:396–401. doi: 10.16168/j.cnki.issn.1002-9982.2015.04.015

26. Wilkerson AH, Bridges CN, Wu C, McClendon ME, Walsh SM, Patterson M, et al. Process evaluation of the BearStand behavioral intervention: a social cognitive theory-based approach to reduce occupational sedentary behavior. *Journal of Occupational and Environmental Medicine.* (2019) 61:927–35. doi: 10.1097/JOM.0000000000001704

27. Li SJ, Cui GH, Kaminga AC, Cheng SX, Xu HL. Associations between health literacy, eHealth literacy, and COVID-19-related health behaviors among chinese college students: cross-sectional online study. *J Med Internet Res.* (2021) 23:e25600. doi: 10.2196/25600

28. Ting L. Sports mental behaviours of college students based on cluster analysis. *J Discret Math Sci Cryptogr*. (2018) 21:1299–1304. doi: 10.1080/09720529.2018.1526405

29. Schwarz AF, Huertas-Delgado FJ, Cardon G, DeSmet A. Design features associated with user engagement in digital games for healthy lifestyle promotion in youth: a systematic review of qualitative and quantitative studies. *Games Health J.* (2020) 9:150–63. doi: 10.1089/g4h.2019.0058

30. Lolokote S, Hidru TH Li XF. Do socio-cultural factors influence college students' self-rated health status and health-promoting lifestyles? A cross-sectional multicenter study in Dalian, China. *BMC Public Health*. (2017) 17:478–82. doi: 10.1186/s12889-017-4411-8

31. Guoxin C, Peixie W, Xiaojuan L. A study on the correlation between students' lifestyle and participation motivation in sports associations in Colleges and universities. *J Sports Knowledge*. (2007) 4:135–44. doi: 10.29596/BGYY.200706.0014

32. Guozai L, Sanren L. Correlation between Internet addiction and healthy quality of life of college students at different stages of sports participation. *J Yongda*. (2011) 11:1–12. doi: 10.30179/BYTITC.201106.0001

33. Sepulveda AR, Solano S, Blanco M. Feasibility, acceptability, and effectiveness of a multidisciplinary intervention in childhood obesity from primary care: Nutrition, physical activity, emotional regulation, and family. *Eur Eat Dis*. (2019) 28:?184–98. doi: 10.1002/erv.2702

34. Godfrey KM, Schumacher LM, Butryn ML, Forman EM. Physical activity intentions and behavior mediate treatment response in an acceptance-based weight loss intervention. *Ann Behav Med.* (2019) 53:1009–19. doi: 10.1093/abm/kaz011

35. Joseph RP, Pekmezi D, Dutton GR, Cherrington AL, Kim YI, Allison JJ, et al. Results of a culturally adapted internet-enhanced physical activity pilot intervention for overweight and obese young adult African American Women. *J Transcultural Nurs.* (2016) 27:136–46. doi: 10.1177/1043659614539176

36. Zixian Y, Huang Juanjuan H. Effects of 12 week loop training on female body composition and sleep quality. *Sport Educ Soc*. (2015) 14:102–14. doi: 10.6169/NCYUJPEHR.14.2.09

37. Rosa RMA, Pernia JAC, Vazquez CC, Cruz JD. Autonomous physical activity based program versus aerobic exercise based interventions to improve health and cardiovascular status in sedentary overweight adults: a review. *J Human Sport Exer.* (2018) 13:S296–308. doi: 10.14198/jhse.2018.13.Proc2.14

38. Theorell-Haglow J, Berne C, Janson C, Sahlin C, Lindberg E. Associations between short sleep duration and central obesity in women. *Sleep.* (2010) 33:593–8. doi: 10.1093/sleep/33.5.593

39. Krittanawong C, Tunhasiriwet A, Wang Z, Zhang HJ, Farrell AM, Chirapongsathorn S, et al. Association between short and long sleep durations and cardiovascular outcomes: a systematic review and meta-analysis. *Eur Heart J -Acute Cardiovas Care.* (2019) 8:762–70. doi: 10.1177/2048872617741733

40. Wheaton AG, Jones SE, Cooper AC, Croft JB. Short sleep duration among middle school and high school students-United States, 2015. *Mmwr-Morbidity and Mortality Weekly Repory.* (2018) 67:85–90. doi: 10.15585/mmwr.mm6703a1

41. Anujuo K, Stronks K, Snijder MB, Jean-Louis G, Rutters F, van den Born BJ, et al. Relationship between short sleep duration and cardiovascular risk factors in a multi-ethnic cohort - the helius study. *Sleep Med.* (2015) 16:1482–8. doi: 10.1016/j.sleep.2015.08.014

42. Kjeldsen JS, Hjorth MF, Andersen R, Michaelsen KF, Tetens I, Astrup A, et al. Short sleep duration and large variability in sleep duration are independently associated with dietary risk factors for obesity in Danish school children. *Int J Obes.* (2014) 38:32–9. doi: 10.1038/ijo.2013.147

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Associations between sexual and reproductive health knowledge, attitude and practice of partners and the occurrence of unintended pregnancy

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Background: Although global contraceptive coverage has increased significantly, high rates of unintended pregnancy remain the current global status quo. A comparative analysis of the differences and correlations of knowledge, attitude and practice (KAP) of sexual and reproductive health (SRH) of both partners will help guide public health work according to gender characteristics and needs, and reduce the occurrence of unintended pregnancy.

Methods: A questionnaire survey of people with unintended pregnancies including women and their male partners (n = 1,275 pairs) who sought help from the Shanghai General Hospital Affiliated to Shanghai Jiao Tong University School of Medicine from October 2017 to October 2021. Data were collected on sexual and reproductive health knowledge, attitudes, and practices in both partners who had unintended pregnancies. Chi-square test and Logistic regression were used to analyze the relationship between the occurrence of unintended pregnancy and KAP and its influencing factors. Paired odds ratio and McNemar's test were used to estimate the difference and concordance of KAP between partners.

Results: This study included 1,275 partners with a mean age of 30.0 years. The partner's overall level of KAP is good. Compared with women, men had better knowledge ($\chi^2 = 3.93$, $p = 0.047$) and more active contraceptive practices ($\chi^2 = 19.44$, $p < 0.001$). In the analysis of partner concordance, male contraceptive intention was found to be better than female [matched pairs odds ratio (OR_{MP}) = 2.56, $p < 0.001$], and the concordance of positive contraceptive practice between partners increased with male education [adjusted odds ratio (aOR) = 1.556, 95% confidence interval (CI) = 1.185–2.044, $p = 0.001$]. In partner-paired regression analysis, compared with good contraceptive knowledge in both men and women in the partner, the risk of negative contraceptive practice was 1.7 times (aOR = 1.721, 95% CI = 1.234–2.400, $p = 0.001$) higher with good contraceptive knowledge in women but negative in men, while women

with poor contraceptive knowledge but men with good knowledge are 1.3 times (aOR = 1.349, 95% CI = 1.000–1.819, $p = 0.05$) more likely to have negative contraceptive practices. In addition, compared with partners with positive contraceptive attitudes, women with positive attitudes but negative men and women with negative attitudes but positive men had 1.7 and 1.4 times the risk of negative contraceptive practices, respectively.

Conclusion: The study found that unintended pregnancy occurs mainly in young people, and the younger age of first sexual intercourse, the low education background and the lack of discussion of contraception between partners are risk factors for not taking contraceptive measures. Men's better knowledge and contraceptive practices compared with female partners, and poor male contraceptive knowledge and attitudes may lead to a higher risk of negative contraceptive practices, the results suggest that male KAP plays an important role in promoting contraceptive use and reducing unintended pregnancy.

KEYWORDS

unintended pregnancy, partner, contraception, knowledge, attitude, practice

Introduction

Unintended pregnancy, including unwanted and mistimed pregnancies, is one of the major public health challenges and a major reproductive health problem (1). It has now affected the health, economic and social life of women and their families, and can lead to adverse social consequences, such as school dropout, violence and suicide, placing enormous physical, psychological and economic burdens on individuals, families and societies. In recent years, despite the almost universal use of condoms and other contraceptive methods, the incidence of unintended pregnancies has been increasing year by year (2). Worldwide, ∼120 million unintended pregnancies occur each year, accounting for 40% of all pregnancies (3–6).

Studies have shown that most of these unintended pregnancy groups choose induced abortion to terminate the pregnancy, which has become a global phenomenon (7). The ever-increasing number of induced abortions not only has adverse consequences for women's physical and mental health (8), but in severe cases can lead to an increased risk of infertility, maternal mortality and neonatal mortality (9–13). According to statistics, worldwide, about 5 million women are hospitalized due to complications of unsafe abortion every year, and 47,000 women die from unsafe abortion (14), especially in less developed countries. In addition, the latest reports say that the US Supreme Court has overturned the 1973 Roe v Wade decision, ending women's 50 years old constitutional right to abortion and imposed comprehensive restrictions on abortion (15, 16), which may increase the incidence of unsafe abortion in the future. In fact, a multinational study found that countries with liberal abortion laws were more likely to offer safe abortion than countries that restricted abortion (14), and a hypothetical nationwide abortion ban would have catastrophic effects on maternal health (17). At the same time, in the United States, people have been relying on safe and legal abortion to cope with unintended pregnancies (18). However, the aftermath of this abortion ban suggests that women living in states that prohibit abortion may face unsafe abortions or may travel to another state or country to evade laws restricting abortion. It is clear that restricting abortion does not reduce its incidence, but rather reduces its safety (19), putting people's health, safety and property at great risk. Therefore, scientific contraception and reducing the occurrence of unintended pregnancy are particularly important.

The most common causes of unintended pregnancy are contraceptive failure and never use of contraceptive methods (20). Among them, the lack of contraceptive knowledge and the unreasonable choice of contraceptive methods are closely related to the increased risk of unintended pregnancy (21). Although people have a preliminary understanding of the existing contraceptive methods, the in-depth understanding of these methods is limited, or the misunderstanding of contraceptive knowledge will lead to an increase in the proportion of ineffective contraception (22), which will lead to the occurrence of unintended pregnancy. In addition, never use of contraceptive methods is also one of the main reasons for unintended pregnancy, and it can be seen from the Demographic and Health Survey (DHS) that the proportion of never use of contraceptive methods is high in developing countries (23), which is mainly related to the partner's negative contraceptive attitude, and of course to the partner's limited awareness of contraceptive methods, less sex education, and limited choice of effective

contraceptives (24, 25). In conclusion, the importance of partners' knowledge, attitude and practice (KAP) of sexual and reproductive health (SRH) in reducing unintended pregnancies is well-documented. Proper knowledge and a positive attitude can increase partners' awareness of contraceptive practices and maximize the rational use of contraceptive methods, thereby preventing unnecessary risks.

Previous articles highlighted some of the current research aspects. First, in China and many other developing countries, research on the causes of unintended pregnancy and reproductive health services and education has focused primarily on women, exploring and documenting women's KAP of SRH is associated with the occurrence of unintended pregnancy (21, 26–29). In recent years, there has been renewed focus on the role of men in preventing unintended pregnancies (30, 31), and male attitudes and practices have been found to play a key role in contraceptive practice (30–33). And the World Health Organization and the United Nations and other organizations (34) mentioned in the global policy initiative on reducing unintended pregnancy that in clinical practice, health promotion and sexual health education, men's participation in decisions related to the prevention and management of unintended pregnancy should be considered. The aim is to encourage men to participate in discussions about contraception and pregnancy decisions.

In fact, decisions about sex, contraceptive use, and termination of pregnancy are rarely made by a woman or a man alone (35, 36), and partners' attitudes and practices also influence each other. Therefore, women and men are equally responsible for causing unintended pregnancy. However, there are few research data combined with both partners to analyze the causes of unintended pregnancy and explore the relationship between KAP of SRH and unintended pregnancy. It is known that in many countries, especially in China, women rely mainly on contraception and reproductive health decision-making and education are often also targeted at women (21). Although the use of contraceptive methods has increased significantly, the incidence of unintended pregnancy has increased year by year (37). Based on such a status quo, it shows that the focus of the past is only on women and not the key to solving the problem, and the previous research results that only used men or women as research objects were relatively one-sided. Therefore, this study conducted an in-depth comparison and analysis of the status of unintended pregnancy by both partners, aiming to jointly analyze the relationship between KAP of SRH and unintended pregnancy from the perspectives of men and women, and put forward gender-specific recommendations to reduce the number of unintended pregnancies, and improve women's reproductive health.

In China, with the release of second and third births, many people feel that "family planning" is outdated. However, according to the World Health Organization (WHO), family planning means "having the ability" to have the desired number of children at the interval and timing of births desired by individuals and partners through the use of contraceptive methods. All in all, the focus of family planning research both now and in the past is to ensure women's access to safe and effective comprehensive contraceptive measures, to protect women's reproductive health and fertility, and to strengthen high-quality fertility. The current status quo suggests that a key direction for the future is estimating the impact of the Coronavirus disease 2019 (COVID-19) pandemic on family planning indicators. Reports and early modeling efforts from administrative agencies and health systems suggest that large-scale disruptions to family planning services occurred in 2020 (38–41), affecting many people's need for abortion and contraception, and the long-term persistence of such changes is likely to result in change long-term fertility desires (42). There are reports that 60% of people's fear of COVID-19 is mainly hindered by the need for abortion, and 42% report that women are much less likely to seek an abortion during the pandemic, seriously affecting people's life plans (43). In addition, a qualitative study of young women under the age of 30 in six countries reported that among women who do not have access to abortion services due to COVID-19, some women choose to use medical abortions at home (44), and others seek unsafe abortions in local informal abortion facilities, increasing the incidence of complications such as infertility, reproductive system infections, and severe gynecological diseases, which can lead to maternal death. As a result, the overall level of contraceptive use reported in population-based surveys has increased to some extent as the pandemic has progressed, along with an increase in the demand for contraceptive and abortion information and a greater desire for access to knowledge (45, 46).

In addition, according to the World Health Organization and related research reports, during the new crown pneumonia pandemic, the provision of sexual and reproductive health guidance services in relevant medical departments was significantly reduced and interrupted (of different length and scale) (41, 47–50), but the proportion of the population in demand for reproductive health services increased from 23% in April 2020 to 40% in September 2020 (48). Therefore, exploring the relationship between the partner's KAP and unintended pregnancy, popularizing sexual and reproductive health knowledge and enhancing contraceptive determination have guiding significance for reducing the incidence of unintended pregnancy in the future.

Materials and methods

Study design and sample

This study was a retrospective questionnaire-based study of women and their male partners who sought help in the Department of Obstetrics and Gynecology, Shanghai

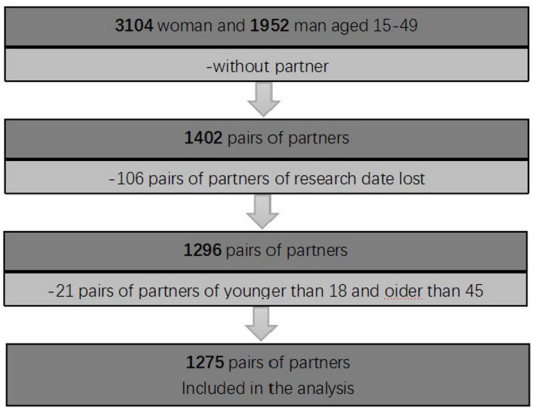

FIGURE 1
Description of the research sample.

General Hospital Affiliated to Shanghai Jiao Tong University School of Medicine for an unintended pregnancy. First, the investigator explained the purpose of the research study to the respondents and obtained informed consent. The Nurses explained precautions to women and their male partners and ensured the confidentiality of their participation in this study. The survey was conducted using an online self-administered questionnaire, including closed-ended and open-ended questions, and took 5–8 min. All questionnaires were conducted from October 2017 to 2021. The studies involving human participants were reviewed and approved by ethics committee of Shanghai Jiao Tong University School of Medicine (SJUPN-201718).

A total of 3,104 females and 1,952 male partners aged 15–49 were collected in this study. The male and female partners were matched according to their names and basic information. Excluding males and females who failed to match successfully, there were 1,402 couples, of which 106 couples lost some information. As well as considering the universality of the research results, the age standard of the research subjects was controlled at 18–45 years old, a total of 21 couples were excluded, and the complete answers of 1,275 couples were finally included in the analysis. In the end, 1,275 couples' complete answers were included in the analysis, as shown in Figure 1. We define a partner as "two opposite-sex partners or couples."

Research surveys included participants' sociodemographic characteristics and sexual and reproductive health. A self-made questionnaire was designed after reviewing previous similar surveys. Subsequently, the readability and comprehension of the questionnaire were verified. The validity of the questionnaire was checked by five experts in obstetrics and gynecology, and the questionnaire was discussed and adjusted with experts in public health and statistics, and content verification was completed in the final data analysis. By calculating the Cronbach's alpha value, which is 0.721, this means that there is acceptable reliability and consistency between test items.

Categories

The final version of the questionnaire that collected the data consisted of four parts. The first part consists of six basic questionnaires, including age, gender, registration, education, profession, and income. The second part is about four items related to reproductive health, including the number of abortions, whether to discuss contraceptive matters, the age of first sexual intercourse, and the number of sexual partners. The third part includes seven questions related to contraception and abortion knowledge and aims to assess women's and men's sexual and reproductive health knowledge. The fourth part further evaluated the partner's contraceptive attitude and practice intention by answering three contraceptive attitude-related questions and three contraceptive practice questions.

Measures

To assess participants' knowledge of sexual and reproductive health, participants were asked a series of questions about reproductive health knowledge, attitudes and practices. Among them, there are five questions about contraceptive knowledge, including "fertile periods of the menstrual cycle," "rhythm contraception is an effective method of contraception," "occasional unprotected sex won't lead to pregnancy," "best time for emergency contraception," "emergency contraceptives can be used frequently instead of oral contraceptives," there are two questions about abortion knowledge, including "the harm of painless abortion is less than that with pain" and "abortion is harmful to the body." There are three questions about contraceptive attitude, including "actively take contraceptive measures in the future," "pregnancy can be avoided by taking proper contraceptive measures," "contraception is troublesome, but worth it." There are three questions on contraceptive practice, including "use contraception during sex," "I can stick to contraception when my partner refuses it," "I can stick to contraception."

All questions use optional variables, and according to whether the answers were correct or not, the overall correct rate of each question, the correct rate of women and men respectively, and the overall response of each pair of partners were counted. For example, a question is "rhythm contraception is an effective method of contraception" and if the answer is "false," then the question is recorded as the correct answer and is coded as "1." If the answer is "correct," "unclear," or "haven't heard of the safe period," the answer is recorded as wrong and coded as "0." The cumulative total scores for KAP of SRH were calculated separately for men, women, and partners. Finally,

with the median as the boundary, respondents with a total score at or above the median were defined as "good," and those with scores below the median were defined as "poor."

In addition, in order to assess the prevalence of partner concordance in KAP of SRH, according to whether the answers to questions related to reproductive health knowledge, contraceptive attitudes, and contraceptive practices were correct or not, we cross-tabulated the number (and percentage) of concordant and discordant answers among partners in four categories: both men and women in a couple answered correctly (W+M+); both men and women answered incorrectly (W-M-); women answered correctly, but men were wrong (W+M-); women answered incorrectly, but men were right (W-M+). Partner concordance on KAP was defined as practice in which both partners answered correctly or incorrectly on a question. Frequency and matched-pair odds ratio analyses were used to estimate patterns of partner concordance for KAP of SRH. The McNemar's test was used to determine the differences in KAP of SRH between male and female partners. "Paired" data were used in the estimation of the odds ratios and McNemar's test.

Furthermore, in order to calculate the concordance values for partner KAP of SRH, we coded the pattern "W+M+" as 1 and 0 otherwise. Univariate and multivariate logistic regression analyses were then used to calculate the matched pairs odds ratio (OR_{MP}), and to test the statistical significance of the association between partner concordance in reproductive health knowledge, contraceptive attitudes and partner consistency in contraceptive practice. In addition, stratified analysis using multivariate logistic regression, according to the ages, registration and education of the couples, were used to confirm that the associations between partner concordance in reproductive health knowledge, contraceptive attitudes and partner concordance in contraceptive practice were consistent among different strata.

Finally, we recorded the total score of the answers to all questions about contraception and abortion knowledge, contraceptive attitude, and contraceptive practice, respectively, greater than the median as good, less than the median as poor, divided into four categories: that is, both women and men in couples were good (W+M+); both men and women were worse (W-M-); women were good, but men were worse (W+M-); women were worse, but men were good (W-M+). Univariate and multivariate logistic regression analyses were then used to calculate the odds ratios (ORs) and 95% confidence intervals (CIs) and to test the statistical significance of the association between partners in KAP of SRH.

Analyses

After the data were exported as SPSS files from the Internet, the data were checked and sorted, and statistical analysis was carried out using IBM SPSS25.0 statistical software. Categorical variables were described using relative indicators such as rate and percentage. Statistical inference was performed using χ^2 analyses, describing the demographic characteristics of 1,275 partners, using a multivariate logistic regression model to examine the association between participants' basic characteristics and KAP variables, reporting unadjusted and adjusted odds ratios (ORs and aORs) and 95% confidence intervals. Frequency and OR_{MP} analyses were used to assess partner concordance in KAP of SRH problems. Finally, after adjusting the variables of age, registration and education level of the partner, multivariate logistic regression was used for analysis. All statistical analysis tests were two-sided hypothesis tests, and the p-value < 0.05 was considered to be statistically significant.

Results

Socio-demographic characteristics

Table 1 shows the sociodemographic characteristics of the participants. A total of 1,275 pairs of partners (2,550 participants) were included and analyzed in this study. Among them, the average age of women is 28 years old, and the average age of men is 31 years old. Unintended pregnancy was most common among women (34.3%) between the ages of 18 and 25. The overall age of unintended pregnancy in men was higher than that in women, especially the number of unintended pregnancies in men over 35 years old (27.2%) was higher than that in women (16.4%). In addition, the study found that more than 41% of the participants were registered in rural areas, and most of the partners had a college education background or above, and they all had their own jobs and good incomes. Among them, it can be seen from the survey results that men's work income is significantly higher than that of women, with a significant difference ($p < 0.001$).

Partner's response to KAP of SRH

Table 2 investigates issues related to contraception and abortion knowledge, contraceptive attitudes, and contraceptive practices. Overall, it can be seen that the overall practice of KAP by partners with unintended pregnancies is good. Among them, in terms of reproductive health knowledge, most partners believe that occasional unprotected sex won't lead to pregnancy (57.3% for women and 70.4% for men), and that Rhythm contraception is an effective method of contraception (67.4% for women and 54.5% for men), this wrong perception may be related to the weak knowledge of contraception and the psychology of luck. In addition, the correct rate of contraceptive knowledge about "fertile periods of the menstrual cycle" and "emergency contraceptive oral time" is significantly lower, indicating that people have a certain understanding of existing

TABLE 1 Sociodemographic characteristics of the participants ($n = 1,275$ pairs).

Variables	Total ($n = 2,550$)	Female ($n = 1,275$)	Male ($n = 1,275$)	χ^2/t	p-value
	n/%	*n*/%	*n*/%		
Age (years)					
18–25	737/28.9	437/34.3	300/23.5	72.622	<0.001
26–30	724/28.4	361/28.3	363/28.5		
31–35	533/20.9	268/21.0	265/20.8		
36–40	350/13.7	152/11.9	198/15.5		
41–45	206/8.1	57/4.5	149/11.7		
Residence					
Shanghai	793/31.1	357/28.0	436/34.2	11.569	0.003
Non-shanghai town	693/27.2	366/28.7	327/25.6		
Non-shanghai rural areal	1,064/41.7	552/43.3	512/40.2		
Education					
Middle school or less	379/14.9	206/16.2	173/13.6	4.038	0.133
High school	814/31.9	410/32.2	404/31.7		
College or higher	1,357/53.2	659/51.7	698/54.7		
Profession					
Works	1,744/68.4	834/65.4	910/71.4	35.991	<0.001
Unemployed	196/7.7	138/10.8	58/4.5		
Other	610/23.9	303/23.8	307/24.1		
Income					
<2,000	272/10.7	192/15.1	80/6.3	147.909	<0.001
2,000–5,000	519/20.4	304/23.8	215/16.9		
5,000–8,000	821/32.2	447/35.1	374/29.3		
>8,000	938/36.8	332/26.0	606/47.5		

contraceptive methods, but their in-depth understanding of these methods is limited. As for the knowledge of abortion, although more than half of the partners believe that an abortion is harmful to the body (65.9% of women and 67.6% of men), a considerable number of people (80.6% of women and 78.3% of men) believed that painless abortion was less harmful to the body than painful abortions. This misperception of abortion methods may lead to partners not paying enough attention to the use of contraceptive methods, which may increase the probability of unintended pregnancies. Overall, compared with women's knowledge level, men had better understandings of sexual and reproductive health knowledge ($\chi^2 = 3.93$, $p = 0.047$).

In terms of contraceptive attitudes, both males and females had positive contraceptive attitudes. Compared with males, females were more determined to contraceptives ($\chi^2 = 27.984$, $p < 0.001$). Compared with female contraceptive behavior intentions, males are more active, and this difference is statistically significant ($\chi^2 = 19.44$, $p < 0.001$).

Associations between sociodemographic and reproductive health characteristics and KAP of SRH among partners

This study used logistic regression analysis to determine the association between sociodemographic and reproductive health characteristics and KAP of SRH, as shown in Table 3. From the results of the study, it can be seen that the educational level of the partner and whether or not to discuss contraceptive matters are closely related to KAP of SRH. Among them, compared with the participants with higher education level, the risk of reporting poor contraceptive knowledge is higher among those with high school or less, which was twice as high as those with college

TABLE 2 Partner responses to questions about KAP of SRH (n = 1,275 pairs).

Practice variables	Response*	Total (n = 2,550) n/%	Female (n = 1,275) n/%	Male (n = 1,275) n/%	χ^2/t	p-value
Knowledge of SRH						
Occasional unprotected sex won't lead to pregnancy	Correct	922/36.2	544/42.7	378/29.6	46.813	<0.001
	Wrong	1,628/63.8	731/57.3	897/70.4		
Rhythm contraception is an effective method of contraception	Correct	996/39.1	416/32.6	580/45.5	44.312	<0.001
	Wrong	1,554/60.9	859/67.4	695/54.5		
Emergency contraceptives can be used frequently instead of oral contraceptives	Correct	1,844/72.3	836/65.6	1,008/79.1	57.947	<0.001
	Wrong	706/27.7	439/34.4	267/20.9		
Fertile periods of the menstrual cycle	Correct	824/32.3	425/33.3	399/31.3	1.212	0.271
	Wrong	1,726/67.7	850/66.7	876/68.7		
Best time for emergency contraception	Correct	829/32.5	436/34.2	393/30.8	3.305	0.069
	Wrong	1,721/67.5	839/65.8	882/69.2		
The harm of painless abortion is less than that with pain	Correct	524/20.5	247/19.4	277/21.7	2.162	1.141
	Wrong	2,026/79.5	1,028/80.6	998/78.3		
Abortion is harmful to the body	Correct	1,702/66.7	840/65.9	862/67.6	0.855	0.355
	Wrong	848/33.3	435/34.1	413/32.4		
Attitude of SRH						
Actively take contraceptive measures in the future	Yes	2,296/90.0	1,188/93.2	1,108/86.9	27.984	<0.001
	No	254/10.0	87/6.8	167/13.1		
Pregnancy can be avoided by taking proper contraceptive measures	Yes	1,748/68.5	859/67.4	889/69.7	1.637	0.201
	No	802/31.5	416/32.6	386/30.3		
Contraception is troublesome, but worth it	Yes	2,177/85.4	1,104/86.6	1,073/84.2	3.018	0.082
	No	373/14.6	171/13.4	202/15.8		
Practice of SRH						
Use contraception during sex	Yes	1,580/62.0	853/66.9	727/57.0	26.415	<0.001
	No	970/38.0	422/33.1	548/43.0		
I can stick to contraception when my partner refuses it	Yes	1,428/56.0	544/42.7	884/69.3	183.983	<0.001

(Continued)

TABLE 2 (Continued)

Practice variables	Response*	Total ($n = 2,550$) n/%	Female ($n = 1,275$) n/%	Male ($n = 1,275$) n/%	χ^2/t	p-value
	No	1,122/44.0	731/57.3	391/30.7		
I can stick to contraception	Yes	1,735/68.0	839/65.8	896/70.3	5.859	0.015
	No	815/32.0	436/34.2	379/29.7		
Summary of selected practice variables (median)						
Knowledge						
Poor practice		1,015/39.8	532/41.7	483/37.9	3.930	0.047
Good practice		1,535/60.2	743/58.3	792/62.1		
Attitude						
Poor practice		1,012/39.7	532/41.7	522/40.9	1.475	0.225
Good practice		1,538/60.3	784/61.5	753/59.1		
Practice						
Poor practice		923/36.2	515/40.4	408/32	19.441	<0.001
Good practice		1,627/63.8	760/59.6	867/68		

*For all the answers to the questions, the correct answer is recorded as correct, otherwise it is recorded as wrong.

education and above (female, aOR = 2.389, $p < 0.001$ and male, aOR = 2.461, $p < 0.001$). Compared with men and women who did not discuss contraception and had only one sexual partner, men and women who discussed contraceptive matters frequently and had multiple sexual partners had good knowledge of contraception. In addition, the study found that women's knowledge level was also related to the number of abortions. Compared with women who had experienced more than one abortion, women who had never had an abortion were 1.3 times more likely to report poor contraceptive knowledge (aOR = 1.301, $p < 0.030$). Finally, an analysis of male participants found that older age (aOR = 0.723, $p = 0.013$) and younger age at first sexual intercourse (aOR = 1.283, $p = 0.048$) were also risk factors for poorer contraceptive knowledge.

In the analysis of contraceptive attitudes, the study found that young women with rural registration and less education were at higher risk of reporting poor contraceptive attitudes, while women who often discussed contraceptive matters with their partners and had multiple sexual partners had more positive contraceptive attitudes. In addition, the study also found that contraceptive attitudes and practices were more negative among men who caused women to have more than one abortion.

Partner concordance for KAP of SRH

Table 4 describes the patterns of sexual and reproductive health knowledge, contraceptive attitudes, and practices among partners, comparing differences between male and female partners. Among them, the correct rate for the question of "whether emergency contraceptives can be used frequently instead of oral contraceptives" is highly consistent (55.1%). Male partners were more likely than female partners to believe that emergency contraceptives should not be used frequently instead of oral contraceptives ($OR_{MP} = 2.277$, $p < 0.001$). At the same time, there are also many partners (45.5%) who agree that an abortion has a great impact on the body, and the error rates of the questions about "female fertile period" and "best time for emergency contraception" are relatively high (47.5 and 48.6%). In addition, some partners (39.5%) mistakenly believe that rhythm contraception is an effective contraceptive method, and more than half (64.4%) of the partners agree that painless abortion is less harmful to women. Finally, through a comprehensive analysis of the answers to sexual and reproductive health knowledge, it again shows that the male partner's knowledge of contraception is better than that of the female partner ($OR_{MP} = 2.26$, $p = 0.031$).

Regarding contraceptive attitudes, there was a high concordance (81.2%) between partners on "actively take contraceptive measures in the future," and female partners had more positive contraceptive attitudes than male partners, with a statistically significant difference ($OR_{MP} = 1.297$, $p < 0.001$). Nearly half (45.5%) of the partners agreed on the use of contraceptive methods in future sex and were able to stick to contraception together. Among them, male partners had better contraceptive intention than female partners ($OR_{MP} = 2.56$, $p < 0.001$). On the whole, both partners have positive

TABLE 3 Logistic regression for the associations between sociodemographic characteristics, reproductive health characteristics and KAP among Partners.

Variables	Female						Male					
	Knowledge		Attitude		Practice		Knowledge		Attitude		Practice	
	aOR[a]	*p*-value	aOR[a]	*p*-value	aOR[a]	*p*-value	aOR[a]	*p*-value	aOR[a]	*p*-value	aOR[a]	*p*-value
Marital status												
Not married vs. married (ref)	0.883	0.337	0.868	0.333	1.049	0.740	0.948	0.715	1.110	0.455	1.166	0.221
Age (years)												
<29 vs. ≥29 (ref)	0.927	0.617	1.486	0.002	1.225	0.083	0.723	0.013	0.922	0.509	0.816	0.162
Residence												
Rural vs. urban (ref)	1.252	0.076	1.330	0.029	0.982	0.889	1.300	0.057	1.093	0.486	0.962	0.782
Education												
High school or less vs. college or higher (ref)	2.389	<0.001	1.645	<0.001	1.606	<0.001	2.461	<0.001	1.676	<0.001	2.076	<0.001
Profession												
Unemployed vs. works (ref)	1.017	0.901	1.317	0.028	0.839	1.197	1.024	0.862	0.991	0.948	1.283	0.065
Income												
<5,000 vs. ≥5,000 (ref)	1.420	0.005	1.133	0.356	1.188	1.160	1.513	0.004	1.368	0.024	1.213	0.197
Number of abortions												
1 vs. ≥2 (ref)	1.301	0.030	0.843	0.174	0.927	0.537	0.767	1.147	0.670	0.018	0.501	<0.001
Discuss contraceptive matters												
No vs. yes (ref)	1.458	0.004	1.341	0.027	1.629	<0.001	1.991	<0.001	1.265	0.093	2.026	<0.001
Age at first sexual intercourse												
<21 vs. ≥21 (ref)	1.082	0.538	1.048	0.724	1.093	0.471	1.283	0.048	0.974	0.826	1.127	0.351
Number of sexual partners												
1 vs. ≥2 (ref)	1.317	0.030	1.298	0.040	1.064	0.628	1.346	0.023	1.175	0.196	0.981	0.889

aOR, adjusted odds ratio.

[a]Adjusting for age, marital status, income, profession, residence, and educational attainment.

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TABLE 4 Partner concordance for KAP of SRH, and comparisons among different patterns (n = 1,275 pairs).

Variables	W+M+ *n*/%	W-M+ *n*/%	W+M- *n*/%	W-M- *n*/%	OR_{MP}	McNemar's test *p*-value
Knowledge of SRH						
Occasional unprotected sex won't lead to pregnancy	178/14.0	200/15.7	366/28.7	531/41.6	1.291	<0.001
Fertile periods of the menstrual cycle	154/12.1	245/19.2	271/21.3	605/47.5	1.403	0.271
Rhythm contraception is an effective method of contraception	225/17.6	355/27.8	191/15.0	504/39.5	1.672	<0.001
Emergency contraceptives can be used frequently instead of oral contraceptives	702/55.1	306/24.0	134/10.5	133/10.4	2.277	<0.001
Best time for emergency contraception	174/13.6	219/17.2	262/20.5	620/48.6	1.880	0.055
The harm of painless abortion is less than that with pain	70/5.5	207/16.2	177/13.9	821/64.4	1.569	0.139
Abortion is harmful to the body	580/45.5	282/22.1	260/20.4	153/12	1.210	0.367
Attitude of SRH						
Actively take contraceptive measures in the future	1,035/81.2	73/5.7	153/12.0	14/1.1	1.297	<0.001
Pregnancy can be avoided by taking proper contraceptive measures	630/49.4	259/20.3	229/18.0	157/12.3	1.668	0.189
Contraception is troublesome, but worth it	949/74.4	124/9.7	155/12.2	47/3.7	2.321	0.072
Practice of SRH						
Use contraception during sex	582/45.6	145/11.4	271/21.3	277/21.7	4.103	<0.001
I can stick to contraception when my partner refuses it	430/33.7	454/35.6	114/8.9	277/21.7	2.301	<0.001
I can stick to contraception	611/47.9	285/22.4	228/17.9	151/11.8	1.420	0.013
Summary of selected practice variables*						
Knowledge	521/40.9	271/21.3	222/17.4	261/20.5	2.260	0.031
Attitude	501/39.3	252/19.8	283/22.2	239/18.7	1.679	0.195
Practice	580/45.5	287/22.5	180/14.1	228/17.9	2.560	<0.001

OR_{MP}, matched pairs odds ratio; W+M+, both men and women in a couple answered correctly; W-M-, both men and women answered incorrectly; W+M-, women answered correctly, but men were wrong; W-M+, women answered incorrectly, but men were right.

*The total score of the answers to questions related to KAP of SRH, greater than the median is regarded as good, and less than the median is regarded as poor, for example, the total score of women's knowledge in couples is greater than the median, which is good, but the total score of men's knowledge is less than the median, which is poor, and finally recorded as W+M-.

attitudes toward contraception, and the concordance is good, but the error rate concordance of some relatively professional common sense related to contraception is much higher than the accuracy rate concordance, which shows that partners' in-depth knowledge of sexual and reproductive health knowledge is weak, leading to an increased risk of contraceptive failure.

After adjusting for male and female age, registration, and education level, it can be seen from Table 5 that the concordance of active contraceptive practice between partners may increase with the education level of male partners (aOR = 1.556, 95% CI = 1.185–2.044, p = 0.001). It shows that the higher the male education level in the partner, the greater the partner's determination to use contraception together. Among them, from the analysis results of contraceptive attitudes, it can be seen that compared with partners with negative contraceptive attitudes, the probability of positive contraceptive practices increases by 2.9 times for couples who are more determined to contraception in the future (aOR = 2.953, 95% CI = 2.103–4.148, $p < 0.001$).

In addition, in the analysis of contraceptive and abortion knowledge and contraceptive attitude and contraceptive practice, it can be seen from Table 5 that the good concordance of contraceptive knowledge among partners increases the probability of positive contraceptive practice partner concordance by 1.477 times (aOR = 1.477, 95% CI = 1.164–1.875, p = 0.001). The concordance of correct abortion knowledge and positive contraceptive attitude among partners increased the odds of positive contraceptive practice concordance by 1.831 and 1.609 times (aOR = 1.831, 95% CI = 1.450–2.313, $p < 0.001$; aOR = 1.609, 95% CI =1.267–2.042, $p <$ 0.001). It shows that good contraceptive and abortion knowledge and positive contraceptive attitude of both partners will promote the use of contraceptive methods, while poor contraceptive and abortion knowledge and negative contraceptive attitude are the

TABLE 5 Logistic regression of associations between knowledge, attitudes of SRH, and contraceptive practice among partners.

Variables	Crude			Multivariate		
	OR	95% CI	*p*-value	aOR[a]	95% CI	*p*-value
Woman's age (years)						
<29 vs. ≥29 (ref)	1.267	1.014–1.583	0.037	1.215	0.969–1.522	0.092
Man's age (years)						
<29 vs. ≥29 (ref)	1.054	0.845–1.315	0.642	0.811	0.600–1.097	0.174
Woman's residence						
Rural vs. urban (ref)	1.324	1.059–1.654	0.014	1.019	0.782–1.327	0.891
Man's residence						
Rural vs. urban (ref)	1.237	0.988–1.549	0.063	0.899	0.692–1.168	0.425
Woman's education						
High school or less vs. college or higher (ref)	1.799	1.413–2.290	<0.001	1.232	0.930–1.631	0.146
Man's education						
High school or less vs. college or higher (ref)	1.868	1.461–2.388	<0.001	1.556	1.185–2.044	0.001
Summary of selected practice variables*						
Contraceptive knowledge						
Others vs. W+M+ (ref)	1.947	1.557–2.434	<0.001	1.477	1.164–1.875	0.001
Abortion knowledge						
Others vs. W+M+ (ref)	2.160	1.726–2.704	<0.001	1.831	1.450–2.313	<0.001
Contraceptive attitude						
Others vs. W+M+ (ref)	1.975	1.572–2.480	<0.001	1.609	1.267–2.042	<0.001
Summary of selected practice variables**						
Contraceptive knowledge						
W+M+	Reference					
W+M-	1.512	0.999–2.287	0.05	1.721	1.234–2.400	0.001
W-M+	1.977	1.340–2.916	0.001	1.349	1.000–1.819	0.05
W-M-	2.895	2.062–4.065	<0.001	2.412	1.696–3.431	<0.001
Abortion knowledge						
W+M+	Reference					
W+M-	2.580	1.612–4.127	<0.001	1.460	1.080–1.973	0.014
W-M+	1.737	1.087–2.776	0.021	2.223	1.649–2.998	<0.001
W-M-	3.954	2.580–6.060	<0.001	3.598	2.331–5.555	<0.001
Contraceptive attitude						
W+M+	Reference					
W+M-	1.534	1.066–2.207	0.021	1.736	1.287–2.342	<0.001
W-M+	1.878	1.297–2.721	0.001	1.433	1.053–1.949	0.022
W-M-	2.858	2.061–3.963	<0.001	2.466	1.763–3.448	<0.001

OR, odds ratio; CI, confidence interval; aOR, adjusted odds ratio.

*The questions of partners' contraceptive knowledge, abortion knowledge and contraceptive attitude were divided into two parts according to the total score, including the partners who performed well (W+M+) and other situations (W+M-/W-M+/W-M-).

**According to the total score, it is divided into four parts, W+M+, both women and men in partners were good; W-M-, both men and women were worse; W+M-, women were good, but men were worse; W-M+, women were worse, but men were good.

[a]Adjusted for age, residence and education level for men and women in partners.

risk factors for not taking contraceptive methods in sexual life between partners.

Analyzing the relationship with contraceptive practice in partner models with different knowledge and attitudes about sexual and reproductive health, it can be seen that compared with partners with good contraception and abortion knowledge and positive contraceptive attitudes, poor contraceptive knowledge (aOR = 2.412, 95% CI = 1.696–3.431, $p < 0.001$), poor abortion knowledge (aOR = 3.598, 95% CI = 2.331–5.555, $p < 0.001$), and negative contraceptive attitudes (aOR = 2.466, 95% CI = 1.763–3.448, $p < 0.001$) in both partners were risk factors for reporting partners' negative contraceptive practice.

In a more detailed comparative analysis of partners, it can be seen that in terms of contraceptive knowledge, compared with good contraceptive knowledge in both men and women in the partner (W+M+), the risk of negative contraceptive practice was 1.7 times (aOR = 1.721, 95% CI = 1.234–2.400, $p = 0.001$) higher in the partner with good contraceptive knowledge in women but negative in men (W+M-), while women with poor contraceptive knowledge but men with good knowledge (W-M+) are 1.3 times (aOR = 1.349, 95% CI =1.000–1.819, $p = 0.05$) more likely to have negative contraceptive practices. It also further indicated that, compared with female partners, poor contraceptive knowledge of male partners may lead to a higher risk of negative contraceptive practice, and thus a greater risk of unintended pregnancy. That is, men with good contraceptive knowledge can promote the use of contraceptive methods. In addition, compared with couples with positive contraceptive attitudes (W+M+), the risk of negative contraceptive practice for women with positive attitudes but negative for men (W+M-) and for women with negative attitudes but positive for men (W-M+) were 1.7 and 1.4 times. That is to say, partners with only men with good knowledge and attitudes had a 0.3–0.4 times lower risk of negative contraceptive practice compared with only women who performed well. Therefore, men's positive contraceptive attitudes have a greater impact on the use of contraceptive methods. The difference is that in terms of abortion knowledge, compared with men who have good abortion knowledge, women's good abortion knowledge has a greater positive impact on contraceptive practice.

Discussion

This study analyzed the relationship between KAP of SRH and the occurrence of unintended pregnancy from the unique perspectives of both partners. Through investigation and analysis, we found that the vast majority of partners believed that good contraceptive knowledge (aOR = 1.477), good abortion knowledge (aOR = 1.831) and positive contraceptive attitude (aOR = 1.609) were the positive promoting factors of partners' contraceptive practice. Among them, compared with women's knowledge level (58.3%), men have better knowledge level (62.1%). This is inconsistent with previous research on American women (26), which showed that men have lower levels of knowledge about contraception than women. Compared with female contraceptive behavior intention, male performance was more positive. One possible explanation is that the vast majority of studies in China have found that men perceive actual or potential unintended pregnancy as a life event that will bring them moral and material dilemmas (34). Or with the development of society, men's sense of responsibility increases, and women's reproductive health may be considered, so they have strong contraceptive intentions, and the understanding of contraceptive knowledge will be more serious and active than women. In terms of contraceptive attitudes, both men and women are more positive in their determination to use contraception in the future, but compared with men, women are more determined to use contraception in the future. This may be because the occurrence of unintended pregnancy is closely related to women's reproductive health, so women's attitude toward contraception is more positive.

Most previous similar studies have investigated the association of KAP with male or female sociodemographic and reproductive health backgrounds on a country-by-country basis (22, 34, 51–54). In this study, we conducted a more detailed analysis of whether men and women in each partner had good knowledge and attitudes, and explored the impact and association of knowledge and attitudes on contraceptive practice between men and women in partners. The results of the study found that among partners, compared with women, men with poor contraceptive knowledge and negative contraceptive attitudes had a higher risk of negative contraceptive practice, and thus a greater risk of unintended pregnancy. That is to say, men with good contraceptive knowledge and positive contraceptive attitude can promote the use of contraceptive methods, indicating that men play an important role in promoting contraceptive practice and reducing the occurrence of unintended pregnancy, and this is similar to the findings (22, 34, 51, 54). Therefore, it is particularly important to reduce the occurrence of unintended pregnancies by changing the previous gender norms of "contraception depends on women." However, according to the latest research report, male contraceptive initiative is generally not high in the world (55), so future research directions should highlight the theoretical focus of intervention behaviors to promote male contraceptive use, and call for reducing the occurrence of unintended pregnancy by helping men move from anticipation or consideration to action when adopting contraceptive practice.

In addition, the study also found that partners' education and income levels were strongly associated with KAP among participants' demographic characteristics. People with higher education and income have better knowledge of contraception and abortion, and have more positive contraceptive attitudes and practices. A survey shows that 74 million (86%) of the 86 million unintended pregnancies worldwide occur in economically

underdeveloped countries (56). Compared with high-income countries, low-income countries have less personalized counseling on the choice of contraceptive measures, and more limited sources of effective and easily accessible reproductive health knowledge and modern contraceptive methods (3). For example, people with economic difficulties often choose the method of rhythm contraception, so they are more likely to have unintended pregnancy.

It is not difficult to understand that the level of education can determine a person's differences in cognition of the same things, which not only affects whether to use contraceptives, but also affects the choice of contraceptive methods and the decision-making of unintended pregnancy. Low education level limits the ability of individuals to receive contraceptive knowledge and abortion hazards, while the higher the education level, the higher the relative income level, and the more likely they are to independently acquire contraceptive-related knowledge through multiple channels. This is similar to the results of previous studies (57, 58), reporting that educational background is one of the most important factors for low contraception and abortion knowledge.

At the same time, after adjusting the variables of age, registration and education level, it was found that the concordance of active contraceptive practice between partners may increase with the education level of men (aOR = 1.556), that is to say, the higher the education level of the male partner, the greater the partner's determination to use contraception together. This can be explained by the fact that people from low educational backgrounds are more likely to see pregnancy as a positive life event, an opportunity to transform into a mature and responsible parent, and thus have relatively negative contraceptive attitudes and practices. For those with higher education, they believe that unintended pregnancy is an obstacle to becoming a mature and responsible person, which will affect their career planning (34), so contraceptive attitudes and practices are more positive. In response to this finding, we need to popularize sexual and reproductive health knowledge among targeted populations. For example, compared with people with high education level, it is particularly important to implement education on sexual and reproductive health knowledge for people with low education background and low income, and stablish relevant policy systems to enable young people to contact and understand relevant knowledge early.

According to the results of the investigation on the causes of unintended pregnancy (result not shown), 53.5% of the population did not use contraceptive methods, 30.8% of the population became pregnant due to contraceptive failure, and 15.7% had unknown reasons, indicating that the main cause of unintended pregnancy was not using contraceptive measures. This is similar to the results of previous studies. Globally, about 21% of married or cohabiting partner use contraceptive methods (57), indicating that the vast majority of partners do not use contraceptive methods during sex. In developing countries, ∼50–60% of the population does not use contraception (23). In sub-Saharan Africa, South, Central, and Southeast Asia, up to 87% of unintended pregnancies occur in women who do not use contraception (59), which may be related to people's lower educational background, limited awareness of contraceptive methods, less sex education, and limited choice of effective contraceptives (20, 24).

The survey results show that although the overall knowledge level of the investigators in this study is relatively good, the correct rate of individual basic common-sense questions is low, such as the fertile periods of the menstrual cycle and the best time for oral contraceptives. At the same time, the concordance analysis found that the error rate concordance of some relatively detailed knowledge of contraception is much higher than the accuracy rate concordance and more than half (64.4%) of the partners in the KAP of SRH concordance analysis on the knowledge of abortion agreed that the painless abortion is less harmful to the body than the painless one. This misconception about contraceptive methods can affect the use of a partner's method of contraception. In recent years, although painless abortion has been accepted by increasing number of women because of its advantages such as less pain during an operation and faster recovery after an operation, it might even take abortion as a routine remedy for contraceptive failure. However, studies have shown that the rate of repeated abortion after painless abortion was higher than that after traditional artificial abortion (11), which increased the risk of anesthesia accidents (60) and also the incidence of complications such as uterine cavity adhesion, genital tract infection, and secondary infertility (8). The short-term and long-term complications affected women's physical and mental health.

In addition, due to people's inherent ideas or just listening to the descriptions of their friends around them, they will also have some wrong perceptions, which will increase the incidence of unintended pregnancy. For example, older women over 40 years of age believe that their reproductive function has deteriorated and they cannot conceive, thus reducing the use of contraceptives, which is likely to lead to unintended pregnancy. Many mothers during lactation believe that they will not be pregnant without menstruation, and they do not need to take contraceptive measures. But in fact, during lactation, even if they do not have menstruation, they may ovulate, and ovulation means there is a risk of unintended pregnancy. It also shows that people lack in-depth understanding of relevant knowledge and lack relatively professional guidance on accurate information and knowledge related to contraception, which has been mentioned in multiple studies (58, 61). Therefore, professionals should be encouraged to attach importance to popularizing knowledge, such as increasing online or offline popularization, promoting convenient and free contraceptive services provided by health care providers, and increasing the popularization of contraceptive methods among pharmacy workers to those in need of contraception.

The use of contraceptive methods has increased substantially worldwide since 1970 (55), but the incidence of unintended pregnancies has increased year by year. This also shows that most partners who have unintended pregnancy are willing to contraception, but do not use contraceptives or take incorrect contraceptive methods due to lack of contraceptive knowledge, and thus have a higher risk of unintended pregnancy. At the same time, the study found that unintended pregnancy was most common in the youngest age group (18–25 years old; 34.3% of women and 23.5% of men), and more than half of the respondents had their first sexual intercourse under the age of 21. In recent years, both the age of gestation and the age of first sexual intercourse tend to be younger (62–64), showing a downward trend (65–69), which is similar to the results of several studies (58, 70–73). Moreover, the study also found that men with smaller AFSI had a lower understanding of reproductive health knowledge ($p < 0.05$), and a younger AFSI is associated with a higher risk of unplanned pregnancy, which is consistent with other studies conducted in China (73). This makes sense given that younger women have lower knowledge of contraceptive methods and have higher frequency of intercourse and fertility. This result may be related to school education patterns and parental educational philosophies regarding sexual and reproductive health in China. Sexual issues are highly individual and secretive, family sex education should be the enlightenment education at the stage of sex education. However, influenced by traditional moral values, parents often avoid talking about sexual behavior with their children, let alone educate them about sex. On the other hand, the school curriculum in China rarely involves sex education or takes it seriously. Therefore, the educational concept of Chinese parents should be improved, and early sexual health education should be carried out for students in school to encourage them to take a more serious attitude.

Limitations

Our analysis has some limitations. First, in China, because sex-related issues are still a very sensitive topic, and participants must recall the past, there may be reporting bias in responses to KAP-related questions, especially among unmarried adolescents. Second, in qualitative studies, there is no uniform definition of contraception or partner communication, and findings are limited in terms of generalizability and risk of bias. The population of this study is limited to paired partners, excluding most of the people who have not been successfully paired, as well as too young and too old partners, and the reported results are relatively limited. Finally, the respondents in this study were matched couples, including unmarried and married couples, and no differential analysis was conducted. There are differences in needs and perceptions of issues between these two groups.

Conclusion

Although the global contraceptive coverage rate has increased significantly in recent years, and the contraceptive penetration rate in China is as high as 80%, the high incidence of unintended pregnancy is still the current global status quo. This study illustrates the lack of sexual and reproductive health education for partners in China through partner profiles. The key role of men in promoting contraceptive use is proposed, while providing evidence for the importance of male KAP in reducing unintended pregnancies between partners, filling the gap in the literature on joint research of both men and women with unintended pregnancy in developing countries and even around the world. Studies have shown that compared with women, men have more reproductive health knowledge, more positive contraceptive practice, and men's knowledge and attitudes are more positive factors in promoting contraception between partners. It shows that in the reproductive health education, the comprehensive education of partners should be given priority, and gender characteristics and needs should also be taken into consideration, not only taking into account the relative weakness of women's knowledge, but also paying attention to the role and role of male KAP in avoiding unintended pregnancy. It promotes male initiative and implements it into the contraceptive action between partners, so that men can be guaranteed in terms of contraceptive responsibility and attitude. In addition, it is also critical to identify targeted strategies when popularizing sexual and reproductive health knowledge. This study found that the younger age of the partner, low educational background, and lack of in-depth knowledge of relevant knowledge are risk factors for unintended pregnancy. Therefore, targeted education should be carried out for low-educated and young people. While emphasizing early sex education in schools and families, the government and health departments should also expand popular methods and promote the concept of "scientific contraception to reduce unintended pregnancy."

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.

Ethics statement

The studies involving human participants were reviewed and approved by Shanghai Jiao Tong University School of Medicine. The patients/participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication

of any potentially identifiable images or data included in this article.

Author contributions

JZ, YY, RL, and XD contributed to conception and design of the study. YY organized the database. RL and XD performed the statistical analysis. RL wrote the first draft of the manuscript. XD wrote sections of the manuscript. XJ, SC, QY, and YT participated in data collection. JZ, YY, YZ, and SW have oversight and leadership responsibility for the planning and execution of research activities. YY and XJ provided financial support. All authors contributed to manuscript revision, read, and approved the submitted version.

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Conflict of interest

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

Publisher's note

References

1. Zeleke LB, Alemu AA, Kassahun EA, Aynalem BY, Hassen HY, Kassa GM. Individual and community level factors associated with unintended pregnancy among pregnant women in Ethiopia. *Sci Rep.* (2021) 11:1–9. doi: 10.1038/s41598-021-92157-4

2. Hellstrom A, Gemzell Danielsson K, Kopp Kallner H. Trends in use and attitudes towards contraception in Sweden: results of a nationwide survey. *Eur J Contracept Reprod Health Care.* (2019) 24:154–60. doi: 10.1080/13625187.2019.1581163

3. Bottcher B, Abu-El-Noor MA, Abu-El-Noor NI. Causes and consequences of unintended pregnancies in the Gaza Strip: a qualitative study. *Br Med J Sex Reprod Health.* (2019) 2018:200275. doi: 10.1136/bmjsrh-2018-200275

4. Mohammed F, Musa A, Amano A. Prevalence and determinants of unintended pregnancy among pregnant woman attending ANC at Gelemso General Hospital, Oromiya Region, East Ethiopia: a facility based cross-sectional study. *BMC Womens Health.* (2016) 16:56. doi: 10.1186/s12905-016-0335-1

5. Bearak J, Popinchalk A, Alkema L, Sedgh G. Global, regional, and subregional trends in unintended pregnancy and its outcomes from 1990 to 2014: estimates from a Bayesian hierarchical model. *Lancet Glob Health.* (2018) 6:e380–9. doi: 10.1016/S2214-109X(18)30029-9

6. Singh S, Sedgh G, Hussain R. Unintended pregnancy: worldwide levels, trends, and outcomes. *Stud Fam Plann.* (2010) 41:241–50. doi: 10.1111/j.1728-4465.2010.00250.x

7. Fathalla MF. Safe abortion: the public health rationale. *Best Pract Res Clin Obstet Gynaecol.* (2020) 63:2–12. doi: 10.1016/j.bpobgyn.2019.03.010

8. Shakya S, Shrestha S, Shrestha RK, Giri U, Shrestha S. Knowledge, attitude and practice of emergency contraceptive pills among community pharmacy practitioners working in Kathmandu Valley: a cross-sectional study. *BMC Health Serv Res.* (2020) 20:699. doi: 10.1186/s12913-020-05543-5

9. Kantorová V. Unintended pregnancy and abortion: what does it tell us about reproductive health and autonomy? *Lancet Glob Health.* (2020) 8:e1106–7. doi: 10.1016/S2214-109X(20)30342-9

10. Gipson JD, Koenig MA, Hindin MJ. The effects of unintended pregnancy on infant, child, and parental health: a review of the literature. *Stud Fam Plann.* (2008) 39:18–38. doi: 10.1111/j.1728-4465.2008.00148.x

11. Maravilla JC, Betts KS, Couto ECC, Alati R. Factors influencing repeated teenage pregnancy: a review and meta-analysis. *Am J Obstet Gynecol.* (2017) 217:52–45.e31. doi: 10.1016/j.ajog.2017.04.021

12. Monea E, Thomas A. Unintended pregnancy and taxpayer spending. *Perspect Sex Reprod Health.* (2011) 43:88–93. doi: 10.1363/4308811

13. Espinoza C, Samandari G, Andersen K. Abortion knowledge, attitudes and experiences among adolescent girls: a review of the literature. *Sex Reprod Health Matters.* (2020) 28:1744225. doi: 10.1080/26410397.2020.1744225

14. Ganatra B, Gerdts C, Rossier C, Johnson BR, Tuncalp O, Assifi A, et al. Global, regional, and subregional classification of abortions by safety, 2010-14: estimates from a Bayesian hierarchical model. *Lancet.* (2017) 390:2372–81. doi: 10.1016/S0140-6736(17)31794-4

15. Cohen IG, Murray M, Gostin LO. The end of roe v wade and new legal frontiers on the constitutional right to abortion. *JAMA.* (2022) 328:325–6. doi: 10.1001/jama.2022.12397

16. Tanne JH. US Supreme Court ends constitutional right to abortion. *Br Med J Publish Group.* (2022) 377:o1575. doi: 10.1136/bmj.o1575

17. Stevenson AJ. The pregnancy-related mortality impact of a total abortion ban in the United States: a research note on increased deaths due to remaining pregnant. *Demography.* (2021) 58:2019–28. doi: 10.1215/00703370-9585908

18. Lazzarini Z. The end of Roe v. Wade—states' power over health and well-being. *N Engl J Med.* (2022) 387:390–3. doi: 10.1056/NEJMp2206055

19. Guillaume A, Rossier C, Reeve P. Abortion around the world. An overview of legislation, measures, trends, and consequences. *Population*. (2018) 73:217–306. doi: 10.3917/popu.1802.0225

20. Habib MA, Raynes-Greenow C, Nausheen S, Soofi SB, Sajid M, Bhutta ZA, et al. Prevalence and determinants of unintended pregnancies amongst women attending antenatal clinics in Pakistan. *BMC Pregn Childb*. (2017) 17:1–10. doi: 10.1186/s12884-017-1339-z

21. Ding R, Guo C, Song X, Zheng X. Male knowledge, attitude and practice and partner pregnancy among Chinese unmarried youth. *PLoS ONE*. (2019) 14:e0214452. doi: 10.1371/journal.pone.0214452

22. Kagesten A, Bajos N, Bohet A, Moreau C. Male experiences of unintended pregnancy: characteristics and prevalence. *Hum Reprod*. (2015) 30:186–96. doi: 10.1093/humrep/deu259

23. Jain AK, Obare F, RamaRao S, Askew I. Reducing unmet need by supporting women with met need. *Int Perspect Sex Reprod Health*. (2013) 39:133–41. doi: 10.1363/3913313

24. Nguyen BT, Violette C, Li HZ, Jensen JT. Expectations for sex without birth control among young men: risk factors from the USA National Survey of Reproductive and Contraceptive Knowledge. *World J Men's Health*. (2019) 2019:190098. doi: 10.5534/wjmh.190098

25. Dixit P, Ram F, Dwivedi LK. Determinants of unwanted pregnancies in India using matched case-control designs. *BMC Pregnancy Childbirth*. (2012) 12:1–12. doi: 10.1186/1471-2393-12-84

26. Quak XES, Sultana R, Aau WK, Goh CC, Tan NC. A 3-year retrospective study of unintended pregnancy in a developed multi-ethnic Asian community: A call for better healthcare system for family planning. *Front Public Health*. (2022) 10:996696. doi: 10.3389/fpubh.2022.996696

27. Finer LB, Zolna MR. Declines in unintended pregnancy in the United States, 2008–2011. *N Engl J Med*. (2016) 374:843–52. doi: 10.1056/NEJMsa1506575

28. Razzaq S, Jessani S, Rizvi N, Saleem S. Unintended pregnancy and the associated factors among pregnant females: Sukh Survey-Karachi, Pakistan. *J Pak Med Assoc*. (2021) 71(11Suppl.7):S50.

29. Yenealem F, Niberet G. Prevalence and associated factors of unintended pregnancy among pregnant woman in Gondar town, North west Ethiopia, 2014. *BMC Res Notes*. (2019) 12:1–5. doi: 10.1186/s13104-019-4203-6

30. Bell DL, Garbers S, Catallozzi M, Hum RS, Nechitilo M, McKeague IW, et al. Computer-assisted motivational interviewing intervention to facilitate teen pregnancy prevention and fitness behavior changes: a randomized trial for young men. *J Adolesc Health*. (2018) 62:S72–80. doi: 10.1016/j.jadohealth.2017.06.015

31. Wheeler NJ, Pilgrim N, Jennings JM, Sanders R, Page KR, Loosier PS, et al. Missed opportunities to address pregnancy prevention with young men in primary care. *Clin Pediatr*. (2018) 57:1558–66. doi: 10.1177/0009922818793351

32. Saewyc EM. What about the boys? The importance of including boys and young men in sexual and reproductive health research. *J Adolesc Health*. (2012) 51:1–2. doi: 10.1016/j.jadohealth.2012.05.002

33. Mishra A, Nanda P, Speizer IS, Calhoun LM, Zimmerman A, Bhardwaj R. Men's attitudes on gender equality and their contraceptive use in Uttar Pradesh India. *Reprod Health*. (2014) 11:41. doi: 10.1186/1742-4755-11-41

34. Kane J, Lohan M, Kelly C. Adolescent men's attitudes and decision making in relation to pregnancy and pregnancy outcomes: an integrative review of the literature from 2010 to 2017. *J Adolesc*. (2019) 72:23–31. doi: 10.1016/j.adolescence.2018.12.008

35. Hayford SR, Guzzo KB. Racial and ethnic variation in unmarried young adults' motivation to avoid pregnancy. *Perspect Sex Reprod Health*. (2013) 45:41–51. doi: 10.1363/4504113

36. Sassler S, Miller A, Favinger SM. Planned parenthood? Fertility intentions and experiences among cohabiting couples. *J Fam Iss*. (2009) 30:206–32. doi: 10.1177/0192513X08324114

37. Singh S. Hospital admissions resulting from unsafe abortion: estimates from 13 developing countries. *Lancet*. (2006) 368:1887–92. doi: 10.1016/S0140-6736(06)69778-X

38. Dasgupta A, Kantorová V, Ueffing P. The impact of the COVID-19 crisis on meeting needs for family planning: a global scenario by contraceptive methods used. *Gates Open Res*. (2020) 4:2. doi: 10.12688/gatesopenres.13148.2

39. Riley T, Sully E, Ahmed Z, Biddlecom A. Estimates of the potential impact of the COVID-19 pandemic on sexual and reproductive health in low- and middle-income countries. *Int Perspect Sex Reprod Health*. (2020) 46:73–6. doi: 10.1363/46e9020

40. Li G, Tang D, Song B, Wang C, Qunshan S, Xu C, et al. Impact of the COVID-19 pandemic on partner relationships and sexual and reproductive health: cross-sectional, online survey study. *J Med Internet Res*. (2020) 22:e20961. doi: 10.2196/20961

41. Organization WH. *Pulse Survey on Continuity of Essential Health Services During the COVID-19 Pandemic: Interim Report, 27 August 2020*. Geneva: World Health Organization (2020).

42. Sobotka T, Skirbekk V, Philipov D. Economic recession and fertility in the developed world. *Popul Dev Rev*. (2011) 37:267–306. doi: 10.1111/j.1728-4457.2011.00411.x

43. Endler M, Al-Haidari T, Benedetto C, Chowdhury S, Christilaw J, El Kak F, et al. How the coronavirus disease 2019 pandemic is impacting sexual and reproductive health and rights and response: results from a global survey of providers, researchers, and policy-makers. *Acta Obstet Gynecol Scand*. (2021) 100:571–8. doi: 10.1111/aogs.14043

44. Meherali S, Adewale B, Ali S, Kennedy M, Salami BO, Richter S, et al. Impact of the COVID-19 pandemic on adolescents' sexual and reproductive health in low- and middle-income countries. *Int J Environ Res Public Health*. (2021) 18:13221. doi: 10.3390/ijerph182413221

45. Polis CB, Biddlecom A, Singh S, Ushie BA, Rosman L, Saad A. Impacts of COVID-19 on contraceptive and abortion services in low-and middle-income countries: a scoping review. *Sexual Reprod Health Matters*. (2022) 30:2098557. doi: 10.1080/26410397.2022.2098557

46. Michael TO, Agbana RD, Ojo TF, Kukoyi OB, Ekpenyong AS, Ukwandu D. COVID-19 pandemic and unmet need for family planning in Nigeria. *Pan Afr Med J*. (2021) 40:186. doi: 10.11604/pamj.2021.40.186.27656

47. Organization WH. *Impact of Covid-19 on SRMNCAH Services, Regional Strategies, Solutions and Innovations: A Comprehensive Report*. Geneva (2020).

48. Sánchez SM, Rivera-Montero D, Murad-Rivera R, Calderón-Jaramillo M, Roldán D, Castaño LM, et al. Changes COVID-19 post-quarantine behaviors, hygiene and expectations in Colombia: population survey from 1st to 13th September, 2020. *medRxiv*. (2020) 2020:20239442. doi: 10.1101/2020.11.26.20239442

49. Bukuluki P, Kisaakye P, Mulekya F, Mushomi J, Mayora C, Palattiyil G, et al. Disruption in accessing sexual and reproductive health services among border populations during COVID-19 lockdown in Uganda. *J Glob Health*. (2022) 12:04065. doi: 10.7189/jogh.12.04065

50. Vora KS, Saiyed S, Natesan S. Impact of COVID-19 on family planning services in India. *Sexual Reprod Health Matters*. (2020) 28:1785378. doi: 10.1080/26410397.2020.1785378

51. Le Guen M, Ventola C, Bohet A, Moreau C, Bajos N. Men's contraceptive practices in France: evidence of male involvement in family planning. *Contraception*. (2015) 92:46–54. doi: 10.1016/j.contraception.2015.03.011

52. Schrager SM, Olson J, Beharry M, Belzer M, Goldsich K, Desai M, et al. Young men and the morning after: a missed opportunity for emergency contraception provision? *J Fam Plann Reprod Health Care*. (2015) 41:33–7. doi: 10.1136/jfprhc-2013-100617

53. Rehnstrom Loi U, Lindgren M, Faxelid E, Oguttu M, Klingberg-Allvin M. Decision-making preceding induced abortion: a qualitative study of women's experiences in Kisumu, Kenya. *Reprod Health*. (2018) 15:166. doi: 10.1186/s12978-018-0612-6

54. Thummalachetty N, Mathur S, Mullinax M, DeCosta K, Nakyanjo N, Lutalo T, et al. Contraceptive knowledge, perceptions, and concerns among men in Uganda. *BMC Public Health*. (2017) 17:1–9. doi: 10.1186/s12889-017-4815-5

55. Haakenstad A, Angelino O, Irvine CMS, Bhutta ZA, Bienhoff K, Bintz C, et al. Measuring contraceptive method mix, prevalence, and demand satisfied by age and marital status in 204 countries and territories, 1970-2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet*. (2022) 400:295–327. doi: 10.1016/S0140-6736(22)00936-9

56. Haffejee F, O'Connor L, Govender N, Reddy P, Sibiya MN, Ghuman S, et al. Factors associated with unintended pregnancy among women attending a public health facility in KwaZulu-Natal, South Africa. *South Afri Fam Practice*. (2017) 60:79–83. doi: 10.1080/20786190.2017.1396790

57. Liang M, Simelane S, Fillo GF, Chalasani S, Weny K, Canelos PS, et al. The state of adolescent sexual and reproductive health. *J Adolesc Health*. (2019) 65:S3–S15. doi: 10.1016/j.jadohealth.2019.09.015

58. Sarder A, Islam SMS, Talukder A, Ahammed B. Prevalence of unintended pregnancy and its associated factors: evidence from six south Asian countries. *PLoS ONE*. (2021) 16:e0245923. doi: 10.1371/journal.pone.0245923

59. Lopez LM, Grey TW, Tolley EE, Chen M. Brief educational strategies for improving contraception use in young people. *Cochr Database Systemat Rev*. (2016) 3:CD012025. doi: 10.1002/14651858.CD012025.pub2

60. Xie K, Zhang W, Fang W, Lian Y, Lin S, Fang J. The analgesic efficacy of oxycodone hydrochloride versus fentanyl during outpatient artificial abortion operation: a randomized trial. *Medicine.* (2017) 96:e7376. doi: 10.1097/MD.0000000000007376

61. Irani L, Speizer IS, Fotso J-C. Couple characteristics and contraceptive use among women and their partners in urban Kenya. *Int Perspect Sex Reprod Health.* (2014) 40:11. doi: 10.1363/4001114

62. Cavazos-Rehg PA, Krauss MJ, Spitznagel EL, Schootman M, Bucholz KK, Peipert JF, et al. Age of sexual debut among US adolescents. *Contraception.* (2009) 80:158–62. doi: 10.1016/j.contraception.2009.02.014

63. McGrath N, Nyirenda M, Hosegood V, Newell M-L. Age at first sex in rural South Africa. *Sex Transm Infect.* (2009) 85:i49–55. doi: 10.1136/sti.2008.033324

64. Wellings K, Collumbien M, Slaymaker E, Singh S, Hodges Z, Patel D, et al. Sexual behaviour in context: a global perspective. *Lancet.* (2006) 368:1706–28. doi: 10.1016/S0140-6736(06)69479-8

65. Zaba B, Pisani E, Slaymaker E, Boerma JT. Age at first sex: understanding recent trends in African demographic surveys. *Sex Transm Infect.* (2004) 80:ii28–35. doi: 10.1136/sti.2004.012674

66. Slaymaker E, Bwanika JB, Kasamba I, Lutalo T, Maher D, Todd J. Trends in age at first sex in Uganda: evidence from Demographic and Health Survey data and longitudinal cohorts in Masaka and Rakai. *Sex Transm Infect.* (2009) 85:i12–9. doi: 10.1136/sti.2008.034009

67. Finer LB. Trends in premarital sex in the United States, 1954–2003. *Public Health Rep.* (2007) 122:73–8. doi: 10.1177/003335490712200110

68. Yu J. Teenage sexual attitudes and behaviour in China: a literature review. *Health Soc Care Community.* (2012) 20:561–82. doi: 10.1111/j.1365-2524.2011.01054.x

69. Burke L, Nic Gabhainn S, Kelly C. Socio-demographic, health and lifestyle factors influencing age of sexual initiation among adolescents. *Int J Environ Res Public Health.* (2018) 15:1851. doi: 10.3390/ijerph15091851

70. Christin-Maitre S. History of oral contraceptive drugs and their use worldwide. Best practice and research. *Clin Endocrinol Metabol.* (2013) 27:3–12. doi: 10.1016/j.beem.2012.11.004

71. Sanga K, Mola G, Wattimena J, Justesen A, Black IK. Unintended pregnancy amongst women attending antenatal clinics at the Port Moresby General Hospital. *Austr N Zeal J Obstetr Gynaecol.* (2014) 54:360–5. doi: 10.1111/ajo.12219

72. Exavery A, Kanté AM, Njozi M, Tani K, Doctor HV, Hingora A, et al. Predictors of mistimed, and unwanted pregnancies among women of childbearing age in Rufiji, Kilombero, and Ulanga districts of Tanzania. *Reprod Health.* (2014) 11:1–9. doi: 10.1186/1742-4755-11-63

73. Shu C, Fu A, Lu J, Yin M, Chen Y, Qin T, et al. Association between age at first sexual intercourse and knowledge, attitudes and practices regarding reproductive health and unplanned pregnancy: a cross-sectional study. *Public Health.* (2016) 135:104–13. doi: 10.1016/j.puhe.2016.01.021

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The effect of community-based health education programs on health literacy in severely impoverished counties in Southwestern China: Results from a quasi-experimental design

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Background: A national health education program in impoverished counties to promote health literacy among rural populations was released by the Chinese government in 2018. Under this nationwide campaign, an integrated health education program was implemented in Yunnan province, which included additional culturally sensitive educational components for the severely impoverished prefectures.

Objective: This study examined the differential effects of the health education program models on health literacy outcomes among residents in poverty-stricken areas.

Methods: A quasi-experimental design was applied with two arms that included surveys at baseline (in October 2019) and endline (in June 2021) to collect a range of individual-level health information, including the Chinese Resident Health Literacy Scale. The intervention group received the national health education program with the additional Yunnan specific program; the control group received only the national program. Respondents were recruited *via* a multi-stage stratified sampling, including 641 participants at baseline (261 from the intervention sites and 380 from the control sites) and 693 participants at endline (288 from the intervention sites and 405 from the control sites). Chi-square and logistic regression analyses were performed to examine the association between program intervention and health literacy outcomes.

Results: The overall health literacy levels were low (1.87%) at baseline, and there was no statistically significant difference between two groups (1.92 vs. 1.84%, $P = 1.000$). A significant increase (from 1.87 to 11.11%, $P < 0.001$) in the health literacy level was observed at endline in both groups. The magnitude of increase was significantly greater in the intervention group relative to the control group (17.71 vs. 6.42%, $P < 0.001$). Adjusting for the confounding

factors of individual and household characteristics, results from multivariate logistic regression revealed that the odds of having adequate health literacy among participants who received both the National Program and the Yunnan Program were 3.92 times higher than those who only received the National Program (95% CI: 2.10–7.33).

Conclusion: The findings highlighted the importance of incorporating non-verbal visual aids and culturally-sensitive media tools in health literacy education to address healthy lifestyle and the living contexts of the populations in poverty-stricken areas.

KEYWORDS

health education, health literacy, poverty alleviation, quasi-experimental study, Southwestern China

1. Introduction

Health literacy, as defined by the World Health Organization (WHO), indicates a set of knowledge, cognition, and skills that determine the motivation and ability of individuals to function effectively in maintaining and promoting health (1). A growing body of evidence has demonstrated that low health literacy is associated with poorer overall health status and higher mortality (2). People with higher levels of health literacy are more likely to use preventive health care (3) or alternative therapies (4). They are more capable of applying their knowledge and skills into health practices, thereby reducing risk of disease (5). Consequently, improving health literacy is perceived as an effective approach for raising health awareness, promoting healthy lifestyles, and improving health outcomes. Enhancing health literacy in populations through evidence-based education and lifelong learning empowers target populations and improves health equity (6). Furthermore, improving health literacy in under-resourced populations particularly contributes to alleviating poverty in developing countries (7, 8).

In China, initial interest in health literacy arose from the *Health Education and Health Promotion Guidelines (2005–2010)* issued in 2005 by the National Health Commission (9). These guidelines officially defined health literacy for the first time in China as having knowledge, skills and behaviors for personal health maintenance (9). Afterwards, the National Health Commission proposed the outline of "Chinese Resident Health Literacy-Basic Knowledge and Skills" in 2008 (10), and a nationwide survey entitled *National Heath Literacy Surveillance* (NHLS) was subsequently conducted (11) to assess the health literacy level of Chinese residents annually. In this survey, adequate health literacy was defined as correct answers to at least 80% of health literacy scale items. According to the results from the previous NHLS survey rounds, the health literacy rate of Chinese residents has increased steadily from 6.48% in 2008 to 14.18% in 2017 as a result of the nationwide health education campaigns (12). However, a significant rural-urban disparity and regional gaps in health literacy persists. Findings from the 2017 NHLS survey demonstrated a much higher health literacy rate among urban residents (19.22%) than among rural residents (10.64%). Furthermore, the health literacy rate among residents in the eastern region was higher (18.71%) than the rate (9.88%) in the western region (12). Other studies revealed that residents living in rural areas and those with low-income levels experienced severe challenges related to low health literacy, such as difficulty accessing health information and services (13–15).

In recent decades, a growing size of literature has focused on health literacy among populations worldwide (16, 17) and effective interventions to improve health literacy (18). Overall, the existing evidence supports the view that health literacy is a knowledge and skill-based capacity which can be improved through health education interventions (19) in both community-based and clinical settings (20). The effectiveness of health literacy interventions varied by locales, program design and settings in which they were implemented (21–23). While some health education programs adopted a single strategy, such as group-based intervention (24, 25) and individual contact (26, 27), other programs pursued an integrated approach to combine multiple medias and learning methods to improve efficiency and overall impact (28). A systematic review covering 27 randomized controlled trials (RCTs), 2 cluster RCTs, and 13 quasi-experimental designs on health literacy interventions revealed that programs using mixed intervention approaches had moderate effectiveness in improving knowledge, self-efficacy, adherence, quality of life and health care utilization, while the strength of evidence for single-feature interventions was low or insufficient (29).

The government of China announced a major stride in its roadmap of poverty elimination in 2012 after the 18th National Congress of the Communist Party. Targeted poverty alleviation was implemented in unprecedented scale and intensity to achieve the target of eradicating extreme poverty by 2020 (30).

Although remarkable achievements had been made from 2013 to 2017, about 30 million populations in rural areas remained in poverty at the end of 2017 with 36.64% of them living in poverty due to illness (31). Recognizing the potential of health promotion in breaking the link between ill-health and poverty (7), the National Health Commission and the State Council Poverty Alleviation Office of China jointly released a national health education program in impoverished counties in 2018 to promote health literacy among rural population (32).

Yunnan province is located in the Southwest of China where 25 indigenous ethnic minorities reside. By the end of 2020, the size of population in Yunnan was 48.58 million, among which 33.6% (16.21 million) were ethnic minorities (33). According to the *Outline for Development-oriented Poverty Alleviation of China's Rural Areas (2001–2010),* 88 counties were categorized as national-level poverty-stricken counties in Yunnan, accounting for 10.5% of the 832 poverty-stricken counties in China. Among the 88 counties, over 30% (27 counties) were further identified as severely impoverished counties (34), according to the *Implementation Opinions on Supporting Poverty Alleviation Effort in Severely Impoverished Regions* issued in 2017 by the General Office of the CPC Central Committee and the General Office of the State Council, which further categorized counties with an average poverty headcount ratio of more than 18% as severely impoverished counties. As a part of the national health education program targeting impoverished counties, the Yunnan Provincial Health Commission designed and implemented a specific health education program with an additional set of culturally sensitive educational components in 2019 in Nujiang and Shangri-La, two prefectures with high concentrations of ethnic minorities and severely impoverished counties.

In this study, we examined the effectiveness of the health education intervention and the differential effect of the program models on health literacy among residents in poverty-stricken areas in Southwestern China. We hypothesized that targeted health interventions which incorporated culturally sensitive features to address the low level of educational attainment and different cultural backgrounds would be more effective, relative to the standard national program, in improving health literacy of people living in poverty.

2. Methods

2.1. Study design

We used a quasi-experimental design which included two arms (an intervention group and a control group) and two rounds of survey data collection at baseline (in October 2019) and endline (in June 2021, 6 months after the one-year interventions). In the control group, participants were selected from poverty-stricken counties in 3 provinces in Southwestern China (including Yunnan, Guizhou and Sichuan) where the standard national health education program was implemented. In the intervention group, participants were selected from Nujiang and Shangri-La prefectures in Yunnan where the national program was implemented with additional culturally sensitive health education components. Ethical approval was obtained from Ethics Committee of the Kunming Medical University's Institutional Review Board.

2.2. Interventions

As mentioned above, to facilitate the Three-Year Action Plan for Poverty Elimination initiated by the Chinese Government between 2018 and 2020, the National Health Commission and the State Council Poverty Alleviation Office jointly announced a national health education program (hereinafter referred to as the National Program) in impoverished rural areas in October 2018 to improve health literacy levels of the rural residents living under the poverty line (32). The proportions of rural residents with adequate health literacy were only 5.03% in Nujiang Prefecture and 6.31% in Shangri-La Prefecture in 2018. Those percentages were far behind the national average level of 17.06% in 2018 (35). The Yunnan Provincial Health Commission designed and implemented an additional set of culturally sensitive health education components (hereinafter referred to as the Yunnan Program) in these two prefectures during 2019–2020 to improve health literacy and reduce illness-related poverty (36).

The differences between the National Program and the Yunnan Program are presented in Table 1, using Lasswell's Model of Communication which includes five key components: communicator (Who?), message (Said what?), medium (In which channel?), audience (To whom?) and effect (With what effect?) (37, 38). In the National Program, the health education team was composed mainly of trained village leaders, and primary health workers. These professionals disseminated health information developed by the national health programs for poverty alleviation at villages, households, and schools. These educational efforts included delivering lectures, pamphlets, training sessions for family members, bulletin boards, quiz competitions, public service announcements, and distribution of practical tools to promote healthy lifestyles. The specific health education materials delivered was determined by the health needs of targeted populations, which mainly included rural residents and students. Under the Targeted Poverty Alleviation Strategy, population-based household surveys at different levels were used to examine the health status and health needs of population living in poverty to inform the design of targeted health education intervention.

In contrast to the National Program, the Yunnan Program established a professional team consisting of health specialists

TABLE 1 Characteristics of two health education programs by Lasswell's model.

Components	National health education program		Yunnan specific health education program	
	Strategy	Details	Strategy	Details
Communicator	Trained village leaders and primary healthcare workers	Visits to villages, households, and schools visits	Health specialists from prefecture- and county-levels	Covered through lecture tours across prefectures
Message	Wide range of knowledge	• National health programs for poverty alleviation • The 66 health facts summarized by National Health Commission • Prevention and control of endemic diseases	Knowledge focused on healthy lifestyle	• Healthy diet • Weight management • Physical activity • Smoking cessation • Alcohol abstinence • Mental health • Rational use of medications • Prevention and control of chronic diseases
Medium	• A wide range of activities covering all impoverished villages, families, residents and students • Materials varied for different targeted populations	• For each village, at least one lecture every 2 months and at least one health bulletin board updated every 3 months • For each family, at least one leaflet and one practical tool distributed to promote one healthy lifestyle, and at least one family member trained • For each school in impoverished areas, health education curricula offered and quiz competitions held	• Culturally sensitive health education materials • Audio-visual materials in ethnic minority languages • Health-promotion settings	• "Healthy China" lecture covered at least 3,000 people in each county • Radio dramas in ethnic minority languages • Public-interest advertisements in ethnic minority languages
Audience	Impoverished rural residents and students	• All impoverished villages and families covered • 50% of primary and secondary schools in impoverished areas covered	• Government officials, medical doctors, and school teachers • Impoverished rural residents and students	• Government officials, medical doctors, and school teachers at county level • All impoverished villages and families covered • 50% of primary and secondary schools in impoverished areas covered
Effect	Improve health literacy levels among residents in poverty-stricken areas by 60% from 2018 to 2020		Raise the health literacy rate among local residents by 16% in 2020 in line with the provincial goal	

from prefecture- and county-levels who directly conducted lecture tours across Nujiang Prefecture and Shangri-La Prefecture. A set of culturally sensitive health education materials was designed and implemented delivered to address healthy lifestyles, including healthy diet, weight management, physical activity, smoking cessation, alcohol abstinence, mental health, appropriate use of medicines, and chronic diseases prevention and control. Furthermore, audio-visual materials with the same contents were developed not only in Mandarin but also in various ethnic minority languages (e.g., Lisu, Dulong, and Zang). In addition to serving rural residents and students living in poverty, the Yunnan program also targeted the local government officials, medical doctors, and schoolteachers in the target audience to foster a friendly and supportive educational environment.

2.3. Participants and sampling

Baseline and endline household health literacy surveys were administered in the study sites through face-to-face interviews with trained researchers. Eligible participants were rural residents aged 15–69 years old who had stayed in the project sites for more than 6 months before the baseline survey. Those who had severe mental illness and intellectual disabilities were excluded. We conducted power analysis to estimate the sample size required to capture the anticipated effect size. The result indicated that a sample size of 500 participants, 250 in each arm, was sufficient to detect a difference of 6% between groups in health literacy score using a two-tailed z-test of proportions between two groups with 80% power and a 5% level of significance.

A multi-stage stratified sampling was adopted to select survey participants consistently for the intervention and control groups at the program sties. Firstly, three prefectures from Yunnan, Guizhou and Sichuan provinces in Southwestern China which shared similar geographical conditions and socioeconomic characteristics to Nujiang and Shangri-La (the intervention group) were selected for the control group Secondly, one severely impoverished county was randomly selected from each of the five prefectures by using a random number table. Then, two townships from each county, two villages from each township, and 35 households from each village were randomly selected. Thirdly, the Kish Grid was used to randomly choose an eligible participant for the survey.

2.4. Data collections

Data collection was implemented by post-graduate students who were trained as the survey interviewers. Baseline data were collected in October 2019 in the selected villages and households *via* a questionnaire administered face-to-face by the interviewers. Each interview took ∼40-min. A total of 746 residents were invited, and 641 completed the survey, including 261 in the intervention group and 380 in the control group. The response rate of the 2019 baseline survey was 85.92%. About 6 months after the 1-year interventions, an endline survey was conducted in June 2021 at the selected program sites following the same sampling procedure. A total of 796 participants were invited and 693 completed the survey, including 288 individuals from the intervention group and 405 individuals from the control group. The survey response rate was 87.06% in 2021. All participants were fully informed about this study and gave written consent. To ensure confidentiality, data collected in this project were saved in password-locked computers and only accessible to the research team.

2.5. Measurements

The Chinese Resident Health Literacy Scale developed by the Chinese Ministry of Health in 2012 was adopted for both the pre- and post-intervention surveys (39). The scale has been assessed in previous studies and was proven to be valid and reliable in the contemporary social contexts in China (39). It included 50 items, which consisted of three dimensions [knowledge and attitudes (23 items), behavior and lifestyle (15 items), and health-related skills (12 items)] and six aspects [scientific views of health (8 items), infectious diseases (6 items), chronic diseases (9 items), safety and first aid (10 items), medical care (11 items), and health information (6 items)]. There were four types of questions: true-or-false, single-choice, multiple-choice and situation questions. A summary health literacy measure was calculated. Each correct answer of true-or-false, single-choice, or situation questions received 1 point; each correct answer for multiple-choice questions received 2 points. The final score ranged from 0 to 65 Adequate health literacy was defined as having correct answers to at least 80% of items across all dimensions and aspects of the health literacy scale items (39).

The survey also collected information on the socioeconomic and demographic characteristics of respondents, including gender (female or male), age (15–24, 25–44 or 45–69 years old), education (primary school, middle school or high school), marital status (single, married or separated/divorced/widowed), occupation (farmer or non-farmer), self-reported chronic medical conditions (yes or no) and household net income per capita ($<$10,800 or $\geq$10,800 Chinese Yuan). The cutoff point, 10,800 Chinese Yuan, was the national average household net income per capital in 2020 (40).

2.6. Statistical analyses

The Pearson chi-square test and Fisher's exact test were performed to compare the differences in socioeconomic characteristics and proportions of participants with adequate health literacy between two groups before and after intervention. Multivariate logistic regression models were performed to examine the differences in health literacy outcomes at endline between individuals who participated in the standard National Program only vs. participating in the additional Yunnan Program, adjusting for confounding factors at individual-level (including sex, age, education level, marital status, occupation, chronic disease history, and living standard) and household-level (including household income, occupation and education level of family members). The results were presented as *odds ratios* (*ORs*) with 95% *confidence intervals* (*CIs*). The log-likelihood value and R-squared value were calculated to measure the goodness of fit of the regression models. All statistical analyses were performed by using Stata 17.0. The significance level was at *P*-value $<$0.05 for all statistical tests.

3. Results

Table 2 presents the background socioeconomic and demographic characteristics between the two study groups at baseline and endline. At baseline, about half of the participants were male (48.05%) and half were between 45 and 69 years old (48.99%). The vast majority were married (79.72%), had less than middle school education (67.71%); and were farmers (77.07%). A significant proportion (14.66%) reported having at least one chronic disease. More than half were living under the national poverty line (57.10%). The vast majority (82.53%) had a household net income per capita below 10,800 Chinese Yuan (approximately equal to $1,563 USD). Few had a family

TABLE 2 Differences in socioeconomic and demographic profiles between intervention and control groups at baseline and endline.

Background characteristics	Baseline (2019)				Endline (2021)				χ^2 (*P*)
	All $n = 641$ %	Intervention group $n = 261$ %	Control group $n = 380$ %	χ^2 (*P*)	All $n = 693$ %	Intervention group $n = 288$ %	Control group $n = 405$ %	χ^2 (*P*)	
Gender									
Male	48.05	49.81	46.84	0.545 (0.460)	46.75	44.44	48.40	1.055 (0.304)	0.225 (0.636)
Female	51.95	50.19	53.16		53.25	55.56	51.60		
Age group									
15–24	11.39	12.04	12.37	1.381 (0.501)	12.41	10.76	13.58	2.113 (0.348)	3.514 (0.173)
25–44	39.63	46.76	40.26		43.72	46.53	41.73		
45–69	48.99	62.04	47.37		43.87	42.71	44.69		
Education level									
Primary school or below	67.71	62.45	71.32	5.681 (0.058)	64.79	61.11	67.41	3.323 (0.190)	1.836 (0.399)
Middle school	22.78	26.05	20.53		23.67	25.35	22.47		
High school/technical school or above	9.52	11.49	8.16		11.54	13.54	10.12		
Marital status									
Single (never married)	11.86	12.26	11.58	1.504 (0.471)	10.82	13.19	9.14	11.527** (0.003)	0.441 (0.802)
Married	79.72	77.78	81.05		81.10	75.35	85.19		
Separated/divorced/ widowed	8.42	9.96	7.37		8.08	11.46	5.68		
Occupation									
Farmer	77.07	81.99	73.68	6.043* (0.014)	78.07	76.04	79.51	1.18 (0.277)	0.191 (0.662)
Non-farmer	22.93	18.01	26.32		21.93	23.96	20.49		
Having any chronic disease									
No	85.34	80.46	88.68	8.363** (0.004)	80.52	73.96	85.19	13.525*** (<0.001)	5.431* (0.020)
Yes	14.66	19.54	11.32		19.48	26.04	14.81		
Living under national poverty line									
No	42.90	41.38	43.95	0.417 (0.519)	42.57	45.14	40.74	1.332 (0.248)	0.015 (0.902)
Yes	57.10	58.62	56.05		57.43	54.86	59.26		
Household net income per capita (in Chinese Yuan)[a]									
<10,800	82.53	81.99	82.89	0.0874 (0.768)	52.53	48.26	55.56	3.5887 (0.058)	135.444*** (<0.001)
≥10,800	17.47	18.01	17.11		47.47	51.74	44.44		
Any family member working in government sector									
No	92.98	91.19	94.21	2.166 (0.141)	91.05	90.97	91.11	0.004 (0.950)	1.675 (0.196)
Yes	7.02	8.81	5.79		8.95	9.03	8.89		

(Continued)

TABLE 2 (Continued)

Background characteristics	Baseline (2019)				Endline (2021)				χ^2 (*P*)
	All $n = 641$ %	Intervention group $n = 261$ %	Control group $n = 380$ %	χ^2 (*P*)	All $n = 693$ %	Intervention group $n = 288$ %	Control group $n = 405$ %	χ^2 (*P*)	
Any female adult with middle school education or above									
No	50.39	50.57	50.26	0.006 (0.938)	49.06	47.22	50.37	0.667 (0.414)	0.235 (0.628)
Yes	49.61	49.43	49.74		50.94	52.78	49.63		
The highest education level among family members									
Primary school or below	24.80	22.99	26.05	1.335 (0.513)	25.69	21.53	28.64	4.601 (0.100)	1.751 (0.417)
Middle school	32.92	32.18	33.42		29.58	31.94	27.90		
High school/technical school or above	42.28	44.83	40.53		44.73	46.53	43.46		

[a]The cutoff point, 10,800 Chinese Yuan was the national average household net income per capital in 2020 (40).
Significance levels: $^{*}P < 0.05$, $^{**}P < 0.01$, $^{***}P < 0.001$.

member working in government sector (7.02%). Less than half (49.61%) had a female adult family member who received middle school education and above; and had any family member (42.28%) who received with a high school education or above. The background characteristics of the intervention and control groups were similar, except that there were a higher proportion of farmers (81.99 vs. 73.68%, $P = 0.014$) and a higher percentage of respondents who reported that they had at least one chronic disease in the intervention group, relative to the control group (19.54 vs. 11.32%, $P = 0.004$).

Results in Table 2 indicated no significant differences in the background characteristics between baseline and endline survey participants in terms of sex, age, education, marital status, occupation, and characteristics of family members. A higher proportion of participants reported having at least one chronic disease at endline, relative to baseline (19.48 vs. 14.66%, respectively $P = 0.020$). The proportion of participants who reported that the household net income per capita was more than 10,800 Chinese Yuan in 2021 increased from 17.47% at baseline to 47.47% at endline ($P < 0.001$).

Results presented in Table 2 also indicated that participants in intervention group and control groups at endline were similar in most of the background characteristics; except that a higher proportion of the respondents were married in the control group (85.19%) relative to the intervention group (75.35%; $P = 0.003$). A higher proportion of respondents in the intervention group reported having at least one chronic disease condition (26.04%) relative to participants in the control group (14.81%, $P < 0.001$).

Results in Table 3 indicated that the overall level of having adequate health literacy (having a score of 80% or above on the health literacy scale) was very low (1.87%) among the survey participants at baseline. There was no statistically significant difference between the intervention group and control group (1.92 vs. 1.84%, respectively, $P = 1.000$). Regarding the three dimensions of health literacy, the level was the lowest (1.40%) for health-related skills, followed by behaviors and lifestyles (5.46%) and knowledge and attitudes (9.36%). As for the six aspects of health literacy, the level was the lowest for health information (2.34%), and the highest for scientific views of health (19.50%). There was no statistically significant difference between the intervention and control groups in the levels and patterns of health literacy as measured by the three dimensions and six aspects of health literacy.

Results in Table 3 indicated statistically significant increases in the overall level of having adequate health literacy from baseline to endline among participants in both the intervention control groups. While the level of having adequate health literacy increased from 1.84% at baseline to 6.42% at endline in the control group, the magnitude of increase was much larger in the intervention group (from 1.92% at baseline to 17.71% at endline, $P < 0.001$). The proportion of participants who had adequate health literacy in the intervention group was 11.29% higher than the control group (17.71 vs. 6.42%, respectively $P < 0.001$) at endline, indicating that the culturally sensitive additions in the Yunnan Program increased the effectiveness of the health literacy intervention among the indigenous population living in poverty-stricken areas in Yunnan.

Regarding the three dimensions of health literacy, the level of increase for the total sample was the highest for behavior and lifestyle (from 5.46 to 25.25%, $P < 0.001$) and the lowest for health-related skills (from 1.40 to 5.19%, $P < 0.001$). As for the six aspects of health literacy, the largest increase from baseline to end-line was the level of awareness of safety and first aid (from 19.50 to 46.90%, $P < 0.001$); followed by scientific views of

TABLE 3 Differences in health literacy levels between the intervention and control groups at baseline and endline.

Health literacy	Baseline (2019)				Endline (2021)				χ^2 (*P*)
	All *n* = 641 %	Intervention group *n* = 261 %	Control group *n* = 380 %	χ^2/Fisher (*P*)	All *n* = 693 %	Intervention group *n* = 288 %	Control group *n* = 405 %	χ^2 (*P*)	
The overall health literacy	1.87	1.92	1.84	–(1.000)[a]	11.11	17.71	6.42	21.716*** (<0.001)	45.650*** (<0.001)
Three dimensions									
Knowledge and attitudes	9.36	10.34	8.68	0.503 (0.478)	23.52	32.64	17.04	22.776*** (<0.001)	47.961*** (<0.001)
Behavior and lifestyle	5.46	6.13	5.00	0.383 (0.536)	25.25	34.03	19.01	20.104*** (<0.001)	98.346*** (<0.001)
Health-related skills	1.40	1.53	1.32	–(1.000)[a]	5.19	7.64	3.46	5.977** (0.014)	14.680*** (<0.001)
Six aspects									
Scientific views of health	19.50	22.22	17.63	2.077 (0.150)	46.90	59.38	38.02	30.807*** (<0.001)	111.810*** (<0.001)
Infectious disease	2.96	3.45	2.63	0.359 (0.549)	8.51	10.07	7.41	1.531 (0.216)	18.629*** (<0.001)
Chronic disease	12.48	14.18	11.32	1.159 (0.282)	29.73	41.67	21.23	33.637*** (<0.001)	58.798*** (<0.001)
Safety and first aid	19.19	19.54	18.95	0.035 (0.851)	53.39	63.54	46.17	20.404*** (<0.001)	167.192*** (<0.001)
Medical care	4.99	4.98	5.00	<0.001 (0.991)	26.41	32.64	21.98	9.848** (0.002)	112.955*** (<0.001)
Health information	2.34	2.68	2.11	0.225 (0.635)	4.33	5.56	3.46	1.790 (0.181)	4.041* (0.044)

[a]Fisher's exact test.
Significance levels: $^*P < 0.05$, $^{**}P < 0.01$, $^{***}P < 0.001$.

health (from 19.19 to 53.39%, $P < 0.001$); and medical care (from 4.99 to 26.41%, $P < 0.001$). There were statistically significant differences in health literacy between the intervention group and control group, with the largest gaps being for scientific views of health (38.02 vs. 59.38%, respectively, $P < 0.001$), followed by chronic diseases (21.23 vs. 41.67%, respectively, $P < 0.001$); and safety and first aid (46.17 vs. 63.54%, respectively, $P < 0.001$). On the other hand, the levels of health literacy were consistently lower for health information (2.34 vs. 4.33%, respectively,) and infectious diseases (2.96 vs. 8.51% respectively) at both baseline and endline for the overall sample. There was no statistically significant difference on the levels of these two health literacy measures between the intervention and control groups.

Results from logistic regression on the effect of the health education intervention on health literacy are presented in Table 4. Results in Model 1 showed the crude effect of health education intervention without adjusting for confounding factors. Relative to participants who only received the National Program, the odds of having adequate health literacy were over 3 times higher [crude *OR* (*COR*): 3.137; 95% CI: 1.904–5.169)] among participants who received both the National Program and the Yunnan Program which included additional culturally sensitive health education components..

In Model 2, after controlling for confounding variables of individual characteristics, such as gender age, education, marital status, occupation, health condition, and economic status, the adjusted odds ratio (AOR) for the effect of the Yunnan Program increased to 3.821 (95% CI: 2.066–7.069).

In Model 3, when the confounding factors of individual socioeconomic background and household characteristics (e.g., household net income per capita, having a family member working in the government sector, and educational attainment of family members) were further accounted for into the model, the odds of having adequate health literacy among those who received the combined intervention increased to 3.923 (95% CI: 2.101–7.327), relative to those participated in the National Program only.

According to the log-likelihood value and R-squared value, Model 3 (−153.218 and 0.366) was a better fit than Model 1 (−231.017 and 0.044) and Model 2 (−156.521 and 0.353). After

TABLE 4 The effect of program intervention on health literacy among residents in severely impoverished counties in Southwest China—results from logistic analysis.

Predictors	Model 1		Model 2		Model 3	
	Crude Odds Ratio	95% CI	Adjusted Odds Ratio	95% CI	Adjusted Odds Ratio	95% CI
Health education interventions						
National program only (Ref.)	1		1		1	
National and Yunnan program	3.137***	(1.904–5.169)	3.821***	(2.066–7.069)	3.923***	(2.101–7.327)
Gender						
Male (Ref.)			1		1	
Female			1.321	(0.719–2.428)	1.200	(0.627–2.294)
Age group						
15–24 (Ref.)			1		1	
25–44			3.938**	(1.584–9.792)	4.189**	(1.655–10.600)
45–69			1.230	(0.385–3.934)	1.231	(0.371–4.089)
Education level						
Primary school or below (Ref.)			1		1	
Middle school			12.258***	(5.342–28.127)	8.810***	(3.578–21.696)
High school/technical school or above			31.016***	(12.120–79.370)	26.597***	(9.235–76.606)
Marital status						
Single (never married) (Ref.)			1		1	
Married			1.075	(0.427–2.705)	0.915	(0.353–2.369)
Separated/divorced/widowed			1.660	(0.404–6.824)	1.450	(0.344–6.115)
Occupation						
Farmer (Ref.)			1		1	
Non-farmer			2.863**	(1.486–5.517)	2.824**	(1.428–5.583)
Having any chronic disease						
No (Ref.)			1		1	
Yes			0.574	(0.214–1.542)	0.544	(0.199–1.485)
Living under national poverty line						
No (Ref.)			1		1	
Yes			1.720	(0.899–3.289)	1.883	(0.966–3.670)
Household net income per capita (in Chinese Yuan)						
<10,800 (Ref.)					1	
≥10,800					1.768	(0.951–3.290)
Any family member working in government sector						
No (Ref.)					1	
Yes					0.897	(0.358–2.245)

(Continued)

TABLE 4 (Continued)

Predictors	Model 1		Model 2		Model 3	
	Crude Odds Ratio	95% CI	Adjusted Odds Ratio	95% CI	Adjusted Odds Ratio	95% CI
Any female adult with middle school education or above						
No (Ref.)					1	
Yes					1.500	(0.656–3.429)
The highest education level among family members						
Primary school or below (Ref.)					1	
Middle school					1.699	(0.473–6.100)
High school/technical school or above					1.216	(0.319–4.642)
Log likelihood	−231.017		−156.521		−153.218	
R-squared	0.044		0.353		0.366	

CI, Confidence Interval; Ref., reference group; Significance levels, $^{*}P < 0.05$, $^{**}P < 0.01$, $^{***}P < 0.001$.

controlling for confounding factors, individuals receiving both the National Program and the Yunnan Program were 3.923 times more likely to have adequate health literacy than those only receiving the National Program.

Individuals who were between 25 and 44 years old (AOR: 4.189; 95% CI: 1.655–10.600), were non-farmers (AOR: 2.824; 95% CI: 1.428–5.583), received a middle school (AOR: 8.810; 95% CI: 3.578–21.696), or had a high school education and above (AOR: 26.597; 95% CI: 9.235–76.606) had higher odds of having adequate health literacy relative to their counterparts.

4. Conclusion and discussion

This study employed a quasi-experimental design to evaluate the effect of two health education interventions on health literacy in severely impoverished counties in Southwestern China. It compared the effectiveness of the National Program and the Yunnan Program, the latter of which included an additional set of culturally sensitive health education components. Health literacy was assessed among residents living in the intervention sites and control sites at baseline and endline, using the Chinese Resident Health Literacy Scale to measure the level of overall health literacy, three dimensions and six aspects of health literacy. Statistical analyses were conducted to examine the differences in health literacy across subgroups and its variation over time from baseline to endline to inform the feasibility and effectiveness of two community-based health education programs. Findings showed that the overall health literacy in the intervention group improved significantly from 1.92% in 2019 to 17.71% in 2021, and the participants in the intervention group were 3.923 times more likely to have adequate health literacy than those in the control group. Findings indicated that a combined implementation of the standard National Program and the Yunnan Program was more effective than the implementation of the National Program only for improving health literacy in populations living in poverty-stricken rural areas in Southwestern China.

Of particular interest for this study is the fact that Yunnan Program was more effective in raising public health literacy in indigenous populations than the National Program only. While numerous studies have shown that health literacy can be enhanced through education or communication initiatives, there is relatively little research on interventions which evaluated program targeting populations in Southwestern China and how such interventions may be optimized with culturally sensitive services (20, 41). Findings from several systematic reviews indicated that differences in the health education communication constructs employed by an intervention program, such as types of content, media, communicators and receivers, affected health education outcomes (20, 29). Building upon the National Program, a set of culturally sensitive health education components was added to the Yunnan Program by the Yunnan Provincial Health Commission to address the low health literacy of residents in two severely impoverished prefectures. This additional protocol in the Yunnan Program aimed to develop a practical and feasible implementation model to accelerate the improvement of health literacy in local populations.

The design of Yunnan program followed the three well-defined guidelines for creating social epidemics described by Malcolm Gladwell (42). First, the Law of the Few states that the social epidemic is often initiated by a few motivated persons, such as mavens, connectors (i.e., those who can diffuse ideas

through extensive social networks) and salesmen. As mentioned above, an important difference between National Program and Yunnan Program lied in communicator selection. While the health education team was composed mainly of trained village leaders, and primary health workers in the National Program, the delivery of Yunnan program was led by health specialists from prefecture and county-levels who played an important role in the success of Yunnan Program. The effective implementation of health education depends on both knowledge dissemination and the practice of effective interpersonal communication. In rural areas, health workers at the village level may have difficulty accessing updated information. With the increase of basic medical care and public health services in rural China (43), it is difficult to carry out meaningful health education relying solely on village doctors. Even if essential training is provided to these personnel, the practical ability to carry out health education would not be developed in the short term. Currently, most health literacy interventions are developed and led by experienced physicians (i.e., mavens) in clinical settings rather than in population-based campaigns (20). Such professionally-designed programs often realize their intent to improve the health literacy of the target audience. In our study, the Yunnan Program also adopted this approach. By establishing a specialized team consisting of health specialists from prefecture- and county-levels, health education lectures were consistently carried out across the county. This specialized education team acted as mavens driving the spread of health knowledge as expected by the design of the Yunnan Program. Moreover, in addition to residents, the leading cadres, officials, teachers and medical doctors were also recruited as participants in the Yunnan Program. Due to their relatively high education background, these participants were more receptive to health knowledge. Additionally, the increased centrality in their social networks allowed them to play the role of "connectors" to facilitate the disseminating information in populations more widely and quickly. Thus, the employment of a professionally-developed program and the inclusion of motivated, well-connected individuals in the target group facilitated the rapid spread of educational material in the Yunnan Program.

The second prominent rule described by Gladwell is the "stickiness" of media applied by education programs, which describes the acceptability and understandability of messages among different audiences. Previous studies indicated a range of useful approaches which helped improve health education outcomes among populations with lower literacy levels, including adding video or oral communication (44, 45) or using less written narratives (46), providing culturally-appropriate health education materials (47) and using an integrated language learning curriculum for non-native language speakers (48). Our study identified education level as the most important factor affecting the level of health literacy. Most of the poor in our study sites had lower education levels, and many residents were ethnic minorities with different languages and cultures. In order to effectively spread health knowledge among such groups, the Yunnan Program employed radio dramas and advertisements with different versions of minority languages. These non-verbal and culturally-sensitive media focusing on promoting lifestyle modification were developed explicitly for low-literacy and low-acculturated populations to increase the "stickiness" of information, making health knowledge memorable and compelling.

The third rule addresses the social environment in which information and new ideas are transmitted. In the area of health promotion, settings-based approaches are often used to create supportive social environment. This type of approach was derived from an ecological perspective and "whole system thinking" that integrated health promotion concepts into the local cultural contexts and the routine living and working environments of the target audience (49). With the main purpose of developing broader corporate social responsibility, this healthy settings approach highlighted an empowerment strategy for health promotion (50). This settings-based approach offers an effective way to enhance the impact of health promotion projects through fostering leadership and advocacy in wider organizations (51). Under the Yunnan program, various institutions including hospitals, schools, government sectors and public spaces, were encouraged to create health-promoting settings in the project counties. The Yunnan Program focused on creating an inclusive and supportive environment where health can be defined, understood and promoted, going beyond of targeting individual skills and behaviors (52).

In terms of specific dimensions of health literacy, this study showed positive impacts of the combined interventions of the National and Yunnan Program particularly for chronic disease prevention and self-management in relation to a health-promoting lifestyle. These results are very encouraging but not surprising, given the fact that the added content for the Yunnan Program focused on lifestyle-oriented learning. At present, health education programs developed in many countries have shown good results, but most programs target highly specific topics, such as comprehending food labels (53) or promoting self-care among diabetic or cardiac patients (45). Compared with the National Program, the Yunnan Program prioritized healthy lifestyle promotion. As a result, after implementing the project, the improvement of health literacy in the dimensions of chronic diseases and healthy lifestyle was the highest, while the improvement of other health-related aspects was relatively modest, and health literacy on infectious diseases and health information were not equally improved. The results implied that a more targeted approach toward these aspects of health literacy may enhance the retention of this information.

As a final note, this study has three main limitations. Firstly, we employed a quasi-experiential design in this real-world implementation research to gauge the effectiveness of our

program services by comparing the differences in key health literacy outcomes over time and between groups. While we have adjusted a range of confounding factors in the regression models, there could be potential confounders that were not captured by the data we collected. The second limitation involved a lack of measurement to monitor the level and pattern of program engagement at the participant and community levels. We were unable to examine whether and how program engagement affected health literacy outcomes in the target population. It is emphasized by WHO and experts from the field that the empowerment of individuals and community in health promotion is critical for the success of health education program (41, 54, 55). We will incorporate the collection of engagement indicators in our future program to examine the effect of program engagement on health literacy outcomes. Another limitation of this study lied in that we were not able to collect survey data from individuals who were under the age of 15 or over the age of 70 due to the restrictions on visits to schools and the senior citizens living in the community during the COVID-19 pandemic. Findings from this analysis did not capture the effect of our healthy literacy intervention on these two subgroups of the population who were also exposed to program intervention at the program sites.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to dengruirita@126.com.

Author contributions

RD and YH conceptualized and designed the study. BL and YH conducted the statistical analyses. BL, RD, YH, and FJ drafted the initial manuscript. HF and CL edited and revised the manuscript. All authors interpreted the results and reviewed and approved the final manuscript as submitted.

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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. WHO. *Health Promotion Glossary*. (1998). Available online at: https://www.who.int/publications/i/item/WHO-HPR-HEP-98.1 (accessed June 16, 1998).

2. Berkman ND, Sheridan SL, Donahue KE, Halpern DJ, Crotty K. Low health literacy and health outcomes: an updated systematic review. *Ann Intern Med.* (2011) 155:97–107. doi: 10.7326/0003-4819-155-2-201107190-00005

3. Cho YI, Lee S-YD, Arozullah AM, Crittenden KS. Effects of health literacy on health status and health service utilization amongst the elderly. *Soc Sci Med.* (2008) 66:1809–16. doi: 10.1016/j.socscimed.2008.01.003

4. Gardiner P, Mitchell S, Filippelli AC, Sadikova E, White LF, Paasche-Orlow MK, et al. Health literacy and complementary and alternative medicine use among underserved inpatients in a safety net hospital. *J Health Commun.* (2013) 18:290–7. doi: 10.1080/10810730.2013.830663

5. Liu L. Qian x, Chen Z, He T. Health literacy and its effect on chronic disease prevention: evidences from China's data. *BMC Public Health.* (2020) 20:690. doi: 10.1186/s12889-020-08804-4

6. World Health Organizaiton. *Promoting Health in the Sdgs. Report on the 9th Global Conference for Health Promotion, Shanghai, China, 21–24 November 2016: All for Health, Health for All*. Geneva: World Health Organization (2017).

7. Whitehead M, Bird P. Breaking the poor health-poverty link in the 21st century: do health systems help or hinder? *Ann Trop Med Parasitol.* (2006) 100:389–99. doi: 10.1179/136485906X97363

8. Ogunsola LA. Health information literacy: a road map for poverty alleviation in the developing countries. *J Hosp Librariansh.* (2009) 9:59–72. doi: 10.1080/15323260802616977

9. Chinese Ministry of Health. *Health Education and Health Promotion Guidelines (2005–2010)*. (2005). Available online at: http://www.nhc.gov.cn/cms-search/xxgk/getManuscriptXxgk.htm?id=18190 (accessed February 4, 2005).

10. Chinese Ministry of Health. *Chinese Resident Health Literacy-Basic Knowledge and Skills (Trail)*. (2008).

11. State Council Information Office. *Chinese Ministry of Health "the First National Heath Literacy Surveillance" Press Conference*. (2009). Available online at: http://www.scio.gov.cn/xwfbh/gbwxwfbh/xwfbh/wsb/Document/498805/498805.htm (accessed December 21, 2009).

12. Lee B, Bai L, Wu K, Deng R. Difficulties and countermeasures of improving health literacy of residents in China. *Health Edu Health Promot.* (2021) 16:53–7. doi: 10.16117/j.cnki.31-1974/r.202101053

13. Wang W, Zhang Y, Lin B, Mei Y, Ping Z, Zhang Z. The urban-rural disparity in the status and risk factors of health literacy: a cross-sectional survey in central China. *Int J Environ Res Public Health.* (2020) 17:3848. doi: 10.3390/ijerph17113848

14. Xie Y, Ma M, Zhang Y, Tan X. Factors associated with health literacy in rural areas of central China: structural equation model. *BMC Health Serv Res.* (2019) 19:300. doi: 10.1186/s12913-019-4094-1

15. Chen W, Ren H, Wang N, Xiong Y, Xu F. The relationship between socioeconomic position and health literacy among urban and rural adults in regional China. *BMC Public Health.* (2021) 21:1–10. doi: 10.1186/s12889-021-10600-7

16. Pleasant A. Health literacy around the world: part 1. *Health Literacy Efforts Outside United States Health Literacy.* (2013) 1:97–203. doi: 10.17226/18325

17. Pleasant A. *Health Literacy Around the World: Part 2 Health Literacy Efforts Within the United States and a Global Overview.* Cleveland, OH: Institute of Medicine Roundtable on Health Literacy (2013).

18. Riemann L, Lubasch JS, Heep A, Ansmann L. The role of health literacy in health behavior, health service use, health outcomes, and empowerment in pediatric patients with chronic disease: a systematic review. *Int J Environ Res Public Health.* (2021) 18:12464. doi: 10.3390/ijerph182312464

19. Nutbeam D. Defining, measuring and improving health literacy. *Health Evaluat Promot.* (2015) 42:450–6. doi: 10.7143/jhep.42.450

20. Walters R, Leslie SJ, Polson R, Cusack T, Gorely T. Establishing the efficacy of interventions to improve health literacy and health behaviors: a systematic review. *BMC Public Health.* (2020) 20:1040. doi: 10.1186/s12889-020-08991-0

21. Liu YB Li YF, Liu L, Chen YL. Effectiveness of the teach-back method for improving the health literacy of senior citizens in nursing homes. *Jpn J Nursing Sci.* (2018) 15:195–202. doi: 10.1111/jjns.12192

22. Soto Mas F, Jacobson HE, Olivárez A. Adult education and the health literacy of hispanic immigrants in the United States. *J Latinos Edu.* (2017) 16:314–22. doi: 10.1080/15348431.2016.1247707

23. Zhuang R, Xiang Y, Han T, Yang G-A, Zhang Y. Cell phone–based health education messaging improves health literacy. *Afr Health Sci.* (2016) 16:311–8. doi: 10.4314/ahs.v16i1.41

24. Otilingam PG, Gatz M, Tello E, Escobar AJ, Goldstein A, Torres M, et al. Buenos Hábitos Alimenticios Para Una Buena Salud: evaluation of a nutrition education program to improve heart health and brain health in Latinas. *J Aging Health.* (2015) 27:177–92. doi: 10.1177/0898264314549660

25. Gharachourlo M, Mahmoodi Z, Kamrani MA, Tehranizadeh M, Kabir K. The effect of a health literacy approach to counselling on the lifestyle of women with gestational diabetes: a clinical trial. *F1000 Res.* (2018) 7:282. doi: 10.12688/f1000research.13838.1

26. Knudsen MV, Petersen AK, Angel S, Hjortdal VE, Maindal HT, Laustsen S. Tele-rehabilitation and hospital-based cardiac rehabilitation are comparable in increasing patient activation and health literacy: a pilot study. *Eur J Cardiovasc Nursing.* (2020) 19:376–85. doi: 10.1177/1474515119885325

27. Tai B-WB, Bae YH, LaRue CE, Law AV. Putting words into action: a simple focused education improves prescription label comprehension and functional health literacy. *J Am Pharm Assoc.* (2016) 56:145–52.e3. doi: 10.1016/j.japh.2015.12.010

28. Geboers B, Reijneveld SA, Koot JAR, de Winter AF. Moving towards a comprehensive approach for health literacy interventions: the development of a health literacy intervention model. *Int J Environ Res Public Health.* (2018) 15:1268. doi: 10.3390/ijerph15061268

29. Berkman ND, Sheridan SL, Donahue KE, Halpern DJ, Viera A, Crotty K, et al. Health literacy interventions and outcomes: an updated systematic review. *Evid Rep Technol Assess.* (2011) 199:1–941.

30. China's State Council Information Office. *Poverty Alleviation: China's Experience and Contribution*. Beijing: Foreign Languages Press Co. Ltd (2021).

31. He D. *Research Report on Health Poverty Alleviation in China*. Beijing: People's Publishing House (2019).

32. National Health Commission of China. *Three-Year Action Plan for Health Promotion in Impoverished Areas Program*. (2018). Available online at: http://www.gov.cn/zhengce/zhengceku/2018-12/31/content_5435465.htm (accessed October 19, 2018).

33. Yunnan Provincial People's Government. *Population and Ethnicity of Yunnan Province.* (2021). Available from: http://www.yn.gov.cn/yngk/gk/201904/t20190403_96251.html (accessed 21 June, 2022).

34. Government CL. Outline of poverty alleviation and development in China's rural areas (2001–2010). *Chin Law Government.* (2011) 44:10–20. doi: 10.2753/CLG0009-4609440601

35. The Central People's Government of the People's Republic of China. *National Urban and Rural Residents' Health Literacy Levels Increased to 17.06% in 2018, Showing a Steady Improvement*. (2019). Available online at: http://www.gov.cn/xinwen/2019-08/27/content_5425007.htm (accessed August 27, 2019).

36. Yunnan Provincial Health Commission. *Notice on the Issuance of the Implementation Plan of the Health Literacy Promotion Action Project in Yunnan Province in 2019*. (2019). Available online at: https://www.ynjkjy.com/detail/id/3719.html (accessed April 30, 2019).

37. Lasswell HD. The structure and function of communication in society. *Commun Ideas.* (1948) 37:136–9.

38. Sapienza ZS, Iyer N, Veenstra AS. Reading Lasswell's model of communication backward: three scholarly misconceptions. *Mass Commun Soc.* (2015) 18:599–622. doi: 10.1080/15205436.2015.1063666

39. China Health Education Center. *Heath Literacy Surveillance Report of Chinese Residents*. Beijing: People's Medical Publishing House Co. (2018).

40. The Central People's Government of the People's Republic of China. *The Information Office of the State Council Holds a Briefing on the White Paper "China's Practice of Human Poverty Reduction*. (2021). Available online at: http://www.gov.cn/xinwen/2021-04/07/content_5598151.htm (accessed April 7, 2021).

41. Nutbeam D, McGill B, Premkumar P. Improving health literacy in community populations: a review of progress. *Health Promot Int.* (2018) 33:901–11. doi: 10.1093/heapro/dax015

42. Gladwell M. *The Tipping Point: How Little Things Can Make a Big Difference: Little, Brown* (2006).

43. Zhao L. Healthcare reform and the development of China's rural healthcare: adecade's experience, development predicament and promotion of good governance. *Chin Rural Econ.* (2019) 9:48–69.

44. Volandes AE, Paasche-Orlow MK, Barry MJ, Gillick MR, Minaker KL, Chang Y, et al. Video decision support tool for advance care planning in dementia: randomised controlled trial. *BMJ.* (2009) 338:b2159. doi: 10.1136/bmj.b2159

45. Eckman MH, Wise R, Leonard AC, Dixon E, Burrows C, Khan F, et al. Impact of health literacy on outcomes and effectiveness of an educational intervention in patients with chronic diseases. *Patient Educ Couns.* (2012) 87:143–51. doi: 10.1016/j.pec.2011.07.020

46. Koops van 't Jagt R, Winter A, Reijneveld SA, Hoeks J, Jansen CJM. Development of a communication intervention for older adults with limited health literacy: photo stories to support doctor–patient communication. *J Health Commun.* (2016) 21:69–82. doi: 10.1080/10810730.2016.1193918

47. Balcazar HG, Byrd TL, Ortiz M, Tondapu SR, Chavez M. A randomized community intervention to improve hypertension control among Mexican Americans: using the Promotoras de Salud community outreach model. *J Health Care Poor Underserved.* (2009) 20:1079–94. doi: 10.1353/hpu.0.0209

48. Soto Mas F, Ji M, Fuentes BO, Tinajero J. The health literacy and Esl study: a community-based intervention for Spanish-speaking adults. *J Health Commun.* (2015) 20:369–76. doi: 10.1080/10810730.2014.965368

49. Bloch P, Toft U, Reinbach H, Clausen LT, Mikkelsen B, Poulsen K, et al. Revitalizing the setting approach—Supersettings for sustainable impact in community health promotion. *Int. J. Behav. Nutrit. Phys. Activity.* (2014) 11:118. doi: 10.1186/s12966-014-0118-8

50. Dooris M. Health promoting settings: future directions. *Promot Educ.* (2006) 13:2–4. doi: 10.1177/10253823060130010101

51. Whitelaw S. Martin, Claudia, Kerr, Ann, et al. An evaluation of the health promoting health service framework: the implementation of a settings based approach within the Nhs in Scotland. *Health Promot Int.* (2006) 21:136–44. doi: 10.1093/heapro/dal009

52. Kokko S, Villberg KJ. The health promoting sports club in Finland—a challenge for the settings-based approach. *Health Promot Int.* (2006) 21:219–29. doi: 10.1093/heapro/dal013

53. Jay M, Adams J, Herring SJ, Gillespie C, Ark T, Feldman H, et al. A randomized trial of a brief multimedia intervention to improve comprehension of food labels. *Prevent Med.* (2009) 48:25–31. doi: 10.1016/j.ypmed.2008.10.011

54. Nutbeam D. Health literacy as a public health goal: a challenge for contemporary health education and communication strategies into the 21st century. *Health Promot Int.* (2000) 15:259–67. doi: 10.1093/heapro/15.3.259

55. World Health Organization. *Promoting Health: Guide to National Implementation of the Shanghai Declaration*. Geneva: World Health Organization (2018).

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Organ donation: Key factors influencing the younger generation's decision-making in China

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Background: The organ transplantation sector in China is facing a severe shortage of donors, and the organ donation rate needs to be increased. Since 2015, voluntary donation by citizens has become the only source of organs for transplantation in China. In recent years, there has been a relatively positive change in young people's attitudes toward organ donation after death. The aim of the study was to understand young people's perceptions and attitudes toward organ donation and the factors that influence them and can positively impact the promotion of organ donation.

Methods: By analyzing relevant literature and legal texts, we developed a questionnaire. Information was obtained through questionnaires and interviews, and 501 valid questionnaires were returned from the target group. A chi-square test was used to examine whether there were significant differences in the willingness to organ donation among young people with different characteristics. A factor analysis was used to investigate the main factors influencing the different attitudes of young people toward organ donation, and a one-way ANOVA was used to examine whether young people with different characteristics were affected differently by different factors.

Results: In our survey of young people aged 18–30 years, 99.2% of respondents knew about organ donation, 47.1% were willing to donate organs, and 15.2% understood that there were corresponding laws and regulations for organ donation. The study's findings showed that urban residents are more willing to be organ donators than rural residents; people with higher education levels have better awareness and are more willing to donate an organ; and people with religious beliefs are more likely to donate organs. The main factors that support the willingness of young people to donate are the social environment that provides support, their optimism in dealing with death, and their desire to realize their final value after death. The main factors for those unwilling to donate were low awareness or misconceptions about organ donation among individuals and their families and their attitudes toward death. As the people who took the questionnaire are probably interested in organ donation, the sample results will show a higher percentage of people who know about organ donation. We hope to discuss further with a larger and broader sample coverage to improve the estimates' validity and reflect the overall picture more accurately in a future study.

Conclusion: Young people knew about organ donation but had a low depth of awareness. Household registration type, education level, and religious affiliation significantly correlate with people's willingness to donate. The supportive environment for organ donation in society and the correct understanding of the organ donation process and laws and regulations can influence people's willingness to donate.

KEYWORDS

organ donation, willingness, factor analysis, the younger generation, China

1. Introduction

Organ transplantation is one of the most outstanding achievements of the 20th century. For patients suffering from end-stage organ diseases, organ transplantation gives them a chance to be "reborn." As the technology of organ transplantation gradually improved, the topic of organ donation has become a hot issue over the last decade in China. According to the National Health Commission of China, both the number of organ donations and the number of transplants in China have increased significantly from 2015 to 2018. In China, 2,766, 4,080, 5,146, and 6,302 organ donations were completed each year from 2015 to 2018. The number of organ transplants in China exceeded 20,000 in 2018, ranking second in the world regarding the number of operations performed. Furthermore, the survival rate of recipients after organ transplantation in China has reached an internationally advanced level. In 2018, the 1 and 3-year cumulative survival rates of recipients after living liver transplantation in China were 92.5 and 89.8%, respectively, which were close to the 1 and 3-year cumulative survival rates of recipients after living liver transplantation in the United States (92.3 and 88.4%). In 2018, the 1-year survival rate after heart transplantation in China was 90.8%, and the 1 and 3-year survival rates of recipients after kidney transplantation were 96.7 and 95.6%, both at the advanced international level. According to the latest data released by the China Organ Donation Management Center, as of 30 May 2021, 34,245 organ donors donated, and the number of registered organ volunteers in China was 3,296,260. As of 2020, the National Health Commission of China has recorded 170 medical institutions with qualifications for human organ transplantation and 33 training bases for human organ transplantation.

Although the number of those requiring organ transplants has grown rapidly, the number of those registered to donate organs remains very insufficient in comparison. According to IRODaT data (International Registry in Organ Donation and Transplantation, available at www.irodat.org), in 2021, the worldwide actual deceased organ donors' rate (number of donors per million people, "pmp" for short), the United States ranked first, 41.88; the United Kingdom, 20.12; and China, 3.63, and the worldwide living organ donors' rate (pmp), Turkey ranked first, 51.92; the United States, 19.75; the United Kingdom, 11.88; and China, 2.25. The gap between China and other countries is huge. In recent years, with the promulgation of a series of documents and norms such as the WHO Guidelines for Human Cell, Tissue and Organ Transplantation, the Declaration of Helsinki, the Regulations on Human Organ Transplantation in China, the Basic Principles of Human Organ Allocation and Sharing, and the Core Policy on Liver and Kidney Allocation and Sharing in China (Version 2010), organ donation has become much more standardized in China. People's awareness of organ donation has also increased. There is also a growing awareness and understanding of organ donation.

The Regulations on Human Organ Transplantation in China, which came into effect on 1 May 2007, stipulate that human organ donation shall be based on the principles of voluntariness and gratuitousness. Citizens have the right to donate or not donate their organs; no organization or individual may force, deceive, or induce others to donate their human organs. Voluntary organ donation in China began in 2010. Since 2015, voluntary donation by citizens has become the only source of organs for transplantation in China.

From December 2020 to April 2021, we surveyed the public's perceptions and attitudes toward organ donation in Chinese society, and this survey included people of all ages. This previous survey showed that the younger Chinese generation (18–30 years old) has a positive perception of organ donation, and the influencing factors are significantly different from the older generation. The aim of the study was to understand young people's perceptions and attitudes toward organ donation and the factors that influence them and can positively impact the promotion of organ donation.

2. Literature review

Regarding organ donation, most researchers currently focus on the following points: the public's knowledge about organ donation and their willingness to donate their organs, the key factors influencing families' decision-making regarding organ donation, and the rights of human organs and the ethical controversy of organ donation.

Since 2010, several studies have been conducted to investigate public attitudes toward organ donation in China (1, 2). Lei et al. (3), Liang et al. (4), Zhang et al. (5), and Long and Liu (6) specially selected a group of college students to study the young generation's attitude toward organ donation (3–6). Hu (7) conducted separate surveys on medical workers, medical students, and the general public to compare the differences in the perceptions, attitudes, and willingness to donate organs among these three groups in a cross-sectional manner (7). Lei et al. (3) administered questionnaire surveys to evaluate the different perspectives of medical students and non-medical students toward organ donation (3). In the United States, the study by Hafzalah assessed American Muslims' willingness to donate organs (8). They found that a lack of awareness of the support of Islam for organ donation and the fear of disfigurement have negatively affected organ donation willingness in Muslim communities. Kobus et al. studied the attitudes and opinions of Judaism's followers regarding organ donation (9). The results showed that most Jewish believers were willing to accept organ transplantation. More than 90% of those interviewed had a positive attitude toward organ transplantation. Kapikiran et al. investigated the knowledge and attitudes about organ donation from the perspective of liver transplant patients (10). The majority of respondents were willing to receive an organ donation as well as to donate an organ. Eventually, all the above studies will agree that awareness should be raised in society about organ donations.

Regarding the willingness of donor family members to donate organs and influencing factors, several studies focused on the key factors influencing families' decision-making regarding organ donation after the death of their family member (11, 12). They analyzed why parents of potential child donors declined to donate organs (13). These surveys showed that fear of surgical pain, disfigurement, and local customs are the main reasons parents of potential child donors refuse organ donation. A special study in Northwestern China concluded that popularizing organ donation knowledge and establishing reasonable compensation and incentive mechanisms may effectively increase the organ donation rate in the economically underdeveloped regions of China (14).

Zeng et al. (15) believed that critically ill patients were often potential organ donors; they surveyed the families of critically ill patients regarding their willingness to donate organs (15). The results showed that measurements such as reinforcement of propaganda

education, the incentive of altruistic behavior, and improvement of compensation and legislation systems might enhance public willingness to donate an organ. Zhang et al. (16) and Sun et al. (17) investigated local community residents' knowledge and attitudes toward organ donation. They found that among the many factors that affect people's willingness to donate organs, traditional Chinese cultural values are an essential factor (16, 17). Lin et al. (18) also found that family opposition is the biggest roadblock hindering organ donation (18). Qian et al. (19) also found that the main reason potential donors fail to register to donate an organ was family disapproval of such a donation (19). Flemming et al. (20) studied African-American perceptions of organ donation. They found that respondents were more likely to donate organs if they understood the pros and cons of organ donations (20).

Jurisprudents are more concerned about the rights of human organs, and social scholars are concerned about the ethical issues of organ donation. Wang (21) discussed the dual attributes of the rights of human organs and believed that the rights of human organs should not be artificially divided into two rights with entirely different attributes just because of "their separation from the human body" (21). Gong (22) proposed that in human organ transplantation, a legal system and an operational mechanism should be created which meet reality and maximize the life and health needs of human organ recipients under the premise of respecting the willingness of organ providers and under the constraints of the theories and jurisprudential principles of balanced protection of human rights, differentiation of value and interest levels, respect for life ethics, and balance of fairness and effectiveness concerning rights and interests (22). Li (23) discussed the liability for repentance and damage compensation for organ donation and argued that to avoid the arbitrary exercise of revocation and repentance by organ donors, which made the recipient an innocent victim in the act of repentance, the liability for compensation and damage compensation when the organ donor's repentance causes damage to the recipient needed to be determined (23). Chandler et al. investigated public reactions to giving prioritization in organ allocation to previously registered donors (24). Supporters justify priority systems because they are fair and will encourage donor registration. There are concerns about the social division that the priority system may cause. Li et al. explored the ethical review and supervision system of organ donation before and after citizen death in medical institutions (25). Yu et al. discussed the concept of incentives in organ donation. They provided an overview of regulations on organ donation by international organizations, focusing on the ethical issues involved in organ donation research and management (26). Luo et al. found that organ donor families were in desperate need of material and emotional support (27).

Although a series of policies have been issued worldwide to promote organ donation, the actual number of organ donations needs to meet the huge demand for organs in China, and the construction of the field of organ donation is in the initial stage of development. Problems such as the low rate of public organ donation, irregular organ donation procedures, incomplete laws and regulations, and illegal organ trading exist in China. We need more surveys to clarify the underlying factors influencing the willingness to donate organs and enhance public awareness and support of organ donation.

3. Material and methods

Random samplings of 501 respondents consisting of young Chinese people aged 18–30 years were selected for this study. In China, "18–30 years old" is called "post-90's" and "post-00s." It refers to young people born after 1990. They were maybe in the late stages of high school, university, or doctoral stage or had worked for a few years. From December 2020 to April 2021, we conducted the survey mainly through online and offline questionnaires.

Before the formal distribution of the questionnaire, we randomly selected 20 people to ask questions such as "whether the questionnaire questions are easy to understand" and "whether the answers to the questionnaire contain all possible answers," revised them according to their opinions, and then distributed the revised formal questionnaire. A total of 600 questionnaires were distributed during the standard survey, and 501 questionnaires were completed and submitted, which is an 83.5% response rate. The same 20 people also filled out the standard questionnaire in the follow-up and became part of the 501 samples.

In terms of sampling, due to geographical constraints, our offline survey was mainly focused on Eastern China, with the majority of the sample coming from online. A small number of questionnaires were also distributed offline in case the respondents did not understand the questions, and we were able to deal with them in time. Fortunately, with the help of the previous 20 interviewers, no such situation was found offline. There are several online channels: the first is a questionnaire website, Questionnaire Star (a well-known survey website in China, www.wjx.cn), which has a corresponding incentive system to ensure the distribution and return of questionnaires, and it also sends out questionnaires by the principle of randomness. The second way is through our social networking software, such as WeChat, QQ, and Weibo (similar to Twitter), to distribute the questionnaires like advertisements. The questionnaire is usually filled out by interested people who meet the age requirement. Online distribution means that the questionnaire is opened, but only when it is completed and submitted does it mean that we have received feedback. By the end of 2021, WeChat, QQ, and Weibo had 1.268 billion, 552 million, and 573 million monthly active users, respectively. Therefore, questionnaires distributed *via* WeChat, QQ, and Weibo will reach most of China's young generation. In the case of Weibo, which is similar to Twitter, for example, a tweet posted by a celebrity is usually viewed by millions. Of course, the people who responded to the questionnaire include many people we know, but many more are people we do not know. From our survey results, the sample profile's diversity is also very diverse. It would be better to reach a more comprehensive sample and a wider range of online and offline people. We had a goal to collect at least 400 questionnaires within a month, so when we collected 501 questionnaires within a month (600 questionnaires were distributed), we thought the samples were basically enough.

We stratified them according to the nature of their household registration, gender, education level, and religious belief. In general, there are two forms of expression of willingness to donate organs in China:

(1) Citizens have expressed their willingness to donate organs for free and have registered with a qualified institute;

(2) Citizens have not expressed their unwillingness to donate before their deaths, but their relatives and family members jointly agreed to donate for free after the citizen's death.

Based on these two points, the core questions of this survey are "When your life cannot be saved, are you willing to donate organs?", "Have you ever registered for organ donation?", and "When your loved ones' lives cannot be saved, are you willing to donate organs as their family member?".

Through the interviews with a small group of people in our pre-survey, it was found that the interviewees who are willing to donate generally have a good understanding of organ donation. Less influenced by traditional Chinese concepts like "keeping the whole body" and "going to the soil for safety," they consider organ donation a great contribution to society by saving the lives of others and recognize its value in the development of medical care and research.

Therefore, we designed the questionnaire considering the influencing factors as much as possible for a survey to understand the source of the motivation of "willing to be a donor." Among the small group interviewees, we found that people unwilling to donate generally have low awareness and know little about organ donation. They have no idea about the process of organ donation. Most of them have severe concerns about organ abuse. The "unwillingness to donate" group and the issue should be investigated from different angles.

The overall content of the questionnaire was set up around six aspects of organ donation: the basic information of the interviewees, awareness of organ donation, attitudes toward organ donation, motivation, underlying reasons for reluctance to donate, and problems that need to be solved urgently in organ donation and possible countermeasures.

The data analysis included the chi-square test, factor analysis, and a one-way analysis of variance (ANOVA). The chi-square test was used to study whether the public with different characteristics has significant differences in organ donation choices, and the factor analysis was used to study groups with varying attitudes toward donation. The main influencing factor, a single-factor analysis of variance, was used to investigate whether the public with different characteristics is affected by other factors to varying degrees. Collected data were analyzed using SPSS, version 22.0 (IBM SPSS).

4. Analysis of results

4.1. Background information

The detailed sociodemographic characteristics of the study participants are mentioned in Table 1. The "household registration" was divided into "rural resident" and "urban resident." Because our presurvey showed a significant difference in organ donation willingness between urban and rural residents regarding gender, the proportions of men and women selected for the survey are not much different. In terms of education, many respondents had undergraduate and junior college degrees.

In 2020, the ratio of male population to female population in China was 51.2:48.8 (according to the National Bureau of Statistics of China). We have tried our best to consider the gender issue comprehensively in this survey. However, unfortunately, we received more responses from women. We suspect that it is likely that more women are registered on Questionnaire Star, and it is also likely that our team is mostly composed of women. On WeChat and QQ, most of our contacts are women, more questionnaires were delivered to women, and as a result, the sample is composed of more women. This is one of our limitations, and we hope to improve it in future studies.

TABLE 1 Sociodemographic characteristics of respondents of the survey.

	Type	Frequency	Percentage
Household registration	Urban	386	77.0
	Rural	115	23.0
Gender	Male	172	34.3
	Female	329	65.7
Education level	Junior high school and below	13	2.6
	High school and technical secondary school degree	17	3.4
	Bachelor's and college degree	460	91.8
	Postgraduate and above	11	2.2
Religious belief	Have religious beliefs	15	3.0
	No religious belief	486	97.0

We separately investigated sample groups of religious and non-religious persons to investigate whether the two groups have a different willingness to donate organs. In Table 1, the basic information of the various types of respondents is distinguished in detail. The purpose of the distinction is to examine the public's awareness of and willingness to donate an organ and the factors affecting their willingness to contribute under different circumstances.

4.2. Analysis of the public's knowledge and attitude toward organ donation

4.2.1. Knowledge and attitude toward organ donation

Table 2 shows that the respondents have a relatively high awareness of organ donation. Most of them learned about organ donation and understood its meaning through media such as radio, television, and the Internet. But they have low awareness of the specific laws and regulations in the organ donation area. However, more than 40% of respondents (young people aged 18–30 years) have a strong willingness to be organ donors. This result shows that the current public's attitudes have changed significantly compared to our previous survey's results. Although the importance of organ donation and transplantation is widely recognized, many respondents who are willing to donate have not registered to donate organs. Many of those who are willing to donate but have not registered feel they have not discussed it with their families, do not know if their families will oppose them, are not sure if their attitudes will change with outside intervention, or are unfamiliar with the organ donation process. After all, they recognize the necessity of an organ donation incentives policy, such as a priority system for organ transplantation and medical protection.

TABLE 2 Respondents' awareness of organ donation.

	Category	Frequency	Percentage
Do you know about organ donation?	Yes	497	99.2
	No	4	0.8
Do you know the laws and regulations on human organ transplantation in China?	Yes	76	15.2
	No	425	84.8
Do you know that China remarkably lacks organ donation?	Yes	410	81.8
	No	91	18.2
Do you know the current sources of transplanted organs?	Yes	184	36.7
	No	317	63.3
Are you willing to donate organs after death?	Yes	236	47.1
	No	265	52.9
Have you filled in the organ donation registration form?	Yes	9	1.8
	No	492	98.2
Do you support organ donation registration when applying for a driver's license?	Yes	74	14.8
	No	311	62.1
	Neutral	116	23.2
Do you support the practice of a priority system for organ transplantation and medical protection, etc.?	Yes	383	76.4
	No	46	9.2
	Neutral	72	14.4

At the same time, they are unfamiliar with relevant procedures for organ donation.

4.2.2. Comparative analysis of different public attitudes toward organ donation

To compare the public's attitudes toward organ donation, we used background information as the independent characteristic variables such as household registration, gender, age, education level, and religious beliefs to conduct a chi-square test (see Table 3).

The assumptions are as follows:

Null hypothesis 1: There is no significant difference in the willingness to donate organs among the public with different household registration;
Null hypothesis 2: There is no significant difference in the willingness to donate organs of the public in different genders;
Null hypothesis 3: There is no significant difference in the willingness to donate organs among the public with different education levels;
Null hypothesis 4: There is no significant difference in the willingness to donate organs of the public with or without religious beliefs.

Since three-fourths of the null hypotheses are rejected (see Table 3), the following conclusions can be summarized:

(1) There is a significant difference in the choice of organ donation among the public with different household registrations. The proportion of rural residents unwilling to donate is higher than that of urban residents.
(2) No significant difference in the choice of organ donation is found among the general public of different genders. From the 501 samples, 87 of 172 men, or 50.6%, were willing to donate organs, and 149 of 329 women, or 45.3%, were willing to donate organs. Although men were more likely to donate organs than women, according to the sample data, the chi-square test reveals that this difference was not significant in the inferred overall population.
(3) There is a significant difference in the choice of organ donation among the public with different levels of education. According to our interview, the respondents with higher education levels have better awareness and a stronger willingness to donate an organ.
(4) There is also a significant difference in the choice of organ donation between the religious and non-religious public. According to our survey results in China, the religions of the respondents are mainly Buddhism and Taoism. These religions advocate a more open-minded attitude toward life and death. Therefore, believers are more supportive of organ donation than those without religious beliefs.

4.3. Factor analysis

The above results showed significant differences in attitudes toward organ donation among respondents from different backgrounds. The key factors that influence their decision to donate are complicated. To further analyse the influencing factors, the exploratory factor analysis method was used to classify each influencing factor and examine the degree of its influence on the attitudes of the respondents.

TABLE 3 Background information and organ donation awareness.

Background information	Type	Are you willing to donate organs after death?		Pearson's chi-squared test	Progressive sig. (Both sides)
		Yes (236)	No (265)		
Household registration	Urban	191 (49.5%)	195 (50.5%)	3.810	0.051*
	Rural	45 (39.1%)	70 (60.9%)		
Gender	Male	87 (50.6%)	85 (49.4%)	1.270	0.260
	Female	149 (45.3%)	180 (54.7%)		
Educational level	Junior high school and below	0 (0.0%)	13 (100.0%)	24.928	0.000***
	High school and technical secondary school degree	6 (35.3%)	11 (64.7%)		
	Bachelor's and college degree	219 (47.6%)	241 (52.4%)		
	Postgraduate and above	11 (100.0%)	0 (0.0%)		
Religious belief	Have religious beliefs	13 (86.7%)	2 (13.3%)	9.713	0.002***
	No religious belief	223 (45.9%)	263 (54.1%)		

***, **, and * indicate significance at the 1, 5, and 10% significance levels, respectively.

4.3.1. Descriptive statistics of influencing factors

Table 4 shows the scores of 236 respondents who are willing to donate organs. The average value is above 3 (5-level scale). It means that these factors can affect the respondents' decision-making for donation. Some factors, such as "facing death calmly," "the society's advocacy for dedication," and "organ transplantation is a way to extend one's own life," have greater influence. This item has the highest average score and the smallest standard deviation, indicating that the sample population is affected by the item with the strongest average value and tends to be consistent.

Table 5 shows that the 265 respondents who are unwilling to donate have relatively high scores on the degree of influence for each factor. The average value is also above 3 (5-level scale). The respondents thought that the following items could significantly affect their decision: "avoidance behaviors toward life and death issues," "family disapproval," "family members do not know the laws and regulations on organ donation," and "fear of organ transplantation abuse." The deviations of these items are relatively small, which means the respondent's attitude tends to be consistent.

4.3.2. Reliability and validity test

Cronbach's α coefficient was used for the reliability test. In general, Cronbach's α coefficient above 0.65 is the minimum acceptable reliability value. Table 6 shows that the influencing factors "willingness to be an organ donor" and "unwillingness to be an organ donor" are both >0.8, which belongs to a very reliable interval range and can pass the reliability test.

The KMO and Bartlett sphericity tests were used for the validity test. The KMO test is based on the comparison of simple correlations and partial correlations between different variables. In general, if KMO > 0.9, the data obtained are very suitable for factor analysis; if KMO > 0.7, the data obtained are more suitable; and if KMO < 0.5, the data obtained are not suitable for factor analysis. The Bartlett sphere test tests whether the correlation matrix is an identity matrix or whether each variable is independent. According to Tables 7, 8, the KMO value is >0.7, and the probability value of the significance test is smaller than 0.05. It means that the results can pass the validity test and are suitable for factor analysis.

4.3.3. Exploratory factor analysis

Many factors influence the public's attitude toward organ donation, and the relationships among the affective factors are complicated. The KMO and Bartlett's sphericity test show that these factors have a strong correlation and can be summarized into several representative items. To study these factors as independent variables, we constructed a multifactor model to extract the main factors that affect the "willingness to donate organs" group and the "unwillingness to donate organs" group, respectively, and to find out some common characteristics among these influencing factors.

We assume that there are n main factors influencing the willingness to donate $X_1,\ldots\ldots X_n$. Through factor analysis, these n original variables are expressed as the linear weighted sum of k common factors $(f_1,f_2\ ,\ldots\ldots f_k)$ $(k\leq n)$ and a special factor ε_i. The principal component method was used to extract the common factors, and the matrix expression is as follows:

$$\begin{bmatrix} X_1 \\ X_2 \\ \ldots \\ X_n \end{bmatrix} = \begin{bmatrix} \alpha_{11} & \alpha_{12} & \ldots & \alpha_{1k} \\ \alpha_{21} & \alpha_{22} & \ldots & \alpha_{2k} \\ \ldots & \ldots & \ldots & \ldots \\ \alpha_{n1} & \alpha_{n2} & & \alpha_{nk} \end{bmatrix} \begin{bmatrix} f_1 \\ f_2 \\ \ldots \\ f_k \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \ldots \\ \varepsilon_n \end{bmatrix} \quad (1)$$

We used the maximum variance method to obtain the explained total variance (as shown in Tables 9, 10). We then extracted the main factor according to the factor extraction criterion with a feature value >1 (as shown in Tables 11, 12).

In general, if the variance explained by each factor extracted is not very different and the cumulative variance interpretation rate is more than 60%, then the factor analysis extraction effect is better. Tables 9, 10 show that when factors are extracted from the influencing factors of "wish to donate" and "unwilling to donate," the cumulative variance contribution rate meets the requirements. Using the extraction factor score to analyse the influencing factors of organ donation willingness, the comprehensive evaluation model obtained is as follows:

TABLE 4 Descriptive statistics (willingness to donate organ).

	Mean	Std. deviation	Analysis *N*
X1: Facing death calmly	4.4576	0.85197	236
X2: Rescue others and realize the ultimate value of oneself	3.9831	1.04766	236
X3: Organ transplantation is a way to extend one's own life	4.5466	0.80023	236
X4: Promote the development of the medical industry	3.7966	1.08811	236
X5: Support from family members and friends for organ donation	3.8856	1.19201	236
X6: Education on organ donation	3.9534	1.04064	236
X7: The society's advocacy for dedication	4.0551	1.02373	236
X8: Awareness of the organ donation process	3.8983	1.09459	236
X9: Awareness of laws and regulations on organ donation	3.8602	1.12682	236
X10: Knowledge of the organs transplantation process	3.9237	1.10824	236
X11: Donors and relatives can get priority right to be donated	3.8898	1.13950	236
X12: Families can get better humanitarian assistance	3.6483	1.20955	236

TABLE 5 Descriptive statistics (unwillingness to donate organ).

	Mean	Std. deviation	Analysis *N*
Y1: Avoidance behaviors toward life and death issues	3.8792	1.03378	265
Y2: Traditional concept of "keeping the whole corpse"	3.9509	1.02315	265
Y3: Family disapproval	4.0340	1.01633	265
Y4: Family members don't know the laws and regulations on organ donation	4.1774	0.96268	265
Y5: Insufficient media promotion	3.5434	0.91235	265
Y6: Unfair use related to a priority system	3.4830	1.08043	265
Y7: Lack of death certificate	3.0792	0.99874	265
Y8: Lack of laws and regulations on organ donation	3.5698	1.24766	265
Y9: Worry about the credibility of the donation system	3.7547	1.09934	265
Y10: Worry about organ transplantation abuse	4.1019	1.03764	265

TABLE 6 Reliability statistics.

Influence factor	N. of items	Cronbach's alpha
Factor influencing willingness to donate organs	12	0.998
Factor influencing unwillingness to donate organs	10	0.997

TABLE 7 KMO and Bartlett's test (willingness to donate organ).

Kaiser-Meyer-Olkin measure of sampling adequacy		0.850
Bartlett's Test of sphericity	~Chi-Square	2,285.420
	Df	66
	Sig.	0.000

For those who are willing to donate:

$$f = \frac{36.602}{74.550}f_1 + \frac{27.224}{74.550}f_2 + \frac{10.725}{74.550}f_3 \quad (2)$$

TABLE 8 KMO and Bartlett's test (unwilling to donate organ).

Kaiser-Meyer-Olkin measure of sampling adequacy		0.728
Bartlett's test of sphericity	~Chi-Square	1,756.346
	Df	45
	Sig.	0.000

For those who are unwilling to donate:

$$f = \frac{32.933}{73.144}f_1 + \frac{22.334}{73.144}f_2 + \frac{17.876}{73.144}f_3 \quad (3)$$

Table 11 shows the load on different variables of the three factors in the group "willingness to be an organ donor." Because it focuses on different specific angles, it is named based on its meaning: Factor 1 has a large load on the variables $X_5 - X_{12}$, and mainly focuses on the external social atmosphere faced by the donor. According to its meaning, it is named "the social atmosphere factor." Factor 2 has a larger load on variables $X_1$and X_3 and focuses on the donor's own ideas, so it is

TABLE 9 Total variance explained (willingness to be an organ donor).

Component	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	6.340	52.837	52.837	6.340	52.837	52.837	4.392	36.602	36.602
2	1.506	12.551	65.388	1.506	12.551	65.388	3.267	27.224	63.825
3	1.100	9.163	74.550	1.100	9.163	74.550	1.287	10.725	74.550

TABLE 10 Total variance explained (unwillingness to be an organ donor).

Component	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	4.744	47.443	47.443	4.744	47.443	47.443	3.293	32.933	32.933
2	1.561	15.613	63.055	1.561	15.613	63.055	2.233	22.334	55.267
3	1.009	10.088	73.144	1.009	10.088	73.144	1.788	17.876	73.144

named "the personal perception factor." Factor 3 has a larger load of variables, X_2 and X_4 focuses on the influence of the incentive mechanism on the willingness to donate, so it is named "altruism factor." The results show that the sample groups' willingness to donate is most affected by the social atmosphere, personal perceptions, and altruism.

Table 12 shows the load on different variables of the three factors for those who are unwilling to be organ donors. Factor 1 has a large load on the variables $Y_3 - Y_4$, $Y_7 - Y_{10}$ concerning the local organ donation system, including the death certificate process, the organ transplantation process, and the fairness of organ distribution. Therefore, it is named "the cognitive bias factor" based on its meaning. Factor 2 has a large load on the variables $Y_1 - Y_2$, related to their family members and own concerns toward organ donation. Therefore, we named it the "traditional stereotype factor." Factor 3 has a relatively large load on the variables $Y_5 - Y_6$. The respondents worried that if donated organs are used for transplantation, they will be given priority to people of higher social class, while those of lower social class may not be able to afford medical expenses and have no opportunity to receive organ transplants. Therefore, we named it the "fairness concern factor."

TABLE 11 Rotated component matrix (willingness to be an organ donor).

	Factor		
	f1	f2	f3
X1: Facing death calmly	0.119	**0.827**	0.102
X2: Rescue others and realize the ultimate value of oneself	−0.074	0.290	**0.797**
X3: Organ transplantation is a way to extend one's own life	0.070	**0.842**	0.171
X4: Promote the development of the medical industry	0.510	−0.012	**0.646**
X5: Support from family members and friends for organ donation	**0.669**	0.602	0.108
X6: Education on organ donation	**0.706**	0.477	−0.083
X7: The society's advocacy for dedication	**0.662**	0.317	−0.144
X8: Awareness of the organ donation process	**0.693**	0.598	0.147
X9: Awareness of laws and regulations on organ donation	**0.663**	0.623	0.031
X10: Knowledge of the organs transplantation process	**0.698**	0.570	0.113
X11: Donors and relatives can get priority right to be donated	**0.856**	0.081	0.154
X12: Families can get better humanitarian assistance	**0.765**	−0.152	0.310

Bold values indicate the factor with the highest load of each X.

4.4. Analysis of impact factors on public attitudes toward organ donation

The above exploratory factor analysis method regrouped many factors affecting the public's attitude toward organ donation into three principal factors. Then, the one-way analysis of variance method was used to analyse the different levels of factors' impact. The results are shown in Tables 13, 14.

For those who were willing to donate, the influence of the "social atmosphere factor" was significant at the 1% level of significance for respondents with different levels of education and religious beliefs, indicating that there was a significant difference in their influence on this factor; the influence of the "optimism factor" was significantly different for respondents with different natures of household registration and gender, and the original hypothesis of "no significant difference in influence" was rejected at the 1% level of significance; the influence of the "value realization factor" was significantly different for respondents with varying levels of education and religious beliefs and for those with no religious beliefs.

For those who are unwilling to be organ donors, the respondents with different ages and household registration are mainly affected

TABLE 12 Rotated component matrix (unwillingness to be an organ donor).

	Factor		
	f1	f2	f3
Y1: Avoidance behaviors toward life and death issues	0.184	**0.939**	0.157
Y2: Fear of deformity in the corpse	0.122	**0.947**	0.137
Y3: Family disapproval	**0.564**	0.371	0.112
Y4: Family members don't know the laws and regulations on organ donation	**0.802**	0.252	0.134
Y5: Insufficient media promotion	0.438	0.119	**0.737**
Y6: Unfair use related to the priority system	0.083	0.202	**0.896**
Y7: Lack of death certificate	**0.727**	−0.039	0.125
Y8: Lack of laws and regulations on organ donation	**0.759**	0.409	0.059
Y9: Worry about the credibility of the donation system	**0.747**	−0.060	0.472
Y10: Worry about organ transplantation abuse	**0.649**	0.167	0.355

Bold values indicate the factor with the highest load of each Y.

TABLE 13 ANOVA (willingness to be an organ donor).

Impact factors and background information	F	Sig.
Household registration and social atmosphere	0.003	0.958
Household registration and personal perception	10.137	0.002***
Household registration and policy incentives	1.407	0.237
Gender and social atmosphere	0.100	0.752
Gender and personal perception	18.436	0.000***
Gender and policy incentives	0.336	0.563
Educational level and social atmosphere	5.726	0.004***
Educational level and personal perception	0.424	0.648
Educational level and policy incentives	5.806	0.003***
Religious beliefs and social atmosphere	11.300	0.001***
Religious beliefs and personal perception	0.421	0.517
Religious beliefs and policy incentives	6.802	0.010***

***, **, and * indicate significance at the 1, 5, and 10% significance levels, respectively.

by the "cognitive biases factor." Due to different sociodemographic characteristics such as household registration, gender, education level, and religious belief, the impacts of the "family resistance factor" and "fairness concern factor" are significantly different on the willingness to donate.

5. Limitations

We wanted to find out about the willingness of China's younger generation to donate organs by surveying our sample, and we did so according to the principle of random sampling. Due to the limitations of our survey, the sample deviated from the total. First, our offline survey was mainly conducted in Eastern China, so the sample results will show more characteristics of the young generation in that region. Second, as the people who took the questionnaire, including those on

TABLE 14 ANOVA (unwilling to be an organ donor).

Impact factors and background information	F	Sig.
Household registration and fairness concern factor	15.119	0.000***
Household registration and family resistance factor	1.259	0.263
Household registration and cognitive biases factor	2.350	0.126
Gender and fairness concern factor	3.027	0.083*
Gender and family resistance factor	0.365	0.546
Gender and cognitive biases factor	15.449	0.000***
Educational level and fairness concern factor	0.976	0.378
Educational level and family resistance factor	5.613	0.004***
Educational level and cognitive biases factor	0.975	0.379
Religious belief and fairness concern factor	2.106	0.148
Religious belief and family resistance factor	2.511	0.114
Religious belief and cognitive biases factor	0.181	0.671

***, **, and * indicate significance at the 1, 5, and 10% significance levels, respectively.

Questionnaire Star and those on social networking sites, are probably interested in organ donation, the sample results will show a higher percentage of people who know about organ donation. Third, as more women follow us on our social networking software, the response rate is also higher for women. The literature clearly shows that women are more interested in this type of social issue than men, which is reflected to some extent in the higher proportion of women in the sample.

Although we have reduced the impact of these limitations on the study by stratifying the sample with factors such as gender and age, in future studies, we still hope to improve this issue of randomness with a larger and broader sample coverage to improve the validity of the estimates and to reflect the overall picture more accurately.

6. Conclusion

The problem of insufficient organ donation in China and worldwide has seriously affected the development of organ transplantation. Promoting organ donation and increasing organ availability are necessary to save the lives of patients who need a transplant and shorten the waiting time on the waiting list.

We differ from other articles in that many of them do not investigate the reasons for willingness and unwillingness to donate organs separately; some only consider family factors, and some only consider social factors, whereas we have set a number of topics for the reasons, trying to find deeper reasons that come from the researcher's understanding of Chinese reality and from his research on the issue before starting this study. Regarding awareness of organ donation, in our survey of young people aged 18–30 years, we found that 99.2% of respondents knew about organ donation, 47.1% were willing to donate organs, and 15.2% understood that there were corresponding laws and regulations for organ donation. Overall, young people knew about organ donation but had a low depth of awareness. Regarding differences in attitudes toward organ donation: a chi-square test was performed on the sample data, and we find that urban residents are more willing to be organ donors than rural residents; no significant

difference in the choice of organ donation is found among the general public of different genders; people with higher education levels have better awareness and are more willing to donate an organ; people with religious beliefs are more likely to donate organs. By using exploratory factor analysis, we find that the factors that support young people's willingness and unwillingness to donate also differ. The main factors that support the willingness of young people to donate are the social environment that provides support, their optimism in dealing with death, and their desire to realize their final value after death. The main factors for those unwilling to donate were low awareness or misconceptions about organ donation among individuals and their families and their attitudes toward death.

To promote organ donation among the young generation, China needs to reconsider the role of families in the decision-making process. It is essential to increase organ donation awareness among the younger generation and encourage them to discuss their willingness to donate with their families. In addition to enhanced publicity, there is also a need to improve policies on humane care and incentives for organ donation.

Data availability statement

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

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The information we used for the study was obtained through questionnaires and interviews. When respondents completed the questionnaire or were interviewed, we clearly communicated the purpose of the survey and their completion of the questionnaire and/or acceptance of the interview implied their consent to participate in this survey.

Author contributions

XC conceived the main ideas of the paper, especially the econometric part, led the whole paper, and contributed much to each part. WW joins every aspect of the paper, especially the wording and tables. WA has expertise in law, and his professional competence and professional work ensured the integrity of our thesis, contributed a lot to every part of the paper.

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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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Supplementary material

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References

1. Wang L, Zhang X. Chinese citizens' attitudes towards organ donation and its influencing factors. *J Nurs People's Lib Army.* (2010) 27:968–71.

2. Zhu S, Zhang J, Cui Y, You J, Xue S, Xu C. Investigation and analysis of the public's cognition and willingness to organ donation. *Med Theory Pract.* (2017) 30:1556–8. doi: 10.19381/j.issn.1001-7585.2017.10.088

3. Lei L, Zhang H, Dong H, Luo Y, Wang D, Luo Y. A cross-sectional survey of cognition of organ donation among medical and non-medical students in Chongqing. *J Nurs Sci.* (2017) 32:96–9.

4. Liang Y, Chen W, Zhang Z, Ma, H, Xia S. A survey of students' cognition, attitude and willingness towards organ donation in a certain university in Guangzhou. *Med Soc.* (2017) 30:48–50+61. doi: 10.13723/j.yxysh.2017.03.015

5. Zhang J, Chen X, Yang Y, Yin Q, Tang H. Analysis of the attitude and willingness level of 330 college students in organ donation. *J Nurs.* (2018) 25:21–4. doi: 10.16460/j.issn1008-9969.2018.24.021

6. Long X, Liu B. Investigation and analysis of college students' cognition and acceptance of organ and body donation. *Youth Soc.* (2019) 27:242+244.

7. Hu D. *A Survey of the Cognition, Attitude and Willingness of Medical Workers, Medical Students and the Public on Organ Donation*. Guangzhou: CNKI (2015).

8. Hafzalah M, Azzam R, Testa G, Hoehn KS. Improving the potential for organ donation in an inner city Muslim American community: the impact of religious, educational intervention. *Clin Transplant.* (2014) 28:192–7. doi: 10.1111/ctr.12296

9. Kobus G, Małyszko J, Bachórzewska-Gajewska H. Opinions of Followers of Judaism Residing in the Northeastern Part of Poland on Organ Donation. *Transplant Proc.* (2020) 52:2895–8. doi: 10.1016/j.transproceed.2020.02.164

10. Kapikiran G, Bulbuloglu S, Ozdemir A, Saritas S. Knowledge and attitudes on organ donation from the perspective of liver transplant patients. *Transplant Proc.* (2021) 53:25–9. doi: 10.1016/j.transproceed.2020.02.173

11. Si J, Huang W, Gu Y, Yan B, Xu Z, Li H, et al. Analysis of factors affecting donation willingness of family members of organ donors after the death of national citizens. *Chin J Transplant.* (2015) 9:17177.

12. Gao H, Wang Y, Jiang L, Sun H, Wu X. On the influencing factors and countermeasures of family members' willingness to organ donation. *Med Philos.* (2016) 37:45–8.

13. Hu T, Lin Y. Analysis and countermeasures of 47 cases of potential child donor parents' refusal to organ donation. *J Nurs.* (2020) 27:67–70. doi: 10.16460/j.issn1008-9969.2020.19.067

14. Jia L, Xiao Q, Yang Q, Liu L, Guo X. Analysis of influencing factors of donation willingness of family members of organ donors after the death of citizens in Northwest China. *Chin Med Ethics.* (2019) 32:47–8.

15. Zeng W, Tang Y, Zhao J, Yu X. The current status and influencing factors of the donation willingness of potential organ donors' family members. *J Nurs Train.* (2021) 36:677–80. doi: 10.16821/j.cnki.hsjx.2021.08.002

16. Zhang Z, Huang F, Qian K. Analysis of the impact of organ donation intervention on the knowledge and attitudes of community residents on organ donation. *China J Pract Nurs.* (2020) 41:23–6. doi: 10.3760/cma.j.issn.1672-7088.2015.03.014

17. Sun S, Wu R, Zhu N, Zhang L, Yang Q, Shen Z. Research progress on the influence of traditional Chinese cultural values on citizens' willingness to donate organs. *Organ Transplant Ethics.* (2016) 18:63–8.

18. Lin J, Liu W, Huang J, Dai Z, Pan X, Li E. The status and countermeasures of organ donation from the family perspective——Based on the empirical investigation of Changsha City, Hunan Province and Wenzhou City, Zhejiang Province. *J Wenzhou Med Univ.* (2020) 50:887.

19. Qian G, Li X, Zhou J, Zhang L, Hu C. Single-centre data analysis of organ donation and utilisation after death. *Organ Transplant.* (2020) 11:599–604.

20. Flemming SSC, Redmond N, Williamson DH, Thompson NJ, Perryman JP, Patzer RE, et al. Understanding the pros and cons of organ donation decision-making: Decisional balance and expressing donation intentions among African Americans. *J Health Psychol.* (2020) 25:1612–23. doi: 10.1177/1359105318766212

21. Wang K. On the dual attributes of human organ rights. *China Finance Legal Rev.* (2015) 1:230–40.

22. Gong B. Perspectives on the rights and interests involved in acquiring human organs and the legal principles. In: *Proceedings of the 19th Annual Academic Conference of the Medical Ethics Branch of the Chinese Medical Association and the International Forum on Medical Ethics.* Dalian (2017). p. 82–8.

23. Li W. The repentance of human organs and the liability for damage compensation. *Civil Commer Law Controv.* (2019) 1:171–4.

24. Chandler JA, Burkell JA, Shemie SD. Priority in organ allocation to previously registered donors: public perceptions of the fairness and effectiveness of priority systems. *Prog Transplant.* (2012) 22:413–22. doi: 10.7182/pit2012324

25. Li H, Cai M, Chen J, Wang J, Jiang H. Ethical review and supervision of organ donation after the death of citizens. *Med Philos.* (2020) 41:336+81.

26. Yu L, Qiu R, Zhai X. Ethical thinking on the encouragement of organ donation after the death of citizens. Medicine and Philosophy. (2019) 40:118+31.

27. Luo A, He H, Xu Z, Deng X, Xie W. Social support of organ donor families in China: A quantitative and qualitative study. *Front Public Health.* (2021) 9:746126. doi: 10.3389/fpubh.2021.746126

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U.S. Cooperative Extension's response to substance misuse: A scoping review

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Background: The U.S. has experienced exponential growth in overdose fatalities over the past four decades and more than 22 million people are currently living with a substance use disorder (SUD). While great strides have been made in advancing the science of SUD prevention and treatment, proven programs and interventions are not commonly disseminated at scale in impacted communities. The U.S. Cooperative Extension System (Extension) has been recognized as a valued partner in addressing SUD in communities. Federal funding supporting Extension's response to the opioid epidemic reached $35 million in 2021 primarily through two grant programs: the United States Department of Agriculture's (USDA) Rural Health and Safety Education program; and the Substance Abuse and Mental Health Services Administration (SAMHSA) Rural Opioid Technical Assistance (ROTA) grants. The primary objective of this scoping review was to identify the range of Extension activities aimed at mediating substance misuse.

Methods: Authors utilized the PRISMA-SCR model to complete this scoping review. Due to the nature of Extension work and the expectation that few activities would be cited in the peer-reviewed literature, the scoping review included a search of peer-reviewed databases, Extension websites for each state and U.S. territory, and the utilization of a web search engine. Upon initial analysis of records returned, authors noted a discrepancy between results returned and the number of states receiving ROTA grants. Thus, authors supplemented the PRISMA-SCR review protocol with a systematic procedure for investigating ROTA funded activities not readily apparent in the peer-reviewed or grey literature.

Results: A total of 87 records met inclusion criteria. Findings included seven peer-reviewed articles and 80 results from the grey literature. An additional 11 ROTA grantees responded to requests for information regarding state level activities.

Conclusions: Nationwide, Extension has scaled multiple efforts to address SUD operating through a loose confederation of organizations connected to the land-grant system. Most activities are funded by federal grants and focus on state-sponsored training and resource sharing. The volume of effort is significant, however, implementation at the community-level has been slow. Significant opportunities exist for local adoption of evidence-based practices aimed at mitigating SUD.

KEYWORDS

substance abuse, cooperative extension, drug abuse, opioid, prevention

Introduction

Overdose fatalities in the U.S. have continued to rise over the past four decades (1). Substance use and misuse are contributing to an escalating burden of disease leading to premature death and disability (2) and a host of other associated harms including childhood and family trauma (3), excessive health care costs (4), and justice system involvement (5). An estimated 174 people die each day in the U.S. from a drug-related overdose (1) and more than 22 million people are currently living with a substance use disorder (SUD) (6). In April of 2021, in the midst of the COVID-19 pandemic, the U.S. surpassed 100,000 drug-related deaths in a 12-month period for the first time in history (7).

Concurrent to these year-on-year increases in overdose fatality, numerous advances have been made in the science of SUD prevention and treatment. Unfortunately, many of these proven programs and interventions are not disseminated to scale in impacted communities to counter the mounting burden of disease. Cited barriers to the dissemination of evidence-based programs and policies include poor translation and clarity of scientific studies (8), perceived patient factors, limited community-level referral sources (9), stigma, and other systemic barriers (10). Moreover, communities most affected by SUD, such as those in rural areas or the Appalachian region, may also be communities with limited resources, and thus, the effective dissemination and implementation of preventative interventions may prove more challenging.

The Cooperative Extension System (Extension) is part of the land grant university system in the United States. Extension is a nationwide network of local offices affiliated with and partially supported by land grant institutions with offices in or near most U.S. counties (11). Local Extension offices house teams of educators who offer educational outreach and programs in several areas, including agriculture and natural resources, 4-H and youth development, family and consumer sciences, and community economic development. Extension efforts are informed by local priorities and needs and shaped by programmatic resources available from the sponsoring land grant institution. Extension personnel serve as vital partners across multiple community-based efforts and more recently have been recognized as valued partners in addressing SUD and related issues impacting families and communities (12). To that end, the Extension Opioid Crisis Response Workgroup was formed in February 2018 at the recommendation of the Extension Committee on Organization and Policy and following the declaration of the opioid crisis as a national public health emergency in 2017 (13). The purpose of this group was to identify and organize resources to help Extension play a clear and intentional role in addressing the opioid crisis and general behavioral health challenges (14). Moreover, a 2018 survey of national Extension leaders indicated that an overwhelming majority agreed that Extension should play a role in reducing opioid misuse and overdose in their respective states, but <24% agreed their Extension System had capacity to respond to the epidemic (14).

Federal funding supporting Extension's response to the opioid epidemic exceeded $35 million between 2017 and 2021 (15, 16). This funding originated primarily through the United States Department of Agriculture's (USDA) Rural Health and Safety Education program and the Substance Abuse and Mental Health Services Administration (SAMHSA) Rural Opioid Technical Assistance (ROTA) grants. Additional funding was also provided through USDA's Children, Youth and Families at Risk grant program (17). For nearly 6 years, Federal funding has prioritized Extension projects and trainings that address the opioid crisis, however, the full scope of this work and related outcomes is unknown.

The primary objective of this scoping review was to identify the full range of Extension activities aimed at mediating opioid and substance misuse from 2016–2022. Furthermore, the review may help to elucidate opportunities for the expansion of existing programs and assets or fill gaps and implement programs in areas that are not currently working in this space, specifically, those in rural communities and those most impacted by SUD.

Materials and methods

Study design and search strategy

This scoping review was conducted from February through July of 2022 and was informed by the PRISMA-SCR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews) model (18). Due to the nature of Extension work, authors anticipated that few activities would be cited in the traditional peer-reviewed literature, thus, the review included searches within peer-reviewed databases and within one standard web search engine. First, authors used combinations of the following search terms to query the peer-reviewed literature *via* PubMed, EBSCOhost, ProQuest, Elsevier, and JSTOR: opioid, cooperative extension, drug, substance, and substance abuse. Authors also utilized the OneSearch platform hosted by the East Tennessee State University's Sherrod Library to expand the search to additional databases. Additional filters applied during the search included: (1) peer-reviewed, (2) full article, and (3) 2016 and newer.

Following a search of the peer-reviewed literature, authors queried Extension websites for each state and U.S. territory and utilized the Google search engine using combinations of the following key terms: opioid, cooperative extension, drug, substance, and substance abuse. Additional filters included records that were written in English and published between 2016 and 2022. Upon conclusion of the initial search and saturation of the traditional literature and web findings, a preliminary review of records excluded duplicates and records or titles that were not connected to Cooperative Extension and/or were not focused on SUD or opioid related topics. In this preliminary review, records were included only if they met all of the following criteria: (1) connection to Extension work; (2) focus on programs or activities designed to mediate opioid or substance misuse; (3) written in English; (4) and published between the years of 2016 and 2022. Each included record was then documented in an Excel spreadsheet and sorted into two categories: peer-reviewed and web results. Authors then classified the web results as press releases, news articles, Extension blogs or feeds, impact statements, and online videos or online training series, and defined these records for the purposes of this review as "grey literature" (19).

A pair of reviewers then conducted a critical analysis of each record to ensure that each still met the inclusion criteria. Reviewers also began coding records into themes or result "types." The reviewing team met on three separate occasions to discuss discrepancies in the thematic codes and any newly excluded results. The Excel spreadsheet was updated

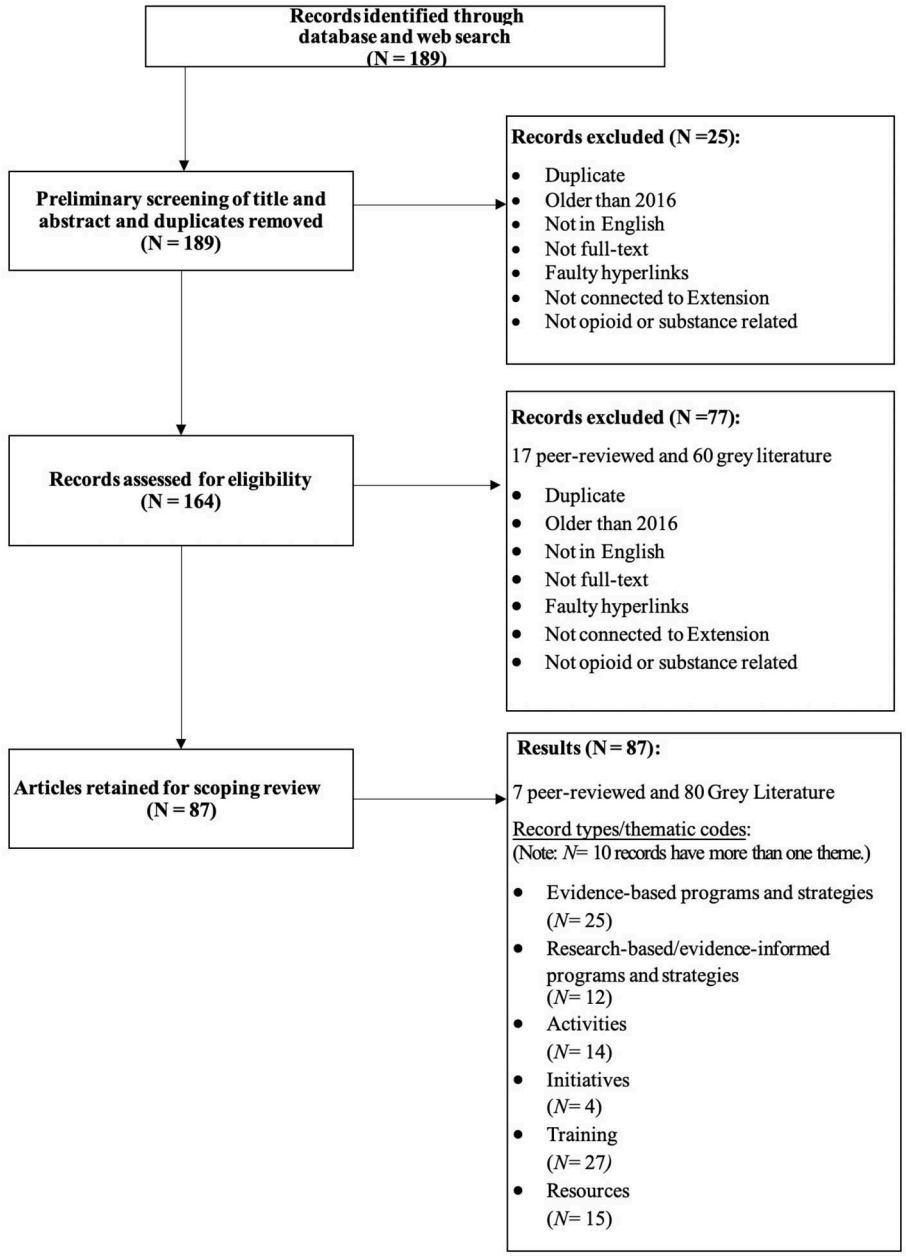

FIGURE 1
Scoping review flow chart.

following each meeting. Upon the third review, a final set of six themes was established for the grey literature and included: evidence-based programs and strategies, research-based and evidence-informed programs and strategies, activities, initiatives, training, and resources. Figure 1 illustrates the comprehensive review process.

Supplemental analysis

Upon conclusion of the records review process, the authors identified a notable discrepancy in the number of records returned as compared to the number of states that received opioid focused grant funds. Twenty-three states received ROTA funding during the years 2016-2022, however, only 9 records identified this funding explicitly *via* the PRIMSA-SCR informed scoping review process. Thus, the authors agreed to supplement the PRISMA-SCR protocol with a systematic *post-hoc* procedure for investigating ROTA funded activities not readily apparent in the peer-reviewed or grey literature and to identify the full range of Extension activities aimed at mediating opioid and/or substance misuse. The authors developed a standard email inquiry and interview guide and then contacted all ROTA-funded state project directors with a request for a brief telephone interview to confirm project activities and scope utilizing a pre-defined set of questions.

Results

The initial search of the peer-reviewed and grey literature resulted in 189 returned records. Following a preliminary review to identify duplicates and titles that did not meet inclusion criteria, 25 records were excluded, and 164 records were retained (22 peer-reviewed and 142 web/grey literature). The next stage in the process included a critical appraisal of each remaining record by two of this paper's authors. This phase included three iterations of review and thematic coding of each record by type. An additional 77 records that did not meet inclusion criteria were removed in this phase of the review. Upon completion of the full review process, final results included 87 records (80 web/grey literature and 7 peer-reviewed). Moreover, ten (9) records found in the grey literature search overlapped across multiple themes.

Peer-reviewed results

The seven peer-reviewed articles included were thematically categorized as: (1) Conceptual-System - focused on the Cooperative Extension System, capacity, and potential as it applies to SUD prevention, education, or behavioral health; (2) Interventions - described evidence-based interventions, approaches, or results; and (3) Coalitions- focused on coalition-based approaches and support; (4) Needs Assessment; and (5) Supplemental.

Two of the seven peer-reviewed results were coded as Conceptual-System. The first provided a conceptual framework for Extension's response to the opioid crisis with examples of Extension professionals as public health agents bringing practical, evidence-based solutions to communities to combat increases in poly-substance use (20). The second provided a framework for science-driven behavioral health translation to more effectively address substance misuse through the Extension system (21).

Two results were coded as Interventions. One record focused on the evidence-based PROSPER system (PROmoting School-Community-University Partnerships to Enhance Resilience created for implementation through Cooperative Extension (22). A second article described a multi-state education and outreach effort including opioid misuse prevention programming in rural communities (23).

A fifth record from the traditional literature focused on coalition-based approaches as a promising approach for addressing disparities in rural health such as substance misuse (24). The sixth record was categorized as a Needs Assessment and described community-focused needs assessment conducted as part of the PROMISE (Preventing Opioid Misuse in the SouthEast) initiative (25). The final peer-reviewed article was deemed Supplemental and included in this review due to the broad focus on 4-H Healthy Living programs, which are widely implemented through Extension across the U.S. This article described an evaluation study reviewing 32 promising health-related positive youth development programs, some of which included prevention of alcohol, tobacco and other drug use (26).

Grey literature results

A total of 80 records were included in the grey literature results. Sources meeting inclusion criteria were representative of Extension in nearly every state except Arizona, Connecticut, Maine, New Jersey, and South Carolina. Authors categorized the grey literature into six coded themes: Evidence-based Programs and Strategies, Research-based and Evidence-Informed Programs, and Strategies. Activities, Initiatives, Training, and Resources. Most states' opioid response activities included a combination of efforts across categories. The paragraphs below summarize findings by thematic code. Table 1 contains a more detailed description of each result including states implementing and all related citations.

Evidence-based programs and strategies

The PRISMA-SCR informed search located eight evidence-based programs/strategies being implemented through the Extension system to address aspects of opioid misuse. Records for eight states implementing Mental Health First Aid were found. States implementing the PROSPER (PROmoting School-community-university Partnerships to Enhance Resilience) model also implemented two evidence-based programs as part of the PROSPER delivery system, one youth- and one family-focused program. Most often Botvin's Life Skills Training and Strengthening Families 10-14 were paired in PROSPER states. Several states offered chronic pain programs including Chronic Pain PATH and the Chronic Pain Self-Management Program, reaching underserved adults in rural areas.

Research-based and evidence-informed programs and strategies

The grey literature also returned 14 research-based and evidence-informed programs implemented through Extension. Programs ranged from multi-week, multi-session education programs for youth and families to training community members in opioid overdose response. Content included nutrition education, financial management, and physical activity. Some incorporated community engagement approaches, while others focused primarily on increasing knowledge or awareness.

Activities

Search results also demonstrated a range of activities that have been implemented through Extension in the U.S., including naloxone kit and fentanyl test strip distribution, awareness-raising community dinners and other community forums, and support for coalition-engaged approaches. Activities are sometimes paired with other educational strategies, like providing training on naloxone use prior to providing naloxone kits. Activities are often conducted with partner organizations (e.g., drug takeback events or drop box placement in collaboration with law enforcement).

Initiatives

The scoping review process yielded two records specifically focused on the workplace. The Recovery Friendly Workplaces initiative implemented in one state helps employers support people

TABLE 1 A description of findings from the grey literature review.

Theme/Type	Title	Description	Implementing states
Evidence-based programs and strategies	Mental health first aid (*N*= 9)	Skills-based training course that teaches participants to identify, understand, and respond to mental health and substance use challenges.	Indiana (27) Ohio (28, 29) Maryland (30) Mississippi (31) Oregon (32) Texas (33) Virginia (34) Wisconsin (35)
Evidence-based programs and strategies	Chronic pain self-management program/chronic pain PATH (Personal action toward health) (*N*= 3)	6-session small group workshop teaching techniques to deal with symptoms of chronic pain with emphasis on cognitive behavioral therapy techniques.	Arkansas (36) Michigan (37) New Hampshire (38)
Evidence-based programs and strategies	PROSPER Delivery System (Promoting School-community-university Partnerships to Enhance Resilience) (*N*= 3)	Delivery system linking Extension with public schools; facilitates delivery of evidence-based programs that reduce risky youth behaviors.	Ohio (29) Virginia (39) Vermont (40)
Evidence-based programs and strategies	Botvin's Life Skills Training (LST) (*N*= 3)	Classroom-based youth program promoting healthy alternatives to risky behavior.	Kentucky (41) Virginia (39) Vermont (40)
Evidence-based programs and strategies	Strengthening Families 10–14 (*N*= 4)	Program for youth ages 10–14 and their parents; taught with 7–10 families over seven weeks of in-person sessions.	Iowa (42) Virginia (39) Vermont (40) Wisconsin (35)
Evidence-based programs and strategies	Raising a thinking child (*N*= 1)	8-week parenting program for parents and caregivers of children 4–7 years; developing interpersonal cognitive problem-solving skills, improving parenting skills and parent-child communication, and in decreasing impulsive and inhibited behaviors in young children.	Wisconsin (35)
Evidence-based programs and strategies	Communities that care (*N*= 1)	Community-driven prevention process promoting healthy youth behavior and universal prevention approaches.	Tennessee (43)
Evidence-based programs and strategies	WISE: Wellness initiative for senior education (*N*= 1)	Educates older adults on variety of topics including safe medication use and avoiding misuse.	Michigan (44)
Research-based /evidence-informed programs and strategies	Empowering youth and families (*N*= 1)	10-week program focused on opioid prevention education for youth and their caregivers.	North Carolina (45)
Research-based /Evidence-informed programs and strategies	Generation Rx (*N*= 1)	Educational initiative providing resources and training on safe medication use.	Ohio (46)
Research-based /Evidence-informed programs and strategies	4-H health rocks! (*N*= 1)	Program teaches life skill development and decision-making to reduce tobacco, alcohol, e-cigarette/vaping and drug use. Uses Teens-as-Teachers model.	Illinois (47)
Research-based /Evidence-informed programs and strategies	Recovering Your Finances (*N*= 1)	8-week program specifically addresses financial issues those in recovery may face and guidance for overcoming those obstacles.	Kentucky (41)
Research-based /Evidence-informed programs and strategies	Youth Advocates for Health (*N*= 1)	Take-PART (Participatory Action Research with Teens) Opioid Research Project Internship in partnership with Upward Bound.	Washington (48)
Research-based /Evidence-informed programs and strategies	Good drugs gone bad (*N*= 1)	Program encouraging safe disposal and safe storage of prescription medications.	Wisconsin (35)
Research-based /Evidence-informed programs and strategies	4-H: Your life, your health (*N*= 1)	5-session educational series addressing underage drinking, drinking and driving, illegal substance abuse and communication skills in families.	North Carolina (49)
Research-based /Evidence-informed programs and strategies	CADA Youth Training - Agents 4 Change (*N*= 1)	Youth-focused training helps youth be community change agents by understanding community engagement and how to organize community change.	Wisconsin (50)
Research-based /Evidence-informed programs and strategies	Mind.Art.Recovery. KY (*N*= 1)	Expressive arts-in-health curriculum piloted with those in rehabilitation and at-risk facilities.	Kentucky (41)
Research-based /Evidence-informed programs and strategies	Community first responder program (*N*= 1)	Teaches members of the community to recognize the signs of overdose and how to respond.	Rhode Island (51)

(Continued)

TABLE 1 (Continued)

Theme/Type	Title	Description	Implementing states
Research-based /Evidence-informed programs and strategies	Stress less with mindfulness (*N*= 1)	5-session program teaching the experience and practice of mindfulness to reduce stress.	Michigan (52)
Research-based /Evidence-informed programs and strategies	Move with Ease (*N*= 1)	6-week program that teaches chronic pain participants to practice poses that help improve range of motion.	Arkansas (36)
Activities	Project STOMP (*N*= 1)	Youth-focused prevention awareness campaign engaging 6-12th graders to produce PSAs addressing substance misuse.	Iowa (53)
Activities	Community Conversations (*N*= 2)	Public meetings to share information about activities or solicit feedback from community members about local needs related to SUD.	Ohio (46) Oregon (32)
Activities	Stakeholder Engagement in Question Development and Prioritization (*N*= 1)	Multi-stakeholder approach to engaging communities in research, problem solving, and action planning.	Virginia (39)
Activities	Opioid education dinners (*N*= 1)	Dinner and discussion about the current state of the opioid crisis and real-world ways to support loved ones and get the help you need.	Utah (54)
Activities	Drug take-backs, drug drop boxes (*N*= 2)	Prescription drug drop off programs and sharps disposal options.	Mississippi (55) Wisconsin (35)
Activities	Coalitions engagement and support (*N*= 3)	Partnerships with community coalitions and engagement and support from academic departments.	Kentucky (41) Ohio (46) Wisconsin (35)
Activities	Fentanyl test strip distribution (*N*= 1)	Partnership with the College of Pharmacy to distribute fentanyl test strips to both clinics and community-based organizations that focus on harm reduction.	Minnesota (56)
Activities	Naloxone kit distribution (*N*= 2)	Distribution of naloxone opioid overdose reversal kits in multiple venues.	Minnesota (56) Rhode Island (51)
Initiatives	Recovery friendly workplaces (*N*= 1)	Webpage shares the results of a statewide survey of MO business owners and also links to the Missouri Recovery Friendly Workplace program.	Missouri (57)
Initiatives	ADA training for employers (*N*= 1)	Poster presentation at the Ohio State University Community Engagement Conference entitled *Employment and the Opioid Crisis in Ohio: How Extension, Community Partners and the American with Disabilities Act Can Support Local Employers*.	Ohio (58)
Initiatives	Healthy grandfamilies (*N*= 1)	Healthy Grandfamilies is a free initiative led by West Virginia State University to provide information and resources to grandparents who are raising one or more grandchildren.	West Virginia (59)
Initiatives	Nutrition education and gardening projects (*N*= 1)	Nutrition education and gardening project implemented in partnership with local recovery center.	West Virginia (60)
Training	Recorded trainings (*N*= 4)	Webinars or recordings of virtual events.	Maryland (61) Montana (62) Michigan (52) Rhode Island (63)
Training	Naloxone/Narcan (*N*= 3)	Training on administering naloxone or Narcan delivered to community members, law enforcement, and other groups.	Rhode Island (63) South Dakota (64) Wisconsin (65)
Training	Drug disposal and safe storage education (*N*= 3)	Educational sessions sharing information on safe storage of drugs and disposal methods.	Mississippi (66) Montana (67) Oklahoma (68)
Training	Opioid and SUD awareness, stigma reduction (*N*= 8)	Training delivered through a variety of formats (live webinars, in person programs, recorded webinars, and voice over PowerPoint) provided to increase awareness of the opioid crisis and SUD, and decrease stigma. Audiences included Extension professionals, healthcare providers, and parents, and community members.	Indiana (27) Kentucky (41) Montana (62) Minnesota (69) Oklahoma (68) Oregon (32) South Dakota (64) Tennessee (43)

(Continued)

TABLE 1 (Continued)

Theme/Type	Title	Description	Implementing states
Training	Continuing education for healthcare providers (asynchronous or live virtual Project ECHO) (*N*= 5)	Variety of training topics many with CE credit on topics such as harm reduction, treatment referral, non-pharmalogical approaches to pain management, and stigma.	Kentucky (41) Michigan (44) New Hampshire (38) Utah (70) Washington (71)
Training	De-stigmatizing Media training (*N*= 1)	Provides best practices for covering substance use disorder prevention, treatment, and recovery through 90-minute virtual sessions.	Oregon (32)
Training	Patient education - opioid risks (*N*= 1)	Target hospital patients to help make them aware of the dangers associated with opioid pain medications.	Virginia (39)
Training	Trauma-Informed Care Training (*N*= 2)	Training to increase understanding of Adverse Childhood Experiences (ACEs) and the impact of trauma.	Ohio (72) Wisconsin (65)
Resources	Story telling (*N*= 5)	Podcasts, audio project, rural radio programs, recovery stories, video PSA	Michigan (52) Montana (62) Oregon (32) Utah (73, 74)
Resources	Your thoughts matter 4-H project book (*N*= 1)	Project book that offers hands-on learning for adolescents and meets National Learning Standards.	Ohio (29)
Resources	Fact sheets (*N*= 6)	-Stigma -Prevention -Understanding addiction and treatment -Adolescent substance use -Opioids in rural farming communities	Colorado (75) Delaware (76) Michigan (52) Minnesota (77) Mississippi (66) Tennessee (78)
Resources	Drug disposal (*N*= 2)		Mississippi (66) Oklahoma (79)
Resources	4-H Opioid display (*N*= 1)		Ohio (46)

affected by SUD and those in recovery. This initiative focuses on creating a workplace culture that promotes employee safety, and health and wellbeing while reducing stigma and providing recovery resources. Another state's initiative focused on employer training dedicated to the Americans with Disabilities Act, including protections for those in recovery. Moreover, this review found several projects offering existing subject-matter expertise and resources to those in recovery and their families through local organization partnerships. Two states conducted nutrition education and implemented gardening projects in partnership with local recovery centers. Finally, as parenting and family life education are traditional areas of Extension outreach, the Healthy Grandfamilies initiative extends this focus to include the provision of information and resources to grandparents who are raising one or more grandchild due to a family members' challenges with substance use disorder.

Training

Results in this category indicated that training was provided on a range of topics with varied target audiences using synchronous, asynchronous, and hybrid methods. Training topics included administering naloxone to community members, law enforcement, and other groups. SUD and opioid awareness topics, including stigma reduction, were also delivered through a variety of formats (live webinars, in person programs, recorded webinars). Audiences included Extension professionals, healthcare providers, parents, and community members. Some states provided continuing education for healthcare providers, both asynchronously and through live virtual sessions utilizing Project ECHO. Training topics included trauma-informed care and other more targeted training, such as a De-stigmatizing Media Training that provides best practices for covering SUD prevention, treatment and recovery. Finally, one state's patient education program addresses opioid risk and provides additional education sessions on safe storage and disposal of drugs.

Resources

A number of states produced a range of educational resources to raise awareness and reduce stigma. Several educational video series offered introductory information about substance use for the public, and other resources included personal stories of people impacted by substance misuse. Recovery resources were also provided including podcasts, audio recordings, videos, and one rural radio program. Web and print publications covered topics including prevention, stigma, understanding addiction and treatment, adolescent substance use, and opioids in farming communities. Some resources supplemented training topics such as prescription drug disposal or resources aimed at youth audiences such as displays and 4-H project books. Social media marketing messages were also developed and included in one statewide campaign.

Supplementary findings from grantee interviews

As discussed previously, the authors of this paper universally agreed that the nine records returned *via* the PRISMA-SCR search

process were insufficient to illustrate the contributions of the 23 states funded by ROTA grants during the six-year time frame for this search. Eleven states responded to the request for interview and the grant program director, or a designee, participated in a 30-min interview by phone or Zoom to answer the pre-defined list of questions. Responses frequently aligned with the six previously identified grey literature themes. The following responses were consistent with the evidence-based programs and strategies theme: Question, Persuade, Refer in Oregon; WeCOPE (Connecting with Our Positive Emotions) in Wisconsin, and CRAFT: Community Reinforcement and Family Training in South Dakota. Virginia also implemented two evidence-based programs: Botvin's Life Skills Training Parent Program and Too Good for Drugs, a universal K-12 prevention education program. Research-based/evidence-informed programs found *via* the supplementary interview process included RELAX: Alternatives to Anger in Michigan, and Learning to Breathe, a mindfulness curriculum for youth, in Wisconsin.

A unique approach implemented in Oklahoma included partnerships with rural fire departments for naloxone education and distribution and aligned with the Initiatives theme. This state relied upon coalition engagement and hired field faculty specifically dedicated to opioid response. A Virginia initiative included hiring regional coordinators to work with coalitions in multiple counties. Several interviewees revealed that their project approaches evolved over time when new data became available thereby informing improvements to their funded strategies. ROTA project interviewees also described newly developed Training tools, such as Montana's Prescription Opioid Toolkit, a 5-module packaged curriculum for Extension field agents use in communities.

Discussion

This scoping review is the first, to our knowledge, to compile efforts of the U.S. land-grant university Extension system to address the opioid crisis. The results offered in this PRISMA-SCR informed review (18) highlight a ramp-up of Extension activities following the 2016 shift in federal funding priorities. However, continued and expanded engagement of Extension personnel is still warranted given the far-reaching impacts of the opioid epidemic and ongoing challenges of SUD and overdose fatality for families and communities. Expanded engagement may be particularly impactful in rural areas disproportionately affected by SUD and where Extension may serve as an active partner in agricultural activity, and thus, may have increased credibility when engaging in community-based SUD initiatives.

University-generated publicity announcing federal grant awards represented a large proportion of the grey literature sources identifying opioid related Extension activities. This information underscores the critical role of federal funding priorities in driving the initiation or expansion of SUD related prevention and recovery activities in many states. Authors are unable to speculate whether states would have pursued the same volume of activities absent external funding support, and to our knowledge, there no studies investigating this topic. Given Extension's limited capacity and resources to address SUD prior to funding availability, it seems unlikely this range of activities would have occurred. The combination of funded activities involving both mental health and SUD illustrates how specific states repurposed or reframed existing programs and traditional Extension content (e.g., stress coping, mindfulness, parenting) to reach new audiences. This approach was likely influenced by evolving ROTA funding requirements which required integration of mental health and SUD.

Few partnerships between Extension and non-Extension community partners were identified in the initial scoping review process. However, findings gleaned through supplemental interviews with ROTA grantees confirmed collaborative efforts and state/regional agency partnerships in opioid response. For example, a social marketing project developed and tested through an Extension partnership with other university academic units primed a larger campaign disseminated by a state agency. This social marketing content originated through Extension effort but would have been unidentified using PRISMA-SCR methods. Collaboration, while essential to opioid response efforts, may have made identifying Extension contributions more difficult. This, however, is probably a necessary by-product of true collaboration where accomplishing the work is more important than naming the headlining or sponsor agency.

Moreover, interviews with ROTA grantees provided context for opioid-focused activities that could not have been obtained through traditional scoping review methods. For example, partnerships with state agencies and community organizations not apparent through grant award announcements and project websites were vital to understanding overall project implementation. These interviews also provided information on implementation processes and barriers beyond the scope of this review but worthy of further exploration. Many interviewees found it difficult to attribute specific activities to a particular funding source or funding period. A series of prerequisite grant funding determined state's initial eligibility for ROTA funding; thus, interrelated grant funded activities were inherent. Work under these funding sources intersected and became interwoven, suggesting movement toward institutionalizing opioid and SUD related activities as opposed to simply adhering to grant timelines and objectives. Implementation of opioid-focused activities that was not required by grant funding also suggests increased acceptance of Extension's role in opioid misuse prevention and other SUD related topics.

Extension is typically located in Colleges of Agriculture within land grant universities. This traditional organizational structure and related subject-matter expertise of the Extension-affiliated faculty specialists may limit the capacity to support work occurring locally. This structure may also hamper visibility of activities addressing SUD by making efforts harder to recognize within the larger university system. A concentrated effort by Federal funding entities to develop formal dissemination strategies for grant-funded outcomes at the local level could address this challenge. This search found limited but intentional linkages between multiple academic units working to impact SUD. Such approaches bridged pharmacy, social work, nursing, and behavioral science disciplines to enhance activities beyond Extension's traditional subject matter focus and thereby potentially expanding overall impact at the organizational and systems levels. Finally, partnerships with external entities, such as state agencies and state or local non-profit organizations, appeared to broaden the reach of Extension activities, thereby strengthening the collective response of the Extension System to the opioid crisis.

Limitations

The PRIMSA-SCR method created a foundation from which to initiate the scoping review, however, it was insufficient to achieve the author's goals, thus requiring the adoption of supplemental methodology (e.g., state-level interviews) to identify the range of Extension activities aimed at mediating substance misuse. Moreover, the inclusion criteria for this search, while appropriate given the focus of this scoping review, may have excluded relevant results broadly related to SUD. Initial shifts in federal funding priorities for Extension specifically related to the opioid crisis, thus, authors may have prioritized data sources specific to opioid misuse. Records returned limited grey literature results beyond those described in the initial funding announcements. However, direct contact with ROTA grantees revealed a range of activities and resources. Thus, a key limitation in our search may be characteristic of the organization of focus (Extension) whereby associated strategies for promotion and marketing may result in infrequent website updates and lack of keywords for search engine optimization. Further limitations are also inherent within the U.S. Extension System. For example, publication in peer-reviewed journals, while standard for disseminating knowledge in academia, is less common among Extension professionals, particularly those focused on local implementation. Furthermore, time parameters for the search may have limited search returns and these results can only be considered current through July 2022. Time needed to produce results, COVID-19 implementation delays, and long wait times for peer-reviewed publication may also explain why few traditional journal articles were found.

Finally, the search methods utilized in this review may have unintentionally excluded efforts of historically black and Native American tribally controlled land-grant institutions. Federal legislation established or extended land-grant status to these institutions in 1890 and 1994, respectively, and they share the Extension mission (80). While selected cooperative activities between land-grant universities were found, particularly in states with tribal colleges, we acknowledge that results may not be fully representative of all work occurring, particularly through institutions with university names not including, "cooperative extension," or other specified search terms.

Conclusions

This is, to our knowledge, the first review of its kind to provide a snapshot of Extension's efforts to address the opioid and SUD crisis in the U.S. While these results may not include every Extension activity that occurred during the specified time frame, Extension has significantly increased efforts to address the opioid crisis and related challenges operating through a loose confederation of organizations that are part of the land-grant system. Numerous training activities, resources, and toolkits have been developed at the state level through funding by federal grant dollars. The volume of effort is significant. Continued efforts and expanded partnerships, particularly for community-level work, are needed to combat the ongoing epidemic of opioid and substance misuse across the country.

Data availability statement

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

Author contributions

AH contributed to the conception and design of the study, reviewed and coded all search results, assisted with writing the introduction, constructed Table 1 and edited Figure 1, inserted all citations, and was responsible for combining, and proofreading all sections of the manuscript. KR conducted the initial web and peer-reviewed literature search, built the excel file for co-authors to review, prepared Figure 1, and assisted with writing results. LW was the Principal Investigator of the Rural Health and Safety Education project (grant no. 2019-46100-30276) from the USDA that funded this work, contributed to the conception and design of the study, reviewed and coded all search results, assisted with writing the introduction, assisted with compiling the results, drafted the discussion, and conclusion sections. All authors contributed to manuscript revision, read, and approved the submitted version.

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Conflict of interest

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

Publisher's note

References

1. Jalal H, Buchanich JM, Roberts MS, Balmert LC, Zhang K, Burke DS. Changing dynamics of the drug overdose epidemic in the United States from 1979 through 2016. *Science*. (2018) 21:361. doi: 10.1126/science.aau1184

2. Kelly JF, Bergman B, Hoeppner BB, Vilsaint C, White WL. Prevalence and pathways of recovery from drug and alcohol problems in the United States population: Implications for practice, research, and policy. *Drug Alcohol Depend*. (2017) 181:162–9. doi: 10.1016/j.drugalcdep.2017.09.028

3. Giano Z, Wheeler DL, Hubach RD. The frequencies and disparities of adverse childhood experiences in the US. *BMC Public Health*. (2020) 1:1327. doi: 10.1186/s12889-020-09411-z

4. Ashford R, Brown AM, Ryding R, Curtis B. Building recovery ready communities: the recovery ready ecosystem model and community framework. *Addict Res Theory*. (2019) 1:11. doi: 10.1080/16066359.2019.1571191

5. Moore KE, Oberleitner L, Pittman BP, Roberts W, Verplaetse TL, Hacker RL, et al. The prevalence of substance use disorders among community-based adults with legal problems in the US. *Addict Res Theory*. (2020) 28:165–72. doi: 10.1080/16066359.2019.1613524

6. Substance Abuse and Mental Health Services Administration. *Key Substance Use and Mental Health Indicators in the United States: Results From the 2018 National Survey on Drug Use and Health (HHS Publication No. PEP19-5068, NSDUH Series H-54)*. Rockville, MD: Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration (2019). Retrieved from: https://www.samhsa.gov/data/

7. Centers for Disease Control and Prevention National Center for Health Statistics. *Drug Overdose Deaths in the U.S. Top 100,000 Annually*. (2021). Available online at: https://www.cdc.gov/nchs/pressroom/nchs_press_releases/2021/20211117.htm (accessed June 17, 2022).

8. Correa VC, Lugo-Agudelo LH, Aguirre-Acevedo DC, Contreras JAP, Borrero AMP, Patiño-Lugo DF, et al. Individual, health system, and contextual barriers and facilitators for the implementation of clinical practice guidelines: a systematic metareview. *Health Res Policy Syst*. (2020) 18:74. doi: 10.1186/s12961-020-00588-8

9. Lowenstein M, Kilaru A, Perrone J, Hemmons J, Abdel-Rahman D, Meisel ZF, et al. Barriers and facilitators for emergency department initiation of buprenorphine: a physician survey. *Am J Emerg Med*. (2019) 37:1787–90. doi: 10.1016/j.ajem.2019.02.025

10. Grella CE, Ostile E, Scott CK, Dennis M, Carnavale J. A scoping review of barriers and facilitators to implementation of medications for treatment of opioid use disorder within the criminal justice system. *Int J Drug Policy*. (2020) 81:102768. doi: 10.1016/j.drugpo.2020.102768

11. USDA National Institute of Food and Agriculture. *Cooperative Extension System*. Available online at: https://www.nifa.usda.gov/about-nifa/how-we-work/extension/cooperative-extension-system (accessed December 10, 2022).

12. Office of National Drug Control Policy. *Rural Community Action Guide: Building Stronger, Healthy, Drug-Free Rural Communities*. (2020). Available online at: https://www.usda.gov/sites/default/files/documents/rural-community-action-guide.pdf (accessed December 10, 2022).

13. Alexander LM, Keahey D, Dixon K. Opioid use disorder: a public health emergency. *JAAPA*. (2018) 31:10. doi: 10.1097/01.JAA.0000545072.09344.ee

14. Washburn LT, Franck KL, Upendram S, Yenerall JN. Cooperative extension professionals' knowledge and attitudes toward the opioid epidemic: implications for capacity development and outreach. *Front Psychiatry*. (2022) 1795. doi: 10.3389/fpsyt.2022.958335

15. United States Department of Agriculture. *Current Research Information System (CRIS)* (2022). Available online at: https://cris.nifa.usda.gov (accessed December 10, 2022).

16. Substance Abuse and Mental Health Services Administration. *Rural Opioids Technical Assistance Grants Notice of Funding Opportunity*. (2018). Available online at: https://www.samhsa.gov/grants/grant-announcements/ti-19-010

17. USDA National Institute of Food and Agriculture. *Children, Youth and Families at Risk (CYFAR)*. Available online at: https://www.nifa.usda.gov/grants/programs/4-h-positive-youth-development/4-h-access-equity-opportunity/children-youth-families-risk-cyfar (accessed December 10, 2022).

18. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med*. (2018) 169:467–73. doi: 10.7326/M18-0850

19. Kamei F, Pinto G, Wiese I, Ribeiro M, Soares S. What evidence we would miss if we do not use grey literature? In *Proceedings of the 15th ACM/IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM)*. (2021). p. 1–11.

20. Bowie M. *A Conceptual Model for Cooperative Extension Professionals as Public Health Change Agents: Three Essays on the Cooperative Extension Program, the Opioid Epidemic, and Substance Use Disorder Needs of Rural Georgia: University of Georgia*. (2020). Available online at: https://marylandrota.org/wp-content/uploads/2021/04/1.3-SPR-Poster.pdf

21. Spoth R, Franz N, Brennan A. Strengthening the power of evidence-based prevention in cooperative extension: a capacity-building framework for translation science-driven behavioral health. *Proc Child Youth Care Forum*. (2021). doi: 10.1007/s10566-020-09559-0

22. Spoth R, Redmond C, Shin C, Greenberg M, Feinberg M, Trudeau L, et al. delivery of universal preventive interventions with young adolescents: long-term effects on emerging adult substance misuse and associated risk behaviors. *Psychol Med*. (2017) 47:2246–59. doi: 10.1017/S0033291717000691

23. Hoffman MS, Ramsay-Seaner K, Letcher A, Heckmann C. Collaboration is key: Implications for successful rural opioid misuse prevention programming. *J Rural Mental Health*. (2021) 45:198. doi: 10.1037/rmh0000184

24. Ken-Opurum J, Lynch K, Vandergraff D, Miller DK, Savaiano DA. A mixed-methods evaluation using effectiveness perception surveys, social network analysis, and county-level health statistics: a pilot study of eight rural Indiana community health coalitions. *Eval Program Plann*. (2019) 77:101709. doi: 10.1016/j.evalprogplan.2019.101709

25. Steen JK, Robertson MN, Seitz H, Downey L, Hardman A, Buys D. Addressing the Opioid Epidemic: Defining Cooperative Extension's Role. *J Ext*. (2021) 57:10.

26. Peterson DJ, Downey LH, Leatherman J. Informing youth health and well-being programs: a national 4-H healthy living evaluation study. *J Youth Dev*. (2018) 13:212–36. doi: 10.5195/jyd.2018.605

27. Purdue University Extension. *Purdue Extension Offers A Substance Use Education Video Series*. (2022). Available online at: https://extension.purdue.edu/opioids/ (accessed December 10, 2022).

28. Ohio State University Extension College of Food and Environmental Sciences. *Opioid Epidemic in Ohio – Extension in Action*. (2022). Available online at: https://extension.osu.edu/about/resources/opioid-epidemic-ohio-%E2%80%93-extension-action#:$\sim$:text=Ohio%20is%20considered%20%22ground%20zero,prevention%20of%20opioid%20abuse%20statewide (accessed December 10, 2022).

29. Dellifield J. *Utilizing Cooperative Extension to Leverage Effective Community Education. Proceedings of the American Public Health Association Conference; 2019*. Philadelphia, PA (2022). Available online at: https://apha.confex.com/apha/2019/meetingapp.cgi/Session/58309

30. Kim J, Hurtado GA, Munoz B J, Randolph S, Bonilla L. Increasing *Rural Capacity to Identify, Respond to, and Address Opioid-related Needs for Prevention through Extension Research and Outreach*. University of Maryland Extension. (2021).

31. Mississippi State Extension. *Mental Health First Aid*. (2022). Available online at: http://extension.msstate.edu/health/the-promise-initiative/mental-health-first-aid (accessed December 10, 2022).

32. Oregon State University. *Coast to Forest: Building on Community Strengths to Promote Mental Health and Reduce Opioid Abuse in Rural Oregon*. (2020). Available online at: https://health.oregonstate.edu/extension/fch/coast-to-forest (accessed December 10, 2022).

33. Mahadevan L. *Mental Health First Aid Research in Rural Texas*. Mental Health News. (2022). Available online at: https://www.openaccessgovernment.org/mental-health-first-aid-rural-areastrauma-informed/131293/ (Accessed July, 2022).

34. Virginia Cooperative Extension. *Opioid Prevention*. (2022). Available online at: https://ext.vt.edu/food-health/opioid-prevention.html2022 (accessed December 10, 2022).

35. University of Wisconsin-Madison Extension. *UW-Madison Division of Extension Receives $500,000 Grant to Address Opioid Issues*. (2020). Available online at: https://fyi.extension.wisc.edu/news/2020/08/13/uw-madison-division-of-extension-receives-500000-grant-to-address-opioid-issues/ (accessed December 10, 2022).

36. US Fed News Service. *Garrison Moon in HESC Leading Group in 2 USDA Funded Health Projects*. (2017). Available online at: https://www.proquest.com/docview/1975626871/E5070349E54D491FPQ/13?accountid=10771&forcedol=true&parentSessionId=3WWnXfwbdSAFSojL3qCk8eTro6djB3VSP6Jn96VM8s4%3D (accessed December 10, 2022).

37. McKendry B. *MSU Research Team Wins Grant to Help Rural Communities Deal With Opioid Crisis*. (2020). Available online at: https://www.canr.msu.edu/news/msu-research-team-wins-grant-to-help-rural-communities-deal-with-opioid-crisis (accessed December 10, 2022).

38. Ray R. *UNH Receives Nearly a Million Dollars to Help Fight the Opioid Epidemic*. University of New Hampshire Media Relations Newsroom. (2020). Available online at: https://www.unh.edu/unhtoday/news/release/2020/08/13/unh-receives-nearly-million-dollars-help-fight-opioid-epidemic

39. Painter A. *Virginia Cooperative Extension forms Key Partnerships to Tackle the State's Opioid Epidemic*. (2018). Available online at: https://vtx.vt.edu/articles/2018/07/cals-opioid.html (accessed December 10, 2022).

40. University of Vermont Extension. *UVM Cultivating Healthy Communities*. (2022). Available online at: https://www.uvm.edu/extension/prosper_programs (accessed December 10, 2022).

41. Pratt K. *Grant will help UK Extension Expand Opioid Prevention And Recovery Efforts*. College News. (2019). Available online at: https://news.ca.uky.edu/article/grant-will-help-uk-extension-expand-opioid-prevention-and-recovery-efforts

42. Iowa State University Extension and Outreach. *Strengthening Families Program: For Parents and Youth 10-14 Web: Iowa State University*. Available online at: https://www.extension.iastate.edu/sfp10-14/ (accessed December 10, 2022).

43. University of Tennessee Institute of Agriculture. *New Approach to Combat Opioid Crisis in Rural Tennessee*. (2020). Available online at: https://utianews.tennessee.edu/new-approach-to-combat-opioid-crisis-in-rural-tennessee/ (accessed December 10, 2022).

44. Michigan State University Extension. *Combating the Opioid Crisis through Outreach and Edcucation*. (2020). Available online at: https://www.canr.msu.edu/resources/combating-the-opioid-crisis-through-outreach-and-education (accessed December 10, 2022).

45. Murray D. *NC Empowering Youth and Families Program (EYFP)*. Available online at: https://carteret.ces.ncsu.edu/2021/03/nc-empowering-youth-and-families-program-eyfp/ (accessed December 10, 2022).

46. Ohio State University Extension College of Food Agricultural and Environmental Sciences. *Opioid Epidemic in Ohio – Extension in Action*. (2022). Available online at: https://extension.osu.edu/about/resources/opioid-epidemic-ohio-%E2%80%93-extension-action#:$\sim$:text=Ohio%20is%20considered%20%22ground%20zero,prevention%20of%20opioid%20abuse%20statewide (accessed December 10, 2022).

47. Illinois Extension College of Agricultural Consumer & Environmental Sciences. *2017 Impact Report*. University of Illinois Extension. (2018).

48. Washington State University Extension. *Take-PART (Participatory Action Research with Teens) Opioid Research Project Internship*. Available online at: https://extension.wsu.edu/clallam/4h/youth-advocates-for-health-ya4-h/ (accessed December 10, 2022).

49. Manning J. *Your Life–Your Health Programming Availability*. (2018). Available online at: https://wilson.ces.ncsu.edu/2017/11/your-life-your-health/ (accessed December 10, 2022).

50. Extension Monroe County. *Agents 4 Change*. Available online at: https://monroe.extension.wisc.edu/4-h-youth-development/agents-4-change/ (accessed December 10, 2022).

51. University of Rhode Island. *URI to Offer Opioid Education, Training to Rural Communities*. (2020). Available online at: https://www.uri.edu/news/2020/02/uri-to-offer-opioid-education-training-to-rural-communities/ (accessed December 10, 2022).

52. Michigan State University. *Farm Stress and Opioid Misuse Awareness*. Available online at: https://www.canr.msu.edu/resources/farm-stress-and-opioid-misuse-awareness (accessed December 10, 2022).

53. Iowa State University Prosper Rx. *Project STOMP is a new initiative just for ISU County Extension & Outreach Staff brought to you by the PROSPER Rx Team*. (2021). Available online at: https://prosper-rx.ppsi.iastate.edu/project-stomp (accessed December 10, 2022).

54. Utah State University. *Community Opioid Education Dinner - Green River*. (2022). Available online at: https://www.usu.edu/calendar/?id=78789 (accessed December 10, 2022).

55. Mississippi State University Extension. *PROMISE:Preventing Opioid Misuse in the Southeast*. (2020). Available online at: http://extension.msstate.edu/the-promise-initiative (accessed December 10, 2022).

56. University of Minnesota Extension. With drug overdoses skyrocketing, Extension and the College of Pharmacy partner in rural Minnesota to reduce harms. *Extension and the College of Pharmacy Combat the Opioid Crisis*. (2021). Available online at: https://extension.umn.edu/family-news/-extension-pharmacy-combat-opioid-crisis (accessed December 10, 2022).

57. Extension University of Missouri. *Statewide Survey Shows that Drugs Affect 70% of Missouri Employers*. (2021). Available online at: https://extension.missouri.edu/news/statewide-survey-shows-that-drugs-affect-70-of-missouri-employers-5455 (accessed December 10, 2022).

58. Akgerman L, Apaliyah G. *Employment and the Opioid Crisis in Ohio: How Extension, Community Partners and the Americans with Disabilities Act Can Support Local Employers*. In: *Proceedings of the Community Engagement Conference*. Columbus, Ohio. (2018). p. 24–5.

59. West Virginia State University Extension Service. *Healthy Grandfamlies*. Available online at: http://healthygrandfamilies.com/about/ (accessed December 10, 2022).

60. West Virginia University Extension. *WVU Extension Service joins Marie's House in the Battle Against the Opioid Epidemic*. (2019). Available online at: https://extension.wvu.edu/news/2019/09/25/wvu-extension-service-joins-marie-s-house-in-the-battle-against-the-opioid-epidemic (accessed December 10, 2022).

61. Maryland ROPTA. *Introducing MarylandROPTA*. (2021). Available online at: https://marylandropta.org/about/ (accessed December 10, 2022).

62. Montana State University Extension. *Opioid Public Service Announcements [Videos]* (2020). Available online at: https://www.montana.edu/extension/health/opioid_pubic_service_announcement_videos.html (accessed December 10, 2022).

63. University of Rhode Island. Learn how to reverse and overdose. *Become a Community First Responder with our Ten Minute Certification Module and Receive Free Narcan*. Available online at: https://web.uri.edu/cfrp/ (accessed December 10, 2022).

64. South Dakota State University Extension. *Strengthening the Heartland*. Available online at: https://extension.sdstate.edu/tags/strengthening-heartland (accessed December 10, 2022).

65. University of Winsconsin-Madison Extension. *EXTENSION'S Role in Addressing Wisconsin's Opioid Crisis* (2019). Available online at: https://extension.wisc.edu/files/2019/03/Extension-OpioidResponseOverview.pdf (accessed December 10, 2022).

66. Mississippi State University Extension. *You Have the Power to Prevent Opioid Addiction*. (2019). Available online at: http://extension.msstate.edu/publications/you-have-the-power-prevent-opioid-addiction (accessed December 10, 2022).

67. Cantrell A. *MSU Extension Researchers Receive Grants for Projects Aimed to Address Prescription Opioid Misuse*. (2019). Available online at: https://www.montana.edu/news/18650/msu-extension-researchers-receive-grants-for-projects-aimed-to-address-prescription-opioid-misuse (accessed December 10, 2022).

68. Oklahoma State University Extension. *Tulsa County Family and Consumer Sciences*. (2022). Available online at: https://extension.okstate.edu/county/tulsa/family-and-consumer-sciences.html (accessed December 10, 2022).

69. University of Minnesota Extension Family Development. *Community Solutions to the Opioid Crisis*. YouTube. (2020). Available online at: https://www.youtube.com/playlist?list=PL-JlTnitjANGcEE6eCT6p349OGvBtPqtL (accessed December 10, 2022).

70. Weibe A. *Utah State University HEART Team Solidifies Vision, Reinforces Project Planning at Impact Collaborative Summit*. (2019). Available online at: https://extension.org/2019/07/24/utah-state-university-heart-team-solidifies-vision-reinforces-project-planning-at-impact-collaborative-summit/ (accessed December 10, 2022).

71. Haskins T, Hartman A. *Webinar: Assessment of Opioid Misuse Risk Among Farmers in the Clinical Setting*. Washington State University (2021).

72. Stewart G. *Ohio State University Extension offers Trauma-Informed Care Training for Noble County*. (2020). Available online at: https://noble.osu.edu/news/ohio-state-university-extension-offers-trauma-informed-care-training-noble-county (accessed December 10, 2022).

73. Utah State University Office of Health Equity and Community Engagement. *Tribal and Rural Opioid Initiative*. Available online at: https://extension.usu.edu/healthwellness/healthequity/troi/index (accessed December 10, 2022).

74. Utah State University Office of Health Equity and Community Engagement. *Debunked* [Podcast]. Available online at: https://extension.usu.edu/healthwellness/healthequity/ (accessed December 10, 2022).

75. Matheson JL, McGrath, R.T. *Adolescent Alcohol and Other Drug Abuse Quick Facts Colorado State University Extension Website*. (2012) [Fact Sheet]. Available online at: https://extension.colostate.edu/topic-areas/family-home-consumer/adolescent-alcohol-and-other-drug-abuse-10-216/ (accessed December 10, 2022).

76. Nelson PT. *Prevention Pays in Families Matter! A Series for Parents of School-Age Youth Newark, DE: University of Delware Cooperative Extension*. (2012). Available online at: https://www.udel.edu/academics/colleges/canr/cooperative-extension/fact-sheets/prevention-pays/ (accessed December 10, 2022).

77. Palombi L, Hager K. Understanding opioid addiction and treatment. *University of Minnesota Extension* (2020). Available online at: https://extension.umn.edu/mental-well-being/understanding-opioid-addiction-and-treatment (accessed December 10, 2022).

78. Kennedy LE. Understanding opioids without the stigma. In: Extension TSUC, editor. *Web: Tennessee State University Cooperative Extension Department of Human Sciences College of Agriculture*. (2019). Available online at: https://www.tnstate.edu/extension/documents/understanding%20opioids%20without%20the%20stigma.pdf (accessed December 10, 2022).

79. Borsuah K, Whitacre B. *Drug Disposal Options for Rural Communities. Oklahoma State University Extension*. (2020). Available online at: https://extension.okstate.edu/fact-sheets/drug-disposal-options-for-rural-communities.html (accessed December 10, 2022).

80. Croft G. *The U.S. Land Grant University System: Overview and Role in Agricultural Research*. Congressional Research Service. (2022).

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Kidney transplant-related knowledge and influencing factors in Chinese kidney transplant candidates and recipients: A cross-sectional study

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Objective: To investigate the kidney transplantation knowledge of kidney transplant (KT) candidates and recipients, and to explore the related influencing factors.

Methods: From March to July 2022, a total of 170 KT candidates and 270 KT recipients were investigated in two tertiary and Grade A hospitals in Hunan Province, China, using demographic questionnaires and the Kidney Transplant Understanding Tool (K-TUT). Multiple linear regression was used to explore the influencing factors of related knowledge of kidney transplantation.

Results: The scores of kidney transplantation knowledge of the two groups were 50.67 (Ranged: 0–63) and 52.79 (Ranged: 0–62), indicating a middle level of knowledge. Education level and whether they have received health education were significantly associated with the knowledge level of kidney transplantation in both KT candidates and recipients. In addition, age and fertility status were only significantly associated with the knowledge level of kidney transplantation in KT recipients.

Conclusion: Our finding shows that the knowledge level of KT candidates and recipients is not optimistic, which suggests that healthcare providers should pay more attention to the health education of this population. In addition, future health education interventions should consider the education level, age, and fertility status factors affecting kidney transplantation knowledge in KT candidates and recipients.

KEYWORDS

kidney transplantation, knowledge, health education, candidates, recipients

1. Introduction

Chronic kidney disease (CKD) refers to the structural and functional abnormalities of kidney caused by various reasons (1). At present, it has become a global public health problem. Epidemiological surveys show that the global prevalence can reach 10–15%, and the incidence is increasing year by year (2, 3). The prevalence of CKD in China was reported to be 10.8%, of which 1–3% would become End-Stage Renal Disease (ESRD) (4). Globally, the number of patients with ESRD is increasing by 7% per year (5). ESRD is a progressive disease that requires prompt renal replacement therapy to prevent death. The disease not only leads to increased hospitalization rates and health care costs, but also a 20–50% mortality

rate within 24 months (6). Kidney transplantation is the best treatment for ESRD. According to the World Health Organization's Global Organ Donation and Transplantation data, a total of 77,319 kidney transplants were performed worldwide by 2017, of which 10,793, or 13.95 percent, were performed in China, ranking second in the world (7). As one of renal replacement therapy, kidney transplantation can effectively improve the survival rate and quality of life of patients with CKD, and significantly reduce the cost of medical care, which is also recognized as the first choice of treatment (8, 9). But post-transplant patients need to have sufficient knowledge of immunosuppressive drugs, health management, infection prevention, and transplant rejection symptoms to take care of themselves (10). Studies had shown that the lack of transplant-related knowledge in KT candidates could cause preoperative anxiety, fear and lack of mental preparation for the postoperative situation (11, 12). For KT recipients, lack of transplant related knowledge would lead to postoperative infection, and even death in severe cases (13).

Therefore, it is very important to understand the transplant related knowledge level of KT candidates and recipients, so as to carry out targeted health education. At present, in China, there is still a lack of research on the transplantation knowledge of KT candidates, or the self-made scale is used to study the transplantation knowledge level of KT recipients, which is not scientific and reliable (14, 15). This study investigated the current status of transplant knowledge of KT candidates and recipients in China by using the Kidney Transplant Understanding Tool of which the Chinese validity and reliability study was conducted by the same authors (16), and to find out its weak points and influencing factors of their kidney transplantation knowledge, so as to provide a basis for formulating targeted health education.

2. Methods

2.1. Participants

Participants were recruited by convenience sampling from March to July 2022 from two tertiary and Grade A hospitals in Hunan Province, China. They met the following inclusion criteria: (a): KT recipients and candidates; and (b) ability to read and communicate effectively; and (c) informed consent and voluntary participation in the study. Patients were excluded from the study if they were with mental illness or cognitive impairment and with $\geq$ 2 or more kidney transplants. According to Kendall's sample size calculation principle, the sample size of the reliability and validity test is 5–10 times of the number of evaluation tool items (17), and the minimum sample size required for this study is 110 participants each. At the same time, according to the requirement that the sample size should be 10–20 times of the independent variable, and considering the sample loss rate of 10%, the minimum sample size required for this study was 132 participants each (18). Finally, a total of 170 KT candidates and 270 KT recipients were included in this study, a total of 440 participants.

2.2. Ethical consideration

The study was approved by the Ethics Committee of Xiangya School of Nursing, Central South University on March 15, 2022 (E202230), with permission and approval from the hospital management, and conformed to the Helsinki Declaration of Ethical Principles for Medical Research. Informed consent was obtained from all participants, participation was voluntary, there were no incentives, they had the right to withdraw from the study at any time, and they were assured that the data would only be used by the research team.

2.3. Questionnaire

The questionnaire included two parts: the first part was the general information of the participants, including age, gender, education level, religious belief, place of residence, occupation, family per capita monthly income, marital status, waiting time for kidney transplantation, and time after transplantation. The second part was the K-TUT, by the Canadian scholar Mansell developed in 2017, mainly to determine the knowledge of KT recipients and candidates in a healthy lifestyle and compliance with medical plans, including concepts related to KT, taking immunosuppressants, identification and prevention of complications, physical changes after KT, traditional treatment measures and infections, pregnancy and sexual health, etc. The tool has 22 questions (9 judgment questions and 13 multiple topics), and multiple choice questions have more than one correct answers. Each option can be considered as a judgment question, and the tool will be transformed into 69 judgment questions. The rule is 1 point for correct answer and 0 point for wrong answer, and the total score is 69 points. The higher the score, the better the patient's understanding of KT related knowledge. It is currently applied in the Korea (10), United States (19), North America (20), Iran (21), Canada (22), etc. The Cronbach's alpha of the tool is 0.79 to 0.88, and the intra-group correlation coefficient is 0.76 to 0.94, which has a good reliability (23). Our research team carried out the Chinese version of the tool. The S-CVI of the Chinese version of KTUT was 0.967, and the I-CVI of each item ranged from 0.8 to 1.0. The internal consistency reliability and retest reliability of the Chinese version of K-TUT were 0.778 and 0.902, respectively, for KT candidates. For KT recipients, the internal consistency reliability and retest reliability of the Chinese version of K-TUT were 0.769 and 0.888, respectively (16).

2.4. Data analysis

SPSS 26.0 was used for statistical analysis. Demographic were described by frequencies, and scores were described by the mean (M) $\pm$ standard deviation (SD). The dependent variables all conform to normal distribution. The main methods included descriptive analysis, sample *t*-test, analysis of variance and multiple regression analysis. The significant level of all indexes was set at $\alpha = 0.05$.

TABLE 1 Demographic characteristics of KT candidates.

Items	KT candidates *n* (%)	Scores	t/F	*P*
Gender			−1.300	0.196
Male	97 (57.1)	50.11 ± 6.174		
Female	73 (42.9)	51.30 ± 5.512		
Age			2.188	**0.030**
≤45	93 (54.7)	51.52 ± 5.774		
>45	77 (45.3)	49.55 ± 5.933		
Nation			−0.601	0.549
Han	161 (94.7)	50.56 ± 5.991		
Ethnic minority	9 (5.3)	51.78 ± 4.324		
Religion			1.665	0.098
No	163 (95.9)	50.78 ± 5.792		
Yes	7 (4.1)	47.00 ± 7.916		
Place of residence			−2.287	**0.023**
Rural	51 (30)	49.06 ± 6.345		
City	119 (70)	51.29 ± 5.611		
Education level			6.037	**<0.001**
Primary school	4 (2.4)	47.25 ± 5.679		
Junior high school	47 (27.6)	48.28 ± 5.136		
High school/secondary Specialized school	44 (25.9)	49.70 ± 6.129		
Undergraduate/ junior college	68 (40)	52.54 ± 5.538		
Postgraduate	7 (4.1)	55.43 ± 5.350		
Occupation			3.424	**0.001**
Medical staff	3 (1.8)	60.67 ± 7.572		
Business staff	33 (19.4)	53.30 ± 5.312		
Civil servants	5 (2.9)	47.60 ± 8.620		
Teacher	9 (5.3)	51.11 ± 5.645		
Self-employed	39 (22.9)	49.85 ± 6.081		
Student	4 (2.4)	53.25 ± 4.349		
Workers	14 (8.2)	48.93 ± 5.076		
Farmer	23 (13.5)	47.83 ± 5.237		
None	40 (23.5)	50.63 ± 5.256		
Marital status			1.956	0.145
Single	30 (17.6)	52.03 ± 6.718		
Married	135 (79.4)	50.19 ± 5.728		
Divorced	5 (2.9)	53.80 ± 4.025		
Widowhood	0			
Fertility status			1.138	0.343
None	40 (23.5)	51.93 ± 6.120		
One girl	33 (19.4)	50.27 ± 4.824		
One boy	47 (27.6)	49.26 ± 5.940		

(Continued)

TABLE 1 (Continued)

Items	KT candidates *n* (%)	Scores	t/F	*P*
One boy and girl	26 (15.3)	50.23 ± 7.607		
Two girls	9 (5.3)	52.33 ± 4.123		
Two boys	12 (7.1)	52.50 ± 4.739		
Others	3 (1.8)	49.33 ± 2.309		
Monthly household income per capita			2.644	**0.035**
1,000 以下	17 (10)	47.24 ± 6.160		
1,000–3,000	31 (18.2)	49.65 ± 5.024		
3,000–5,000	38 (22.4)	50.61 ± 7.262		
5,000–8,000	31 (18.2)	50.81 ± 5.388		
8,000 以上	53 (31.2)	52.19 ± 5.122		
Renal waiting time			0.421	0.794
<1 year	102 (60)	50.32 ± 6.121		
1–3 years	43 (25.3)	51.33 ± 5.723		
3–5 years	10 (5.9)	50.20 ± 4.517		
5–10 years	11 (6.5)	51.73 ± 4.982		
More than 10 years	4 (2.4)	48.75 ± 9.215		
Health education			4.447	**<0.001**
Yes	120 (70.6)	51.86 ± 5.325		
No	50 (29.4)	47.66 ± 6.242		
Knowledge scores	50.67 ± 5.912			

The bold values indicated P < 0.05.

3. Results

3.1. Socio-demographic characteristics

Among the 440 participants in our study, there were 170 KT candidates and 270 KT recipients. For KT candidates, male (57.1%) was slightly higher than female (42.9%). What's more, most of the patients were Han nationality (94.7%) and had no religious belief (95.9%). About one-third of the patients were from rural areas (30%) and the rest were from cities; see the Table 1 for other basic information. For recipients, the proportions of gender, nation, religious belief and residence were similar to those of the recipients. See the Table 2 for other basic information.

3.2. Univariate analysis of influencing KT related knowledge

The results showed that there were significant differences in age, place of residence, education level, occupation, family per capita monthly income, and whether the patients received health education among KT candidates ($P < 0.05$). To be specific, patients with age ≤45, living in cities, higher education level, medical staff, higher family per capita monthly income, and receiving health education had higher knowledge level of kidney transplantation, and their knowledge mean score was 50.67 (63), as detailed in the Table 1. There were significant differences in age, place of residence, education level, occupation, birth status, family per capita monthly income, and whether to receive health education among KT recipients ($P < 0.05$), and the specific results are similar to those of KT candidates. Their knowledge mean score was 52.79 (62), as detailed in the Table 2.

3.3. Multivariate analysis of influencing KT related knowledge

The K-TUT scores of KT candidates and recipients were considered as dependent variables. Statistically significant data in general data (age, place of residence, education level, occupation, fertility status, family per capita monthly income, and health education) were considered as independent variables. Multiple linear regression models were established respectively. The results showed that the two independent variables of education level and whether to receive health education affected the transplant-related knowledge level of KT candidates (see Table 3). The details were as follows: Education level and whether they have received health education have a positive association on the knowledge level of kidney transplantation. The higher the education level, the higher the knowledge level of KT candidates, and the level of kidney transplantation was higher in KT candidates who had received health education (B = 1.589, SE = 0.507, p-value = 0.002; B = −4.663, SE = 0.889, p-value = 0.000). The results showed that the four independent variables, age, education level,

TABLE 2 Demographic characteristics of KT recipients.

Items	KT recipients *n* (%)	Scores	t/F	*P*
Gender			−1.677	0.095
Male	152 (56.3)	50.11 ± 6.174		
Female	118 (43.7)	51.30 ± 5.512		
Age			4.647	**<0.001**
≤45	168 (62.2)	53.99 ± 5.265		
>45	102 (37.8)	50.81 ± 5.721		
Nation			−0.662	0.508
Han	240 (88.9)	52.71 ± 5.666		
Ethnic minority	30 (11.1)	53.43 ± 5.538		
Religion			0.964	0. 336
No	260 (96.3)	52.85 ± 5.572		
Yes	10 (3.7)	51.10 ± 7.475		
Place of residence			−2.227	**0.027**
Rural	95 (35.2)	51.76 ± 5.163		
City	175 (64.8)	53.35 ± 5.830		
Education level			5.924	**<0.001**
Primary school	7 (2.6)	49.71 ± 4.152		
Junior high school	55 (20.4)	50.96 ± 5.246		
High school/secondary Specialized school	83 (30.7)	51.71± 5.009		
Undergraduate/junior college	112 (41.5)	54.50 ± 5.606		
Postgraduate	13 (4.8)	54.31 ± 7.836		
Occupation			2.770	**0.006**
Medical staff	9 (3.3)	58.11 ± 7.079		
Business staff	46 (17.0)	53.39 ± 5.607		
Civil servants	18 (6.7)	52.72 ± 6.884		
Teacher	24 (8.9)	53.13 ± 5.343		
Self-employed	46 (17.0)	52.80 ± 5.924		
Student	7 (2.6)	54.43 ± 3.155		
Workers	20 (7.4)	50.70 ± 4.624		
Farmer	29 (10.7)	49.72 ± 4.284		
None	71 (26.3)	53.30 ± 5.434		
Marital status			0.939	0. 422
Single	53 (19.6)	53.77 ± 5.067		
Married	196 (72.6)	52.65 ± 5.701		
Divorced	19 (7.0)	51.79 ± 6.588		
Widowhood	2 (0.7)	50.00 ± 5.657		
Fertility status			3.406	**0.003**
None	75 (27.8)	54.24 ± 5.151		
One girl	57 (21.1)	53.07 ± 4.982		
One boy	68 (25.2)	52.28 ± 5.550		

(Continued)

TABLE 2 (Continued)

Items	KT recipients *n* (%)	Scores	t/F	*P*
One boy and girl	36 (13.3)	53.58 ± 5.400		
Two girls	17 (6.3)	49.35 ± 7.541		
Two boys	9 (3.3)	49.22 ± 6.515		
Others	8 (3.0)	49.25 ± 6.205		
Monthly household income per capita			3.375	**0.010**
1,000 以下	18 (6.7)	52.06 ± 5.765		
1,000–3,000	64 (23.7)	51.55 ± 5.489		
3,000–5,000	70 (25.9)	51.97 ± 5.907		
5,000–8,000	58 (21.5)	53.28 ± 4.902		
8,000 以上	60 (22.2)	54.82 ± 5.703		
Renal waiting time			1.365	0.254
<1 year	169 (62.6)	52.35 ± 5.284		
1–3 years	86 (31.9)	53.73 ± 6.307		
3–5 years	10 (3.7)	53.10 ± 6.244		
e 5–10 years	5 (1.9)	50.80 ± 2.387		
More than 10 years	0	0		
Time after kidney transplantation			1.876	0.099
<3 months	27 (10.0)	55.26 ± 5.502		
3 months−1 year	44 (16.3)	51.43 ± 4.795		
1–3 years	61 (22.6)	52.48 ± 6.305		
3–5 years	39 (14.4)	52.36 ± 5.183		
5–10 years	61 (22.6)	53.49 ± 5.781		
More than 10 years	38 (14.1)	52.42 ± 5.436		
Health education			4.447	**<0.001**
Yes	248 (91.9)	51.86 ± 5.325		
No	22 (8.1)	47.66 ± 6.242		
Knowledge scores	52.79 + −5.646			

The bold values indicated P < 0.05.

fertility status and whether to receive health education, affect the transplant-related knowledge level of KT recipients (see Table 4). Specifically, the influence of education level and whether they have received health education on the knowledge level of KT recipients is similar to that of KT candidates (B = 0.867, SE = 0.415, *p*-value = 0.038; B = −5.884, SE = 1.126, *p*-value = 0.000). The difference is that age and fertility status have a negative association on the knowledge level of KT recipients. The older they were, the more children they had, and the lower the knowledge level of KT recipients.

TABLE 3 Multiple linear regression of KT candidates.

Items	B	SE	β	t	*P*
Constant	51.912	3.427	–	15.148	**<0.001**
Age	−1.409	0. 878	−0.119	−1.605	0.111
Place of residence	0.713	0.948	0.055	0.753	0.453
Education level	1.589	0.507	0.257	3.133	**0.002**
Occupation	−0.126	0.169	−0.056	−0.741	0.459
Monthly household income per capita	0.376	0.323	0.086	1.163	0.247
Health education	−4.663	0.889	−0.360	−5.248	**<0.001**

R^2, 0.269; Adjusted R^2, 0.242; F, 10.013; P < 0.001.
The bold values indicated P < 0.05.

4. Discussion

This study investigated the knowledge level and associated factors of kidney transplantation among Chinese KT candidates and recipients through K-TUT after Chinese translation. The results showed that the average K-TUT score of KT candidates was 50.67 (63 points), while the average K-TUT score of KT recipients was slightly higher than that of KT candidates, which was 52.79 (62 points). This is consistent with the results of Rosaasen and

TABLE 4 Multiple linear regression of KT recipients.

Items	B	SE	β	*t*	*P*
Constant	57.607	2.691	–	21.404	**<0.001**
Age	−2.115	0.690	−0.182	−3.066	**0.002**
Place of residence	0.781	0.706	0.066	1.106	0.270
Education level	0.867	0.415	0.142	2.091	**0.038**
Occupation	0.001	0.134	0.001	0.008	0.994
Fertility status	−0.439	0.210	−0.121	−2.092	**0.037**
Monthly household income per capita	0.467	0.282	0.102	1.656	0.099
Health education	−5.884	1.126	−0.286	−5.224	**<0.001**

R^2, 0.240; Adjusted R^2, 0.220; F, 11.849; P < 0.001.
The bold values indicated P < 0.05.

Kang et al. (10, 23). Both in the medium level, but the accuracy is <10% of individual items, such as entry "Every person who receives a kidney transplant feels better than they did before the transplant," "Your creatinine will always be normal after your kidney transplant," etc., showed that most patients see only positive aspects of KT, and ignore the negative aspects of transplantation or the importance of self-care, highlights the importance of health education. Therefore, in the future, medical staff should carry out targeted health education to further improve their knowledge level.

It was worth noting that this study showed that there are similarities and differences in factors affecting the knowledge level of KT recipients and candidates. Education level and health education were correlated with the knowledge level of kidney transplantation. Education level had a significant positive predictive effect on the knowledge level of renal transplantation. Several studies have arrived at similar conclusions (19, 24). This may be because patients with high education level are good at using various channels and opportunities to acquire knowledge, and have stronger ability to understand, accept and process knowledge and information. Good learning ability and strong knowledge seeking ability will have a positive impact on their knowledge level. However, patients with low education level have less ways and means to receive knowledge and information, and have no strong desire to understand the knowledge related to kidney transplantation, so they have weak cognition of the knowledge related to kidney transplantation (25, 26). This suggests that medical personnel should formulate personalized plans for people with different education levels when conducting health education. For example, for patients with low education levels, they can conduct propaganda and education through pictures, videos and other easy to understand ways, and regularly give feedback or carry out patient exchanges (27). Patients with high knowledge scores can share their own life habits, spread knowledge, and obtain positive stimulation among patients, so as to improve the knowledge level of kidney transplantation (13, 28). This study shows that patients who have received health education have a higher level of knowledge about kidney transplantation, which is consistent with the study. This may be because health education is an important way to acquire knowledge. After health education, patients can understand and master the knowledge of kidney transplantation more easily (29), which suggests that it is very important for medical staff to implement health education for patients.

The study also confirmed that age and fertility status had significant effects on KT recipients ($P < 0.05$), while these two factors had no effect on KT candidates. Specifically, the level of KT knowledge of KT recipients aged >45 years is higher than that of those aged <45 years, this may be because with the increase of age, the memory and cognitive ability of the patients decrease, the ability to accept the knowledge related to renal transplantation is poor, and the access to medical care knowledge is also less; On the other hand, with the change of health concepts and the development of network information, young people pay more and more attention to their own health, are more willing to take the initiative to acquire health-related knowledge through the Internet and other ways, and have stronger ability to accept new knowledge and new ideas (30). This suggests that medical staff should try their best to use concise and clear language when carrying out health education for older patients. Key knowledge can be explained repeatedly to facilitate patients to strengthen their memory. Health education for young patients can be integrated with new media means to meet their needs. In addition, fertility status has a negative impact on the knowledge level of KT recipients. This is consistent with the study of Sun et al. (31). This may be because the increase in the number of children has put great financial pressure on families and strained resources. In the long run, this limits patients' access to important health promotion resources. This suggests that medical staff should pay more attention to KT recipients with a large number of children in the future.

This study has some limitations. First, the sample size of this study was small, which may affect the validity of the study results. Subsequent large cross-sectional studies should be conducted to explore the effectiveness of the Chinese-translated tools in this study. In addition, convenience sampling was used to select participants in this study, which may have a certain impact on the representativeness of the sample. In the future, the results of the survey and analysis should be based on large samples. The advantage of this study is that it is the first time in China to verify the K-TUT in the KT candidates and recipients. It provides a reliable tool for China to investigate the related knowledge level, analyze its influencing factors, and provide reference for formulating targeted health education and improving its knowledge level.

5. Conclusion

In conclusion, our results show that the Chinese version of the K-TUT has good reliability and validity, and the knowledge of KT candidates and recipients in China is at a medium level. Education level and whether they have received health education are the influencing factors of KT knowledge. In addition, age and fertility status will affect the KT knowledge level of KT recipients. This article can help medical staff to screen the weak points of kidney transplantation knowledge of patients, provide reference for the development of targeted health education, and suggest that medical staff can also start from the above factors to improve their knowledge level of kidney transplantation.

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 studies involving human participants were reviewed and approved by Xiangya School of Nursing, Central South University. The patients/participants provided their written informed consent to participate in this study.

Author contributions

HM and JW: conception, design of study, and drafting the manuscript. HM and MH: data collection and data analysis. 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. Kalantar-Zadeh K, Jafar T H, Nitsch D, Neuen B L, Perkovic V. Chronic kidney disease. *Lancet.* (2021) 398:786–802. doi: 10.1016/S0140-6736(21)00519-5

2. Ene-Iordache B, Perico N, Bikbov B, Carminati S. Remuzzi, A, et al. Chronic kidney disease and cardiovascular risk in six regions of the world (ISN-KDDC): a cross-sectional study. *Lancet Glob Health.* (2016) 4:e307–19. doi: 10.1016/S2214-109X(16)00071-1

3. Wilson S, Mone P, Jankauskas S S, Gambardella J, Santulli G. Chronic kidney disease: Definition, updated epidemiology, staging, and mechanisms of increased cardiovascular risk. *J Clin Hypertens (Greenwich).* (2021) 23:831–4. doi: 10.1111/jch.14186

4. Zhang L, Wang F, Wang L, Wang W, Liu B, Liu J et al. Prevalence of chronic kidney disease in China: a cross-sectional survey. *Lancet.* (2012) 379:815–22. doi: 10.1016/S0140-6736(12)60033-6

5. Cao YY, Liu HR, Peng YJ, Yang Q, Yang SR, Tao YL et al. A survey on the satisfaction of renal transplant recipients' participation in surgical decision-making. *Chinese J Nurs.* (2021) 56:1340–6. doi: 10.3761/j.issn.0254-1769.2021.09.010

6. Benjamin O, Lappin SL. End-Stage Renal Disease. In *StatPearls [Internet]*. Treasure Island (FL): StatPearls Publishing (2022).

7. Cappadona R, De Giorgi A, Di Simone E, Di Muzio M, Di Muzio F, Di Muzio F et al. Infodemiology of solid organ transplantation: relationship to the global observatory on donation and transplantation data. *Eur Rev Med Pharmacol Sci.* (2020) 24:12630–7. doi: 10.26355/eurrev_202012_24159

8. Karimi F, Chafai M, Fadili W, Laouad I, Lisri M, Habiballah M et al. Knowledge of Chronic Hemodialysis Patients on Kidney Transplantation in Morocco. *Transplant Proc.* (2019) 51:2250–3. doi: 10.1016/j.transproceed.2019.01.173

9. Voora S, Adey D B. Management of Kidney Transplant Recipients by General Nephrologists: Core Curriculum (2019). *Am J Kidney Dis.* (2019) 73:866–79. doi: 10.1053/j.ajkd.2019.01.031

10. Kang CM, Jeong IS. Validation of the Korean version of the kidney transplant understanding tool. *Asian Nurs Res (Korean Soc Nurs Sci).* (2020) 14:320–6. doi: 10.1016/j.anr.2020.09.002

11. Zhan LL, Fu R, Xun PF. Meta-integration of the experience of dialysis patients while waiting for kidney transplantation. *Nurs Res.* (2020) 34:3233–8.

12. Peipert JD, Hays RD, Kawakita S, Beaumont JL, Waterman AD. Measurement characteristics of the knowledge assessment of renal transplantation. *Transplantation.* (2019) 103:565–72. doi: 10.1097/TP.0000000000002349

13. Urstad KH, Wahl AK, Moum T, Engebretsen E, Andersen MH. Renal recipients' knowledge and self-efficacy during first year after implementing an evidence based educational intervention as routine care at the transplantation clinic. *BMC Nephrol.* (2021) 22:265. doi: 10.1186/s12882-021-02468-x

14. Zhong BF, Zhou Y. Effect of diversified health education on rehabilitation of patients after renal transplantation. *Electron J Practic Organ Transplant.* (2019) 7:204–5. doi: 10.3969/j.issn.2095-5332.2019.03.010

15. Chen WC, Zhang MY, Peng WJ, Luo XP. Application of staged health education in renal transplantation patients. *Nurs Pract Res.* (2020) 17:68–70. doi: 10.3969/j.issn.1672-9676.2020.18.025

16. Ma H, Hu M, Wan J. Validation of the Chinese version of the kidney transplant understanding tool in Chinese patients. *Nurs Open.* (2023) 2:1544. doi: 10.1002/nop2.1544

17. Ding ZY. *Study on the Chinese translation, reliability and validity of AACN Healthy Work Environment Assessment Scale [master's thesis]*. Hang Zhou (China): Zhejiang University (2019), p. 85.

18. Zhao JM, Fang X, Meng Q, Zhan J, Zhang MX. A study on the status quo and influencing factors of personal life control in renal transplant patients. *Chinese J Nurs.* (2022) 57:1213–8. doi: 10.3761/j.issn.0254-1769.2022.10.009

19. Bruns C, Giese J, Phillippi D, Moore D, Hall P. Knowledge and attitudes toward renal transplantation in individuals undergoing transplant evaluation. *Prog Transplant.* (2021) 31:271–8. doi: 10.1177/15269248211024613

20. Mansell H, Rosaasen N, West-Thielke P, Wichart J, Daley C, Mainra R, et al. Randomized controlled trial of a video intervention and behavior contract to improve medication adherence after renal transplantation: the VECTOR study protocol. *BMJ Open.* (2019) 9:e025495. doi: 10.1136/bmjopen-2018-025495

21. Ganjali R, Ghorban Sabbagh M, Nazemiyan F, Mamdouhi F, Badiee Aval S, Taherzadeh Z, et al. Factors associated with adherence to immunosuppressive therapy and barriers in asian kidney transplant recipients. *Immunotargets Ther.* (2019) 8:53–62. doi: 10.2147/ITT.S212760

22. Mansell H, Rosaasen N, West-Thielke P, Wichart J, Daley C, Mainra R, et al. A randomized controlled trial of a pretransplant educational intervention in kidney patients. *Transplant Direct.* (2021) 7:e753. doi: 10.1097/TXD.0000000000001202

23. Rosaasen N, Taylor J, Blackburn D, Mainra R, Shoker A, Mansell H. Development and validation of the kidney transplant understanding tool (K-TUT). *Transplant Direct.* (2017) 3:e132. doi: 10.1097/TXD.0000000000000647

24. Barth A, Szollosi G J, Nemes B. Measuring patients' level of knowledge regarding kidney transplantation in eastern Hungary. *Transplant Proc.* (2021) 53:1409–13. doi: 10.1016/j.transproceed.2021.01.040

25. Nwanji V, Ghahramani A, Dauleh M, Ghahramani N. Knowledge about benefits of kidney transplantation: a survey of dialysis patients. *Ann Urol Nehrol.* (2021) 2:550. doi: 10.33552/AUN.2021.02.000550

26. Okoro RN, Ummate I, Ohieku JD, Yakubu S, Adibe MO, Okonta MJ. Kidney disease knowledge and its determinants among patients with chronic kidney disease. *J Patient Exp.* (2020) 7:1303–9. doi: 10.1177/2374373520967800

27. Ganjali R, Taherzadeh Z, Ghorban Sabbagh M, Nazemiyan F, Mamdouhi F, Tabesh H et al. Effect of an interactive voice response system on self-management

in kidney transplant recipients: protocol for a randomized controlled trial. *Med (Baltimore)*. (2019) 98:e14291. doi: 10.1097/MD.0000000000014291

28. Zeng Y. Influence of health education on self-management knowledge and quality of life of patients after renal transplantation. *Intell Health*. (2020) 6:56–57+63. doi: 10.19335/j.cnki.2096-1219.2020.9.028

29. McPherson LJ, Hamoda RE, Patzer RE. Measuring patient knowledge of kidney transplantation: an initial step to close the knowledge gap. *Transplantation*. (2019) 103:459–60. doi: 10.1097/TP.0000000000002350

30. Zhang M, Yang H, Wang YX, Cheng H, Cao HL. Current status and influencing factors of disease knowledge in patients with first-episode acute myocardial infarction. *Nurs Res*. (2020) 34:2375–9. doi: 10.12102/j.issn.1009-6493.2020.13.024

31. Sun ST, Lu JJ, Wang YW, Wang Y, Wu LH, Zhu D, et al. Gender differences in factors associated with the health literacy of hospitalized older patients with chronic diseases: a cross-sectional study. *Front Public Health*. (2022) 22:2748. doi: 10.3389/fpubh.2022.944103

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Reflections on medical student evaluations of a public health clerkship

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Introduction: The COVID-19 pandemic demonstrated the need for skilled medical practitioners in public health, and outbreak investigations. The College of Medicine and Health Sciences at the United Arab Emirates University (UAEU) introduced a clerkship in public health constituting theoretical and practical sessions to 5th year medical students in 2015. The aim of this study is to explore the satisfaction of the students with the public health clerkship which is crucial for the assessment and reformation of the taught curriculum.

Methods: A cross-sectional, post-evaluation analysis was conducted from the period 2015–2022. The evaluation questionnaire was conducted *via* an online university system. The survey contained 5 themes: pre-course instructions, structure of the clerkship, academic staff, activities, and learning outcomes. Ethics approval was secured from the Social-IRB of the UAEU. We used SPSS version 26 to analyze the data using independent *t*-test and ANOVA.

Results: One hundred and seventy four students (27.4% response rate) participated in the study. Overall, the students had an average satisfaction score of 2.86 out of 4. The majority of the students reported having a good understanding of public health (93.7%), improving their oral presentation skills (91.2%), and developing new skills (87.2%). Furthermore, more than 9 in 10 students (96.1%) reported that the program expanded their knowledge, skills, and confidence. The mass (90.2%) of students agreed that the clerkship content was covered in sufficient depth, majority of the students agreed that they had received enough information about the clerkship before it started (74.6%), majority of the students agreed that the faculty were interested in their personal development (86.1%) The students who completed the clerkship prior to the COVID-19 pandemic had a statistically significant ($P = 0.02$) higher average rating (72.8%) than students who completed the clerkship during the pandemic (71.1%).

Discussion: Medical students at the UAEU were satisfied with the activities and delivery of the public health clerkship and found it rewarding. Conducting needs assessment and proposal writing provided them with the knowledge, skills, and confidence to conduct research in their career. These findings may be useful in helping and support other institutes to plan and develop a clerkship in the public health.

KEYWORDS

public health, clerkship, reflection, UAE, student evaluations

Introduction

The overall improvement of the health of the public, not just of individuals, is the main goal of public health medical education. Hence, public health knowledge and competencies are undisputedly a central necessity rather than an option or a mere luxury (1). Historically, the need to include public health, among others, in medical education had been advocated as far back as 1855 (2). However, the importance of basic understanding of public health has again attracted attention nowadays, a development mostly attributable to the recent pandemics including SARS, avian influenza, West Nile Virus and more recently the COVID-19 pandemic (3). Moreover, another notable factor bringing to light the importance of public health in medical education is the current epidemic of chronic non-communicable diseases witnessed in both developed and developing countries (3). The COVID-19 pandemic demonstrated the need for skilled medical practitioners in public health, outbreak investigations and needs assessments. Medical students are the future healthcare taskforce, therefore, training them on community diagnostics and on designing population-based epidemiological studies is fundamental. Fineberg identified six aspects and pillars in which public health matters to medicine, these aspects are: epidemiology; impact of ecological, dietary, societal, and behavioral determinants on wellbeing; systems thinking; culture orientation; population health and global health (4).

The Institute of Public Health (IPH) at the College of Medicine and Health Sciences (CMHS) at the United Arab Emirates University (UAEU) recognized the value of public health and introduced a public health clerkship to 5th year medical students in 2015. The four-week clerkship compulsory public health takes place among the clinical clerkship rotations of main medical specialties during the last 2 years of medical education. Building on the exposure of medical students to biostatistics, epidemiology and health promotion in the 1st and 2nd years, the clerkship provides a unique opportunity to recapitulate public health knowledge and skills, and put them in practical context in the practice-oriented last 2 years of medical training. Such positioning of public health education in a medical program is a quite rare example and provides a recognition of the field among the main medical specialties.

The design of the public health clerkship at the United Arab Emirates University is based on sociocultural theory by the psychologist Lev Vygotsky (5). The sociocultural theory tackles the impacts of society and surroundings on individual education; therefore, in the Institute of Public Health, we adopt a social pedagogy in which students are sensitized to the community approach (6). The clerkship offers a combination of theoretical and practical sessions over a 4-week period 9.00–17.00 daily, except the half-day program on the last working day of the week. The major themes of the consecutive weeks are the main areas of public health, field practice including the field visits, epidemiological study methodology and assessment, respectively. The content spans almost all the major public health themes including biostatistics and basic epidemiology, epidemiology of communicable and non-communicable diseases including injuries, occupational medicine and environmental health, health promotion, health policy and health management. Although theory is discussed in details in lectures, the training focuses on delivering practical public health skills in the form of several case studies, three field visits, portfolios, group-based assessment of public health priorities, and development of epidemiological study proposals. The group-based exercises are typically performed in four groups, each group having a designated faculty supervisor, identifying a separate public health priority based on literature review, and developing a protocol to study the issue. On the last week of the clerkship, students are assessed individually by performing a test of multiple-choice questions and by completing an e-portfolio, as well as in teamwork, when they communicate their findings in the form of oral presentations and written assignments describing the developed protocol.

Student satisfaction is an important aspect of the medical education and exploring the satisfaction of the current medical students with the public health clerkship as well as the impact of the clerkship on their skills is crucial for the assessment and reformation of the taught curriculum. This will allow coordinators and academic staff to reflect on the structure, and activities of the clerkship, and redesign it accordingly. The paper by Jereb et al. associated teaching staff, followed by organizational support, curriculum, physical location, place of the institution, social life and support amenities to student satisfaction (7).

The aim of this study is to explore the satisfaction of medical students with the current structure, content, and activities of the public health clerkship at College of Medicine and Health Sciences at the United Arab Emirates University. Moreover, the study aims at evaluating student satisfaction with the remote delivery of the clerkship during the COVID-19 pandemic.

Materials and methods

Sample

The target population of the study was 5th year national medical students who attended the public health clerkship offered by the Institute of Public Health. The medical education department of the college of medicine and health sciences extracted the evaluation of the students over the period of the last seven academic years, from 2015/2016 to 2021/2022.Students. The survey is part of the non-mandatory evaluation of the courses conducted by the Department of Medical Education at the College of Medicine and Health Sciences at the United Arab Emirates University.

Data collection instrument

The survey is comprised of 37 close-ended and open-ended questions categorized into five themes: pre-course instructions, structure of the clerkship, academic staff, activities of the clerkship including the research project, seminars, and assignments, and learning outcomes. For each statement in the survey, level of agreement could be given on a 4-item Likert scale comprising of "strongly agree," "agree," "disagree," and "strongly disagree."

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Data analysis

The overall satisfaction and rating of the clerkship program by students was presented as average percentage response scores. These percentage scores were computed by assigning scores of four, three, two and one to the responses strongly agree, agree, disagree, and strongly disagree, respectively, to each of the positive evaluation statements. For the few negative evaluation statements, this order of scoring was reversed to allow for aggregation of overall satisfaction score by each student. The average of these scores was then computed for all the statements and for each student. These averages were then converted to percentage scores to obtain the percentage satisfaction scores. The percentage satisfaction score was tested to assume a skewed distribution using Shapiro–Wilk test for normality. Accordingly, the percentage scores were descriptively summarized using median and interquartile range (IQR). Categorical variables were summarized as frequencies and percentages.

Furthermore, differences in percentage satisfaction scores were examined across gender and period (in relation to COVID-19 to examine the impact of remote teaching and learning on the overall student experience) using Mann-Whitney U test and across academic sessions using Kruskal-Wallis test. Responses to each evaluation statement were also summarized and presented as proportions of the four possible responses—strongly agree, agree, disagree and strongly disagree. Specific responses to all the individual evaluation statements were described and summarized using percentages. Each evaluation statement had four possible ranked responses: strongly agree, agree, disagree, and strongly disagree. Proportions of respondents who indicated any of the options for each evaluation statement were reported alongside the total number of those who responded to the particular evaluation statement. Finally, line graphs were used to illustrate trends in examination score and the clerkship satisfaction score over the academic years. The correlation between these two scores was statistically examined using Pearson correlation coefficient. All inferential statistics were performed with a significance level of 0.05 SPSS version 28 was used for the analysis. (IBM Corp. Released 2021. IBM SPSS Statistics for Windows, Version 28.0. Armonk, NY: IBM Corp).

Results

A total of 174 clerkship national students of the United Arab Emirates participated in the voluntary evaluation (27.4% response rate), completing a set of questions about their overall clerkship experience. Of these 150 (86.2%) were female and 24 (13.8%) were male. Most participants were from the 2020/2021 academic year (n = 32, 18.4%) while the least were during the academic year 2017/2018 (n = 16, 9.2%). Table 1 shows the general characteristics of the participants.

Overall, the students had an average satisfaction score of 2.86 out of 4 translating to an average score of71.4% (95% confidence interval = 71.1–73.3). Female students rated the program 72.2% on average, while male students rated it at 70.5% (Table 2). The difference between the two genders was not statistically significant (Mann-Whitney U test, P = 0.138). The students who completed the clerkship prior to the COVID-19 pandemic with classroom-based sessions had a statistically significant (Mann-Whitney U test, P = 0.02) higher average rating (72.8%) than students who completed the clerkship during the pandemic having online sessions (71.1%), although the difference is not large (Table 2).

TABLE 1 Distribution of students who responded to the clerkship evaluation by gender, academic year, and period with respect to COVID-19 pandemic (N = 174).

Characteristic	Frequency	Percentage	Total number of students
Gender			
Female	150	86.2	482
Male	24	13.8	155
Academic year			
2014/2015	26	14.9	80
2015/2016	24	13.8	66
2016/2017	18	10.3	81
2017/2018	16	9.2	97
2018/2019	17	9.8	77
2019/2020	18	10.3	79
2020/2021	32	18.4	73
2021/2022	23	13.2	84
Period			
Before COVID-19 pandemic	101	58.0	401
During COVID-19 pandemic	73	42.0	236

Statistically significant differences in satisfaction score were also observed across the seven academic years (Kruskal-Wallis test, P = 0.01). Students from the 2015/2016 academic year rated the program the highest with an average score of 76.9%, followed by the 2016/2017 academic year with an average score of 73.6%, both of which were pre-COVID-19 pandemic. In contrast, the academic year 2021/2022 (COVID-19 pandemic) had the lowest satisfaction score with a score of 62.8% (Table 2). In general, satisfaction scores for the public health clerkship were typically 0.1–0.4 below the average satisfaction scores for other clerkships delivered on year 5 (Table 3).

Figure 1 illustrates the trends in public health clerkship average satisfaction score and the average marks obtained by the students in the clerkship examination. Overall, there was no significant correlation between the scores (r = 0.253, P = 0.585). However, there seemed to be a positive relationship between the two scores in later academic years of 2019/2020 to 2021/2022 where the average satisfaction score increases or decreases with the corresponding increase or decrease in the average marks obtained in the exam (Figure 1).

TABLE 2 Satisfaction scores by gender, period, and academic year ($N = 174$).

Characteristic	Median (%)	IQR (%)	*P*-value
Gender			
Female	72.2	16.3	0.138
Male	70.5	18.2	
Period			
Before COVID-9 pandemic	72.8	15.6	0.020*
During COVID-19 pandemic	71.1	15.6	
Academic year			
2014/2015	70.8	18.2	0.010*
2015/2016	76.9	11.9	
2016/2017	73.6	22.4	
2017/2018	71.1	11.5	
2018/2019	72.8	18.6	
2019/2020	71.7	21.4	
2020/2021	72.8	17.7	
2021/2022	62.8	17.8	

IQR, interquartile range.
*$P < 0.05$.

TABLE 3 Satisfaction scores for other 5th year clerkships in comparison to the public health clerkship.

Academic year	Average response for public health clerkship (out of 4)	Average response for the other 5th year clerkships (out of 4)
2014/2015	3.30	3.40
2015/2016	3.19	3.60
2016/2017	2.89	3.18
2018/2019	3.21	3.29
2019/2020	2.97	3.34
2020/2021	3.17	3.36
2021/2022	2.82	3.19

Table 4 presents a summary of the students' responses to the specific evaluation statements. Majority of the statements were positive which indicates a positive satisfaction, for instance, "I have found the clerkship rewarding." Response summary for the few negative evaluation statements are also reported in the table. Overall, a substantial majority (ranging from 72.3 to 96.1%) of the participants agreed to each of the positive statements.

Pre-course instructions

The majority of the students agreed that they had received enough information about the clerkship before it started (74.6%), about the assignments (79.1%), about the research project (81.5%), as well as about the site visit (88.5%) (Table 4).

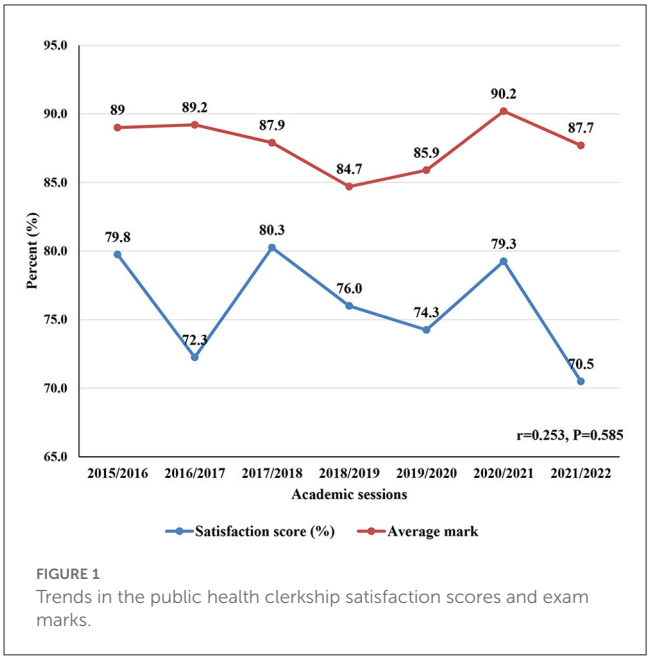

FIGURE 1
Trends in the public health clerkship satisfaction scores and exam marks.

Structure of the clerkship

About 90% of the students agreed that the clerkship content was covered in sufficient depth, and that 93% agreed there were enough opportunities to ask questions and discuss ideas. However, the majority of them also lamented that there was too much in the program timetable (75%) and that the workload of the clerkship was heavier when compared with the other clerkships (62.4%) (Table 4). Below are some opinions of the students:

> *"The self study session was a really good session to benefit from."*
>
> *"I would like to have critical thinking session able the student to think about a solution of public health issues."*
>
> *"Too much works to do and too much heavy subjects that I think I don't need it in my future either."*

Academic staff

The students were quite pleased with the faculty members throughout the course as assessed by five statements in the evaluation. The majority of the students agreed that the faculty were interested in their personal development (86.1%), the assessment by the faculty was fair and reasonable (84%), and that the faculty members were ready to help in case of any problems (80.9%) (Table 4). A comment on the strengths of the clerkship is:

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TABLE 4 Summary of students' responses to the specific evaluation statements.

Statement	SA	AG	DA	SD	Number of respondents
Pre-course instructions					
I received enough information about the clerkship before it started	31.8	**42.8**	17.9	7.5	173
I received enough information about the assignment	25.7	**53.4**	14.2	6.8	148
I received enough information about the research project	30.6	**50.9**	12.7	5.8	173
I received enough information about the site visit	38.5	**50.0**	7.7	3.8	26
Structure of the clerkship					
Overall, the clerkship was well-organized	35.8	**50.9**	8.7	4.6	173
I always knew what was expected of me	28.9	**47.4**	15.0	8.7	173
The clerkship content was covered in sufficient depth	36.4	**53.8**	7.5	2.3	173
The clerkship was a coherent program and NOT just a selection of unrelated subjects	26.0	**54.3**	13.9	5.8	173
There were enough opportunities to ask questions and discuss ideas	37.8	**55.2**	4.1	2.9	172
There was enough time to do a good job	22.7	**55.2**	16.3	5.8	172
There was enough time for reflection	27.9	**51.7**	10.9	9.5	147
Overall, I found self-study sessions useful	31.1	**45.3**	14.2	9.5	148
The self-study sessions gave me an opportunity to clarify issues related to public health	24.5	**51.7**	17.0	6.8	147
I received enough information to be able to self-study	25.7	**52.0**	16.9	5.4	148
The self-study sessions gave me an opportunity to interact with my supervisors	27.9	**49.7**	13.6	8.8	147
The pace of teaching was too fast*	**42.3**	19.2	34.6	3.8	26
The pace of teaching was too slow*	29.5	31.8	34.7	4	26
There was too much in the timetable*	36.6	**38.4**	21.5	3.5	172
There was too little in the timetable*	28.0	24.0	**36.0**	12.0	25
The detail in the lectures was just about right	42.3	**46.2**	11.5	0.0	26
Compared with other clerkships the work-load has been heavier*	28.9	**33.5**	31.8	5.8	173
I found the materials on Blackboard useful	34.6	**61.5**	3.8	0.0	26
Academic staff					
Teachers were interested in my personal development	35.8	**50.3**	11.6	2.3	173
The assessment has been fair and reasonable	19.7	**56.1**	15.0	9.2	173
The research project assessment has been fair and reasonable	24.0	**64.0**	12.0	0.0	25
The site visit assessment has been fair and reasonable	40.0	**44.0**	12.0	4.0	25
Help was available if I had any problems	28.3	**52.6**	10.4	8.7	173
Activities of the clerkship					
Overall, I enjoyed working on the public health assignment and preparing for seminar	27.0	**50.7**	10.1	12.2	148
The public health priority assignment was relevant at this stage in my medical training	23.1	**59.2**	9.5	8.2	147
Overall, I enjoyed the research project	31.2	**48.0**	11.6	9.2	173
The research project was relevant at this stage in my medical training	33.1	**50.6**	12.8	3.5	172
Overall, I enjoyed the site visit	29.5	**46.8**	10.4	13.3	173
The visits were relevant at this stage in my medical training	26.5	**52.4**	9.5	11.6	147
I feel the time would have been better spent on some other activity*	**39.3**	38.2	19.1	3.5	173

(Continued)

TABLE 4 (Continued)

Statement	SA	AG	DA	SD	Number of respondents
I didn't like the research project and feel the time would have been better spent on some other activity*	**28.9**	28.9	30.6	11.6	173
I would prefer real field research in the community*	37.8	**50.7**	6.1	5.4	148
I didn't like the field visits and feel the time would have been better spent on some other activity*	25.7	**35.1**	20.3	18.9	148
During the project I always knew what was expected of me	23.1	**69.2**	7.7	0.0	26
Overall, the lectures were relevant at this stage in my medical training	38.5	**53.8**	7.7	0.0	26
Learning outcomes					
The clerkship program was relevant at this stage in my medical training	30.1	**50.9**	13.3	5.8	173
I have found the clerkship rewarding	26.0	**50.3**	13.9	9.8	173
I now have a good understanding of what community medicine and public health are all about	43.4	**50.3**	3.5	2.9	173
I feel I need to seek more information on public health issues	17.6	**54.7**	20.9	6.8	148
I feel that I learned a lot and developed new skills	39.2	**48.0**	4.7	8.1	148
I learned data collection techniques	33.8	**51.4**	10.1	4.7	148
I learned data analysis techniques, including descriptive and inferential statistics	33.1	**54.7**	8.1	4.1	148
I learned a lot working on written protocol	34.5	**51.4**	6.1	8.1	148
I improved my oral presentation skills	35.1	**56.1**	4.7	4.1	148
I feel I learnt a lot about public health practice	27.0	**49.3**	12.8	10.8	148
I received enough information about the public health practice	28.4	**56.1**	5.4	10.1	148
I learned about the infectious disease screening process	35.8	**48.6**	4.7	10.8	148
I learned about preventive services	34.5	**50.7**	4.7	10.1	148
I learned about health promotion programs	31.1	**52.0**	7.4	9.5	148
I learned about electronic notification	35.8	**49.3**	4.7	10.1	148
The project has encouraged me to do research in the future	34.6	**61.5**	3.8	0.0	26
I am satisfied with my achievements in this rotation	42.3	**53.8**	3.8	0.0	26
This clerkship rotation has expanded my knowledge, skills, and confidence	40.0	**56.0**	4.0	0.0	25

SA, Strongly agree; AG, Agree; DA, Disagree;SD, Strongly Disagree.
*Negative evaluation statements. Bold values indicates the highest proportion.

> *"Very helpful and kind tutors. They like their field which was reflected by the way they teach us. Great!"*

Activities of the clerkship

Overall, the majority of students indicated that they are happy with the various activities, including research and practical sessions. However, while the majority of students agreed that they found the public health priority assignment (82.3%), the research project (83.7%), and the site visits (78.9%) relevant, the majority (88.5%) of students reported that they would prefer real field research in the community (Table 4). Below are some comments on strengths of the clerkship:

> *"The self- study sessions helped us improve our data collection skills."*
>
> *"Research project was my favorite part of the whole rotation. learned a lot from it."*
>
> *"The visits were relevant at this stage in my medical training."*

Learning outcomes

The majority of students rated the clerkship program favorably regarding its learning outcomes. They had a good understanding of what community medicine and public health were all about (93.7%), they improved their oral presentation skills (91.2%), and they developed new skills (87.2%). Furthermore, 96.1% of students

indicated that they were satisfied with their achievements in the clerkship and that the program expanded their knowledge, skills and confidence (Table 4). Below are some of the comments of the students about the learning outcomes:

> *"The protocol benefited us as students because it taught us how writing a research looks like and how is information gathered. Nevertheless, the doctors were helpful."*
>
> *"The project helped me understand the concepts that were taught during the sessions and apply the knowledge in depth. I appreciate this and am really thankful for it."*
>
> *"The rotation would be best if it were given at an earlier stage in our medical school. for example at the premed or preclinical stage. Since we were given the opportunity to learn how to write a research protocol, and many students would like to conduct different types of research earlier and this would help them vastly."*
>
> *"Overall, the Public Health rotation opened my eyes to understand the health needs of my society and how to approach it. The group work and addressing critical issues as a team really helped my personal and academic development."*

Discussion

The results of this study show that medical students at the United Arab Emirates University were satisfied with the activities and delivery of the public health clerkship and found it rewarding. Conducting needs assessment and proposal writing provided students with the knowledge, skills, and confidence to conduct research in their career.

The majority of our cohort were females (86.2%) and that mirrors the common ratio of females in medical schools in the UAE (8, 9), and yet there was no statistically significant difference in satisfaction level between genders in our cohort. Our study revealed that the medical students were less satisfied with the clerkship during COVID-19 pandemic in comparison with their pre-pandemic satisfaction. We articulate that the students wanted the social interaction with peers in addition to attending field and site visits (to occupational medical clinic, Public Health Center and the Environment Agency), which were on hold during the pandemic. Our findings are in consonance with the literature, a nationwide cross-sectional study of 2,721 UK medical students conducted by Dost et al. in May 2020 across 40 UK medical schools alluded those medical students did not find online teaching to be engaging or enjoyable, with limited chances to raise queries. Besides, they did not find it as effective as face-to-face teaching (10). These findings are parallel to our results, since our medical students were less satisfied with the field visits, especially during the COVID-19 pandemic when all sessions were provided online, including "virtual visits," during which invited field practitioners explained public health activities but without real hands-on practical engagement. Another approach to interpret these results is that because of the pandemic, everyone—including medical students—had much greater awareness of public health/global health problems and efforts to ameliorate the conditions, and thus went into the course with a greater understanding of public health and a greater expectation of what they would learn from the course.

While studying the impacts of society and surroundings on individual education, the sociocultural theory explains that a student's psychological development is steered by mentors and teachers as well as communication with social assembles (5). This can be translated by the satisfaction with the activities of the public health clerkship and their expressed preference of the real field research in the community (88.5%).

The pedagogies that are rooted in the public health clerkship offered by the Institute of Public Health are a mixture of active learning, project-based learning, cooperative learning and context-based learning (11). The hybrid of pedagogies addressing the different learning styles of the students allows faculty to engage students and apply concepts as well as steering students to work together to exploit their own and each other's learning journey. A randomized controlled trial conducted to test the power of pedagogies on learning outcomes in public health concluded that cooperative learning pedagogy improved the performance on higher cognition in contrast to the self-study pedagogy, a technique that is used throughout our public health clerkship (12). Cooperative learning tackles cooperative skills therefore public health clerkship emphasized the value of group work by dividing the students to groups from day one to produce a group protocol and present it as a group to the faculty and their peers. The group work helps prepare the students for the practice in healthcare setting as they will eventually work as a team with other healthcare providers.

The structure of the clerkship offered by the Institute of Public Health bridges all the four P's: Public health, Prevention, Population health, and Policy (13). The themes include all the information fundamental to public health, namely: Biostatistics, Epidemiology, Environmental Health Sciences, Health Services Administration, Social and Behavioral Sciences. These are core accreditation areas used by accrediting bodies including the Council on Education for Public Health (CEPH) in the USA (14). A scoping review of studies evaluating the education of health professional students about public health conducted by Evashwick et al. acknowledged a dearth of the literature on appraisals of methodologies for teaching public health (15). The medical students were satisfied with the structure of the clerkship and stated that it was well-organized, and that it was coherent and not just a selection of unrelated subjects. They embraced the structure of the clerkship in terms of self-study sessions and opportunities to interact with their supervisors as well as the easiness of retrieving materials on the learning management system (Blackboard).

The students stated that teachers were interested in their personal development and were available if the students had any problems. In each public health clerkship at the Institute of Public Health, students are divided into groups and assigned a mentor from day one. The mentors support the students in conducting the needs assessment and proposal writing. The timetable of the clerkship has scheduled sessions for the students to meet with their mentors on daily basis. The mentors oversee the students' progress, address their challenges, provide them with resources and introduce them to stakeholders. The mentors help the students navigate and select pressing public health issues that are of value

to the United Arab Emirates. In addition to the development of a study protocol, the mentors may secure funding to the students by applying for the internal grant named the Summer Undergraduate Research Experience (SURE) PLUS to explore and test a research idea and to promote and support the engagement of undergraduate students in research experiences, thereby providing the students with exposure to, and training in, conducting research while working in teams under the supervision of qualified faculty members. Moreover, all abstracts of the students' proposals are published in a book of abstracts (16). It is worth mentioning that in addition to the assigned mentor, other faculty can provide additional mentorship to the students based on their area of expertise and research interests. These practices are in synch with the literature investigating the effect of mentorship in the success and academic development of the mentees, especially in the Science, Technology, Engineering and Mathematics (STEM) fields (17, 18).

As expected with the subjective nature of survey, students varied in their responses toward pace of teaching and the timetable as some (75%) stated that there was too much in the timetable. In contrast 52% stated in another evaluation statement that there was too little in the timetable. Variable expectations among medical students are documented in the literature. A qualitative exploratory study conducted by Yoon et al. in 2021 among medical students in dermatology clerkship echoed a variability in the student's experiences (19).

Medical students in the United Arab Emirates University are eager for literacy in public health and that desire was amplified during the pandemic. In our cohort, all questions related to learning outcomes were on the agreement side. Students found the clerkship rewarding and acquired a good understanding of the value of public health for the community. Students were satisfied with the soft skills that they fostered, like oral presentation skills and preparation for seminars. These learning outcomes are in line with the Institute of Medicine's (IOM) radical report "The Future of Public Health "that reformed and revolutionized the public health education and called for equipping public health practitioners with salient methodological, political, administrative and programmatic skills (20).

The strength of our study is being the first to address the satisfaction of undergraduate medical students with regard to the public health clerkship in the UAE. The study covered a wide scope of themes including pre-course instructions, structure of the clerkship, the academic staff, activities of the clerkship and learning outcomes. The hybrid of open-ended and close questions allowed the detailed investigation and analysis of students' responses. These findings can support other medical colleges and institutions establishing or reviewing a public health clerkship. Nevertheless, since the questions on student satisfaction asked by the Department of Medical Education are standardized, and therefore fixed, we were unable to diagnose further details of some issues, which warrant further investigation. The inherited biases of cross-sectional surveys constitute a limitation of this study. The low response rate is another limitation that we faced, but due to the voluntary and anonymous nature of the feedback centrally organized by the College, we could not control. That was one of the reasons why we included several academic years to have a better understanding of the students' satisfaction. Response rate varied over the years and female medical students were significantly more likely than males to complete the evaluation form. Moreover, the low response to the open-ended questions deprived this analysis from in-depth understanding of students' opinions. A very long student feedback form is used. It might have had a larger response if it was briefer. The anonymous nature of the survey hindered connecting satisfaction to academic achievement and other characteristics on individual level. Moreover, not having a tailored survey for students' satisfaction during the pandemic limited our understanding of their poorer satisfaction in this period. The lack of records at the University about the specializations chosen after graduation is another limitation that made linking our findings to the future carrier path of the students impossible.

Our findings warrant further investigations that may include conducting a qualitative focus group discussion among alumni. Such studies will reveal the impact of this clerkship on their career path, and by that help to improve the curriculum to better meet the needs of public health practice, and increase its satisfaction scores that are typically lower than for the other clerkships.

In conclusion, the public health clerkship offered by the Institute of Public Health at the College of Medicine and Health Sciences at the United Arab Emirates University facilitated a good understanding of what community medicine and public health were all about and improved the oral presentation skills of the fifth-year medical students. Furthermore, majority of the students indicated that they were satisfied with their achievements in the clerkship and that the program expanded their knowledge, skills, and confidence. If there is a need for an online offering of the clerkship, the structure of the rotation needs to be reformed. The results of this study can be utilized for the further development of the clerkship curriculum with the final aim to provide the necessary basic public health knowledge and skills for all graduating medical doctors.

Data availability statement

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

Ethics statement

The studies involving human participants were reviewed and approved by Social-IRB of the UAEU. Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

AR, BÁ, MG, and SS conceived the study. AA, MA, and SA acquired and analyzed the data. AR and AA produced the first draft.

BÁ, MG, MS-H, and JN reviewed the first draft. All others reviewed the final draft.

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. Barss P, Grivna M, Al-Maskari F, Kershaw G. Strengthening public health medicine training for medical students: development and evaluation of a lifestyle curriculum. *Med Teach.* (2008) 30:e196–218. doi: 10.1080/01421590802334267

2. Maeshiro R. Responding to the challenge: population health education for physicians. *Academic Medicine.* (2008) 83:319–20. doi: 10.1097/ACM.0b013e318166ae9f

3. Tyler IV, Hau M, Buxton JA, Elliott LJ, Harvey BJ, Hockin JC, et al. Canadian medical students' perceptions of public health education in the undergraduate medical curriculum. *Academic Medicine.* (2009) 84:1307–12. doi: 10.1097/ACM.0b013e3181b189b4

4. Fineberg HV. Public health and medicine: where the twain shall meet. *Am J Prev Med.* (2011) 41:S149–S51. doi: 10.1016/j.amepre.2011.07.013

5. Jaramillo JA. Vygotsky's sociocultural theory and contributions to the development of constructivist curricula. *Education.* (1996) 117:133–41.

6. Badyal DK, Singh T. Learning theories: the basics to learn in medical education. *Int J Appl Basic Med Res.* (2017) 7:S1. doi: 10.4103/ijabmr.IJABMR_385_17

7. Jereb E, Jerebic J, Urh M. Revising the importance of factors pertaining to student satisfaction in higher education. *Organizacija.* (2018) 51:271–85. doi: 10.2478/orga-2018-0020

8. Ausman J, Javed A, Ahmed S, Samad MA, Pour AS, Mathew E, et al. Social factors influencing career choice in a medical school in the United Arab Emirates. *Edu Med J.* (2013) 5:16. doi: 10.5959/eimj.v5i1.16

9. Saddik B, Hussein A, Sharif-Askari FS, Kheder W, Temsah M-H, Koutaich RA, et al. Increased levels of anxiety among medical and non-medical university students during the COVID-19 pandemic in the United Arab Emirates. *Risk Manag Healthc Policy.* (2020) 13:2395. doi: 10.2147/RMHP.S273333

10. Dost S, Hossain A, Shehab M, Abdelwahed A, Al-Nusair L. Perceptions of medical students towards online teaching during the COVID-19 pandemic: a national cross-sectional survey of 2721 UK medical students. *BMJ Open.* (2020) 10:e042378. doi: 10.1136/bmjopen-2020-042378

11. Hickman AC, Shelley K, Rutherford Z, Gardiner PA, Buckley L, Lawler S. Using innovative curriculum design and pedagogy to create reflective and adaptive health promotion practitioners within the context of a master of public health degree. *Int Handbook Teach Learn Health Promot: Springer.* (2022) 3:377–98. doi: 10.1007/978-3-030-96005-6_24

12. Riley W, Anderson P. Randomized study on the impact of cooperative learning: distance education in public health. *Quart Rev Dist Edu.* (2006) 7:129. Available online at: https://uaeu.idm.oclc.org/scholarly-journals/randomized-study-on-impact-cooperative-learning/docview/231181122/se-2

13. Campos-Outcalt D. The integration of public health and prevention into all years of a medical school curriculum. *Am J Prev Med.* (2011) 41:S306–S8. doi: 10.1016/j.amepre.2011.06.012

14. Rosenstock L, Helsing K, Rimer BK. Public health education in the United States: then and now. *Public Health Rev.* (2011) 33:39–65. doi: 10.1007/BF03391620

15. Evashwick C, Tao D, Perkiö M, Grivna M, Harrison R, A. scoping review of studies evaluating the education of health professional students about public health. *Public Health.* (2020) 178:105–11. doi: 10.1016/j.puhe.2019.08.019

16. Institute of Public Health. *Public Health Clerkships. Research Protocol Abstracts*. Al Ain: Institute of Public Health, College of Medicine and Health Sciences, United Arab Emirates University (2022).

17. Trawick C, Monroe-White T, Joseph M, Tolbert NC, Tola J, Haynes JK. Investigating the influence of mentor–mentee race and gender pairs on public health persistence. *Pedag Health Promot.* (2021) 7(1_suppl):63S−70S. doi: 10.1177/23733799211049238

18. Zaniewski AM, Reinholz D. Increasing STEM success: a near-peer mentoring program in the physical sciences. *Int J STEM Edu.* (2016) 3:1–12. doi: 10.1186/s40594-016-0043-2

19. Yoon J, Said JT, Thompson LL, Molina GE, Richards JB, Chen ST. Medical student perceptions of assessment systems, subjectivity, and variability on introductory dermatology clerkships. *Int J Women's Dermatol.* (2021) 7:323–30. doi: 10.1016/j.ijwd.2021.01.003

20. Walker B. The future of public health: the Institute of Medicine's 1988 report. *J Public Health Policy.* (1989) 10:19–31. doi: 10.2307/3342941

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QATCHEPP: A quality assessment tool for critical health promotion practice

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Background: The origins of health promotion are based in critical practice; however, health promotion practice is still dominated by selective biomedical and behavioral approaches, which are insufficient to reduce health inequities resulting from the inequitable distribution of structural and systemic privilege and power. The Red Lotus Critical Health Promotion Model (RLCHPM), developed to enhance critical practice, includes values and principles that practitioners can use to critically reflect on health promotion practice. Existing quality assessment tools focus primarily on technical aspects of practice rather than the underpinning values and principles. The aim of this project was to develop a quality assessment tool to support critical reflection using the values and principles of critical health promotion. The purpose of the tool is to support the reorientation of health promotion practice toward a more critical approach.

Research design: We used Critical Systems Heuristics as the theoretical framework to develop the quality assessment tool. First, we refined the values and principles in the RLCHPM, then created critical reflective questions, refined the response categories, and added a scoring system.

Results: The Quality Assessment Tool for Critical Health Promotion Practice (QATCHEPP) includes 10 values and associated principles. Each value is a critical health promotion concept, and its associated principle provides a description of how the value is enacted in professional practice. QATCHEPP includes a set of three reflective questions for each value and associated principle. For each question, users score the practice as strongly, somewhat, or minimally/not at all reflective of critical health promotion practice. A percentage summary score is generated with 85% or above indicative of strongly critical practice, 50% $\leq$ 84% is somewhat critical practice, and $<$ 50% minimally or does not reflect critical practice.

Conclusion: QATCHEPP provides theory-based heuristic support for practitioners to use critical reflection to assess the extent to which practice aligns with critical health promotion. QATCHEPP can be used as part of the Red Lotus Critical Promotion Model or as an independent quality assessment tool to support the orientation of health promotion toward critical practice. This is essential to ensure that health promotion practice contributes to enhancing health equity.

KEYWORDS

health promotion, public health, reflective practice, critical systems heuristics, values, principles, quality assessment, quality improvement

1. Introduction

1.1. Critical health promotion practice

Health promotion practice is described in the CompHP Core Competencies Framework for Health Promotion developed by the International Union for Health Promotion and Education (IUHPE) (1). Health promotion practice refers to health promotion programs, projects, policy, strategies, and initiatives. Health promotion practitioners refers to those whose main role is health promotion practice, for example people who work in health promotion specific government, non-government, or community organizations. Health promotion practice is also undertaken as a component of other practitioners' roles, for example clinical and allied health practitioners, educators, urban planners, and climate and social justice activists. The CompHP Core Competencies Framework for Health Promotion was informed by key international health promotion documents, leaders, and practitioners. It is used internationally for the accreditation of health promotion practitioners and university academic programs, the development of health promotion position descriptions, and professional development programs (1).

The CompHP Core Competencies Framework for Health Promotion includes nine domains of competency standards for practice: enable change to reduce health inequities; advocate and build capacity for health and wellbeing; mediate through partnerships to enhance the impact and sustainability of health promotion; communicate appropriately with diverse audiences; demonstrate leadership for health promotion action; conduct community health and wellbeing assessment; plan evidence-based health promotion programs; implement ethical health promotion programs; conduct appropriate evaluation and research to determine efficacy and effectiveness of health promotion programs. The competency standards are underpinned by a set of ethical values required to be enacted in health promotion practice.

The origins of health promotion are based in critical practice (2, 3). However, health promotion practice is still dominated by a selective health promotion approach which adopts a biomedical and behavioral health paradigm and tends to focus on populations that are structurally and systemically privileged. This results in health promotion programs focusing on changing individual level behaviors related to disease rather than the broader structural and systemic determinants of health and wellbeing (4–6). Recognizing the broader determinants of health but developing health promotion programs that focus on individual behaviors has been criticized as "lifestyle drift" (7, 8) or "downstream drift" (6), and using the "lazy language of lifestyles" (9, 10). The selective approach is insufficient to address the full range of health and wellbeing determinants and reduce health inequities (4–6, 11–13).

In contrast to selective health promotion, critical health promotion is "a social justice approach to health promotion that is underpinned by a system of values and related principles that supports the reflective process of explicitly identifying and challenging dominant social structures and discourses that privilege the interests of the powerful and contribute to health and wellbeing inequities" (14). The values of critical health promotion are the practice concepts that are most important in professional practice, for example, health equity, systems science, salutogenesis, and non-maleficence. The principles of critical health promotion are the actions taken to accomplish the values, for example the value of health equity is accomplished by prioritizing working with people and communities that are most impacted by the inequitable distribution of structural and systemic privilege and power (15). However, rarely are the values and principles that underpin health promotion programs made explicit in research and practice environments (16, 17). As such, health promotion activity generally reflects and reinforces the dominant selective approach (11, 18), for which evidence of effectiveness is more plentiful due to its specific focus on behavioral factors. However, as per Nutbeam's inverse evidence law, there is relatively little evidence about the effectiveness of health promotion programs addressing the broader structural and systemic determinants of health and wellbeing and health equity (19). A selective approach is not fully reflective of what is considered good health promotion practice (4, 11). As such, good health promotion practice should be shared with the field to enable maximal adoption (20).

1.2. Quality concepts in health promotion

Quality in health promotion practice has been defined as the extent to which key predictors of effect are incorporated in a program (21). Øvretviet (22) proposed that ideas about quality emerging from the quality movement were compatible with good practice in health promotion, and advocated for widespread adoption of such quality concepts in order to improve the quality of health promotion practice. He proposed that a combination of the three dimensions of quality be adopted by health promotion practitioners: consumer quality (level of consumer and community satisfaction), professional quality (quality of program planning and design, including methods for reconciling conflicts between community and professional views and higher-level requirements), and management quality (quality of implementation, efficacy of resource use, meeting higher-level requirements). Øvretviet posited that this approach would provide a balance between the consumer and professional dimensions, rather than privileging the professional and managerial dimensions at the expense of the consumer dimension, give equal status to the process and outcome of health promotion programs, and incorporate considerations of cost and higher-level directives. He believed that incorporating the three domains into quality assessment would also address the requirement for health promotion to work with priority populations to reduce health inequities.

Speller et al. (23) developed quality assurance standards for health promotion practice in the United Kingdom. The authors noted that the standards were limited to the inputs and processes of health promotion activity. Fazal et al. (24) developed criteria to distinguish between worst, promising, and best practices for health promotion based on impact, adaptability, and quality of evidence. These criteria focus specifically on the quality of health promotion "interventions". The IUHPE competency framework provides the first set of international standards that describe the requirements for the implementation of good quality health promotion (1). Individual countries have also developed competency frameworks, for example Australia (25), Israel (26), and New Zealand (27).

Whilst these frameworks provide clear standards or statements describing good quality practice, they are not designed to be used by practitioners as quality assessment tools.

Quality assessment tools are used in the quality improvement process. Quality improvement has multiple definitions all of which involve the common principle of a continuous, systematic process to improve health practices and therefore enhance health outcomes for people and communities (28). In health promotion, quality assessment tools support practitioners to determine the level or extent to which good quality practice is evident in a health promotion program and identify areas for improvement (29). Much of the development of health promotion quality assessment tools has taken place in settings-based health promotion. For example, in the field of workplace health promotion, many quality assessment checklists have been developed such as the United States Centers for Disease Control Worksite Health ScoreCard (30), the HERO Health and Well-Being Best Practices Scorecard (31, 32), and WELCOA's Worksite Health Promotion Benchmarks (33). Other quality assessment tools focus on particular aspects of practice such as program outcomes (34).

At a broader level, the Healthy Austria Fund produced Quality Criteria for Basic Principles of Health Promotion including nine principles with criteria and indicators for each principle. The principles include positive, comprehensive and dynamic concept of health; health equity; resource orientation; empowerment; setting and determinant orientation; target group orientation; participation of the actors in the setting; networking; and sustainability of the changes (35). The Quality Criteria instrument is intended to be used as a guide in the development and assessment of health promotion projects. It does not include a scoring system. Preffi 2.0 is a quality assessment tool that includes 39 indicators of effective health promotion programs grouped into clusters, which are scored as weak, moderate, or strong, depending on the yes/no answers for each indicator in the cluster (36). Each of the clusters focuses on technical aspects of health promotion practice, including contextual conditions, analysis, selection and development of interventions, implementation, and evaluation.

As an outcome of the Getting Evidence into Practice Project funded by the European Commission, the Netherlands Institute for Health Promotion and Illness Prevention and the Flemish Institute for Health Promotion produced the European Quality Instrument for Health Promotion (EQUIHP) for the purpose of improving the quality of health promotion practice (37, 38). EQUIHP includes 95 indicators grouped into 13 criteria for effective health promotion, which are further grouped into four domains: framework of health promotion principles; project development and implementation; project management; and sustainability. The framework of health promotion principles includes indicators for a positive and comprehensive approach to health, attention for the broad determinants of health, participation, empowerment, equity, and equality. Each indicator is framed as one or more questions with three possible responses: no (not achieved), partly (partly achieved), or yes (achieved). The user manual for EQUIHP does not include a quantitative scoring system, however research projects that have used the instrument as a quality assessment tool have devised their own scoring systems (39–41).

The German Cooperation Network "Equity in Health" developed the Criteria for Good Practice in Health Promotion Addressing Social Determinants, which provides a framework to plan and implement health promotion programs to address the social determinants of health (42). The framework includes 12 criteria described as technical concepts: concept and project planning; target group orientation; settings approach; integrating intermediaries; sustainability; low-threshold methodology; participation; empowerment; integrated action/networking; quality management; documentation and evaluation; and capturing cost effectiveness. For each criterion, a definition of the criterion is provided, followed by an explanation and example of different implementation levels across a continuum. The number of levels vary across the criteria between three and six, with the highest level representing good quality practice. The Criteria for Good Practice document is designed to be used as a qualitative reflection tool and does not include a quantitative scoring system.

The health promotion quality assessment tools developed to date focus primarily or exclusively on technical aspects of practice, and most do not have a scoring system that enables quantitative assessment of the extent to which the practice aligns with good or best health promotion practice. In addition, existing tools do not explicitly incorporate health promotion values and their related principles. It is important that practitioners develop the skills to critically reflect on the underlying values and principles of health promotion to enable them to reorient practice toward a more critical approach (43).

1.3. Critical reflection

Critical reflection is a professional skill integral to the practice of critical health promotion. It involves examining the underlying assumptions of a health promotion program and the source of such assumptions (43). Through critical reflection, practitioners increase their consciousness about the dominant values and principles of health promotion programs, and the implications for whom they are intended (22–25). Health promotion practitioners are encouraged to engage in critical reflection at individual and team levels as a mechanism for enhancing the quality of practice (44–46). Johnson and MacDougall describe critical reflection as an active process that requires practitioners to:

> …describe, question and challenge our assumptions, beliefs, values, and theories about why things happen and explore how things may be different. It behooves us to think critically, seek feedback, and to move out of our comfort zones and individual frame of reference as we question the assumptions on which we base our practice [(46), p. 250–1].

Key elements of critical reflection include questioning underlying assumptions, a social focus as distinct from an individual focus, the analysis of power relations, and emancipation (46). Critical reflection assists practitioners to better understand and learn about their health promotion practice, and to change, enhance or transform their practice in the future (44–49). Practice elements might include the philosophical approach, values and principles, theory and models used (46, 50), all of which underpin

and guide the design, implementation, and evaluation of health promotion programs (50). Critical reflection is crucial to improve and transform practice if health promotion is to affect the broader political economic, social, and cultural determinants of health, and thereby enhance health equity (46).

While acknowledged as important, there has been insufficient attention paid to critical reflection as a key health promotion skill (45). As such, there is a lack of awareness about the influence of the perspectives of those that plan and deliver health promotion programs and their underlying societal and professional norms, on the nature of practice (45). Critically reflecting on practice is not always a priority for practitioners due to the focus on technical aspects of their everyday work (47). Practitioners need to allocate time for critical reflection individually, as a team or with a practice mentor (45–48, 51). Critical reflection processes and tools are required to support practitioners (45–48, 51). Existing processes and tools provide some guidance for reflecting on the various components of a health promotion program at a technical level, but few focus on the critical elements of reflective practice. Fleming (45) proposed a typology for enhancing the "neglected art" of reflective practice in health promotion. The typology outlines a series of reflective questions that practitioners can ask individually and at a team level about the context and process of program planning across the components of a health promotion program. However, this typology does not focus specifically on making the values and principles that underpin health promotion programs explicit. Practitioners need models and frameworks to support their engagement in critical reflection. To respond to this need, we developed the Red Lotus Critical Health Promotion Model (RLCHPM), which incorporates the practice of critical reflection.

1.4. Red Lotus Critical Health Promotion Model

Document analysis was used to develop the original version which was titled the Red Lotus Health Promotion Model and first published in 2007 (50). The model was underpinned by critical systems theory (52, 53) and used the red lotus plant to symbolize the components of health promotion, including health status (pod), people's characteristics (stamens), environmental determinants of health and wellbeing (first petal layer), community assessment (second petal layer), planning (third petal layer), implementation (fourth petal layer), evaluation (fifth petal layer), values (roots), principles (stems), and sustainability (leaves). The rationale for choosing the red lotus plant as the symbol and its cultural, culinary, medicinal, and spiritual significance is described in detail elsewhere (50). The content of the model was derived from the international health promotion declarations and charters produced by the World Health Organization and existing health promotion models and frameworks.

Most significantly, the model included a system of ethical, philosophical, and technical values and associated principles that characterized a critical approach to health promotion, which had been identified as a major gap in other health promotion models (16, 50). It is important to note that the terms "values" and "principles" are not used interchangeably in the model. The phrase "values and principles" is a succinct expression of the more complete phrase "values and associated principles." The values in the model refer to the key health promotion concepts that underpin critical practice, and the associated principles refer to the actions required to enact the value. For example, the model includes the value of holistic health paradigm, and the associated principle of framing health as a complex concept that includes physical, mental, spiritual, social, cultural, and environmental aspects of wellbeing. The values and principles were derived from World Health Organization health promotion charters and declarations, the health promotion literature (16), and health promotion competency frameworks at the international (54) and national (25) levels.

Over the following years, the Red Lotus Health Promotion Model was applied in teaching (55, 56), research (16, 43, 52, 57–60) and practice. To assess the impact of the model on our graduates' practice, we conducted a mixed-methods study with our former students who had graduated between 2008 and 2016 using an online survey and semi-structured interviews (55). Most participants were knowledgeable about and confident in using the model, and felt it was relevant and useful to their practice. Using the heuristic to evaluate their own health promotion practice, most participants rated their practice as somewhat or strongly aligned with a critical approach. However, qualitative findings identified the need for more structured support for evaluating the criticality of their own and others' health promotion practice.

We have also engaged in ongoing reflection on the model (53) and gathered informal feedback from students, researchers, and practitioners using the model. As a result of the formal and informal feedback, we identified several potential areas for improvement in the model. We recognized that the process of critical reflection was not represented in the model, and that the values and principles were not at the base of the model. We had categorized values and principles into philosophical, ethical, and technical domains and users of the model interpreted this categorization to mean that not all values and principles were important to ethical practice. Some of the model's 19 values and principles were difficult for users to translate into practice due to their complexity. We also identified that the values and principles did not fully explicate the structural and systemic underpinnings of critical health promotion. Furthermore, the term "critical" was missing from the title of the model, thereby the critical intent of the model was not explicit in the title. Finally, we identified that the model needed updating to reflect current developments in understanding about the breadth and depth of intersecting structural and systemic determinants of health and wellbeing.

Version 2 was published as the Red Lotus Critical Health Promotion Model (RLCHPM) in 2021 (14) and 2022 (52) (Figure 1) (59). The tuber and roots have been reassigned to represent the values and principles, and the stems to represent the critical reflection process. The tuber and roots are the foundation of the plant which more appropriately represent the values and principles underpinning critical health promotion. The stems connect the tuber and roots to the flower and leaves, which more appropriately represent the role of critical reflection in applying the values and principles in practice. The number of values and principles has been reduced to 10 without categorization into domains, with some refinement of the wording of the values and principles to

reflect the structural and systemic underpinnings of critical health promotion, and emergent determinants of health and wellbeing are included. The RLCHPM has been used in our teaching including as a framework for examining the determinants of health and wellbeing, identifying priority populations, and the development of strategies to address priority issues. We have also used the RLCHPM in research (61, 62), and further studies are required to test its effectiveness in practice.

The values and principles system included in the RLCHPM has been used as a heuristic to evaluate the extent to which health promotion practice aligns with a critical health promotion approach (15, 55). For example, O'Hara et al. (57) used the heuristic to evaluate weight related public health initiatives spanning a 10 year period in Australia. Based on a critical discourse analysis of the initiatives' documentation, they rated the program as strongly critical, somewhat critical, somewhat selective, or strongly selective for each value and associated principle. They found that although there was some evidence of a somewhat critical approach, overall, these initiatives were strongly aligned with a selective approach. In addition to applying the heuristic in research projects, we have used the heuristic in our undergraduate and graduate courses as an assessment task, whereby students critique an existing health promotion program and evaluate the extent to which the program aligns with a critical approach. To support this critique, we ask reflective questions to help students identify the range of evidence that may demonstrate the implicit or explicit application of the values and principles in the program being evaluated. Over the years of doing this, it has become strongly apparent to us that these *ad hoc* reflective questions are key to enabling the critical reflection process. As such we concluded that structuring the reflective questions into a formalized tool would significantly enhance the critical reflection process.

Through the application of the heuristic in our own research, together with student and graduate feedback, and our own ongoing reflection, the need for a quality assessment tool to support critical reflection on the alignment of health promotion practice with a critical health promotion approach became apparent.

2. Research design

2.1. Aim

The aim of this project was to develop a quality assessment tool to support critical reflection on health promotion practice.

2.2. Epistemology and approach

The research was guided by constructionist epistemology, which acknowledges that the knowledge generated was constructed by us, and informed by our experiences within our professional and personal contexts (63). We both come from health promotion practice backgrounds and have worked in various positions as health promotion practitioners in government, non-government, and community organizations prior to working in academia. We therefore approach this research as both practitioners and researchers. As such, the research was also guided by a pragmatic approach (64), whereby the knowledge generated is intended to be applied in a practice environment. In this context, the intended application is the reorientation of health promotion programs away from the more dominant selective approach, and toward the more effective critical approach.

2.3. Theoretical framework

Critical Systems Heuristics (CSH) was used as the theoretical framework to develop the quality assessment tool. CSH is a framework for reflective practice which requires the development of the critical competence of practitioners to engage in systems thinking and reflective discourse to identify the dominant values of a system (65–67). The term heuristic derives from the Greek term heurisko which means to assist to discover (29). In this context, the term heuristic refers to a practical tool to assist practitioners and the communities they work with to engage in critical reflective dialogue about the boundary judgements implicitly or explicitly influencing a health promotion program (25). CSH assists practitioners to make sense of the broader context of a health promotion program by asking purposeful questions to identify the sources of knowledge, power, motivation, and legitimation for those involved in and those affected by the health promotion program (68). Through this questioning process, the assumptions or judgements that multiple program stakeholders unconsciously or consciously hold about the program are made explicit. These prior (apriori) judgements are referred to as boundary judgements which are explored through the process of boundary critique. In this project, boundary critique involves a structured critical dialogue using a heuristic of critical questions (66–69) that focus on *what ought to be* present in a critical health promotion program and *what is* present in a current or proposed health promotion program.

Some boundary judgements are more privileged than others due to structural power imbalances. These privileged boundary judgements are referred to as normative content, which constitutes the accepted and unchallenged value judgements of those who hold the power and excludes those that live with the experience and implications of such value judgements in a health promotion program (69). The value judgements of health promotion practitioners are legitimized through their professional roles and therefore influence the community assessment, planning, implementation, and evaluation components of a health promotion program, but practitioners are not necessarily accountable to the communities they work with. CSH enables practitioners to engage in boundary critique by using a heuristic tool to support reflective practice with the range of stakeholders throughout all components of a health promotion program (68, 69). The outcome of this critical reflection is intended to provide guidance for practitioners in the design of new programs or the reorientation of existing programs toward a more critical health promotion approach.

2.4. Method

The method used to develop the quality assessment tool consisted of first, refining the 10 values and principles in the Red Lotus Critical Health Promotion Model. Second, we created critical reflective questions based on the content of each value and

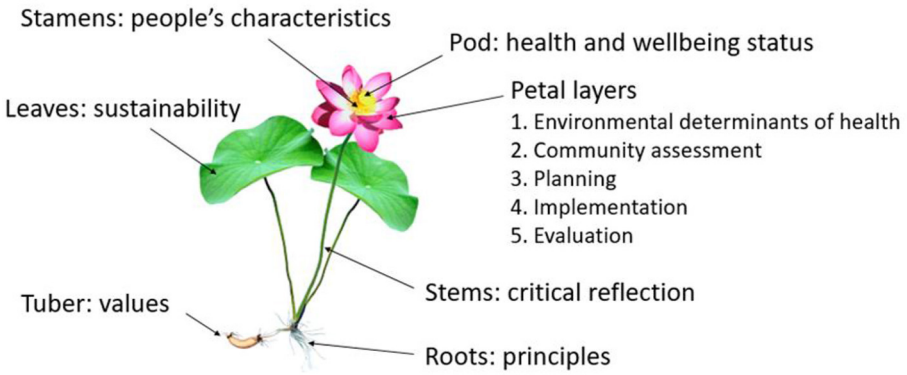

FIGURE 1
Red Lotus Critical Health Promotion Model. Reproduced with permission from Springer Nature (15).

principle and the framework of CSH boundary judgement (68). Third, we changed the categorization in the heuristic from strongly or somewhat reflective of critical or selective health promotion to strongly critical, somewhat critical, minimally critical/not at all critical, and added a new category for no evidence available. We removed the categories related to selective health promotion because the focus of the tool is on critical health promotion. Fourth, a numerical score was allocated to each category to allow for the quantitative assessment of each question, each value and principle, and the program overall. A scoring calculation method was developed to allow users to interpret the results. Fifth, we included the requirement to provide evidence (if available) from the program source to support the assigned ratings.

To pilot test QATCHEPP, one of us (LOH) trialed it as part of an assignment for graduate public health students in 2022. Students were required to critically review a health promotion program using QATCHEPP. All nine students in the course were health practitioners, four of whom were health promotion practitioners, two of whom used the assignment to assess the health promotion program they were currently working on in their professional roles. At the conclusion of the course, as part of the continuous quality improvement process, students were asked to provide feedback on the clarity of the questions in the tool, the ease of use, and suggestions for amendments. All students found the tool relatively easy to use, however, they found some reflective questions somewhat unclear, and some aspects of the scoring system not straightforward or intuitive. As a result of suggestions from the students, we made several amendments to the wording of questions and the scoring system.

3. Results

The **Q**uality **A**ssessment **T**ool for **C**ritical **He**alth **P**romotion **P**ractice (QATCHEPP—pronounced catchep) includes 10 values and associated principles (Table 1). The values that characterize critical health promotion practice are: priority populations determined by structural inequality; holistic health paradigm; salutogenic approach; systems science; assume people do the best they can for their wellbeing; work with people as an ally; empowering engagement processes; comprehensive use of evidence, theory, and models; maximum beneficence; and non-maleficence is a priority consideration. To assist practitioners to identify how critical health promotion is distinct from selective health promotion practice, QATCHEPP also notes *in italics* the values and principles associated with selective health promotion practice. QATCHEPP includes a set of three reflective questions for each of the 10 values and associated principles to guide the practitioner's critical reflection on a health promotion program. In QATCHEPP, the term program encompasses all types of health promotion action including a project, policy, strategy, or initiative. QATCHEPP reflective questions are theoretically informed and designed to assist practitioners to interrogate the key features of each value and principle and make an evaluative judgement about the extent to which they are enacted in practice in the health promotion program. The set of three questions for each value and associated principle follows a sequential order intended to guide the practitioner through a stepped process of identifying relevant evidence from the program outputs. Outputs may include program plans, evaluation reports, websites, journal articles, conference posters and presentations, community presentations, program briefs, funding applications, program communications, media releases and posts, program resources, meeting minutes, or any other outputs from the program.

For each reflective question in QATCHEPP, users score the practice as strongly (2 points), somewhat (1 point), or minimally or not at all (0 points) aligned with critical health promotion. If there is no relevant evidence within program documents, the question is scored as 0 points. Each reflective question is of equal value with no questions weighted more heavily than any others. The scores for the three reflective questions for each value and associated principle are summed to create 10 individual scores, which are summed to create a summary score out of 60 and then converted to a percentage value. A summary score of 85% (54/60) is indicative of strongly critical health promotion practice. This requires a minimum of 24 of the 30 reflective questions to be rated as strongly critical and an additional six questions to be rated as somewhat critical. On average, this means that at least eight of the 10 values and principles would have been rated as strongly critical. Based on our academic experience, it is our subjective judgment that 85% is generally the lower boundary of the highest category of achievement. A summary score of between 50% (30/60) and <85% (53/60) is indicative of

TABLE 1 Quality assessment tool for critical health promotion practice.

Number	Critical and selective values	Critical and selective principles	Critical reflection questions	Strongly critical 2	Somewhat critical 1	Minimally or not at all critical 0	No evidence available 0	Evidence from source to support the rating	Total score for each value
1	Critical: Priority population determined by structural inequality	Critical: In recognition that the enjoyment of the highest attainable standard of health is a fundamental human right, prioritizing working with people and communities that are most impacted by the inequitable distribution of structural and systemic privilege and power	1a Were criteria used to identify the priority population related to the inequitable distribution of structural and systemic privilege and power?						
			1b Is the priority population described as a priority population as opposed to being labeled as a disadvantaged, marginalized, vulnerable, at risk, or target population?						
	Selective: Priority populations determined by structural privilege	*Selective: Without explicit recognition that the enjoyment of the highest attainable standard of health is a fundamental human right, prioritizing working with people and communities that benefit from structural and systemic privilege and power*	1c Does the program use discourse that reflects social and environmental justice ideologies as opposed to neoliberal, capitalist, and colonialist ideologies?						
2	Critical: Holistic health paradigm	Critical: Framing health as a complex concept that includes physical, mental, spiritual, social, cultural, and environmental aspects of wellbeing	2a Does the program address multiple holistic health and wellbeing aspects?						
			2b Does the program describe the connections between the different aspects of health and wellbeing?						
	Selective: Biomedical-behavioral health paradigm	*Selective: Framing health as the absence of disease or injury, and the absence of "unhealthy" behaviors, primarily related to the body and mind, excluding social, spiritual, and environmental health and wellbeing*	2c Does the program evaluation focus on multiple holistic health and wellbeing outcomes?						
3	Critical: Salutogenic approach	Critical: Enhancing strengths and assets that create and support health, wellbeing, resilience, sense of coherence, happiness, self-respect, and meaning in life, in addition to structural and systemic factors that create poor health and wellbeing	3a Does the program focus on the creation of good health and wellbeing as the primary outcome?						

(Continued)

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TABLE 1 (Continued)

Number	Critical and selective values	Critical and selective principles	Critical reflection questions	Strongly critical 2	Somewhat critical 1	Minimally or not at all critical 0	No evidence available 0	Evidence from source to support the rating	Total score for each value
			3b Does the program present health and wellbeing related data about people and environments from a salutogenic perspective?						
	Selective: Deficit approach	*Selective: Focusing on needs, including deficits, problems, or "risk factors" for disease and injury using prevention/preventive strategies*	3c Does the program consistently use salutogenic discourse?						
4	Critical: Systems science	Critical: Using systems science, which recognizes that the determinants of health and wellbeing operate in multiple complex intersecting ecosystems (from the individual to the family, group, community, population, and global level), which need to be addressed to achieve sustainable health and wellbeing outcomes	4a Does the program refer to systems science and/or systems thinking as the underpinning framework?						
			4b Does the program identify and address intersecting intrapersonal, interpersonal, and environmental determinants of health and wellbeing at multiple levels?						
	Selective: Reductionist science	*Selective: Using reductionist science, which assumes that health outcomes are caused by discrete "risk factors" for disease and injury and does not address the full range of intersecting determinants of health and wellbeing that operate across multiple levels*	4c Does the program evaluation focus on health and wellbeing outcomes at multiple levels?						
5	Critical: Assume that people are doing their best for their wellbeing	Critical: Assuming that when left to their own devices, people will do the best for their wellbeing including that of their families, communities, and environment, given their circumstances and available resources	5a Does the program focus on improving circumstances and resources that support health and wellbeing?						
			5b Does the program implicitly or explicitly blame people for their circumstances, available resources, and consequential poor health and wellbeing outcomes?						
	Selective: Assume that people are not doing the best for their wellbeing	*Selective: Assuming that when left to their own devices, people will naturally adopt "unhealthy lifestyles" and harmful environmental behaviors, irrespective of their circumstances and available resources*							

(Continued)

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TABLE 1 (Continued)

Number	Critical and selective values	Critical and selective principles	Critical reflection questions	Strongly critical 2	Somewhat critical 1	Minimally or not at all critical 0	No evidence available 0	Evidence from source to support the rating	Total score for each value
			5c Does the program use terms that imply individual responsibility for health and wellbeing, such as "lifestyle" and "unhealthy choices"?						
6	Critical: Practitioner works with people as an ally	Critical: Working with people transparently as a culturally and socially sensitive and reflexive ally and resource respectful of all aspects of diversity	6a Does the practitioner privilege the diverse voices and lived experiences of priority populations?						
			6b Does the practitioner acknowledge their own privilege within the cultural and social contexts of their work?						
	Selective: Practitioner works on people as an expert	*Selective: Working on people as an outside expert without explicit attention to the relevant cultural and social context or all aspects of diversity.*	6c Does the practitioner consistently use allyship rather than expert oriented discourse?						
7	Critical: Empowering engagement processes	Critical: Using participatory enabling processes that empower and meaningfully engage priority populations in collaborative governance and decision making about health promotion programs designed with them	7a Are members of the priority population actively involved in the community assessment, planning, implementation, and evaluation phases of the health promotion program?						
			7b Does the program include collaborative governance and decision-making structures and processes?						
	Selective: Disempowering engagement processes	*Selective: Using non-participatory patriarchal processes that "target" people identified as "at risk" and limit or exclude their engagement in governance and decision making about health promotion "interventions" designed for them*	7c Is the program discourse appropriate for the priority population as opposed to being jargonistic and exclusionary?						
8	Critical: Comprehensive use of theories, models, and evidence	Critical: Basing health promotion practice on the comprehensive application of appropriate theories, models, and evidence across community assessment, planning, implementation, and evaluation components of a health promotion program to ensure sustainable health and wellbeing outcomes	8a Is the program based on a broad range of evidence types including community views, empirical studies, epidemiological data, and relevant practice-oriented theories/models?						

(Continued)

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TABLE 1 (Continued)

Number	Critical and selective values	Critical and selective principles	Critical reflection questions	Strongly critical 2	Somewhat critical 1	Minimally or not at all critical 0	No evidence available 0	Evidence from source to support the rating	Total score for each value
			8b Does the program identify specific theory and/or health promotion models or frameworks as its foundation?						
	Selective: Limited or selective use of theory, models, and evidence	*Selective: Basing health promotion practice on selective application of theories, models, and evidence across community assessment, planning, implementation, and/or evaluation components of a health promotion program.*	8c Are all components of the theories and models applied in the program?						
9	Critical: Maximum beneficence	Critical: Actively considering what the benefits of a health promotion program may be to the full range of beneficiaries particularly those with less structural and systemic advantage	9a Does the program identify the full range people who may benefit from the program?						
			9b Does the program prioritize strategies that benefit priority populations with less structural and systemic advantage?						
	Selective: Limited beneficence	*Selective: Considering what the benefits of a health promotion program may be to a limited range of beneficiaries who may have structural and systemic advantage*	9c Does the program evaluation focus on the assessment of health and wellbeing outcomes for priority populations with less structural and systemic advantage?						
10	Critical: Non-maleficence is a priority consideration	Critical: Actively considering who may be harmed by the health promotion program and in what way; taking steps to minimize or avoid this harm; and communicating the risk of harm involved in a truthful and open manner	10a Does the program explicitly identify who may be harmed by the program and in what way?						
			10b Does the program include strategies to minimize or avoid potential harms?						
	Selective: Scope of maleficence not fully considered	*Selective: Considering only a limited range of potential harms, in part due to a belief that health promotion programs will automatically result in positive health outcomes, and/or due to assumptions derived from structural and systemic advantage*	10c Does the program include strategies to communicate the risk of harm that may arise from the program?						

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somewhat critical health promotion. This requires a minimum of 15 of the 30 reflective questions to be rated as somewhat critical, meaning that on average, at least five of the 10 values and principles would have been rated as somewhat critical. A score of below 50% is indicative of practice that minimally or does not reflect critical health promotion. Results of QATCHEPP can be analyzed and reflected on for each question, each value and principle, and overall.

4. Discussion

The aim of this project was to develop a quality assessment tool to support critical reflection on health promotion practice. The Quality Assessment Tool for Critical Health Promotion Practice (QATCHEPP) includes 10 values and associated principles, three reflective questions for each value and principle, and a scoring system. QATCHEPP assists practitioners to critically reflect on a health promotion program, which includes any project, policy, strategy, or initiative designed to improve health equity. The purpose of QATCHEPP is to support the reorientation of health promotion practice toward a more critical approach.

Despite health promotion's critical foundations explicated in the Ottawa Charter onwards, much health promotion activity is still selective rather than comprehensive (11, 18) or critical (15, 55). It is important therefore that tools to support researchers and practitioners to critically reflect on the normative content of policies and programs so that they align with critical health promotion are incorporated in health promotion models. The critical health promotion values and principles in the Red Lotus Critical Health Promotion Model form the basis of QATCHEPP, which can be used as part of the RLCHPM or independently as part of a quality assessment process.

Quality assessment of health promotion practice is important to ensure that health promotion programs contribute to health equity. Quality assessment tools have made an important contribution to quality improvement in health promotion practice (70). Whilst there is a range of quality assessment tools available to practitioners, they primarily focus on assessing the quality of the technical aspects of practice. For example, the HERO Health and Well-Being Best Practices Scorecard includes questions in six sections: strategic planning, organizational and cultural support, programs, program implementation, participation strategies, and measurement and evaluation (31). Likewise, Preffi 2.0 does not include any reference to the values and/or principles of health promotion (36). The Criteria for Good Practice in Health Promotion Addressing Social Determinants includes some concepts that could be regarded as values, and provides an excellent framework describing levels of implementation, however it is self-described as being focused on the technical aspects of practice (38). Another limitation of many of the quality assessment tools is the lack of a scoring system. For example, whilst the Healthy Austria Fund quality criteria include a mix of technical principles (for example networking) and conceptual health promotion principles (for example health equity), it does not include a scoring system or process for assessing the extent to which programs meet the criteria.

There has been considerable discussion within the health promotion field about the values and principles that should inform and be evident in good health promotion practice (16, 17, 71), and a set of values is included in the International Union for Health Promotion and Education's Competency Standards Framework (1). There are calls for the explicit adoption of critical reflection in health promotion practice (59, 72), but to date, critical reflection is not included in the IUHPE competency standards. Furthermore, quality assessment tools do not require critical reflection on or assessment of the values and principles that underpin the practice.

To our knowledge, QATCHEPP is the first quality assessment tool for critical health promotion that is underpinned by CSH. This theoretical underpinning provides heuristic support to enable practitioners to engage in boundary critique through critical reflection to assess the extent to which a health promotion program aligns with critical health promotion. It provides the evidence for the reorientation of programs toward a more critical approach, which is essential for addressing structural and systemic determinants of health and wellbeing to enhance health equity (2, 5, 12–14, 73). The structure of QATCHEPP is designed to enable the development of the critical reflection competence of practitioners to engage in systems thinking and reflective discourse to identify the dominant values of a health promotion program (65–67). Whilst the language used in some of the values, principles, or questions may be unfamiliar to some, it is congruent with critical theory. An essential aspect of a critical approach is to embrace uncertainty and new ways of knowing, being, and doing, which enables transformation to more critical practice.

CSH boundary critique involves using a heuristic to ask critical questions about *who/what is* and *who/what ought to be* the four sources of influences of the system, in this case the health promotion program, including sources of motivation, sources of control, sources of knowledge, and sources of legitimacy (68). For example, with respect to sources of motivation, QATCHEPP includes questions about *who is* and *ought to be* the beneficiaries of a health promotion program, and *what is* and *ought to be* the purpose of the program. With respect to sources of control, QATCHEPP includes questions about *who is* and *ought to be* the decision makers, and *what is* and *ought to be* within the scope of decision makers in a health promotion program. With respect to sources of knowledge, QATCHEPP includes questions about *what* knowledge and *who's* knowledge *is* and *ought to be* valued and *what is* and *ought to be* the role of the practitioner in a health promotion program. With respect to sources of legitimacy, QATCHEPP includes questions about *who is* and *ought to be* the priority population for a health promotion program, *what is* and *ought to be* the process for their authentic participation in all stages of program design and implementation, and *what is* and *ought to be* the strategy to minimize or avoid potential harm. Other questions within QATCHEPP further explore these sources of influence.

QATCHEPP can be used by individual or teams of practitioners to guide the design of health promotion programs or critique planned, current, or past programs. It is scalable and can be used to assess small scale health promotion programs at a local level through to national and international level program, policies, and strategies. QATCHEPP can be used by practitioners whose main role is health promotion practice within government, non-government, or community organizations. It can also be used by those for whom health promotion is a component of their role, for example clinical and allied health practitioners, educators, urban planners, climate and social justice activists, and by people

in the community who may be involved in health promotion programs. Research on the application of quality assessment tools demonstrates that practitioners are reliable assessors of their own health promotion practice (74). QATCHEPP could be adopted as a quality assessment tool by funding bodies, journals, conference convenors, and ethics review boards. We now provide four examples of how QATCHEPP may be used in different health promotion practice contexts.

Using QATCHEPP, a practitioner may identify that the health promotion program they are working on is rooted in the biomedical-behavioral health paradigm, which is reflective of selective health promotion. Evidence to support this assessment is that the program goal is to reduce cardiovascular disease, and the objectives focus on reducing behavioral and physiological risk factors. The holistic health paradigm value and associated principle can then be used to invoke questions about how to reorient the program toward framing health as a complex concept that includes physical, mental, spiritual, social, cultural, and environmental aspects of wellbeing. The pilot test of QATCHEPP we conducted with students provided early evidence of its effectiveness to support reorientation of health promotion toward a more critical approach. The two graduate students who used QATCHEPP to critique the health promotion program they were working on in practice reported that it was extremely valuable for highlighting aspects of the program that had not been considered to date or could be improved. They plan to present the findings of their critical reflection to their managers, and advocate for reorientation of the program toward a more critical approach by addressing the specific aspects identified as being somewhat or minimally critical.

A community organization may use QATCHEPP to conduct an internal review of a current health promotion program. In another example, focused on increasing rates of volunteering within their community as a strategy for enhancing social health and wellbeing. They identify that the program is limited to addressing determinants of volunteering at the individual level, which is reflective of selective health promotion. Evidence to support this assessment is that the program strategies are exclusively focused on changing individual people's knowledge and attitudes about volunteering. They use the findings to invoke questions about how to reorient the program to use systems science to identify the full range of intersecting determinants of volunteering at multiple levels.

An assessor of a funding application for a new Health Promoting Schools program may use QATCHEPP to identify that the proposed program is focused on schools in middle and higher socioeconomic areas that benefit from structural and systemic privilege and power, which is reflective of selective health promotion. Evidence to support this assessment is that the priority population was determined by ease of access to these schools rather than equity considerations. In addition, the students in these schools are described as the "target group." As a result, the assessor provides feedback to invoke questions about how to reorient the proposed program to prioritize schools in lower socioeconomic areas that are most impacted by the inequitable distribution of structural and systemic privilege and power. In addition, they suggest that the applicant reconsider their choice of language to describe the priority population.

A journal reviewer may use QATCHEPP to identify that a manuscript about a mental health promotion program does not describe any potential harms that may have arisen from the program, which is reflective of selective health promotion. Evidence to support this assessment is that the manuscript fails to address the risk that the program may have inadvertently increased stigmatization of people with mental health issues. They provide feedback to invoke questions about how the authors can revise the manuscript to include information about who may have been harmed by the program and in what way, what steps were taken to minimize or avoid this harm, and how the risk of harm was communicated.

These are just some examples of how QATCHEPP may be used to enhance critical practice. Although the results of the pilot test are promising, QATCHEPP still needs to be tested in a broad range of professional contexts. To support practitioners' use, we plan to develop a digital platform for QATCHEPP with hyperlinks to a user guide that includes more detailed explanations of the values and principles, reflective questions, and types of evidence for each response category and score. We also intend to develop a series of publicly available videos providing guidance for QATCHEPP users. These strategies will contribute to enhancing the utility and reliability of the tool. Further research is required to evaluate the application of QATCHEPP in a full range of practice environments and determine the intra-rater, inter-rater, and test-rest reliability of QATCHEPP as a quality assessment tool.

A strength of QATCHEPP is that it addresses the need for a quality assessment tool focused specifically on critical health promotion. To our knowledge, it is the only tool to do so. Due to its critical theoretical foundation, it extends existing quality assessment tools beyond technical aspects of health promotion practice to incorporate underlying values and principles of a critical approach. QATCHEPP can be used in a broad range of health promotion contexts, by a variety of users, for multiple purposes. QATCHEPP is the result of over 15 years of systematic, continuous refinement of the Red Lotus Critical Health Promotion Model in response to user reflection and feedback. The reflective questions were developed by us as researchers with extensive practice and academic experience in a critical health promotion approach. As such, the questions reflect our beliefs about the intent of the values and principles and how each is and ought to be operationalized in practice. Consistent with the constructionist epistemology, we acknowledge that other researchers may have different beliefs about what critical health promotion is and ought to be. Similarly, users of QATCHEPP will interpret the values and principles and reflective questions based on their own practice experience. As such, the evidence they identify to support their assessment for each question will likewise be informed by their own professional lived experience.

A limitation in the interpretation of the results of QATCHEPP is the arbitrary scoring for individual reflective questions, the summary score, and the cut off points for the overall assessment of the program as strongly, somewhat, or minimally critical health promotion. These numerical and categorical results generated by QATCHEPP are intended to provide a guide to inform quality improvement of programs rather than a summative judgement. A further limitation is that QATCHEPP has only been tested informally and with graduate students. Further research is required to determine the reliability of the instrument in a range of practice contexts.

5. Conclusion

The purpose of health promotion practice is to develop, implement, and evaluate health promotion programs to bring about changes in the determinants of health and wellbeing to enhance health equity. QATCHEPP provides heuristic support for practitioners to engage in critical reflection to assess the extent to which a health promotion program aligns with critical health promotion. QATCHEPP can be used as part of the Red Lotus Critical Promotion Model or as an independent quality assessment tool to support the orientation of health promotion programs toward critical health promotion practice. This is essential to ensure that health promotion practice contributes to enhancing health equity.

Data availability statement

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

Author contributions

LO'H and JT: conceptualization, methodology, data analysis, writing—original draft preparation, and writing—reviewing and editing. 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. International Union for Health Promotion and Education. *Core Competencies and Professional Standards for Health Promotion 2016*. (2016). Available online at: https://www.iuhpe.org/images/JC-Accreditation/Core_Competencies_Standards_linkE.pdf (accessed December 14, 2022).

2. World Health Organization. *The Ottawa Charter for Health Promotion*. (1986). Available online at: https://www.who.int/healthpromotion/conferences/previous/ottawa/en/ (accessed December 14, 2022).

3. World Health Organization. *Shanghai Declaration on promoting health in the 2030 agenda for sustainable development*. (2016). Available online at: https://www.who.int/healthpromotion/conferences/9gchp/shanghai-declaration.pdf?ua=1 (accessed December 14, 2022). doi: 10.1093/heapro/daw103

4. Baum F, Fisher M. Why behavioural health promotion endures despite its failure to reduce health inequities. *Sociol Health Illn.* (2014) 36:213–25. doi: 10.1111/1467-9566.12112

5. Boyd RC, Castro FG, Finigan-Carr N, Okamoto SK, Barlow A, Kim B-KE, et al. Strategic directions in preventive intervention research to advance health equity. *Prevent Sci.* (2022). doi: 10.1007/s11121-022-01462-5

6. McLaren L, Masuda J, Smylie J, Zarowsky C. Unpacking vulnerability: towards language that advances understanding and resolution of social inequities in public health. *Can J Public Health.* (2020) 111:1–3. doi: 10.17269/s41997-019-00288-z

7. Powell K, Thurston M, Bloyce D. Theorising lifestyle drift in health promotion: explaining community and voluntary sector engagement practices in disadvantaged areas. *Crit Public Health.* (2017) 27:554–65. doi: 10.1080/09581596.2017.1356909

8. Baum F. From Norm to Eric: avoiding lifestyle drift in Australian health policy. *Aust N Z J Public Health.* (2011) 35:404–6. doi: 10.1111/j.1753-6405.2011.00756.x

9. de Gruchy J. *The Lazy Language of 'Lifestyles' – Let's Rid this from Our Talk About Prevention Association of Directors of Public Health (UK).* (2019). Available online at: https://www.adph.worg.uk/2019/04/the-lazy-language-of-lifestyles-lets-rid-this-from-our-talk-about-prevention/ (accessed December 14, 2022).

10. Robinson M, Smith JA. The lazy language of 'lifestyles'. *Health Promot J Austr.* (2022) 34:3–5. doi: 10.1002/hpja.677

11. Fry D. Language and framing as determinants of the predominance of behavioural health promotion: an Australian view. *Health Promot Int.* (2019) 35:624–31. doi: 10.1093/heapro/daz039

12. McPhail-Bell K, Bond C, Brough M, Fredericks B. 'We don't tell people what to do': ethical practice and Indigenous health promotion. *Health Promot J Austr.* (2015) 26:195–9. doi: 10.1071/HE15048

13. Lucyk K, McLaren L. Taking stock of the social determinants of health: a scoping review. *PLoS ONE.* (2017) 12:e0177306. doi: 10.1371/journal.pone.0177306

14. Taylor J, O'Hara L, Talbot L, Verrinder G. *Promoting Health: The Primary Health Care Approach*, 7th ed. Chatswood, NSW: Elsevier Australia (2021).

15. O'Hara L, Taylor J. A critical health promotion research approach using the Red Lotus Critical Health Promotion model. In: Potvin L, Jourdan D, editors. *Global Handbook of Health Promotion Research, Vol 1: Mapping Health Promotion Research.* Cham: Springer International Publishing (2022), p. 541–66.

16. Gregg J, O'Hara L. Values and principles evident in current health promotion practice. *Health Promot J Austr.* (2007) 18:7–11. doi: 10.1071/HE07007

17. Carter S, Rychetnik L, Lloyd B, Kerridge I, Baur L, Bauman A, et al. Evidence, ethics, and values: a framework for health promotion. *Am J Public Health.* (2011) 101:465–72. doi: 10.2105/AJPH.2010.195545

18. Jancey J, Barnett L, Smith J, Binns C, Howat P. We need a comprehensive approach to health promotion. *Health Promot J Austr.* (2016) 27:1–3. doi: 10.1071/HEv27n1_ED

19. Nutbeam D. How does evidence influence public health policy? Tackling health inequalities in England. *Health Promot J Austr.* (2003) 14:154–8. doi: 10.1071/HE03154

20. Barnfield A, Savolainen N, Lounamaa A. Health promotion interventions: lessons from the transfer of good practices in CHRODIS-PLUS. *Int J Environ Res Public Health.* (2020) 17:1281. doi: 10.3390/ijerph17041281

21. Mihić J, Novak M, Hosman C, Domitrovich C. Assessing the quality of mental health promotion and prevention in Croatia: the case of Istria. *Health Promot Int.* (2015) 32:511–21. doi: 10.1093/heapro/dav111

22. Øvretviet J. Quality in health promotion. *Health Promot Int.* (1996) 11:55–62. doi: 10.1093/heapro/11.1.55

23. Speller V, Evans D, Head MJ. Developing quality assurance standards for health promotion practice in the UK. *Health Promot Int.* (1997) 12:215–24. doi: 10.1093/heapro/12.3.215

24. Fazal N, Jackson SF, Wong K, Yessis J, Jetha N. Between worst and best: developing criteria to identify promising practices in health promotion and disease prevention for the Canadian Best Practices Portal. *Health Promot Chronic Dis Prev Can.* (2017) 37:386–92. doi: 10.24095/hpcdp.37.11.03

25. Shilton T, Howat P, James R, Hutchins C, and Burke L. Potential uses of health promotion competencies. *Health Promot J Austr.* (2008) 19:184–8. doi: 10.1071/he08184

26. Melville L, Howat P, Shilton T, Weinstein R. Health promotion competencies for the Israeli workforce. *Promot Educ.* (2006) 13:178–84. doi: 10.1177/175797590601300302

27. Health Promotion Forum of New Zealand. *Health Promotion Competencies for Aotearoa New Zealand*. (2012). Available online at: https://hpfnz.org.nz/professional-development/health-promotion-competencies-for-aotearoa-new-zealand/ (accessed December 14, 2022).

28. Backhouse A, Ogunlayi F. Quality improvement into practice. *BMJ.* (2020) 368:m865. doi: 10.1136/bmj.m865

29. Ader M, Berensson K, Carlsson P, Granath M, Urwitz V. Quality indicators for health promotion programmes. *Health Promot Int.* (2001) 16:187–95. doi: 10.1093/heapro/16.2.187

30. Lang JE, Mummert A, Roemer EC, Kent KB, Koffman DM, Goetzel RZ. The CDC worksite health scorecard: an assessment tool to promote employee health and well-being. *Am J Health Promot.* (2020) 34:319–21. doi: 10.1177/0890117119898026c

31. Rosenbaum E, Grossmeier J, Imboden M, Noeldner S. The HERO health and well-being best practices scorecard in collaboration with mercer (HERO scorecard). *Am J Health Promot.* (2020) 34:321–3. doi: 10.1177/0890117119898026d

32. Imboden MT, Castle PH, Johnson SS, Jenkins KR, Pitts JS, Grossmeier J, et al. Development and validity of a workplace health promotion best practices assessment. *J Occup Environ Med.* (2020) 62:18–24. doi: 10.1097/JOM.0000000000001724

33. Weaver GM, Mendenhall BN, Hunnicutt D, Picarella R, Leffelman B, Perko M, et al. Performance against WELCOA's worksite health promotion benchmarks across years among selected US organizations. *Am J Health Promot.* (2018) 32:1010–20. doi: 10.1177/0890117116679305

34. Watt RG, Harnett R, Daly B, Fuller SS, Kay E, Morgan A, et al. Evaluating oral health promotion: need for quality outcome measures. *Community Dent Oral Epidemiol.* (2006) 34:11–7. doi: 10.1111/j.1600-0528.2006.00257.x

35. *Quality Criteria: Healthy Austria Fund*. Available online at: https://fgoe.org/qualitaetskriterien

36. Molleman GRM, Ploeg MA, Hosman CMH, Peters LHM. Preffi 20- a quality assessment tool. *Promot Educ.* (2006) 13:9–14. doi: 10.1177/175797590601300101

37. Bollars C, Kok H, Van den Broucke S, Molleman G. *User Manual European Quality Instrument for Health Promotion (EQUIHP)*. Woerden: Netherlands Institute of Health Promotion and Disease Prevention (2005).

38. Getting Evidence into Practice Project. *European Quality Instrument for Health Promotion (EQUIHP)*. Brussels, Belgium: European Commission (2005). Available online at: http://ec.europa.eu/health/ph_projects/2003/action1/docs/2003_1_15_a10_en.pdf (accessed December 14, 2022).

39. Besor O, Manor O, Paltiel O, Donchin M. Rauch Oy, Kaufman-Shriqui V. A city-wide health promotion programme evaluation using EQUIHP: Jerusalem Community-Academic Partnership (J-CAP). *Eur J Public Health.* (2020) 30:455–61. doi: 10.1093/eurpub/ckaa166.362

40. Cerdá-Gómez R, Paredes-Carbonell JJ, López-Sánchez MP. Applicability and perceived utility of the European Quality Instrument for Health Promotion (EQUIHP) in a health promotion programme. *Gac Sanit.* (2018) 32:135–42. doi: 10.1016/j.gaceta.2017.01.007

41. Besor O, Paltiel O, Manor O, Donchin M, Rauch O, Kaufman-Shriqui V. Associations between density and quality of health promotion programmes and built environment features across Jerusalem. *Eur J Public Health.* (2021) 31:1190–6. doi: 10.1093/eurpub/ckab132

42. German Cooperation Network 'Equity in Health'. *Criteria for Good Practice in Health Promotion Addressing Social Determinants Cologne and Berlin: German Cooperation Network 'Equity in Health'*. (2015). Available online at: www.gesundheitliche-chancengleichheit.de/good-practice

43. Tretheway R, Taylor J, O'Hara L. Finding new ways to practise critically: applying a critical reflection model with Australian health promotion practitioners. *Reflective Pract.* (2017) 18:627–40. doi: 10.1080/14623943.2017.1307721

44. Baum F. *The New Public Health*, 3rd ed. South Melbourne: Oxford University Press (2008).

45. Fleming P. Reflection: a neglected art in health promotion. *Health Educ Behav.* (2007) 22:658–64. doi: 10.1093/her/cyl129

46. Johnson A, MacDougall C. Reflective practice. In: Keleher H, MacDougall C, Murphy B, editors. *Understanding Health Promotion.* South Melbourne: Oxforn University Press (2007), p. 244–51.

47. Ife J, Tesoriero F. *Community Development: Community-based Alternatives in An Age of Globalisation,* 3rd ed. Frenchs Forest: Pearson Education Australia (2006).

48. Schutz S. Reflection and reflective practice. *Community Pract.* (2007) 80:26–9. Available online at: https://www.proquest.com/scholarly-journals/reflection-reflective-practice/docview/213343549/se-2

49. Schon D. *The Reflective Practitioner: How Professionals Think in Action*. New York, NY: Basic Books (1983).

50. Gregg J, O'Hara L. The Red Lotus Health Promotion Model: a new model for holistic, ecological, salutogenic health promotion practice. *Health Promot J Austr.* (2007) 18:12–9. doi: 10.1071/HE07012

51. Dick B, Dalmau T. *Values in Action - Applying the ideAs of Argyris and Schon*, 2nd ed. Brisbane: Interchange (1999).

52. O'Hara L, Taylor J. A research approach using the red lotus model. In: Potvin L, Jourdan D, editors. *Global Handbook of Health Promotion Research*, Vol 1. New York, NY Springer (2022), p. 541–66.

53. Taylor J. *Development of a Health Promotion Model and the Impact Evaluation of the Model on Practitioners' Health Promotion Practice*. Sippy Downs, QLD: University of the Sunshine Coast (2012).

54. Barry MM, Battel-Kirk B, Dempsey C. The CompHP core competencies framework for health promotion in Europe. *Health Educ Behav.* (2012) 39:648–62. doi: 10.1177/1090198112465620

55. O'Hara L, Taylor J. Impact of the use of the Red Lotus Critical Health Promotion Model as a pedagogical framework on health promotion graduates' professional practice: a mixed methods study. *Health Promot J Austr.* (2022) 33(Suppl 1):76–−86. doi: 10.1002/hpja.642

56. Woodall J, Cross R. *Essentials of Health Promotion*. London: Sage (2021).

57. O'Hara L, Taylor J, Barnes M. The extent to which the public health 'war on obesity' reflects the ethical values and principles of critical health promotion: a multimedia critical discourse analysis. *Health Promot J Austr.* (2015) 26:246–54. doi: 10.1071/HE15046

58. O'Hara L, Taylor J, Barnes M. We are all ballooning: multimedia critical discourse analysis of 'measure up' and 'swap it, don't stop it' social marketing campaigns. *Media Cult J.* (2015) 18:1–11. doi: 10.5204/mcj.974

59. Tretheway R, Taylor J, O'Hara L, Percival N. A missing ethical competency? A review of critical reflection in health promotion. *Health Promot J Austr.* (2015) 26:216–21. doi: 10.1071/HE15047

60. Mensinger JL, Meadows A. Internalized weight stigma mediates and moderates physical activity outcomes during a healthy living program for women with high body mass index. *Psychol Sport Exerc.* (2017) 30:64–72. doi: 10.1016/j.psychsport.2017.01.010

61. O'Hara L, Ahmed H, Elashieb S. Evaluating the impact of a brief Health at Every Size®-informed health promotion activity on body positivity and internalized weight-based oppression. *Body Image.* (2021) 37:225–37. doi: 10.1016/j.bodyim.2021.02.006

62. O'Hara L, Alajaimi B, Alshowaikh B. "I was bullied for being fat in every situation, in every outfit, at every celebration": a qualitative exploratory study on experiences of weight-based oppression in Qatar. *Front Public Health.* 11:1015181. doi: 10.3389/fpubh.2023.1015181

63. Crotty M. *The Foundations of Social Research: Meaning and Perspective in the Research Process*, 1st ed. Crows Nest: Allen and Unwin (1998). doi: 10.4324/9781003115700-1

64. Liamputtong P. The science of words and the science of numbers. In: Liamputtong P, editor. *Research Methods in Health: Foundations for Evidence Based Practice*, 3rd ed. Melbourne, VIC: Oxford University Press (2017), p. 3–28.

65. Bammer G. *Embedding Critical Systems Thinking and Other Integration and Implementation Sciences in the Academy*. Canberra: National Centre for Epidemiology and Population Health, The Australian National University (2003).

66. Ulrich W. Beyond methodology choice: critical systems thinking as critically systemic discourse. *J Oper Res Soc.* (2003) 54:325–42. doi: 10.1057/palgrave.jors.2601518

67. Ulrich W. *A Brief Introduction to Critical Systems Heuristics (CSH)*. Milton Keynes: Systems Department and Knowledge Media Institute (2005).

68. Ulrich W, Reynolds M. Critical systems heuristics In: Reynolds M, Holwell S, editors. *Systems Approaches to Managing Change: A Practical Guide*. London: Springer (2010), p. 243–92. doi: 10.1007/978-1-84882-809-4_6

69. Ulrich W. Critical heuristics of social systems design. *Eur J Oper Res.* (1987) 31:276–83. doi: 10.1016/0377-2217(87)90036-1

70. Mielck A, Kilian H, Lehmann F, Richter-Kornweitz A, Kaba-Schönstein L. German cooperation-network 'equity in health'—health promotion in settings. *Health Promot Int.* (2016) 33:318–24. doi: 10.1093/heapro/daw069

71. Demaio A, Drysdale M, de Courten M. Appropriate health promotion for Australian Aboriginal and Torres Strait Islander communities: crucial for closing the gap. *Glob Health Promot.* (2012) 19:58–62. doi: 10.1177/1757975912441230

72. Wigginton B, Fjeldsoe B, Mutch A, Lawler S. Creating reflexive health promotion practitioners: our process of integrating reflexivity in the development of a health promotion course. *Pedagogy Health Promot.* (2019) 5:75–8. doi: 10.1177/2373379918766379

73. Marmot M, Allen J, Boyce T, Goldblatt P, Morrison J. *Health Equity in England: The Marmot Review Ten Years on*. London: Institute of Health Equity (2020). doi: 10.1136/bmj.m693

74. Molleman GRM, Peters LWH, Hosman CMH, Kok GJ, Oosterveld P. Project quality rating by experts and practitioners: experience with Preffi 20 as a quality assessment instrument. *Health Educ Res.* (2005) 21:219–29. doi: 10.1093/her/cyh058

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A quality analysis of thyroid cancer videos available on TikTok

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Background: Thyroid cancer (TC) is becoming an increasing public health problem worldwide. TikTok is a global video-sharing social media app, which can be a source of information on TC. However, the information quality of these videos remains unknown.

Methods: A search of TikTok was performed with the term "甲状腺癌"and "甲状腺肿瘤" ("thyroid cancer" and "thyroid neoplasm" in Chinese). Videos included were independently assessed using six predefined questions for content scores and DISCERN scale for information quality, while the video popularity index (VPI) was also calculated. A correlation analysis was performed among duration, presence of animation, VPI, DISCERN scores, and content scores.

Results: A total of 56 videos were finally included, of which 49 were uploaded by physicians, 4 by health organizations, and 3 by hospitals. While 43 were real content videos, 13 were animated. The mean of DISCERN score and content score was 3.44±0.72 and 5.19±0.95, respectively. Good consistency was found between the two reviewers in terms of both DISCERN scores and content scores. The video duration and presence of animation were positively correlated with VPI, while DISCERN scores and content scores were not correlated with VPI.

Conclusion: The overall quality of TC-related videos was satisfactory, although the quality varies greatly depending on the type of source. Patients should be cautious when using TikTok as a source of TC-related information.

KEYWORDS

thyroid cancer, TikTok, health information, short video, social media

Introduction

Thyroid cancer is the most common malignancy of the endocrine system, with the differentiated thyroid cancers papillary and follicular accounting for the majority of new cases (1). Furthermore, TC is more likely to occur in women with an incidence of 2.5 times (2), and the five-year survival rate is 98.1% (3). An apparent increase in TC incidence was shown in recent studies (4, 5), which may be driven by a combination of increased surveillance, lifestyle, and environmental factors (6–8).

Due to an increase in health awareness, people have a greater demand for health information, especially for patients suffering from cancer. Patients are increasingly demanding to be involved in decision-making process (9). Health information could be provided by diverse sources besides professional physicians. Although such information is not a substitute for medical advice, it could reinforce knowledge and help patients to make personal decisions.

Social media is an important way to disseminate information. However, social media is also a major source of misinformation, especially health relevant information. Misinformation tends to spread faster and more broadly than verified information due to the diversity of users and

lack of monitoring and censorship mechanisms. Several studies have shown the potential for social media to be misleading in disseminating health information (10–16). TikTok is a short video-sharing app that allows users to create and share videos on any topic. In China, TikTok reached the first position on the global mobile app download list in December 2021 (17). Compared with other social media, TikTok has become more popular because it is easy to produce and share short videos, including elements like music, animation, and various visual effects (18). TikTok is expanding its coverage of topics on many aspects of daily life, such as beauty and makeup, education, cooking, wellness and technology (19). Educational healthcare content has also become an important part of TikTok's content ecosystem (20). However, the unregulated content of TikTok video and the lack of peer review process increases the likelihood of dissemination of inaccurate and large volumes of information with varying quality and credibility, raising a significant challenge in the provision of optimal healthcare. Given the increasing use of TikTok app by increasingly patients, physicians, and researchers as an effective channel for healthcare communication in recent years (21, 22), it thus is vital for patients and health care providers to understand the quality of information that patients are likely to find, and for health educators to make higher quality short video available.

Although TC is a disease with a good prognosis, receiving a cancer diagnosis is a sensational event for the general person. Correct dissemination of TC-related health information plays an important role in enhancing patient belief and maintaining good patient–physician relationships. However, to our knowledge, the quality of short video content regarding to TC has not yet been analyzed. To address this gap, this study aims to assess the quality of the short videos about TC from TikTok.

Methods

Search strategy

Keywords "甲状腺癌" and "甲状腺肿瘤" ("Thyroid cancer" and "thyroid neoplasm" in Chinese) was searched within TikTok app on March 20, 2022. The first 100 videos that appeared on each search were reviewed. A total of 56 videos were finally included for analyzing in this study after excluding videos with advertising content ($n = 8$), duplicated ($n = 36$), as shown in the Supplementary Figure S1.

Data collection

All selected videos were categorized into three groups according to source: physicians, hospital channel (non-profit organization), and health organizations (for-profit organizations). In order to confirm the authenticity of the included videos, we not only carefully checked the registration information of the video uploader's account, but also accessed the official website of the hospital where the video author worked to confirm the author's real identity. Information of videos was extracted and coded, including source of video, the content of the videos, the presence of animation, duration (in seconds), the upload date, and other viewer interactive quality markers including number of views, likes, and comments. The VPI was calculated using the formula "(number of likes/number of views) × 100)" (12).

Quality assessment of video information

Videos were assessed from two aspects: the quality of information and their contents. The quality of information was rated using an adapted DISCERN tool by Singh et al. (23) considering the following reasons: (1) It is a widely used tool for evaluating the quality of health information (24, 25); (2) It is useful for assessing information quality on other video-based platforms (e.g., YouTube) (26). This DISCERN tool has five questions in total, and each question is answered yes or no. Yes answer is 1 point and no answer is 0, and a maximum of 5 points can be obtained. DISCERN scores thus ranged from 1 = unacceptable, 2 = poor, 3 = acceptable, 4 = good, to 5 = excellent, higher scores indicate a greater video reliability (25). Questions used in the DISCERN scale are shown in Table 1.

Content score was rated in terms of six predefined questions (definition of a disease, risk factors, evaluation, signs and symptoms, management, and outcomes; one point is given for covering 1–2 aspects, two points is for 3 aspects, three points is for 4 aspects, four points is for 5 aspects and five points is for full coverage. The rating criteria are the same as DISCERN scores). To facilitate statistical analysis, we recorded the basic information of each video (publication date; duration; views, likes, comments, shares; presence of animation or not) and basic information of the video publisher (account name, self-description, publisher identity). Two reviewers independently appraised the quality of the included videos.

Ethics statement

This study focused on the quality assessment of TikTok videos contributed and viewed by the public, so ethics committee approval was not required.

Statistical analysis

Statistical analysis was made using IBM SPSS Statistics for Windows, version 19.0. The statistical analysis methods used include descriptive statistical analysis, Pearson correlation analysis, and one-way ANOVA. The continuous variables were expressed as mean ± standard deviation, median (min-max), while nominal variables were given as frequency and percentage. $p < 0.05$ was considered statistically significant.

Results

Video characteristics

Of the 56 videos included in this study, 49 (87.5%) were uploaded by physicians, 4 (7.1%) by health organizations, and 3 (5.4%) by

TABLE 1 Assessment of reliability of videos on TC found on TikTok APP.

No.	Questions
1	Are the targets clear enough?
2	Are reliable sources of information used? (Doctors, health channel……)
3	Is the information presented balanced and unbiased?
4	Are the alternative sources offered to patients?
5	Are areas of uncertainty mentioned?

hospital channels. There wasn't video from patients or their relatives. Forty three (76.8%) videos were real content videos, 13 (23.2%) were videos with animation.

Descriptive statistics for videos

The duration of the videos varied from 5 to 111 s. The least online days of video were 2 days prior to data collection, whereas the most online days were nearly 3 years. Median (min-max) number of views, likes, comments, collection, sharing, and VPI were 46,211 (578–11,088,000), 1378.5 (22–308,000), 83 (0–73,000), 82.5 (1–1775), 130.5 (15–5,796) and 2.5 (2–8.82) prior to data collection. There were no significant differences among different sources of video (physician, hospital channel, and health organization) regarding such video characteristics mentioned above except for VPI between health organization and hospital channel ($p = 0.002$), physicians ($p < 0.001$).

Quality assessment of video

The average DISCERN score given by the two reviewers was 3.44 ± 0.72, while the DISCERN score for individual reviewers was 3.5 ± 0.71 and 3.38 ± 0.73, respectively. A good agreement was observed, $\kappa = 0.72$ ($p < 0.001$). Regarding the source of videos, the videos contributed by hospital (4.0 ± 0.12) and physicians (3.4 ± 0.7) had higher DISCERN scores than the one by the health organization (2.3 ± 0.5). Significant quality difference was observed between health organizations and hospitals ($p = 0.014$), physicians ($p = 0.006$). More than 85% of videos have a DISCERN score greater than 3 (Table 2). In addition, the video content responded the predefined six questions to different degrees, as shown in Figure 1. The average content score given by the two reviewers was 5.19 ± 0.95, while for individual reviewers was 5.21 ± 0.91 and 5.16 ± 0.99, respectively. The κ-coefficient for content scores was 0.781 ($p < 0.001$), which indicated a good consistency between the two reviewers. The results also showed that most of videos sufficiently addressed definition

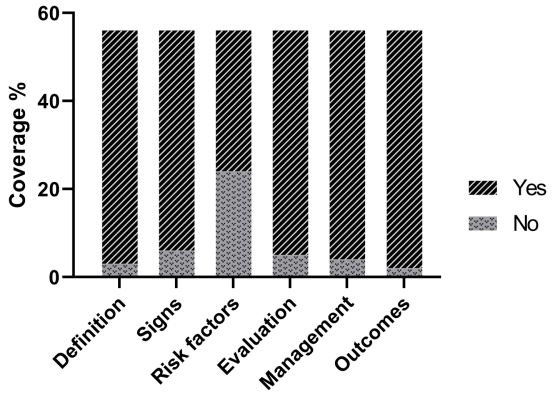

FIGURE 1
Percentage of videos addressing each TC topic.

TABLE 2 General characteristics of the videos.

	Mean±SD	Median	Min	Max
Video duration (second)	**41.45 ± 21.18**	**37**	**5**	**111**
Number of days online (days)	**243.18 ± 278.18**	**129**	**2**	**1,082**
Views (count)	**298919.16 ± 1473716.1**	**46,211**	**578**	**11,088,000**
Likes (count)	**8020.61 ± 40954.84**	**1378.5**	**22**	**308,000**
Comments (count)	**1460.54 ± 9736.43**	**83**	**0**	**73,000**
Collection (count)	**266.5 ± 403.82**	**82.5**	**1**	**1775**
Sharing (count)	**542.05 ± 1008.05**	**130.5**	**15**	**5,796**
VPI (%)	**2.68 ± 1.02**	**2.5**	**2**	**8.82**
DISCERN score reviewer 1	**3.5 ± 0.71**	**2**	**0**	**3**
reviewer 2	**3.38 ± 0.73**	**2**	**0**	**3**
Content score reviewer 1	**5.21 ± 0.91**	**5**	**3**	**6**
Reviewer 2	**5.16 ± 0.99**	**5**	**2**	**6**
Good quality videos	**n (%)**			
DISCERN score ≥ 3 reviewer 1	**49 (87.5)**			
reviewer 2	**48 (85.7)**			
Source of upload	**n (%)**			
Physicians	**49 (87.5)**			
Hospitals (non-profit)	**3 (5.4)**			
Health organization (for-profit)	**4 (7.1)**			
Presence of animation	**n (%)**			
Yes	**17 (30.3)**			
No	**39 (69.6)**			

(53/56, 94.6%), signs and symptoms (50/56, 89.3%), management (52/56, 92.9%), evaluation (51/56, 91.1%) and outcomes (54/56, 96.4%), while risk factors (32/56, 57.1%) were absent in 42.9% videos.

The top 10 videos, the source of videos, the video content, the upload date, and VPI values are given in Table 3.

Correlations between descriptive parameters

The duration of the video and presence of animation were positively correlated with VPI of videos (duration: $r = 0.40$, $p = 0.002$; animation: $r = 0.52$, $p < 0.001$). Both DISCERN score and content score were not correlated with VPI, and no correlation was noted between DISCERN score and content score, as shown in Figure 2.

TABLE 3 General characteristics and VPI values of the top 10 videos.

Uploader source	Content	Upload date	VPI (%)
Hospital channel	**Education**	**12/01/2020**	**8.82**
Hospital channel	**Education**	**04/07/2019**	**5.75**
Physician	**Education**	**09/20/2021**	**3.33**
Physician	**Education**	**12/02/2021**	**3.33**
Physician	**Education**	**04/01/2020**	**3.33**
Physician	**Education**	**12/23/2021**	**3.23**
Physician	**Education**	**08/06/2021**	**3.13**
Physician	**Education**	**08/03/2021**	**3.13**
Physician	**Education**	**03/05/2022**	**3.03**
Physician	**Education**	**01/20/2022**	**3.03**

Discussion

TikTok as information source

Video-based social media were important platforms for producing and disseminating health-related videos. Recent evidence indicates that TikTok has demonstrated strong communication potential during the COVID-19 pandemic (27), however, the role of TikTok in disseminating TC relevant information remains unclear.

Our results suggest that the overall quality of TC-related videos from TikTok was satisfactory. Videos included in this study have received approximately 16.74 million views since they were uploaded. These results indicated that TikTok is a new source of information on TC.

Information quality appraisal

TikTok app is primarily an entertainment-oriented application which may differentiate itself from other social media by publishing quirky videos rather than serious professional content (18). As the number of users grows, some professional knowledge sharing videos, such as medical education, have also been integrated into TikTok's content ecosystem (21, 28). Our results here indicated that the quality

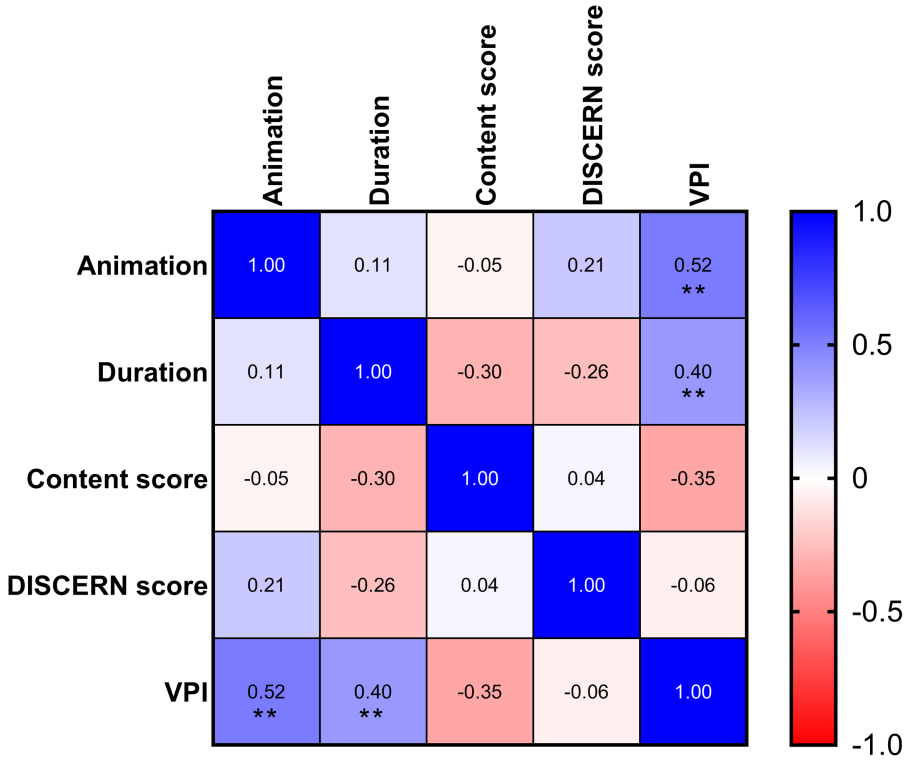

FIGURE 2
Correlations considering animation, duration, VPI, DISCERN scores, and content scores. **p <0.01.

of video on TC found on TikTok was satisfactory. These results were consistent with some previous studies about other disease videos found on TikTok (29–31), which found that the information provided in these videos was generally reliable.

Our results also show that the videos included in this study all covered predefined relevant questions to varying degrees, which may be due to the duration limit of TikTok videos (the duration of videos for new users is limited to 15 s, and longer videos require a certain number of fans and views) (32). The most frequently mentioned topic was the outcomes of TC, which may be due to the fact that this disease is the nature of cancer and is not generally known by the general population to have a low rate of malignancy. It is clearly helpful for patients to improve their risk perception of the prognosis of the disease by using TikTok to communicate such information to them.

TikTok app has a strict audit system for video publishers of health knowledge sharing (33). Therefore, there are no videos uploaded by patients or their relatives in the first 100 videos we search each time. Of the included 56 videos, 49 (87.5%) were uploaded by physicians, 4 (7.1%) by health organizations, and 3 (5.4%) by hospital channels. Videos published by physicians and hospitals had the higher quality which have been confirmed by many previous studies, while those from the health organizations for profit had the lowest quality (34, 35). These results indicated that physicians and government-sponsored platforms are more likely to publish high-quality information than for-profit organizations. However, the videos contributed by the hospital channel account for a mere portion of the total videos on TikTok. Considering the busy routine of physicians, we therefore suggest that public hospitals organize professionals to contribute more high-quality videos to patients and leverage the power of this social media channel to promote public health.

For videos found on TikTok, the video popularity attributes to many factors, such as the rules set by TikTok and common social interactions, even the psychological effects of the audience (36), which challenge to find videos from trustworthy sources. Therefore, since trustworthiness is not the only criterion for TikTok ranking, it is possible that videos from trusted sources will receive a lower ranking, while misleading and incorrect videos may receive a higher ranking. Notably, a new algorithm is needed to enable higher user acceptance and trusted videos remain in the top positions in order to help patients to access quality and trusted video resources.

Animated videos in previous study (10) were reported to be correlated positively with the number of views and negatively with the video duration. However, videos with animation had no advantage over non-animated videos in terms of number of views, DISCERN scores, or content scores in our study. This may be due to the small number of animated videos and the use of similar and repeated animation resources. In addition, a weakly positive correlation existed between duration, animation, and VPI. This may attribute to the type of video. Unlike entertainment videos, health knowledge sharing videos need longer duration to accommodate more information. TikTok has recently raised its video duration limit to 10 min (37), which is good for health-sharing videos.

Limitations

Limitations to this study should be mentioned. First, the search results on TikTok are dynamic over time; the results thus might vary with the use of different search dates and time. Second, the research results may vary according to the geographical location of the viewer. Third, video sampling retrieves only the first 100 in each search which can lead to inadequate coverage.

Conclusion

In this study, we analyzed the quality of information provided by TikTok video regarding TC. The overall quality of information based on DISCERN scores and content scores was satisfactory. Our finding also supports TikTok as a new source of information on TC, and therefore, physicians and hospitals should embrace this evolving technology and provide videos with higher quality to improve patients' awareness about TC. Patients should also be cautious when watching TC relevant videos on TikTok due to the complexity of VPI.

Data availability statement

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

Author contributions

LW and YL: Conceptualization and Methodology. JG and LX: Experiments and Data analysis. LW and YL: Writing. 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/fpubh.2023.1049728/full#supplementary-material

References

1. Brito JP, Hay ID, Morris JC. Low risk papillary thyroid cancer. *BMJ*. (2014) 348:g3045. doi: 10.1136/bmj.g3045

2. Enewold L, Zhu K, Ron E, Marrogi AJ, Stojadinovic A, Peoples GE, et al. Rising thyroid cancer incidence in the United States by demographic and tumor characteristics, 1980–2005. *Cancer Epidemiol Biomark Prev*. (2009) 18:784–91. doi: 10.1158/1055-9965.EPI-08-0960

3. Bibbins-Domingo K, Grossman DC, Curry SJ, Barry MJ, Davidson KW, Doubeni CA, et al. Screening for thyroid cancer: US preventive services task force recommendation statement. *JAMA*. (2017) 317:1882–7. doi: 10.1001/jama.2017.4011

4. Wang J, Yu F, Shang Y, Ping Z, Liu L. Thyroid cancer: incidence and mortality trends in China, 2005–2015. *Endocrine*. (2020) 68:163–73. doi: 10.1007/s12020-020-02207-6

5. Rosário PW, Ward LS, Carvalho GA, Graf H, Maciel RM, Maciel LM, et al. Thyroid nodules and differentiated thyroid cancer: update on the Brazilian consensus. *Arq Bras Endocrinol Metabol*. (2013) 57:240–64. doi: 10.1590/s0004-27302013000400002

6. Davies L, Welch HG. Increasing incidence of thyroid cancer in the United States, 1973-2002. *JAMA*. (2006) 295:2164–7. doi: 10.1001/jama.295.18.2164

7. Pandeya N, McLeod DS, Balasubramaniam K, Baade PD, Youl PH, Bain CJ, et al. Increasing thyroid cancer incidence in Queensland, Australia 1982-2008 - true increase or overdiagnosis? *Clin Endocrinol*. (2016) 84:257–64. doi: 10.1111/cen.12724

8. Friedenreich CM, Ryder-Burbidge C, McNeil J. Physical activity, obesity and sedentary behavior in cancer etiology: epidemiologic evidence and biologic mechanisms. *Mol Oncol*. (2021) 15:790–800. doi: 10.1002/1878-0261.12772

9. Vahdat S, Hamzehgardeshi L, Hessam S, Hamzehgardeshi Z. Patient involvement in health care decision making: a review. *Iran Red Crescent Med J*. (2014) 16:e12454–4. doi: 10.5812/ircmj.12454

10. Cassidy JT, Fitzgerald E, Cassidy ES, Cleary M, Byrne DP, Devitt BM, et al. YouTube provides poor information regarding anterior cruciate ligament injury and reconstruction. *Knee Surg Sports Traumatol Arthrosc*. (2018) 26:840–5. doi: 10.1007/s00167-017-4514-x

11. Goobie GC, Guler SA, Johannson KA, Fisher JH, Ryerson CJ. YouTube videos as a source of misinformation on idiopathic pulmonary fibrosis. *Ann Am Thorac Soc*. (2019) 16:572–9. doi: 10.1513/AnnalsATS.201809-644OC

12. Aydin MA, Akyol H. Quality of information available on YouTube videos pertaining to thyroid cancer. *J Cancer Educ*. (2020) 35:599–605. doi: 10.1007/s13187-019-01502-9

13. Bai G, Pan X, Zhao T, Chen X, Liu G, Fu W. Quality assessment of YouTube videos as an information source for testicular torsion. *Front Public Health*. (2022) 10:905609. doi: 10.3389/fpubh.2022.905609

14. Suarez-Lledo V, Alvarez-Galvez J. Prevalence of health misinformation on social media: systematic review. *J Med Internet Res*. (2021) 23:e17187. doi: 10.2196/17187

15. Johnson SB, Parsons M, Dorff T, Moran MS, Ward JH, Cohen SA, et al. Cancer misinformation and harmful information on Facebook and other social media: a brief report. *J Natl Cancer Inst*. (2022) 114:1036–9. doi: 10.1093/jnci/djab141

16. Chou W-YS, Oh A, Klein WMP. Addressing health-related misinformation on social media. *JAMA*. (2018) 320:2417–8. doi: 10.1001/jama.2018.16865

17. Annie A. *TikTok won the top of the global app download list at Christmas*. (2021); Available online at: https://blog-en.olivech.com/hots/6308/.

18. Wang Y. Humor and camera view on mobile short-form video apps influence user experience and technology-adoption intent, an example of TikTok (DouYin). *Comput Human Behav*. (2020) 110:106373. doi: 10.1016/j.chb.2020.106373

19. Wright C. Are beauty bloggers more influential than traditional industry experts? *J Promo Commun*. (2017) 5:303–22.

20. News B. *TikTok makes moves into education market*. (2020); Available online at https://www.bbc.com/news/technology-53079625.

21. Zhu C, Xu X, Zhang W, Chen J, Evans R. How health communication via Tik Tok makes a difference: a content analysis of Tik Tok accounts run by Chinese provincial health committees. *Int J Environ Res Public Health*. (2019) 17:192:17. doi: 10.3390/ijerph17010192

22. Basch CH, Fera J, Pierce I, Basch CE. Promoting mask use on TikTok: descriptive cross-sectional study. *JMIR Public Health Surveill*. (2021) 7:e26392. doi: 10.2196/26392

23. Singh AG, Singh S, Singh PP. YouTube for information on rheumatoid arthritis--a wakeup call? *J Rheumatol*. (2012) 39:899–903. doi: 10.3899/jrheum.111114

24. Khazaal Y, Chatton A, Cochand S, Coquard O, Fernandez S, Khan R, et al. Brief DISCERN, six questions for the evaluation of evidence-based content of health-related websites. *Patient Educ Couns*. (2009) 77:33–7. doi: 10.1016/j.pec.2009.02.016

25. Charnock D, Shepperd S, Needham G, Gann R. DISCERN: an instrument for judging the quality of written consumer health information on treatment choices. *J Epidemiol Community Health*. (1999) 53:105–11. doi: 10.1136/jech.53.2.105

26. Gorrepati PL, Smith GP. DISCERN scores of YouTube information on eczema treatments. *J Am Acad Dermatol*. (2021) 85:1354–5. doi: 10.1016/j.jaad.2020.11.007

27. Comp G, Dyer S, Gottlieb M. Is TikTok the next social media frontier for medicine? *AEM Educ Train*. (2020) 5:532. doi: 10.1002/aet2.10532

28. Kassamali B, Villa-Ruiz C, Mazori DR, Min M, Cobos GA, LaChance AH. Characterizing top educational TikTok videos by dermatologists in response to TikTok and dermatology: an opportunity for public health engagement. *J Am Acad Dermatol*. (2021) 85:e27–8. doi: 10.1016/j.jaad.2021.02.051

29. Song S, Xue X, Zhao YC, Li J, Zhu Q, Zhao M. Short-video apps as a health information source for chronic obstructive pulmonary disease: information quality assessment of TikTok videos. *J Med Internet Res*. (2021) 23:e28318. doi: 10.2196/28318

30. Li Y, Guan M, Hammond P, Berrey LE. Communicating COVID-19 information on TikTok: a content analysis of TikTok videos from official accounts featured in the COVID-19 information hub. *Health Educ Res*. (2021) 36:261–71. doi: 10.1093/her/cyab010

31. Kong W, Song S, Zhao YC, Zhu Q, Sha L. TikTok as a health information source: assessment of the quality of information in diabetes-related videos. *J Med Internet Res*. (2021) 23:e30409. doi: 10.2196/30409

32. TTEP.*Cn: Time limit requirements for TikTok*. (2022). Available online at: http://www.ttep.cn/jy/93448.html.

33. CN-HEALTHCARE. *TikTok statement: only these people and units can publish medical content*. (2022); Available online at: https://www.cn-healthcare.com/article/20210323/content-552617.html.

34. Shires CB, Wilson CD, Sebelik MJGS. Thyroid surgery YouTube videos: estimating quality by surgeon characteristics and view rate. *Gland Surg*. (2018) 8:207–11. doi: 10.21037/gs.2018.10.01

35. Ocak U. Evaluation of the content, quality, reliability and accuracy of YouTube videos regarding endotracheal intubation techniques. *Niger J Clin Pract*. (2018) 21:1651–5. doi: 10.4103/njcp.njcp_207_18

36. Fan Y, Tang S, Zheng B. Factors influencing the popularity of scientific short videos: a case study of TikTok account of Chinese Academy of Sciences. *Stud. Sci. Pop.* (2020) 4:55–62. doi: 10.19293/j.cnki.1673-8357.2020.04.007

37. Spangler T. *TikTok bumps up max video length to 10 minutes*. (2022). Available online at: https://variety.com/2022/digital/news/tiktok-maximum-video-length-10-minutes-1235191773/.

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Action learning and public health pedagogy: Student reflections from an experiential public health course

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Introduction: Applied practice experiences are essential components of the Masters of Public Health (MPH) curriculum. The objective of this study was to examine students' perspectives on the skills and expertise they developed in an MPH course offering applied practice opportunities.

Methods: Of 236 students who took the course from 2008 to 2018, email addresses were obtained for 212 and 104 completed the consent form. Following consent, reflection essays were de-identified and analyzed using a rapid qualitative analysis approach. The essays addressed students' learning experiences and application of the competencies for MPH programs set by the Council for Education in Public Health (CEPH). Deductive and inductive analytical lenses were used to identify the key lessons learned by each cohort of students. Semi-structured guides and matrixes for essay analysis were created using assignment instructions and CEPH competencies.

Results: Although the reflection paper assignment varied across the years, commonalities were observed in the student reflections. Key themes included turning theory into practice, navigating the complex environment of public health practice, skill building, critical self-reflection, challenges encountered, and elements that facilitated project success. Students reported developing practical skills, such as planning for independent research (e.g., preparing for institutional review board (IRB) submission, consulting with faculty and other experts), identifying realistic approaches for data extraction during chart reviews and analyses of electronic medical records, and disseminating findings for diverse stakeholders and audiences. Students also reported strengthening cross-cutting skills such as communication, teamwork, and problem-solving that were useful for navigating power dynamics and balancing competing interests and expectations. Students explored their identity as public health professionals as they navigated the dynamics of public health practice.

Conclusion: The applied practice experience served as a valuable tool for knowledge and skills acquisition. Moreover, it served as an opportunity for students to engage with the unique organizational cultures of their respective community partners and to deepen their understanding the complexities of conducting meaningful community-engaged research.

Implications: This study demonstrates the utility of analyzing students' critical self-reflections as a tool for exploring learning experiences when training future

public health professionals. The findings can help educators design future applied practice experiences.

KEYWORDS

community-based experiential learning, action learning, rapid qualitative analysis, public health education, interprofessional education

1. Introduction

Bridging the gap between research and practice is essential to addressing real-world public health issues. Experiential learning in conjunction with rigorous coursework has been shown to be a promising strategy for training students to translate academic research into praxis that will mitigate disparities and improve the health of diverse communities (1, 2). The Council for Education in Public Health (CEPH) is the accrediting body for public health training programs and seeks to provide a framework for public health education that is responsive to the needs of diverse communities (3). In 2014, CEPH revised its accreditation requirements to emphasize a set of competencies that highlight the science of public health as well as the skills needed to practice public health (4). Applied practice experiences allow students to immerse themselves in the practice of public health in a mentored environment (5). Practice-based Community Health Research (PBCHR) is a practicum offered by the Yale School of Public Health (YSPH) and satisfies the requirements of the MPH Applied Practice Experience as defined by CEPH (4). This is an elective course that provides a unique opportunity for students to strengthen their research skills while learning to work within the complex dynamics of public health practice. MPH students take PBCHR in the spring semester of their first or second year. There are no prerequisites other than being an MPH student or the permission of the instructor. This course has been described previously, and is centered on student teams working collaboratively over the spring semester with preceptors from host community organizations to complete projects proposed by the host organizations (5).

Since 2008, the current course instructor has oriented the course to center the importance of community partnerships for student and community capacity building, emphasizing the role of individuals in the relevant communities as experts on their own lived experiences (6). Engaging community agencies as active and equal partners creates space for the elevation of knowledge and ideas not always represented in health literature (6–8). Previous research has often focused on capacity building as community empowerment and acquisition of new skills; however, increasing capacity of academic partners and MPH professionals to pursue authentic research partnerships is equally important (9, 10). Several pedagogical strategies exist for teaching this strengths-based approach to community health research; however, there is a gap in the literature on the impact of such teaching methods on public health students (10–12).

To assess the impact of applied practice experiences in public health training, we wanted to understand how students perceived their experience working in a local, community-centered context. Previous studies have identified the potential for analysis of reflective essays to illuminate students' meta-cognitive processes in experiential learning (13, 14). The combination of applied learning and critical reflection is essential to a continual process of thinking and doing (13). Similarly, Ball et al.'s framework for training educators to advance equity suggests that epistemological change is generated when learners are simultaneously (1) exposed to theoretical frameworks, (2) challenged with real-world problem solving, and (3) engaged in critical self-reflection (15).

Thematic elements gleaned from these studies can help educators better understand how students construct meaning from their practicum and classroom experiences. This project involved qualitative analysis of reflective essays from an experiential public health course to identify key elements of the student learning experiences. In analyzing reflection papers submitted two-thirds of the way through the semester, we identified commonalities in learning experiences and course elements that students experienced as most impactful.

2. Methods

2.1. Participants

All students in the Practice Based Community Health Research (PBCHR) course were graduate students at the Yale School of Public Health (YSPH) or other Yale-affiliated school. Table 1 shows the YSPH departments represented in the study sample. Table 2 organizes the number of agencies and students represented in the sample by year. Records held by the Yale School of Public Health alumni office and online searches were used to obtain email addresses of PBCHR students between 2008 and2018. Twenty four out of 236 former students did not have recorded email addresses and thus, were not contacted for participation. All former students for whom email addresses were obtained were contacted by the course's instructor. The emailed invitation to participate included an overview of the proposed project as well as an information sheet about the study and a link to a Qualtrics survey where students indicated their consent to participate. Out of 212 emails that did not lead to a bounce-back error, 104 consents were obtained after two rounds of outreach.

2.2. Data characteristics

Reflection papers were written by students about two thirds through the semester. Although assignment details changed throughout the years, all students were asked to reflect on their learning experiences in the course. We noticed trends in students essays throughout the decade; however, the underlying drivers of these trends are uncertain due to the diversity of students who have taken the course in the past decade. For example, in 2008, the assignment

TABLE 1 Participant characteristics by department affiliation.

Department (response rate=49.1%)	Total (*n*=212)	Consented to essay analysis (*n*=104)
Advanced professionals	24 (11.3%)	11 (10.6%)
Biostatistics	4 (1.9%)	2 (1.9%)
Chronic Disease Epidemiology (CDE)	27 (12.7%)	14 (13.5%)
Social & Behavioral Sciences (SBS)	22 (10.4%)	11 (10.6%)
CDE & SBS Combined Program*	10 (4.7%)	5 (4.8%)
Environmental Health Science	2 (0.9%)	0
Epidemiology of Microbial Diseases	20 (9.4%)	15 (14.4%)
Health Policy and Management	23 (10.8%)	13 (12.5%)
Other	13 (6.1%)	5 (4.8%)
Missing	67 (31.6%)	28 (26.9%)

*Prior to 2017, SBS was a division within the CDE department.

instructions simply asked students to reflect on ideas raised in course readings and apply these themes to their own current community project or past work. Students were also asked to include reflections on one of the public health code of ethics guidelines. Beginning in 2009, these reflective essays shifted away from a more narrative style when students were asked to link their learning experiences in the course to guidelines dictated by the YSPH Public Health Practice Requirements.

2.3. Data analysis

Rapid qualitative analysis was used to identify themes underlying student experiences. Rapid analysis methods have been extensively refined and adapted by researchers needing to analyze qualitative data rapidly without sacrificing richness in findings (16–19). Matrixes have been used to streamline the process of identifying themes, similarities, and differences between responses in qualitative research (20, 21). The current study utilized templates and a matrix based on the YSPH Public Health Practice Requirement Guidelines (2008–2015) and the YSPH Core Public Health & Cross-Cutting Competencies (2016–2018).

Essays from consenting alumni were anonymized by the course instructor prior to analysis. First, essays were organized by cohort as the reflection paper assignment varied slightly across the years. See Appendices A, B for assignment instructions. Summary templates in Microsoft Word were created using deductively generated codes based on assignment objectives for each cohort. These templates standardized the summarizing process while allowing flexibility for differences in assignment instructions by year. Additional codes were generated as needed. Materials from each summary were then reviewed and transferred into a matrix in Microsoft Excel to organize quotes by cohort. Quotes of interest were transferred to a second Excel workbook to systematically analyze all data under umbrella themes. All essays were analyzed by CNP and DLH to identify *a priori* and emergent themes. CNP completed the course in 2021, and DLH is the course instructor. Weekly meetings were used to address questions and discuss the themes that were identified.

TABLE 2 Participant characteristics by year.

Year	Number of Students		Number of agencies represented in analysis sample
	Total (*n* =212)	Consented to essay analysis (*n* =104)	
2008	19	6	4
2009	23	8	5
2010	11	5	4
2011	10	7	3
2012	17	8	4
2013	18	7	4
2014	18	10	5
2015	13	6	3
2016	13	8	4
2017	29	20	7
2018	41	19	8

2.4. Ethics approval statement

This study was determined to be exempt from review by the Yale University Social Science, Behavioral, and Educational Research Institutional Review Board.

3. Results

Overall, differences in department representation between the group of students who consented to essay analysis and the overall sample were minimal (data not shown). Six major themes emerged upon analysis of student reflection papers: turning theory into practice, navigating the complex environment of public health practice, skills learned, personal reflections, challenges, and strengths. See Appendix C for additional quotes.

3.1. Theme 1: Turning theory into practice

Students were able to apply the theories and frameworks they had learned in the classroom to real world problems and strengthen skills relevant to their future careers. In addition, students found the experience of working on real projects that were timely and relevant to neighboring communities to be fulfilling. Many wrote about feeling motivated by the knowledge that their work could directly benefit the community members served by their preceptor organizations.

> *"When we began this project I had already enrolled in many biostatistics courses for my MPH concentration. However, biostatistics courses tend to emphasize theory over practice, leaving me relatively skilled at reciting the calculus behind the relationships between survivor functions but not so clear on how to wrestle EMR data into a format to which I can apply those statistical tools" (Student 2, 2016 Cohort).*

> *"We felt like our project was worth something. We were reminded time and time again throughout our project, especially during difficult times when it seemed we would have no interviewees, that our project was important and that it was serving to "plant the seed" of a necessary endeavor that [preceptor] had been wanting to do on their own for a long time but they needed someone to collect the necessary information first" (Student 1, 2014 Cohort).*

3.2. Theme 2: Navigating the complex environment of public health practice

Hands-on experiences exposed students to the dynamics of public health practice and allowed students to immerse themselves in the complex process of developing solutions to immediate issues. Several students reported feeling overwhelmed by the realization of how politics and social dynamics can impact the direction of their project.

> *"I learned of how politics heavily surrounded our project in [community], and it became very overwhelming at times to find myself immersed in politically charged environment. What I took away from these stressful situations is how essential flexibility is moving forward in any collaborative public health project and how complex/delicate power can be. I learned of how my words via email or over the phone can be mistaken with some [institution] baggage and as a result I am more mindful of the ways in which I choose to convey my thoughts, feelings, and intentions" (Student 1, 2015 Cohort).*

This complexity led some students to highlight the importance of interprofessional collaboration and communication. Students also learned to balance the different needs and expectations that may arise from within a single preceptor organization.

Power was a running theme throughout many of the essays. Students reflected on their position as outside researchers and specifically, as graduate students from a well-known educational institution. One student noted how their partnership with the community agency forced them to critically reflect on the relationships between their preceptor and other institutions.

> *"Working with [agency] required an understanding of systems and the way that constructs of power inform the way community actors and organizations function at different levels in ways that both hinder and strive to promote equity" (Student 1, 2018 Cohort).*

While unequal power dynamics were often cited as challenges, some students also recognized this as a sign of a deeper issue of mistrust between community members and academic research institutions.

> *"The [student organizing the interviews] was also the holder of the keys, and because of this, I was seen as having power by the inmates…However, building trust and rapport with the inmates was crucial for successful execution of the study and I often felt I held a level of power that I didn't deserve" (Student 1, 2008 Cohort).*

These power dynamics were also evident in the community agencies' hesitancy to criticize institutions, especially when the organizations are dependent on outside stakeholders for donations and financial support.

> *"Cultural and political factors play into the donations [agency] receives from [institution]. [institution] donations are difficult to incorporate into [agency] meals, and often do not meet sanitation guidelines and must be discarded. [agency] has not addressed these issues with [institution] because their relationship is skewed, with [institution] having much more social and political power. Similarly, [agency] cannot do much to change the donations they receive from other organizations" (Student 2, 2018 Cohort).*

Aside from differences in power, students also identified differences in value systems. The reflexivity demonstrated in these essays revealed ways in which the students realized that their perceptions of health may not always align with the values that communities deem important. In addition to becoming more sensitive to the social context of their project, students learned to pivot quickly to ensure that their project met their preceptors' needs.

> *"I'll admit when I first started on this project I was concerned the intervention might be damaging to the kids' self-esteem: who wants to discuss their weight in a group with a bunch of strangers? Immediately, however, I saw this was not the case. Our culture's obsession with privacy makes group health care relatively unusual, yet in communities like [community], it is a reasonable and perhaps desirable option. It allows providers to reach more patients, it is cost effective for clinics, and it has the important potential to foster a sense of social support among individuals with similar health issues" (Student 2, 2008 Cohort).*

3.3. Theme 3: Skills learned

Students highlighted a myriad of research and project management skills including data analysis, problem solving, interviewing, conducting focus groups, communication, and teamwork. Skills relevant to academic public health were also noted as valuable lessons from the course. Students felt that the practicum-oriented curriculum allowed them to not only strengthen their skills in the field, but also learn how to disseminate their findings. Students who had not participated in formal public health research before especially appreciated guidance on the IRB process and poster preparation. Students also gained experience in developing program planning tools such as logic models, program theories, and budgets. Outside of strengthening existing skills, true collaboration with community partners allowed students to learn the real-life application of skills learned in class and thus bridge the gap between research and practice.

> *"My group has worked to [develop] a program theory and logic model, which has allowed us to us to assess our short- and long-term project goals as well as the theoretical basis for our project to impact positive change within and beyond [community]. We have also enhanced several skills necessary for community health practicum*

> *work, including developing a project budget and completing an IRB application for the project. Additionally, by having guest speakers who are conducting community-based participatory research at Yale and within the New Haven community, this practicum has improved our knowledge of similar work within the field" (Student 1, 2013 Cohort).*

Bridging this gap between research and practice came with some growing pains. As the students worked on their project, they realized that standard research practices may not be applicable to every public health program. One student described how her team had to adapt their initial recommendations to avoid overburdening the preceptor agency:

> *"We had to consider a sustainable system that would not generate mountains more of paperwork, lead to resentment on the staff members' part of being given another item on their to-do list, or alienate participants in [the program] by making them feel forced to fill out a lengthy personal survey. These considerations led us to cut out huge portions of our original evaluations, including weight and diabetes status, and inspired us to think of efficient ways to administer surveys, like through QR codes" (Student 1, 2016 Cohort).*

Communication, leadership, and teamwork skills were also frequently discussed throughout student essays. Although there were clashes in different working and learning styles at times, students described how they learned to quickly resolve conflicts and avoid miscommunication.

> *"I feel as if I've strengthened my group communication skills… I believe that the coordination that we've had to do as a group has been truly impressive, and I'm proud of us for being to find time to travel to [community] for meetings and interviews. It takes a surprising amount of effort to coordinate the schedules of five MPH students, but we were able to manage it. I'm more understanding of other people's schedules and conflicts, and I feel as if I'm become a much more flexible person" (Student 3, 2018 Cohort).*

3.4. Theme 4: Personal reflections

In addition to reflecting on the impact of their project, students also acknowledged the ways in which they had benefited from existing relationships between course instructors and community agencies. The course's experiential model allowed students to catch a glimpse of the reality of public health practice. Some admitted that it was only after intimately working with community organizations that they learned to appreciate the unique strengths of these agencies—traits that may have been overlooked in the literature.

> *"[agency] epitomizes a complex adaptive system, with changing external factors in the form of donation sources from foodbanks or institutions. Prior to this class I would have deemed [agency] as chaotic, an unproductive surface-level conclusion that connotes a certain inability for change. Now I would characterize [agency] as dynamical and uncertain, which indicates a different set of expectations and approaches" (Student 1, 2018 Cohort).*

After working so closely with a community partner over the span of 4–5 months, many used this opportunity to reflect on their roles as researchers and think critically about the tools and metrics they had been taught to use. Some questioned the impact of their work as researchers and future public health professionals—there was a question of *how* they should conduct research instead of simply *if* they should research.

> *"As a researcher I suppose the question to grapple with is whether you should do research to collect descriptive statistics alone, or if you should go one step further to help solve the problem; I think that the latter is the only way to make an impact" (Student 3, 2008 Cohort).*

Time and resource constraints forced students to be creative and utilize novel approaches to solving public health issues. Upon reflecting on their experience working within these bounds, one student described changes in the way that they conceptualized problems and analyzed data.

> *"I feel that this practicum experience has also introduced me to new methods and theories of ways to analyze data, and even consider what "data" is and how research questions can be derived from within the community for tangible and practical needs" (Student 2, 2015 Cohort).*

3.5. Theme 5: Challenges

Challenges were commonly associated with differing expectations, limited support from preceptors, unfamiliarity with research practices, and time and resource constraints. Differing expectations between teams and preceptor organizations led to confusion and delayed progress. Sometimes, the public health issues that preceptors wished to address were too large to accomplish in one semester. Honest conversations between preceptors and student teams made it possible to determine more specific and manageable goals. One student explained:

> *"Through multiple preliminary conversations and meetings with stakeholders, we were able to determine which programs to focus on and which health outcomes [agency] as a whole was most interested in assessing. In that way, we "defined the issue" to analyze and address. I found this part of the process the most challenging, since each staff member expressed different priorities and even different target groups. It certainly provided practical experience in working and communicating with a diversity of stakeholders" (Student 3, 2015 Cohort).*

Although preceptors and project teams were eager to collaborate, time and resource limitations proved to be another common challenge.

> *"They were really hoping for our team to evaluate almost every aspect across the organization including the community programs, urban farm, and high school. We had to communicate to them that we did not have the time or capacity to do this, and that we could*

> *focus on a few priorities in order to do a thorough job" (Student 4, 2015 Cohort).*

In some cases, preceptors did not have the infrastructure to support a research-based community health project. Students found it difficult to seek guidance when the community agency itself was facing management issues. Administrative delays and unfamiliarity with research practices could also hinder progress. Some expressed the need for preceptors to undergo basic research ethics training to avoid setbacks related to IRB non-compliance.

Some teams struggled to design their project in a way that best fit the community partner's needs while balancing competing interests from within the preceptor organization. Internal politics were difficult to navigate but proved to be valuable learning experiences in inter-professional collaboration.

> *"A lack of communication between [two preceptors] required us to negotiate the organizational politics and hierarchy. This is the type of work that I can read about all day long, yet is essentially trial by fire in terms of internalizing the concepts and testing the practice. Overall, I strengthened my knowledge and capacity of developmental evaluation principles and CBPR values through being a part of the [agency] team" (Student 1, 2018 Cohort).*

3.6. Theme 6: Important course elements

Adequate *support* from both stakeholders and faculty members can help teams overcome communication challenges. While this student previously noted communication challenges between their team and the community partner, they were able to move forward with the help of their preceptor. Although this preceptor did not consider themselves a public health expert, the team found their insight and support extremely valuable:

> *"To my knowledge, I do not think any of the staff at [agency] have Public Health degrees or if they would consider themselves to have public health expertise. However, [the] agency and [preceptor] provided more support than I originally expected. He was very thoughtful in providing a theory of change and a logic model to us at the beginning of the course and continued to have excellent input on the content of the survey and the focus group questions" (Student 3, 2015 Cohort).*

Many teams also found it helpful to *consult with experts* such as faculty members and representatives from organizations outside of their partnership. Mutual *communication and respect* were key elements of a positive relationship between preceptors and student teams.

Gratitude also went a long way—students described how showing appreciation for one another and recognizing each team member's unique strengths helped them form tighter bonds. Many students found it helpful to set up informal gatherings with their peers before the course began.

> *"Before the fall semester ended, we met up to create guidelines and expectations for the project and communication. Being able to step and delegate tasks is also very important. Having these clear guidelines allowed for the project to run smoothly. In previous group projects, there was often miscommunication. Meeting regularly with the preceptors also allowed for us to have clear communication with the lead center. We also discussed our expectations and learned about our preceptor's expectations" (Student 4, 2018 Cohort).*

3.7. Other observations

Following a change in the assignment instructions in 2009, essays began to resemble a list of competencies they had addressed through their project. While this yields valuable information about the concrete skills that students identify as important, it limits the educator's view of the student's processes of identity construction throughout the course. However, several of the essays from 2009 onwards did include discussions of the personal lessons that students had learned by building authentic relationships with their preceptors. Probing for more personal reflection may make visible the factors that shaped students' beliefs and values as future public health professionals.

4. Discussion

Innovations in public health pedagogy have highlighted the value of learning experiences where students are challenged to apply their public health skills in less controlled and more 'real world' environments (22). Applied practice experiences can allow students to master concrete research skills that are crucial in developing a well-trained public health workforce (23, 24). In 2011–2012, a survey launched by the New York City Health Department examined the most common skill weaknesses among MPH graduates working in local health departments. These included quantitative data analysis, scientific writing, and project management (25). Like other applied practice courses described in the literature, CBPHR gave students the opportunity to practice synthesizing and applying evidence-based knowledge to real world problems (24, 26–29). Many students reported honing skills that they had not previously developed such as submitting Institutional Review Board (IRB) applications, extracting and cleaning data from electronic medical records, and preparing research posters. Team-based learning during the semester project allowed students to collaborate with peers from different training backgrounds and gave them the opportunity to strengthen less developed research skills (30).

Communication, leadership, research, and project management were reported to be some of the most valuable cross-cutting skills learned from the course. Despite taking rigorous research methods courses in the past, a number of students reflected on the difficulties they faced putting these skills into practice. Similar to students from other practice-based public health courses, students in this study noted challenges related to the length of the course (12, 31). A single semester left students with a relatively short time frame to adapt and pivot as needed when they were inevitably faced with unexpected challenges and roadblocks. Despite these challenges, many students wrote about their personal growth through the semester. While many students described themselves as "type-A" individuals who have a natural tendency to take on leadership roles in the past, the

collaborative nature of the course forced them to quickly adapt to each other's working styles. Building close relationships with their preceptors allowed for students to become embedded in the culture of their preceptor organization—giving them another perspective of the reality of public health practice. Working with community partners challenged students to apply their research skills in a way that was sensitive to the political and economic context of the community. For many, problem solving involved more than just building a good team dynamic. It also required students become comfortable working in ambiguity and to be diligent in making sure that their project met the interests and needs of their preceptors. These findings are consistent with previous research on experiential course design for clinical students (14, 32).

In this course, learning occurred through meaningful collaboration between students and their preceptors. Although some students entered the course with background knowledge of community health, many wrote about how their project experiences allowed them to gain a deeper understanding of public health practice. Several students grappled with the power imbalance that is inherent in many community research partnerships. Additionally, some students addressed their positionality as students from a prestigious institution with a deep and complex history with the surrounding community (33). While this study did not explicitly investigate how students perceived their roles as "outsiders" in their research project, reflections on power imbalances came up in multiple student essays. This is another gap in the research on student experiences in public health pedagogy. Previous studies have utilized qualitative methods to analyze perceptions of power in community-academic research partnerships but these are limited in number and often do not focus on the perspective of students or trainees (34–36). Several students in this study reflected on how their experiences within the course exposed them to the realities of practicing public health at a community level. Previous studies have suggested that active learning *via* community partnerships can encourage students to foster a sense of civic responsibility (24). Many students who did not plan on pursuing careers in community health reported feeling inspired to incorporate principles for community-engaged research into their future work (37). While a curriculum focused on career readiness and skill mastery is important for upholding practice standards and promoting innovation in research, there is a continued need for innovation in public health pedagogy to drive social change and address health inequities (38, 39). Thus, the inclusion of required readings and lectures on theoretical frameworks in public health practice could have helped prepare students for their participation in community health research while encouraging them to develop their worldview (40).

Although these field settings are essential for preparing students for their future careers as public health professionals, applied practice experiences such as this course require a heavy amount of preparatory work. While there was great enthusiasm from students to be in partnership with community organizations, any university-community dyad demands a great deal of conscientiousness and diligence from the teaching team to ensure that preceptor organizations benefit from their involvement in students' education (41). The instructor(s) and teaching assistants needed to make sure that the scale and scope of each project matched the skillsets, availabilities, and interests of students (31). Key elements for success included: support from preceptors and course instructors, clear communication between team members and community partners, coursework about topics relevant community health practice, and guidance on program planning tools (42). Students commonly reported the importance of having strong support and guidance from preceptors and course instructors. These findings were consistent with lessons described by instructors and students of applied practice courses at different public health programs (28, 31). An article evaluating an experiential learning program at the University of Iowa College of Public Health noted the importance of including a preparatory classroom component to the applied practice experience (28). This recommendation was echoed by several CBPHR students who reported feeling more confident in their research and project management skills because of the instruction they had received in weekly lectures and reading assignments. Challenges associated with conflicting expectations between stakeholders suggest a need for processes to determine preceptor and student readiness before collaboration can begin.

For many, this "hands on" experience allowed them to see the connection more clearly between big data and lived experiences (43, 44). Reflections from student essays demonstrated the value of experiential learning in exposing students to the different ways in which they can apply their existing skills to problems addressed by local service organizations. Especially for students who did not plan on staying in the realm of community health research or practice, experiential learning in this context was a rare opportunity to directly engage with the people affected by public health issues that they may address later in their careers.

4.1. Implications

Results from this study can help educators better understand students' perspectives on experiential learning and inform the development and evaluation of other applied practice courses in public health education. In addition to revealing key elements of the course that students found important, rapid analysis of student reflection essays demonstrated the value of essay analysis as a tool for exploring students' learning experiences. Leveraging reflective practices is crucial for examining how experiential learning can play a role in developing students' professional identity as well as understanding and passion for public health (45, 46). Analyzing student reflections from applied practice courses through a social justice lens may reveal the thought processes that occur as students observe how health inequities manifest in the specific context of their project. Encouraging reflection throughout the course may not only provide narratives for future analyses but also encourage students to critically examine their role as future public health practitioners (12, 31).

4.2. Limitations

While reflection papers were always due 2–3 weeks after spring break, not all teams were on the same stages of their project at this point in the semester. This discrepancy may explain slight variances in student reflections because not all students had finished their project at the time their essays were written. Class sizes varied, and more recent student cohorts were larger. Students from the 2015 through 2018 classes contributed 50% of the essays analyzed; thus, results may not be representative of student experiences from earlier years. Inability to

contact students from earlier years may explain differences in response rates. Furthermore, variances in response rates among cohorts may obscure themes that are unique to certain groups of students. Because this study includes the analysis of essays written over the span of 11 years, student experiences may differ due to changing social contexts and emerging theories in public health research.

Although this study was able to capture immediate reflections, its retrospective design limits our understanding of the processes by which students construct meaning from the relationships they built with their peers and community partners. Beliefs and attitudes formed during the years after the course were not included in this study. Longitudinal investigation of alumni experiences would be needed to understand the longer-term impacts of the course. Essays included in this study predate the COVID-19 pandemic, so some findings may not be generalizable for experiential public health courses after March 2020. Adapting to a world where COVID-19 remains a threat would require flexibility to accommodate for students' needs while being mindful of budget and resource constraints on community organizations (11).

5. Conclusion

Experiential learning in public health provides students with a unique opportunity to collaborate with local community organizations and directly engage in public health practice. The themes identified in this study reveal lessons learned and challenges faced by students in the Practice-based Community Health Research course. Student reflections also revealed key elements of the course that facilitated success in their projects. Observations made throughout the course helped shape students' beliefs and values about public health, which in turn, will likely influence the approaches that they take in their future work. The methods used demonstrate potential for harnessing reflective practices in teaching and understanding students' learning experiences.

Data availability statement

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

Ethics statement

Ethical review and approval was not required for the study of human participants in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

DH designed the study. CP collected the consents and took the lead on analyzing results and drafted the initial manuscript. DH and SC reviewed analysis and results, provided feedback and assistance in conceptualizing results, and made substantive contributions to the manuscript. 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

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References

1. Marriott LK, Lipus AC, Choate L, Smith J, Coppola L, Cameron WE, et al. Experiential learning through participatory action research in public health supports community-based training of future health professionals. *Pedagogy Health Promot.* (2015) 1:220–32. doi: 10.1177/2373379915601119

2. Woods-Jaeger B, Daniel-Ulloa J, Kleven L, Bucklin R, Maldonado A, Gilbert PA, et al. Building leadership, capacity, and power to advance health equity and justice through community-engaged research in the Midwest. *Am J Community Psychol.* (2021) 67:195–204. doi: 10.1002/ajcp.12462

3. Council on Education for Public Health. Accreditation Criteria. (2021) Available at: https://media.ceph.org/wp_assets/2016.Criteria.pdf (Accessed 2 November 2021).

4. Foster A, King LR, Bender K. Are public health academia, professional certification, and public health practice on the same page? *J Public Health Manag Pract.* (2018) 24:S47–50. doi: 10.1097/PHH.0000000000000746

5. Humphries DL, Bastida C, Walker MC. Lessons from a community driven experiential public health course. *Pedagogy in Health Promotion.* (2022) 8:231–7. doi: 10.1177/23733799211056311

6. Filler T, Benipal PK, Torabi N, Minhas RS. A chair at the table: a scoping review of the participation of refugees in community-based participatory research in healthcare. *Glob Health.* (2021) 17:103. doi: 10.1186/s12992-021-00756-7

7. Culhane-Pera KA, Pergament SL, Kasouaher MY, Pattock AM, Dhore N, Kaigama CN, et al. Diverse community leaders' perspectives about quality primary healthcare and healthcare measurement: qualitative community-based participatory research. *Int J Equity Health.* (2021) 20:226. doi: 10.1186/s12939-021-01558-4

8. Han HR, Xu A, Mendez KJW, Okoye S, Cudjoe J, Bahouth M, et al. Exploring community engaged research experiences and preferences: a multi-level qualitative investigation. *Res Involv Engagem.* (2021) 7:1–9. doi: 10.1186/s40900-021-00261-6

9. Hicks S, Duran B, Wallerstein N, Avila M, Belone L, Lucero J, et al. Evaluating community-based participatory research to improve community-partnered science and community health. *Prog Community Health Partnersh*. (2012) 6:289–99. doi: 10.1353/cpr.2012.0049

10. Rubin CL, Martinez LS, Chu J, Hacker K, Brugge D, Pirie A, et al. Community-engaged pedagogy: a strengths-based approach to involving diverse stakeholders in research partnerships. *Prog Community Health Partnersh*. (2012) 6:481–90. doi: 10.1353/cpr.2012.0057

11. Mejia AP. "Plan for the worst, Hope for the best, but realistically, expect a combination of both": lessons and best practices emerging from community-engaged teaching during a health crisis. *J High Educ Outreach Engagem*. (2021) 25.

12. Kelley A. Critical reflections from a community-based participatory research course. *Educ Health*. (2013) 26:178–82. doi: 10.4103/1357-6283.125996

13. Ash SL, Clayton PH. Generating, deepening, and documenting learning: The power of critical reflection in applied learning. (2009). Available at: https://scholarworks.iupui.edu/handle/1805/4579 (Accessed 27 April 2022).

14. Kelly L, Walters L, Rosenthal D. Community-based medical education: is success a result of meaningful personal learning experiences? *Educ Health*. (2014) 27:47–50. doi: 10.4103/1357-6283.134311

15. Ball AF, Greene DM, Friedman JSL, Dray BJ. The trifecta framework: preparing agents of change in urban education. *Urban Educ*. (2021) 17:004208592110231. doi: 10.1177/00420859211023113

16. Beebe J. *Rapid qualitative inquiry: a field guide to team-based assessment*. Washington DC: Rowman & Littlefield (2014). 283 p.

17. Sangaramoorthy T, Kroeger KA. *Rapid ethnographic assessments: A practical approach and toolkit for collaborative community research*. London: Routledge (2020). 198 p.

18. Vindrola-Padros C, Johnson GA. Rapid techniques in qualitative research: a critical review of the literature. *Qual Health Res*. (2020) 30:1596–604. doi: 10.1177/1049732320921835

19. Watkins DC. Rapid and rigorous qualitative data analysis: the "RADaR" technique for applied research. *Int J Qual Methods*. (2017) 16:1609406917712131. doi: 10.1177/1609406917712131

20. Averill JB. Matrix analysis as a complementary analytic strategy in qualitative inquiry. *Qual Health Res*. (2002) 12:855–66. doi: 10.1177/104973230201200611

21. Kara A, Wright C, Funches L, Williamson F, Hicks RA, Sutton TA, et al. Serving on a graduate medical education diversity, equity, inclusion, and justice committee: lessons learned from a journey of growth and healing. *Front Public Health*. (2022) 10:867035. doi: 10.3389/fpubh.2022.867035

22. Meredith GR, Welter CR, Risley K, Seweryn SM, Altfeld S, Jarpe-Ratner EA. A new baseline: master of public health education shifting to meet public health needs. *J Public Health Manag Pract JPHMP*. (2022) 28:513–24. doi: 10.1097/PHH.0000000000001537

23. Caron RM, Hiller MD, Wyman WJ. Public health system partnerships: role for local boards of health in preparing the future public health workforce. *J Community Health*. (2014) 39:29–34. doi: 10.1007/s10900-013-9737-2

24. Yigletu S, Kosinski KC, Kuah A, Alfaro K, Holmes AC, Tendulkar SA. "Collaboration toward one collective goal": a mixed-methods study of short-term learning outcomes and long-term impacts among students participating in an undergraduate community-based participatory research (CBPR) course. *Front Public Health*. (2021) 9:694840. doi: 10.3389/fpubh.2021.694840

25. Hemans-Henry C, Blake J, Parton H, Koppaka R, Greene CM. Preparing master of public health graduates to work in local health departments. *J Public Health Manag Pract JPHMP*. (2016) 22:194–9. doi: 10.1097/PHH.0000000000000232

26. Minlikeeva AN, Amato KA, Przybyla SM. Modern public pealth problems and solutions: an undergraduate capstone course to prepare the next generation of public health practitioners to enhance health equity. *Front Public Health*. (2022) 10. doi: 10.3389/fpubh.2022.992835

27. Martinez LS, Perea FC, Ursillo A, Pirie A, Ndulue UJ, Oliveira C, et al. Research as curriculum: engaging undergraduates and community residents in immigrant Health Research partnerships. *Prog Community Health Partnersh*. (2012) 6:491–8. doi: 10.1353/cpr.2012.0059

28. Chorazy ML, Klinedinst KS. Learn by doing: a model for incorporating high-impact experiential learning into an undergraduate public health curriculum. *Front Public Health*. (2019) 7:31. doi: 10.3389/fpubh.2019.00031

29. Villanueva AM, Hovinga ME, Cass JL. Master of public health community-based practicum: students' and preceptors' experiences. *J Public Health Manag Pract*. (2011) 17:337–43. doi: 10.1097/PHH.0b013e3182140c78

30. Lang DL, Walker ER, Steiner RJ, Woodruff RC. Implementation and mixed-methods evaluation of team-based learning in a graduate public Health Research methods course. *Pedagogy Health Promot*. (2018) 4:140–50. doi: 10.1177/2373379917707222

31. Flicker S, Mawani FN, Dellavilla M. Reflections on teaching, learning and doing participatory research in a graduate seminar. *Prog Community Health Partnersh*. (2019 Fall) 13:293–302. doi: 10.1353/cpr.2019.0057

32. Takamura A, Misaki H, Takemura Y. Community and interns' perspectives on community-participatory medical education: from passive to active participation. *Fam Med*. (2017) 49:507–13.

33. Hogan A, Panos J. Yale University and the New Haven community. ArcGIS StoryMaps. (2021). Available at: https://storymaps.arcgis.com/stories/615c749ffb1c4b8a823648bb46bc37aa (Accessed13 December 2022).

34. Caldwell WB, Reyes AG, Rowe Z, Weinert J, Israel BA. Community partner perspectives on benefits, challenges, facilitating factors, and lessons learned from community-based participatory research partnerships in Detroit. *Prog Community Health Partnersh Res Educ Action*. (2015) 9:299–311. doi: 10.1353/cpr.2015.0031

35. Jagosh J, Bush PL, Salsberg J, Macaulay AC, Greenhalgh T, Wong G, et al. A realist evaluation of community-based participatory research: partnership synergy, trust building and related ripple effects. *BMC Public Health*. (2015) 15:725. doi: 10.1186/s12889-015-1949-1

36. Egid BR, Roura M, Aktar B, Amegee Quach J, Chumo I, Dias S, et al. 'You want to deal with power while riding on power': global perspectives on power in participatory health research and co-production approaches. *BMJ Glob Health*. (2021) 6:e006978. doi: 10.1136/bmjgh-2021-006978

37. Kim MM, Cheney A, Black A, Thorpe RJ, Cene CW, Dave GJ, et al. Trust in Community-Engaged Research Partnerships: a methodological overview of designing a multisite clinical and translational science awards (CTSA) initiative. *Eval Health Prof*. (2020) 43:180–92. doi: 10.1177/0163278718819719

38. DeSalvo KB, Wang YC, Harris A, Auerbach J, Koo D, O'Carroll P. Public health 3.0: a call to action for public health to meet the challenges of the 21st century. *Prev Chronic Dis*. (2017) 7:E78. doi: 10.5888/pcd14.170017

39. Merzel CR. Pedagogy to guide the next 70 years of SOPHE and 150 years of American public health. *Pedagogy Health Promot*. (2022) 8:243–5. doi: 10.1177/23733799221133853

40. James TG, Sullivan MK, Henderson H, Varnes JR. Competency focused versus philosophically grounded health promotion practice: impacts on innovation and addressing health inequities. *Pedagogy Health Promot*. (2022) 8:246–50. doi: 10.1177/23733799221094617

41. Hall BL, Etmanski C, Dawson T, Ball J. "On thin ice: managing risks in community-university research partnerships," in *Learning and Teaching Community-Based Research: Linking Pedagogy to Practice*. Toronto: University of Toronto Press (2014) 25–44.

42. Drahota A, Meza RD, Brikho B, Naaf M, Estabillo JA, Gomez ED, et al. Community-academic partnerships: a systematic review of the state of the literature and recommendations for future research. *Milbank Q*. (2016) 94:163–214. doi: 10.1111/1468-0009.12184

43. Soliman AS, Stainton L, Chamberlain RM. Experiential learning in career development. *J Cancer Educ*. (2021) 36:874–9. doi: 10.1007/s13187-020-01716-2

44. Ruckenstein M, Schüll ND. The Datafication of health. *Annu Rev Anthropol*. (2017) 46:261–78. doi: 10.1146/annurev-anthro-102116-041244

45. Blenner SR, Roth SE, Manukyan R, Escutia-Calderon Y, Chan-Golston AM, Owusu E, et al. Community partnerships and experiential learning: investing in the next generation of a diverse, qualified public health workforce. *Health Promot*. (2021) 7:51S–62S. doi: 10.1177/23733799211046974

46. Kumagai AK, Naidu T. Reflection, dialogue, and the possibilities of space. *Acad Med*. (2015) 90:283–8. doi: 10.1097/ACM.0000000000000582

47. Pham C. Exploring learning experiences of students in an experiential community health practice course. Public Health Theses (2022); Available at: https://elischolar.library.yale.edu/ysphtdl/2189

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Factors influencing the satisfaction of community senior care services in China: an analysis based on an extended Anderson model

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Community-based senior care, as a convenient and promising care model, has gradually been accepted by the public. However, community services developed to facilitate older adults often fail to achieve the expected effect. With the fast-growing aging population in China, the problems of underutilization and low service satisfaction of senior care facilities need to be resolved urgently. In this study, we further developed an extended Anderson behavior model by incorporating social psychological factors, and the vertical and horizontal fairness perceptions. In addition, a binary logistic regression model was used to analyze factors affecting the satisfaction of older adults in life care services, health care services, and mental and spiritual comfort services. The study used data from a survey of 322 urban area seniors in Shaanxi Province. The results showed that factors influencing older adults' satisfaction of different service categories are different. Moreover, with the addition of the social psychological factors, we observed that the vertical fairness perception of the survey respondents affected their satisfaction of senior care services significantly more than the horizontal fairness perception.

KEYWORDS

extended Anderson behavior model, utilization of senior care services, satisfaction, fairness perception extended Anderson behavior model, fairness perception

1. Introduction

Population aging has been a crucial policy issue globally. In the past two decades, the fertility rate in China has continuously reduced, and the aging population structure has become increasingly serious. The Fifth Chinese Population Census in 2000 revealed that China had entered an aging society. After 20 years, according to the latest Seventh Chinese Census in 2021, the proportion of population aged ≥60 years accounts for 18.7% of the total (1). Moreover, researchers have forecasted that in the following decades, the population aging rate in China will continue to accelerate and maintain a high-speed growth after reaching its peak around 2060, which could be termed as a "plateau" trend (2).

With a low fertility rate, traditional family care in China has become challenging. Family care is insufficient to meet the care needs of older adults. In 2015, the demand for senior care services in urban and rural areas reached 15.3%, which considerably increased compared with 12.37% in 2010 and 6.6% in 2000 (3). Therefore, meeting the senior care needs has become an urgent problem for the Chinese government. Community care service, as a more "win–win" option, has become the most widely used senior care model in China. Combining the advantages of traditional family care and

institutional care, the community can be seen as a platform for connecting professional institutions and nursing staff with older adults at home. This means older adults can receive medical and non-medical services and solve their daily living problems in the community or even at home.

Pardasani and Thompson (4) studied six types of community care services, namely community center, wellness center, lifelong learning, continuum of care, entrepreneurial center, and the café program. In China, community care services mainly comprise the first three types (5). With the continuous expansion of the older population, the demand for senior care service is gradually showing a diversified and differentiated trend, thereby pushing communities to upgrade their service contents and quality. However, numerous studies have revealed the persistence of problems of underutilization and low service satisfaction in senior care service [(6, 7); Hu et al., 2019].

First, from the supply and demand perspective, the choice of current senior care service is limited (8). By contrast, because of factors such as regional culture, income level, age, and gender, the service demand among older adults is quite different. Therefore, a gap exists between the supply of senior care services and the diversified and differentiated care service needs of older adults (9). The current senior care services often cannot accurately assess "need," "unneeded," and "want" from the older adults, thus resulting in an imbalance in the supply and demand structure of senior care service (10). Second, from the perspective of characteristics of older adults, differences in factors such as age, gender, marital status, income level, and self-care status (11) have an impact on the satisfaction with senior care services. Similarly, the attitude and acceptance toward social senior care services among older adults significantly affect the utilization of these services. A study revealed that people less influenced by the filial piety culture were more likely to use the senior care services to a great extent (12). Third, social psychological factors such as social trust, social capital, social integration, social equality, and social participation significantly affect the satisfaction with senior community care services (13). Specifically, older adults experience psychosocial problems such as social isolation, identity threat, and lack of social support, all of which affect the senior care intention (14).

The current research on the satisfaction with utilization of senior care service focuses more on personal characteristics, service quality, and affordability but relatively less on social psychological factors. This paper constructs a model by adding another dimension about social psychosocial factors in the traditional Anderson model. Using binary logistic regression analysis, this study explored the main factors that affect the satisfaction with community senior care services. The findings hopefully provide some effective suggestions for improving the community senior care service utilization rate and realize the Chinese social vision of "the older will be looked after properly."

2. Methodology

2.1. Analysis framework

The Anderson behavior model was used to study the conditions facilitating or impeding the utilization of personal medical services (15). Over the years, the model has undergone continuous improvement. It has now been extended to analyze the actual or expected use of various services by different people groups (16). The traditional framework focused on a series of predisposing, enabling, and need factors influencing service utilization. Over the years, scholars have modified the model for answering different research questions. By combining the Anderson behavior model with the P-E fit theory, Wu found that interpersonal, spatial, and information linkage would have a great impact on facilitating service utilization in the process of older adults adapting to a new environment (17). According to the P-E fit theory, older adults using community care services is more of a process of their re-adaptation to the social environment, which includes two aspects, adaptation to the organization and interaction among people. As the linkages with the community are becoming tighter, older adults would more likely to become comfortable with their new identities and be able to better utilize community resources in meeting their needs. Yu et al. (18) reported that the Anderson behavior model has been studied mostly from the demand perspective and not from the supply perspective. According to the previous research (Yu et al., 2021), the Anderson behavior model has been studied mostly from the demand perspective and not from the supply perspective. The quality, price, and accessibility of the service would significantly impact the demand from elders. These findings are consistent with those of one study reporting that an increment in community senior care services would in turn increase the demand for these services (19).

Bradley showed that although the traditional Anderson behavior model referred to the concept of "faith" in predisposing factors, it mainly discussed about factors such as older adults' view on diseases and health services, while focusing little on social psychological factors (20). Shi also demonstrated that the psychological perception of older adults would influence the supply–demand satisfaction. On the one hand, older adults' psychological perception about basic living needs, living environment, personal traits, and livability for the aged would directly influence their satisfaction as clients (21). On the other hand, in the process of using community-based senior care service, perceptions of inequality, independence of consciousness, social trust, tradition, and other cultural values would affect older adults' attitude and action about accepting social help (13, 22, 23). Moreover, based on the results of Bradley's research, Zeng extended the model with social psychological factors and found that intergenerational ties, unmet needs for Long-Term Care (LTC), and self-image evaluation would influence LTC needs (24). Therefore, fairness perception was examined as a psychological factor in our model.

Studies have often adopted equity theory to analyze the reasons for social help from social psychology perspectives (25). In most studies about fairness, scholars have focused on the inequity status in the utilization process, such as the unequal utilization status because of race, gender, income, etc. (26–28). Fewer studies have examined whether differences exist in older adults' subjective perception of fairness, which thus affects their community service utilization satisfaction. Wang et al. found that with age, people are more inclined to exhibit interpersonal tendencies in social interactions, that is, when interacting or comparing with other old people, they become more tolerant of unfair treatment and become less competitive (29). Therefore, this study incorporated the perception of fairness as a social psychological factor into the research framework model. More or less inequity in service supply will be observed in the actual service utilization process. This study divided old people's resonance of unequal treatments into two dimensions: the perception of vertical and horizontal injustice. We propose that vertical injustice more significantly influences service utilization than horizontal injustice. To summarize, an extended Anderson behavior model can be established for the satisfaction about community healthcare service utilization among older adults, as shown in Figure 1.

This study extends the traditional Anderson behavior model from three dimensions to four dimensions by adding social psychological factors as a dimension. Based on this model, we examined how fairness perception has an impact on older adults' satisfaction of community-based senior service. Moreover, compared with a previous study, this study discusses not only the utilization of medical community healthcare services but also the non-medical community healthcare service with life care service satisfaction and spiritual comfort service satisfaction. By comparing the differences between their contributing factors, we can make more targeted recommendations.

2.2. Data and sample

Economic development in Shaanxi Province, located in the west of China, had been limited by its location and fast-growing aging population. The policy support from the central government and new immigrants have recently ensured some promising development in this province. Selecting Shaanxi as the study area expanded our survey scope to reach different senior groups, as Shaanxi is a province of diversity and possibility owing to its unique geographical environment and historical and cultural background. The sample was drawn from 12 urban communities in three cities of this province. In total, 340 urban community residents aged ≥60 years responded to the survey. Later, 18 responses were deemed invalid, resulting in the inclusion of 322 survey responses in this study.

2.3. Dependent variables

Our dependent variable is satisfaction with the community-based senior care service. This study analyzed the differences in factors influencing various community service types. Considering both physical and psychological service demands, we categorized community-based service for senior into three types: life care service, health care service, and spiritual and mental care service. The questions such as "how satisfied are you with life care services/healthcare services/mental and spiritual service provided by the community?" were asked to assess the outcome. We here recoded the variables so that "very satisfied" and "satisfied" were uniformly categorized as "satisfied," and "neutral," "unsatisfied," and "strongly unsatisfied" were categorized as "not satisfied."

2.4. Independent variables

2.4.1. Predisposing variables

Predisposing factors were typically associated with demographic, social structure, and health beliefs. Age, gender, education, and marital status were included to measure biological and social imperatives.

2.4.2. Enabling variables

Enabling factors refer to the accessibility of service resources among older adults. From the Wu's perspective, when old people attempt to use community care services, they are re-adapting to the environment after their retirement. In this process, when older adults reach their optimal state with the environment, they become more willing to use senior care services. Therefore, this study primarily focused on personnel, spatial, and information linkage factors to indicate the basic conditions of older adults and the environment whether it would enable or impede their senior care service utilization. First, closeness with others was the crucial predictor for measuring personal linkage. Personal linkage was measured through the question "how frequently do you see your family and interact with neighborhoods and friends." Spatial linkage mainly pointed to the accessibility of community-based aging service and was measured through the question "the convenience you went to senior service organization(s) such as the Community Senior Service Center, Community Health Care Center and Community Recreation Center." Lastly, information linkage, a crucial method for older adults to adapt the environment, was measured on the basis of the index of seniors' proficiency in using smartphones. The answers for these three questions

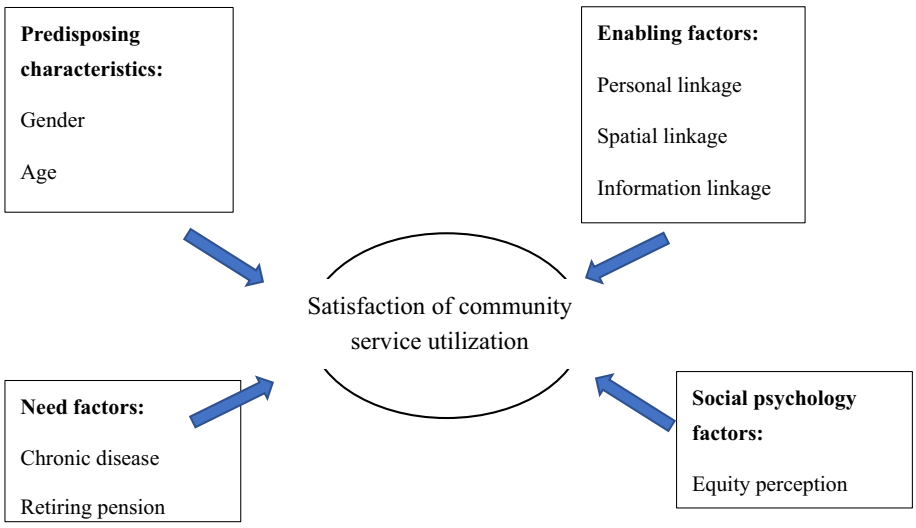

FIGURE 1
Analytical framework of community service utilization satisfaction.

included "not close/inconvenient/strange (1)," "close/convenient/proficient (2)," and "very close/convenient/proficient (3)."

2.4.3. Need variables

Need factors included those caused by the physical function or financial limitations and those perceived service demands. Chronic diseases, retiring pension, and labor income were selected as the indices for use as need variables. We enquired old people whether they have any chronic disease, retiring pension, and labor income. The answers were "yes (1)" and "no (0)."

2.4.4. Social psychological variables

As illustrated in our analytical model (Figure 1), fairness perceptions, including vertical and horizontal fairness perceptions, were introduced in the framework. Vertical fairness perception was measured by comparing whether the services they received matched with their previous contributions to the society, and horizontal fairness perception was measured by comparing whether other old people received the same treatment of senior care services. They were measured on the basis of questions such as "Do you agree that the services you received are equal to those other old people" and "Do you agree that the services you received can match with your contributions to the society." The answers included "disagree (1)," "agree (2)," and "strongly agree (3)."

The measurements of all variables are shown in Table 1.

3. Results

3.1. Descriptive statistics

The characteristics of predisposing, enabling, and need factors are presented in Table 2. From the perspective of predisposing characteristics, 194 (or 60.2%) respondents were women and 128 (or 39.8%) were men. Age of the majority (87.88%) of the respondents ranged from 60 to 80 years and their physical and cognitive skills functioned relatively well. This group of older adults would be more likely to know and utilize senior care services. In total, 89 (or 27.64%) respondents received elementary school and below education, and 41.3% of the respondents received high school and above education.

Regarding enabling factors, when questioned about their closeness with the community, over half of the respondents expressed that they maintained a frequent contact with others. For spatial linkage measurements, although most old people were satisfied with the convenience to all types of community institutions, 38.82, 25.55, and 30.75% of the respondents reflected that they had some trouble in visiting the nearby community life care center, healthcare center, and recreation center, respectively. For information linkage, 68.94% of the respondents could not operate their smartphones properly.

Moreover, regarding need factors, in general, approximately half of the survey respondents claimed that they had at least one chronic disease. Overall, 96% of the respondents had retirement pension, and 25.78% of the respondents chose to work and had labor income after retirement.

Table 3 presents the characteristics of social psychological factors. Overall, 51.86% of the respondents felt unfair in the process of receiving community care service, and approximately 48% of the respondents felt that they received the same treatments as others in terms of service contents and quality. Regarding vertical fairness, 62.11% of the respondents indicated that their current service benefits did not match their social contribution value before retirement, a sense of being under-served. Approximately 38% of the respondents agreed that they had been valued by the community.

Table 4 lists the characteristics of dependent variables. Respondents who expressed dissatisfaction with the three different care services accounted for 31.68, 41.61, and 28.88%, respectively. The results showed that people had a relatively higher negative impression about the health care service than about the other two types of services. By contrast, majority of the respondents were satisfied with the community care services they had received.

3.2. Binary logistic regression

Table 5 presents the results of the binary logistic regression model for satisfaction with the utilization of three service types. We conducted three different regression analyses for the three dependent variables of life care, healthcare, and mental and spiritual service satisfaction. As shown in Table 5, models 1–1, 2–1, and 3–1 all incorporated predisposing characteristics, enabling factors and need factors, and then psychological factors were incorporated in models 1–2, 2–2, and 3–2.

As shown in Table 5, in models 1–1, 2–1, and 3–1, factors affecting utilization satisfaction levels regarding three service types were different. Regarding predisposing factors, age exhibited no significant relationship with service satisfaction. Gender, marital status, and educational level had different effects on service satisfaction. In life care service, men mostly provided a negative evaluation compared with women (odds ratio [OR] = 0.59). Moreover, people who were married were also more satisfied than those who were single (OR = 1.99). Thus, marital status had a similar relationship with healthcare service (OR = 1.15). Gender exhibited no significant relationship with healthcare service satisfaction, whereas the education level was negatively related; the higher the education level, the more likely the people to be unsatisfied (OR = 0.75; OR = 0.83). The educational level was the only predisposing factor that was significantly related to mental and spiritual care service; people with middle school literacy or high school and above literacy were mostly unsatisfied with the service than those with primary school and below education (OR = 0.42; OR = 0.48).

Regarding enabling factors, old people who were closely linked with family and friends in their communities exhibited lower satisfaction with healthcare services and mental and spiritual services than those who were not (OR = 0.58; OR = 0.34). For spatial linkage, convenience to nearby community service centers such as life care center, healthcare center, and mental and spiritual service center had a positive effect on satisfaction. The satisfaction of respondents who find it convenient or very convenient to visit service centers was approximately three to seven times higher than that of people who do not find it convenient. For information linkage, proficiency in using smart phones negatively affected the evaluation of satisfaction about healthcare service but positively affected the evaluation of satisfaction about the mental and spiritual care service.

Regarding need factors, respondents who had chronic diseases apparently agreed that the healthcare service in the community did

TABLE 1 Measurements of variables.

Variable type	Variable name	Variable label	Measurement
Dependent variable			
Service utilization satisfaction	Life care service utilization satisfaction	Overall satisfaction with community-based senior life care service utilization	1 = "not satisfied" ; 2 = "satisfied"
	Healthcare service utilization satisfaction	Overall satisfaction with community-based senior healthcare service utilization	1 = "not satisfied" ; 2 = "satisfied"
	Mental and spiritual service utilization satisfaction	Overall satisfaction with community-based senior spiritual and mental service utilization	1 = "not satisfied" ; 2 = "satisfied"
Independent variable			
Predisposing factors	Age	Age	Age ≥ 60
	Gender	Gender	0 = female ; 1 = male
	Education	Education	1 = primary school and below, 2 = middle school, 3 = high school and above
	Marital status	Marital status	0 = without spouse (single, divorced or widowed),1 = married
Enabling factors	Spatial linkage	Convenience to community older service center	1 = "inconvenient" ; 2 = "convenient" ; 3 = "Very convenient"
		Convenience to community healthcare center	1 = "inconvenient" ; 2 = "convenient" ; 3 = "Very convenient"
		Convenience to community recreation center	1 = "inconvenient" ; 2 = "convenient" ; 3 = "Very convenient"
	Personal linkage	Closeness to family & friends	1 = "not close" ; 2 = "close" ; 3 = "very close"
	Information linkage	Proficiency in using smartphones	1 = "strange"; 2 = "proficient" ; 3 = "very proficient"
Need factors	Health status	Whether the respondent has any chronic diseases	0 = "No"; 1 = "Yes"
	Retiring pension	Whether the respondent has retiring pension	0 = "No"; 1 = "Yes"
	Labor income	Whether the respondent has labor income	0 = "No"; 1 = "Yes"
Social psychological factors	Fairness perception	Compared with other senior citizens, the fairness about the equal access to all senior care services	1 = "disagree"; 2 = "agree" ; 3 = "Very agree"
		The received services whether reflect the respondent's social contribution before retirement	1 = "disagree"; 2 = "agree" ; 3 = "Very agree"

not meet their expectation (OR = 0.64). Regarding economic condition, the satisfaction of respondents who received retirement pension was higher with the mental and spiritual service than that of those who did not receive (OR = 0.41). Respondents who had labor income were more satisfied with all three types of service than those without any income.

Models 1–2, 2–2, and 3–2 introduced psychological factors, mainly including horizontal and vertical fairness perceptions in the process of using senior care service in the community. As Table 5 shows, in both sets of models, predisposing, enabling, and need factors, showed consistent relationships between the dependent and independent variables. For the horizontal fairness perception, it apparently affected older adults' satisfaction in the mental and spiritual service; people who perceived themselves to be receiving fair treatment were more satisfied than those who claimed to receive unfair treatment (OR = 2.35). No significant difference in satisfaction was observed between people who received "equal" and "very equal" services. Moreover, the vertical fairness perception positively and significantly influenced older adults' satisfaction in all three service types. In general, the satisfaction of older adults who agreed or strongly agreed that the service they received sufficiently matched their previous contribution was approximately three or four times higher than that of those who believed they were not treated fairly compared to their former contribution.

4. Discussion

In this study, community-based senior care services included life care service, healthcare service, and mental and spiritual service. Based on an extended Anderson behavior model with social

TABLE 2 Descriptive statistics about predisposing, enabling, and need factors (*N*=322).

	Variable categories	*N* (%)		Variable categories	*N* (%)
Predisposing factors	*Gender*		*Enabling factors*	*Closeness to family and friends*	
	Male	128(39.75%)		Not close	42(13.04%)
	Female	194(60.25%)		Close	138(42.86%)
	Age			Very close	142(44.10%)
	60–69	152(47.20%)		*Convenience to community life care center*	
	70–79	131(40.68)		Inconvenient	125(38.82%)
	≥80	39(12.11%)		Convenient	87(27.02%)
	Education			Very convenient	110(34.16%)
	Elementary school and below	89(27.64%)		*Convenience to healthcare center*	
	Middle school	100(31.06%)		Inconvenient	82(25.55%)
	High school and above	133(41.30%)		Convenient	100(32.15%)
	Marital status			Very convenient	139(43.30%)
	Single	89(27.64%)		*Convenience to recreation center*	
	Not single	233(72.36%)		Inconvenient	99(30.75%)
Need factors	*Chronic disease*			Convenient	92(59.32%)
	Yes	164(50.93%)		Very convenient	131(40.68%)
	No	158(49.07%)		*Proficiency in using smart phone*	
	Pension			Strange	222(68.94%)
	Yes	309(95.96%)		Proficient	66(20.50%)
	No	13(4.04%)		Very proficient	34(10.56%)
	Labor income				
	Yes	83(25.78%)			
	No	239(74.22%)			

TABLE 3 Descriptive statistics about social psychological factors (*N*=322).

Variable names		*N* (%)
Social psychological factors	*Be treated equally in community care services*	
	Disagree	167(51.86%)
	Agree	83(25.78%)
	Strongly agree	72(22.36%)
	Received care services matched with previous social contribution	
	Disagree	200(62.11%)
	Agree	68(21.12%)
	Strongly agree	54(16.77%)

TABLE 4 Descriptive statistics about dependent variables (*N*=322).

Variable names		*N* (%)
Community-based service utilization satisfaction	*Life care service satisfaction*	
	Not satisfied	102(31.68%)
	Satisfied	220(68.32%)
	Healthcare service satisfaction	
	Not satisfied	134(41.61%)
	Satisfied	188(58.39%)
	Mental and spiritual service satisfaction	
	Not satisfied	93(28.88%)
	Satisfied	229(71.12%)

psychological factors, the study revealed that horizontal and vertical fairness perceptions were positively related to the satisfaction of older adults.

The results indicated that the proportion of respondents who were dissatisfied with community healthcare service was higher (41.61%) than that of respondents who were dissatisfied with the

TABLE 5 Results of binary logistic regression for community-based care service utilization satisfaction (N=322).

Variables		Life care service satisfaction		Healthcare service satisfaction		Mental and spiritual service satisfaction	
		Model 1–1 (OR)	Model 1–2 (OR)	Model 2–1 (OR)	Model 2–2 (OR)	Model 3–1 (OR)	Model 3–2 (OR)
Predisposing factors	Age	1.01	1.01	1.02	1.02	0.98	0.97
	Gender (female = 0)	0.59*	0.55**	0.94	0.81	1.01	0.96
	Marital status (single = 0)	1.99**	2.45***	1.15**	1.41**	1.50	1.72
	Education (primary school and below)						
	Middle school	0.59	0.58	0.75**	0.89**	0.42***	0.54**
	High school and above	0.70	0.69	0.83*	0.84*	0.48*	0.37*
Enabling factors	Closeness to family and friends (not close = 0)						
	Close	1.27	1.19	1.36	1.28	0.62	0.54
	Very close	0.96	0.76	0.58*	0.43*	0.34**	0.25**
	Convenience to life care center (inconvenient = 0)						
	Convenient	2.04***	2.26***				
	Very convenient	2.33***	2.26***				
	Convenience to healthcare center (inconvenient = 0)						
	Convenient			3.29***	3.68***		
	Very convenient			3.35***	3.59***		
	Convenience to mental and spiritual service center (inconvenient = 0)						
	Convenient					7.01***	7.75***
	Very convenient					4.02***	3.79***
	Proficiency in using smart phone (strange = 0)						
	Proficient	1.07	0.89	0.97*	0.91*	2.06**	2.07**
	Very proficient	0.86	0.70	0.92*	0.87*	2.99**	2.43**
Need factors	Having any chronic disease	1.05	1.04	0.64*	0.52**	0.75	0.67
	Retiring pension (No = 0)	0.91	0.96	0.54	0.56	0.41*	0.51*
	Labor income (No = 0)	2.24**	2.33*	3.47***	3.62***	2.22***	2.21***
Psychological factors	Treatments matched previous contribution (disagree = 0)						
	Agree		2.03***		3.89**		1.32
	Strongly agree		2.61***		3.77**		3.33**
	Be treated equally (disagree = 0)						
	Agree		1.38*		1.22		2.35*
	Strongly agree		1.56		1.06		1.31*
	(constant)	1.26	0.75	0.27***	0.31**	5.43*	10.67*
	Pseudo R-square	0.07	0.15	0.123	0.210	0.14	0.205

β, regression coefficient; *$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$.

other two service types (31.68 and 28.88%). Healthcare service is typically considered to be demanded the most by older adults, but the supply always cannot adequately meet older adults' needs (Di et al., 2017). Our survey revealed that people with high educational levels expected higher service quality, especially in medical care and recreation activities. Regarding predisposing factors, people with better conditions, such as higher education levels and having a spouse, are more likely to be unsatisfied with community services than others.

Regarding enabling factors, guided by the P-E fit perspective, this study examined that the utilization satisfaction with different types of community-based senior care services varies among personal, spatial, and information linkage. In line with the results of previous studies, the accessibility of care services would allow older adults to use the community care service (17). This is understandable because of physical weakness, older adults depend more on nearby services. In this study, the proficiency in using smart phones negatively affects the satisfaction of using the healthcare service and positively affects the satisfaction of using mental and spiritual service. Because an increasing number of older adults use smartphones, using smartphones was proven beneficial for improving older adults' health status and psychological condition. However, older adults were likely to have some psychological problems such as depression and emotional disturbances caused by excessive smartphone usage (Wang, 2020). For example, older adults generally tend to be more interested in news and knowledge related to health and illness, the overwhelming information on the internet, much of it being incorrect or inaccurate, will make them more anxious and suspicious. Therefore, with older adults using smartphones more frequently and proficiently, they may become less patient in the process of using the community healthcare service. On a positive note, the use of smartphones provided convenience to older adults, allowing them to participate in community recreational activities.

Regarding needing factors, older adults with chronic diseases rely more on social support and professional medical services. The current community healthcare service supply was still limited in meeting some basic needs and was a type of welfare wherein services were provided for free or at a low price for older adults (30). This study revealed that older adults with chronic diseases were more likely to be unsatisfied with the community healthcare service than others. Because the main research subjects were the urban older adults, they mostly had a retirement pension. Whether or not having a retirement pension only influenced the satisfaction of using the mental and spiritual care service. Different from the retirement pension, additional labor income after retirement significantly and positively affected utilization satisfaction of all three service types. Life care service and healthcare service are linked to old people's daily life, and recreational activities were only considered as non-necessities. Furthermore, retirement pension was considered a guaranteed item that can only support the old people's basic daily life, but labor income can help old people seek some other high-quality services.

Regarding psychological factors, our study highlights that the "fairness perception" was positively associated with the satisfaction of using the community-based care service among respondents. As expected, the data revealed that the vertical fairness perception had a more profound influence than the horizontal fairness perception. According to relative deprivation theory, with the increasing age, old people usually tend to reject social help, because their relative deprivation sense decreases with age and so they would not pay any additional attention to chase high-quality life. Consistent with previous findings, older adults were more tolerant with some unfair treatments and were careful in maintaining good relationships with others. Refined and differentiated senior care services are required. The service quality must be improved to ensure that older adults feel being valued. In this study, being treated equally positively affected the utilization satisfaction of the mental and spiritual service. Such services or activities are often arranged in groups with no distinction, and thus, many older adults would easily feel being treated unequally. People tend to have higher demands for entertainment services when their basic living needs are ensured. This is consistent with the results of needing factors that respondents with more economic support tended to demand for more service content and quality beyond basic life care or medical care services. It may suggest that old people tend to care for their subjective perception such as fairness more when they have more money. In the future studies, we can attempt to justify whether older adults with better conditions such as more economic and emotional support would feel more unsatisfied in receiving basic level senior care services.

This study has some limitations. First, owing to the challenges in recruiting respondents, we could not measure aspects such as ethnicity and other potential confounding factors that could affect the service utilization satisfaction of older adults. Additionally, all the data in this study were from the Shaanxi Province, and the results may not be applicable to other regions.

5. Conclusion

This study extended the Anderson behavior model from the original three dimensions to four dimensions by including social psychological factors. First, the study reflects different influential factors for three types of community-based senior care service utilization satisfaction. Second, guided by the P-E fit theory, we discussed how personal, spatial, and information linkage worked in the re-adaptation process. Lastly, we testified that in terms of psychological factors, fairness perception was associated with the service utilization satisfaction of older adults. As China's population is aging rapidly, enhancing the community service quality and improving the service utilization satisfaction among older adults are of great significance.

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 Xi'an Jiaotong University (2016-416; 30 June 2016). The patients/participants provided their written informed consent to participate in this study.

Author contributions

WM: conceptualization. LL and JW: methodology. HZ: literature review. LL and WM: original draft writing. JW, WM, and LL: revising and editing. All authors have read and agreed to the published version of the manuscript.

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Conflict of interest

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

Publisher's note

References

1. People.com.cn (2021). *National Bureau of Statistics of China: The proportion of the population aged 60 and over has reached 18.7%. The aging process has accelerated significantly*. Available at: http://finance.people.com.cn/n1/2021/0511/c1004-32100026.html

2. Dong KY, Wang ZZ, Zhang D. China's population aging and the construction of the old-age system. *Comparat Econ Soc Syst*. (2020) 1:53–64. doi: 10.1111/jonm.13396

3. People.com.cn (2016). *The need for care services for the older in urban and rural China is urgent*. Available at: http://world.people.com.cn/n1/2016/1010/c57506-28765414.html

4. Pardasani M, Thompson P. Senior centers: innovative and emerging models. *J Appl Gerontol*. (2012) 31:52–77. doi: 10.1177/0733464810380545

5. Chen L, Han WJ. Shanghai: front-runner of community-based eldercare in China. *J Aging Soc Policy*. (2016) 28:292–307. doi: 10.1080/08959420.2016.1151310

6. Du P, Wang YM. Determinants of utilization of social care service for older persons in China. *Popul Res*. (2017) 41:26–37. doi: 10.3969/j.issn.1674-4802.2017.04.004

7. Wang Q. Demands and determinants of community home-based care services for urban older: based on the 2010 national older survey in China. *Popul Res*. (2016) 40:98–112.

8. Sun JF, Yao WZ. The endowment service problems of suburban areas at the present stage in China. *Econ Manag*. (2013) 35:174–80. doi: 10.3969/j.issn.1003-3947.2020.01.006

9. Ding ZH, Wang LL. Study on the equalization of home-based care services for the older in China. *Popul J*. (2011) 5:83–8.

10. Hou B. Community home-based care service for urban older: demand levels and satisfying strategy. *Chin Soc Secur Rev*. (2019) 3:147–59. doi: 10.2307/800066

11. Dai JB, Li Q. An analysis of the dependence of self care ability and community care service for the older living alone in the city. *Soc Secur Stud*. (2017) 4:36–44.

12. Wang YM, Du P. Behavioral attitudes of the older towards social care services: the case of Beijing. *Popul Res*. (2018) 42:74–86. doi: 10.15884/j.cnki.issn.1007-0672.2019.06.010

13. Liu Y, Cheng Z. Research on the satisfaction of pension services in urban communities based on social cohesion. *J Xiangtan Univ*. (2021) 45:92–8.

14. Schmader T, Sedikides C. State authenticity as fit to environment: the implications of social identity for fit, authenticity, and self-segregation. *Personal Soc Psychol Rev*. (2018) 22:228–59. doi: 10.1177/1088868317734080

15. Li YE, Lu S. A review of the development of the Anderson model's theoretical construction and analysis path. *Chin Health Serv Manag*. (2017) 34:324–7. doi: 10.3969/j.issn.1674-4802.2015.03.016

16. Azfredrick EC. Using Anderson's model of health service utilization to examine use of services by adolescent girls in South-Eastern Nigeria. *Int J Adolesc Youth*. (2016) 21:523–9. doi: 10.1080/02673843.2015.1124790

17. Wu DX, Gao XL, Xie ZF, Xu ZN. Understanding the unmet needs among community-dwelling disabled older adults from a linkage perspective. *Int J Env Res Pub Health*. (2021) 18:389. doi: 10.3390/ijerph18020389

18. Yu Z, Wang LJ, Ariyo T. Supply and demand-related decisive factors in the utilization of non-medical community healthcare services among older Chinese. *Int J Env Res Pub Health*. (2021) 18:228. doi: 10.3390/ijerph18010228

19. Zhang HF, Luo W. A study of the influence of care service resources on the demand for social care service for senior citizens. *China Popul Resoyr Environ*. (2019) 29:168–76.

20. Bradley EH, McGraw SA, Curry L, Buckser A, King KL, Kasl SV, et al. Expanding the 5. Andersen model: the role of psychosocial factors in long-term care use. *Health Serv Res*. (2002) 37:1221–42. doi: 10.1111/1475-6773.01053

21. Shi JG, Hua WW, Tang DZ, Xu K, Xu QW. A study on supply–demand satisfaction of community-based senior care combined with the psychological perception of the elderly. *Healthcare*. (2021) 9:643. doi: 10.3390/healthcare9060643

22. Elizabeth M. The reluctance of the older to accept help. *Oxford Univ Press*. (1978) 25:293–303.

23. Lin SL. Inequities in access: the impact of a segmented health insurance system on physician visits and hospital admissions among older adults in the 2014 China family panel studies. *Int J Health Serv*. (2020) 50:184–98. doi: 10.1177/0020731419867529

24. Zeng L, Xu XC, Zhang CX, Chen LH. Factors influencing long-term care service needs among the older based on the latest Anderson model: a case study from the middle and upper reaches of the Yangtze River. *Healthcare*. (2019) 7:157. doi: 10.3390/healthcare7040157

25. Lin WY. Factors influencing community service utilization by the older: the Oretical perspectives and literature review. *Soc Secur Stud*. (2015) 3:105–12.

26. Adini B. Ethnic inequality within the older population in utilizing healthcare services. *Isr J Health Pol*. (2019) 8:1–4. doi: 10.1186/s13584-019-0311-y

27. Allard K, Hasselgren C, Dellve L. Gender equality and managers' work in older and social care: a structural equation modelling approach. *J Nurs Manage*. (2021) 29:2689–96. doi: 10.1111/jonm.13396

28. Wu H, Liu YQ. Examining inequality in utilisation of health management services for the older in rural Henan China. *BMC Health Serv Res*. (2020) 20:758. doi: 10.1186/s12913-020-05630-7

29. Wang Q, Wu J, Wang XY, Wang YQ. The influence of the unfair aversion of the older on the social decision-making behavior under the Chinese cultural background. *Chin J Gerontol*. (2017) 99:2286–8. doi: 10.3390/ijerph18020389

30. Wang LJ, Yang L, Di X, Dai XL. Family support, multidimensional health, and living satisfaction among the older: a case from Shaanxi Province, China. *Int J Env Res Pub Health*. (2020) 17:8434. doi: 10.3390/ijerph17228434

31. Hu YH, Lin GR, Zhong XY, Ye XC, Qiu HJ. Using status and influencing factors of home: based care services for the older in Putian City. *Northwest Popul J*. (2019) 40:101–13. doi: 10.3390/ijerph18010228

32. Tang D, Yu YJ, Sun X, Gao XD. Satisfaction study on government-purchased community senior care service:empirical analysis based on survey data of Shanghai. *Northwest Popul*. (2017) 38:93–9. doi: 10.3390/healthcare7040157

33. Wang Y. Study on the effect of smartphone use on the subjective health of the older———base on the China longitudinal aging social survey of 2016. *Popul Develop*. (2020) 26:65–76.

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People's knowledge, attitudes, practice, and healthcare education demand regarding OSA: a cross-sectional study among Chinese general populations

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Background: Population knowledge and attitudes toward obstructive sleep apnea (OSA) syndrome are critical to public health initiatives to overcome the disease. Healthcare education is an appropriate approach to expediting the process to build active medical practice models in the public.

Objective: This study aimed to assess the level of knowledge, attitude, and practice (KAP) regarding OSA and healthcare education demand among the Chinese general population.

Methods: A cross-sectional survey was performed online via Wenjuanxing in China between 8 February and 8 March 2022, using a 34-item questionnaire designed and reviewed by multidisciplinary experts.

Results: This study enrolled 1507 respondents, aged 18 to 68, with a city-to-countryside ratio of approximately 2:1. Four-fifths of respondents reported that they had children ($n = 1237$), and mothers accounted for 57.7%. If they or their children had symptoms of OSA, nearly nine in 10 respondents would undertake positive medical practices, especially parents. A total of 89.4% of the respondents reported a desire to receive healthcare education through the new multimedia approach, and most were concerned about the etiology of OSA.

Conclusion: The current study indicated that even the higher educated and urban populations in China had insufficient knowledge about positive attitudes toward and practices regarding OSA, indicating an urgent demand for healthcare education. A special emphasis should be placed on appropriating population demand for healthcare education and promoting the benefits of active medical practice models in sleep medicine.

KEYWORDS

OSA, general population, sleep health care education, KAP, public health

1. Introduction

Obstructive sleep apnea (OSA) is a group of sleep breathing disorders involving both sexes and all ages. It is characterized by recurrent, intermittent upper airway obstruction, or reduced airflow during sleep, leading to repetitive episodes of desaturation, hypercapnia, and arousal (1). Adult patients with OSA typically complain of loud snoring, witnessed apnea, fragmented unrefreshing sleep, and daytime hypersomnolence. OSA is associated with a series of short-term and long-term negative consequences (2). If untreated, it not only can reduce patients' work efficiency and quality of life but also can relate to the occurrence and progression of chronic cardiovascular and metabolic diseases and neurocognitive problems and can increase the risk of all-cause mortality (3–5). The clinical presentation of children is different from that of adults, and pediatric patients with OSA often present with mouth breathing, nocturnal snoring and sweating, enuresis, and restless sleep (6, 7). Secondary to OSA, a myriad of negative consequences severely affect children's and teenagers' facial appearance and quality of life, such as adenoid face, poor school performance, possible depression, growth defects, and neurocognitive dysfunction (7–9).

The main risk factors for OSA are obesity and aging, which have increased in a striking proportion worldwide over the past four decades (10). Consequently, vulnerability to OSA has increased, affecting nearly one billion people or one in seven adults worldwide (11). Therein, the affected general population of China ranks at the top of the global list, with a prevalence of more than 23.6% among adults older than 30 years of age (11). However, as previous surveys have reported, the incidence of OSA has remained underestimated, and the undiagnosed proportion was 75 to 90% in the US (12, 13). In addition, the undiagnosed condition contributed to an enormous global healthcare burden, causing the social level costs to amount to more than $150 billion per year in the US (10, 14, 15), and medical costs up to €10.7 to €32.0 billion per year in Italy were due to OSA (16).

Considering the prevalence and negative effects of OSA on health, medical workers have paid more attention to OSA in various countries (17–19). Effective screening and early recognition performed by healthcare providers are needed to minimize the negative health impacts and maximize cost-effectiveness (11). The absence of awareness of the serious adverse effects of OSA among the general population results in people's unwillingness to be evaluated. However, previous studies have indicated that the current knowledge of and attitudes about OSA are insufficient among medical service providers (20–24). A survey performed in 2017 with a large sample of 1306 participants found that only 13.0% of participants could correctly define OSA (3). Xu et al. (25) conducted a descriptive study of childhood OSA in 2019 focused on parents in the Guangdong Province of China, suggesting that parents had limited awareness of its complications.

Abbreviations: OSA, Obstructive sleep apnea syndrome; KAP, Knowledge, attitude, and practice; QR code, Quick response code; FNP, Flexible nasopharyngoscopy; PSG, Polysomnography; CPAP, Continuous positive airway pressure; UOR, Unadjusted odds ratio; ATOR, Adjusted odds ratio; CI, Confidence interval.

However, there is a paucity of data with large-scale samples focused on China regarding the knowledge, attitude, and practice (KAP) regarding OSA and healthcare demand among the general population. The purpose of this study was to evaluate the current KAP level and to investigate the education demand for OSA among the Chinese general population. In addition, we further explored the influencing factors for seeking medical help to determine whether there were correlations between the demographic data and medical practice patterns.

2. Methods

2.1. Participants

Before distributing the survey, the minimum sample size was calculated using G*Power (version 3.1; Heinrich Heine University) to achieve a power of 0.80. In the G*Power software, a logistic regression test was conducted for *a priori* power calculation with an odds ratio (OR) of 1.2 and a significance level of.05. The minimum sample needed to achieve a power of 0.80 was 1484 for our study. Considering the missing and non-responsive cases, we expanded it by 10%, yielding a predicted sample size of 1632. In the present study, the population focused on general adult residents who were from China, were at least 18 years old, and were competent to answer the questions online. Those who were illiterate or unwilling to participate were not invited. In the process of data screening, the inclusion criteria were Chinese residents $\geq$ 18 years old who volunteered to participate and were competent to comprehend the content of the questionnaire. Those who answered contradictory or factual content or had a response time of $\leq$ 180 s were excluded.

2.2. Ethics approval

Ethical approval regarding human subject research was obtained from the Ethics Committee on Biomedical Research, West China Hospital of Sichuan University (approval number: 2022.416). Informed consent was obtained from each participant online by placing a question about their agreement to participate in the study at the beginning of the survey. Participants were assured of the confidentiality and anonymity of this study and their rights to exit at any time. We declare that the data were collected for academic use only.

2.3. Instrument

The primary version of the questionnaire was developed in Chinese by an investigation team based on a deep literature review of comparable studies and international guidelines (3, 25–28), including otolaryngologists, medical sociologists, and a statistician. Researchers randomly invited 20 participants face-to-face from the general population to answer the questionnaire online for pretext and collected their feedback about the comprehensibility of questions and options. Four experts in the field of sleep medicine and survey studies reviewed these responses and each item of the survey and confirmed the final version of a 34-item

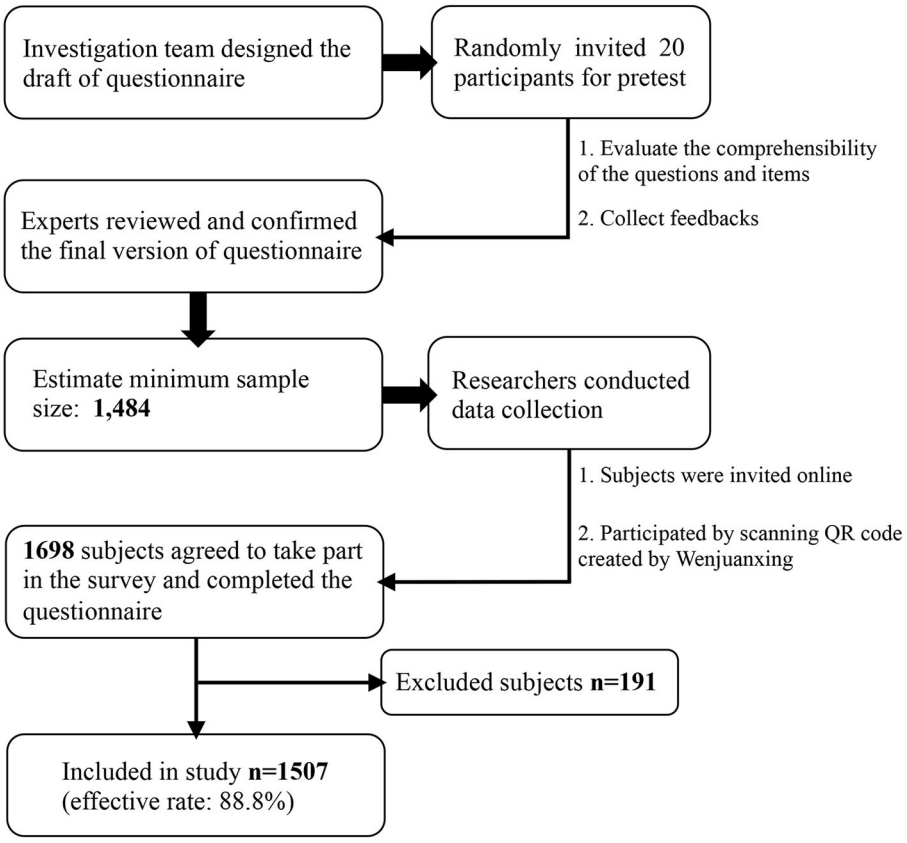

FIGURE 1
Basic flow chart of the study.

questionnaire (see Supplementary material). The face validity and content validity of the survey were established. It comprised basic demographic data and four sections about knowledge, attitudes, practices, and demand regarding popular healthcare toward OSA. A series of options were listed with points for each question and zero for ignorance or mistakes. The total scores for symptoms, examinations, complications, and treatments in OSA were 13, 5, 12, and 9, respectively. Cronbach's α was >0.7 for each scale (0.885 for symptoms, 0.738 for examinations, 0.863 for complications, and 0.835 for treatments for OSA).

2.4. Procedures

The cross-sectional survey was conducted in China between 8 February and 8 March 2022, using a 34-item questionnaire designed and reviewed by multidisciplinary experts (Figure 1). The general Chinese adult population was randomly invited online and offline. Participants were informed that the survey was based on voluntary principles and that their data would be anonymous and confidential. First, our investigation team created a questionnaire QR code (quick response code or dimensional barcode) by Wenjuanxing (https://www.wjx.cn), which is an online questionnaire platform widely used in academic studies in China. Then, researchers distributed the QR code using Chinese popular social media to get access to the general populations as many as possible, including WeChat (https://web.wechat.com) and QQ (https://www.qq.com). In addition, five researchers performed face-to-face invitations to scan the QR code in possible surveyed populations in different public scenarios, such as hospitals, universities, and commercial venues. Participants' IP addresses were restricted to ensure only one submission. The chief researcher was responsible for checking the collected data from Wenjuanxing, and up to 11.2% of submitted questionnaires were excluded for invalid response times and logistic errors.

2.5. Statistical analysis

The data are summarized as the means and standard deviations for continuous variables and percentages for categorical variables. Comparisons between groups were performed with the *t*-test and chi-square test. Univariate (unadjusted) and multivariate logistic regression models (adjusted for confounders) were applied to assess the associations between various demographic factors and the practice of seeking medical help for OSA. All statistical analyses were performed using IBM SPSS statistics software (version 26.0) and two-sided tests at a 5% level of significance ($p < 0.05$).

TABLE 1 Participants' primary sociodemographic information.

Sociodemographic	Data, *n* (%)
Population	1,507
Age (mean ± SD)	36.2 ± 9.25
Sex	
Male	560 (37.2)
Female	947 (62.8)
Region	
Sichuan Province	878 (58.3)
Zhejiang Province	188 (12.5)
Jiangsu Province	105 (7.0)
Others	336 (22.2)
Place of residence	
Countryside	1,044 (69.3)
City	463 (30.7)
Educational background	
College degree and less	523 (34.7)
Bachelor's degree	810 (53.7)
Master's or doctoral degree	174 (11.5)
Work status	
Employed	1,347 (89.4)
Unemployed	160 (10.6)
Monthly household income	
< 10,000	947 (64.7)
10,000–30,000	338 (22.4)
≥ 30,000	195 (12.9)
Whether they had children	
Yes	1,237 (82.1)
No	270 (17.9)

3. Results

3.1. Baseline characteristics of respondents

This study enrolled 1507 respondents (560 men and 947 women), their ages ranged from 18 to 68 years, and they came from 28 provinces, autonomous regions, and municipalities (including Sichuan, Zhejiang, Jiangsu, Liaoning, Fujian, Shandong, and Anhui provinces). The respondents' characteristics are shown in Table 1. Among employed respondents (n = 1,347), majors in medicine numbered 40.9%. Four-fifths of respondents reported that they had children (n = 1,237), mothers accounted for 57.7%, and fathers ranked second (36.5%).

3.2. Knowledge of OSA

When asked whether they had heard of OSA, 62.8% of respondents said they had only heard of it or knew little, and 292 respondents reported that they had never heard of it. Nevertheless, the majority regarded OSA as a severe disease (76.0%). In the description of OSA, only 37.2% of respondents answered all four questions correctly (Table 2). In particular, the description of "Untreated OSA would increase the morbidity of traffic accidents" at 68.5% correct was the lowest.

TABLE 2 Correct rate in four common descriptions of OSA.

Description	Correct rate
Obstructive sleep apnea syndrome increases the incidence of traffic accidents.	68.5%
The most common cause of obstructive sleep apnea in children is hypertrophy of the tonsils and adenoids.	72.5%
Children's hearing loss could be related to adenoid hypertrophy.	71.7%
Which picture shows an "adenoid face"?	71.9%

Regarding diagnostic methods in OSA, the respondents were asked to identify the symptoms, examinations, and complications that those suffering from OSA might have, as shown in Figure 2. The average awareness rate of symptoms of OSA was the highest (60.9%), followed by the examination method (55.6%), and the complication rate was only 50.6%. In particular, nocturia more than once per night (44.3%) and bed-wetting in children (44.1%) were the most neglected symptoms of OSA. Approximately 40.5% of respondents could determine that X-rays are commonly used to diagnose OSA. Among its complications, <40% of respondents associated spinal dysplasia, diabetes, and hyperlipidemia with OSA. For the treatment of OSA, the average awareness rate was 55.9%, and continuous positive airway pressure was the most underrated treatment in the general public (46.7%) (Figure 2).

3.3. Attitudes and practices in OSA

When asked if they had symptoms of OSA and whether they sought medical help, most of the participants answered positively (87.6%), and they were most likely to visit the otolaryngology and respiratory medicine clinics. For parents, 95.6% of them indicated that they would take their children to see doctors if their child or children had related presentations (n = 1,237). A total of 73.3% of parents also chose to see otolaryngologists, only 39.5% of them chose pediatricians, and several participants referred to sleep medicine, departments of neurology, and traditional Chinese medicine. Regarding the reasons why they did not seek medical advice, more than half of them regarded OSA as a non-fatal disease, as shown in Table 3.

A total of 24.1% of respondents indicated they had a previous diagnosis of OSA, and 42.0% of parents reported that their children had been diagnosed with OSA. Among these children with OSA (n = 519), 42.2% had received conservative therapy, 28.1% had undergone surgical treatment, and 29.5% never had any intervention. Tonsillectomy and adenoidectomy were the most common surgeries they reported (65.8%, n = 146).

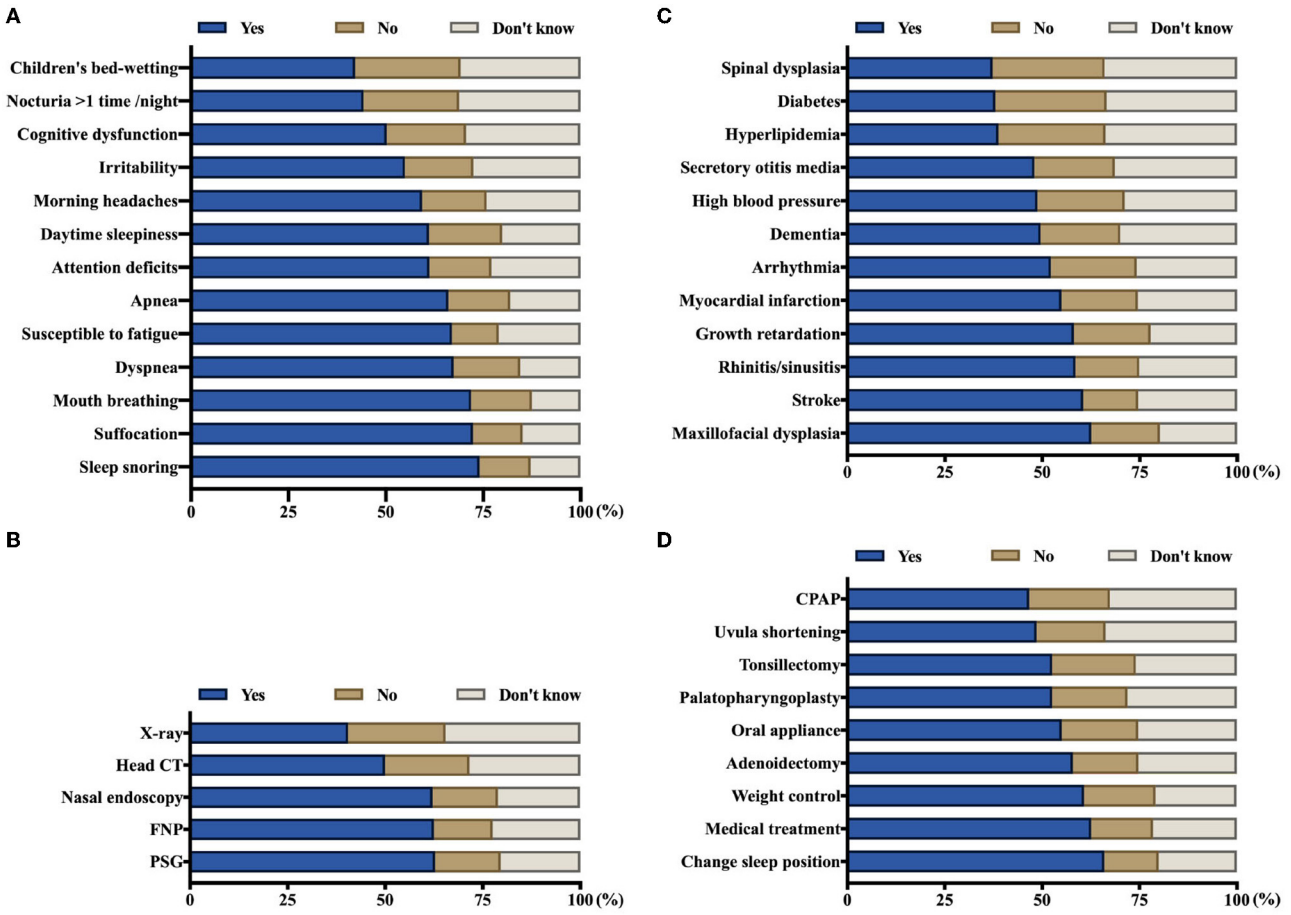

FIGURE 2
Awareness rate of symptoms, examinations, complications, and treatments among the general population, corresponding to parts **(A–D)** respectively ($N = 1507$). FNP, flexible nasopharyngoscopy; PSG, polysomnography; CPAP, continuous positive airway pressure.

3.4. Healthcare education demand of OSA

Nine in 10 (89.4%) of the respondents were willing to receive popular healthcare education about OSA, and the most common referred content that they were eager to receive consisted of the causes, symptoms, complications, and treatment of OSA (74.9%). Some child caregivers reported that they wanted to differentiate OSA from benign snoring. Another wondered whether there were any effective methods to prevent this disease. In terms of the channels to access this healthcare information, the internet/new media and the healthcare delivery produced by medical professionals were the preferred outlets (68.3 and 67.0%, respectively).

3.5. Analysis of the factors influencing the KAP of OSA

In this study, the items of symptoms, examinations, complications, and treatments in OSA were accumulated scores as the baseline data. The comparison between these scores that showed significant differences in sex, age, educational background, household income, occupational background, and residence is shown in Figure 3. In the present study, respondents who were women, $\geq$ 40 years of age, had a bachelor's degree or more, had <10,000 yuan monthly household incomes, had a related medical occupation, and lived in a city with higher scores in OSA knowledge. The total scores of the four sections showed no significant differences in whether seeking medical advice when one's children had presentations of OSA ($p = 0.085$). To examine the influencing factors associated with seeking medical advice, the variables of interest were tentatively incorporated into a regression model (Table 4). In the multivariate regression, many demographic and individual factors independently influenced the practices regarding OSA among the general population. The results showed that the respondents with > 30,000 yuan monthly household incomes had a higher odds ratio for active practice regarding OSA (adjusted OR = 4.621, $p = 0.001$) compared to those in lower income groups (< 10,000 yuan). Additionally, the people who lived in the city had a higher odds ratio for seeking medical advice for OSA than those who lived in the countryside (adjusted OR = 2.789, $p < 0.001$). Respondents who had a prior diagnosis of OSA and had a positive attitude toward healthcare education were significantly more likely to seek medical advice on

TABLE 3 Percentage of various reasons why they did not seek medical help when they had symptoms of OSA.

Reasons for not seek medical help ($n = 524$)	Percentage (%)
Obstructive sleep apnea is a non-fatal disease	54.4
Lack confidence for existing treatment options	40.2
Worry about surgery risks	38.3
During the epidemic of COVID-19, worry about the infection	33.2
Worry about medical cost	22.5
Have no time to see doctors due to the busy work	17.4
Worry about the time costs affecting children's learning	14.5
It is inconvenient to go to hospital	10.5
Other: [a]	4.4

[a]Being unaware of the abnormal presentations or the disease had no influence on quality of life.

their own initiative ($p < 0.001$). In contrast, sex, age, educational and occupational background, and scores in the four sections of knowledge about OSA did not significantly affect their medical practice ($p > 0.05$).

The subsequent analysis focused on the child caregivers group to further determine how demographic, knowledge, and attitude factors affected the practice of taking children to the clinic for OSA. In comparison to unemployed people, respondents who had stable work status (employed) were significantly more likely to undertake an active practice for OSA children (adjusted OR = 2.663, $p = 0.03$). Among the relationships with children, mothers had a higher odds ratio for taking children to seek medical advice for OSA than fathers (adjusted OR = 2.115, $p = 0.017$). Parents whose children had ever been diagnosed with OSA were significantly more likely to engage in positive practices for their children's symptoms (adjusted OR = 49.507, $p < 0.001$). Conversely, age, monthly household income, place of residence, the number of children < 14 years old, and scores in four sections of knowledge about OSA did not significantly affect the practice of treating OSA among child caregivers ($p > 0.05$) (Table 5).

4. Discussion

Obstructive sleep apnea is a common medical condition among the general population with serious medical, psychological, and socioeconomic morbidities, yet most affected patients with OSA remain undetected and lack timely intervention. According to clinical studies, OSA causes significant adverse health and quality of life consequences and has a major impact on the global disease burden (10, 11). Despite the availability of effective diagnostic methods and treatments, screening and case identification of OSA remain difficult challenges (29). Lack of initiative to seek medical help in symptomatic patients was a barrier that impeded the early recognition of and interventions for OSA. Therefore, this lack stimulates the need for improved access to healthcare education among the general population. At the same time, experts in public health and epidemiology are also cooperating with clinicians in popular healthcare science, hoping to identify more subhealthy and preclinical patients through various forms of information provision. Early recognition and intervention for these patients will substantially lower morbidity and mortality rates and reduce overall medical costs (30). In this study, most participants showed insufficient knowledge of OSA, and their average awareness rates in several sections were <60%. Approximately nine-tenths of them had positive attitudes and practices toward OSA, especially parents. If their children had symptoms of OSA, people were more likely to undertake positive medical practices compared with themselves (95.6 vs. 87.6%). For further correlations, household economic factors and related medical history significantly influenced the medical practice pattern. None of the specific sections in scores of knowledge about OSA showed a positive effect on the medical practice pattern. The majority of respondents reported a desire to receive healthcare education through the new multimedia approach, and the majority were concerned about the etiology of OSA.

The survey focused on the general population in China, while the respondents were concentrated in the southwest and coastal areas, and the majority came from urban areas. Encouragingly, more than half of the respondents said that they heard of OSA, and only a few reported being unaware of it. The vast majority considered OSA a serious disease that warranted recognition and early intervention (76.0%). This finding suggested that OSA had a certain public awareness, and its prevalence attracted some people's attention. In the section on knowledge, only seven out of 10 respondents were able to correctly identify the four descriptions of OSA disease. In particular, patients with OSA can present drowsiness, excessive daytime sleepiness, and fatigue proneness during driving, increasing the risk of vehicular accidents (27). Although this association has been fully proven in many large-scale clinical research studies, 31.5% of people did not recognize it. In general, knowledge of OSA was not sufficient since the average awareness rate was <60%.

Among the common symptoms of OSA, "children's bed-wetting" and "nocturia >1 time/night" were the most underestimated. These two presentations are common problems in children (31, 32), affecting approximately 20% of 5-year-old children and 10% of 7-year-old children (6). Parents had a common belief that bed-wetting in children would disappear or be cured with age. However, some clinical trials have indicated that children affected by OSA were at increased risk for nocturnal enuresis (33). In addition, "nocturia > 1 time/night" is not uncommon in middle-aged and older men, who present with an increased number of nocturia episodes due to benign prostatic hyperplasia (34). Attributed to their poor predictive value, these signs have been widely ignored by the general population with potential clinical impacts. Snoring in sleep, the most common symptom recognized by 74.1% of respondents, is the chief complaint of patients with OSA. Nevertheless, this problem was always observed by patients' bedroom partners, and their complaints concerning breathing pauses triggered a referral to a sleep clinic. Regarding examinations, X-ray is the most underestimated diagnostic method for OSA. It is known that tonsil and/or adenoid hyperplasia is a major anatomical contributor to OSA in children (35). For

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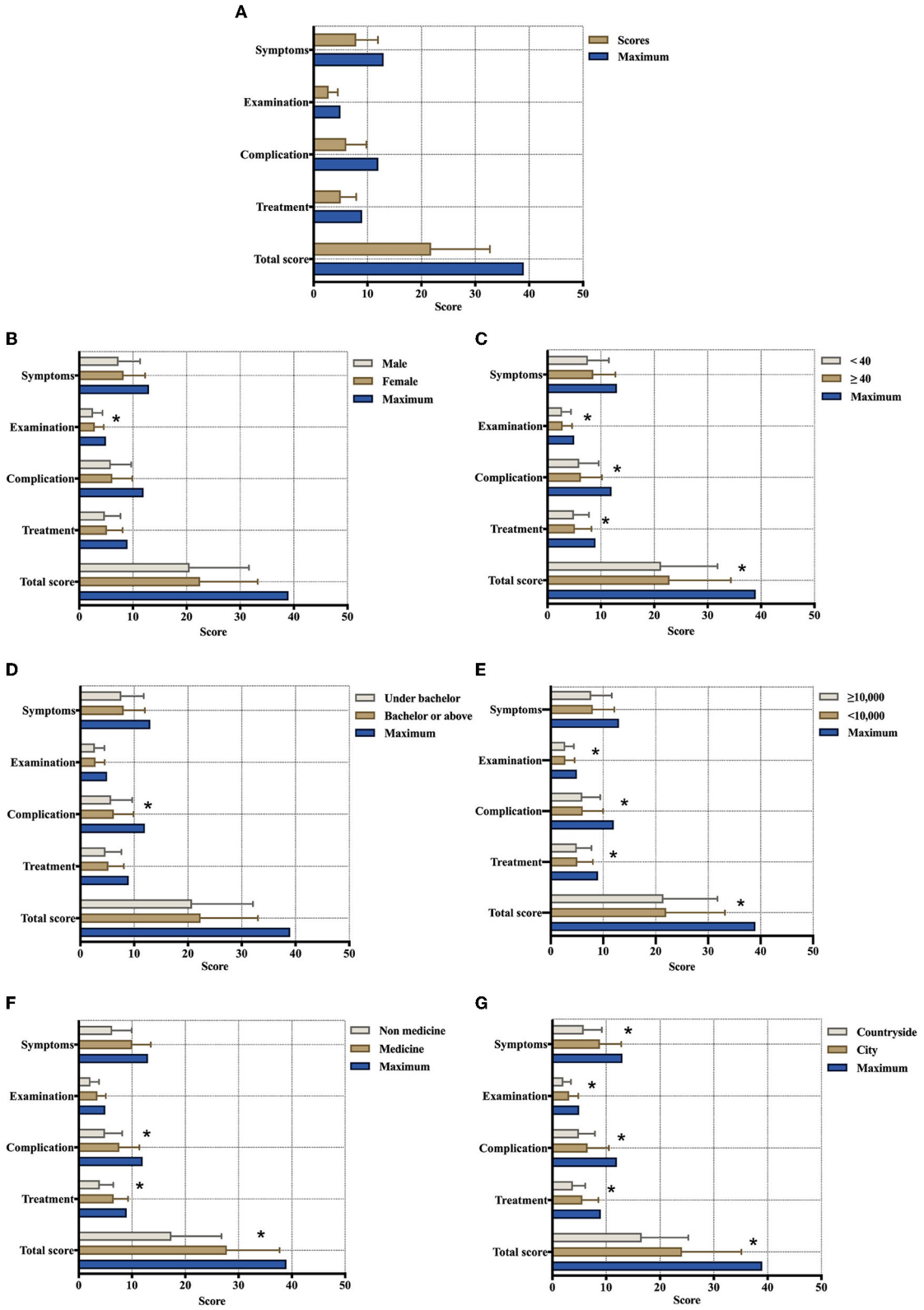

FIGURE 3
Various subgroups of scores in the symptoms, examinations, complications, and treatments of OSA among the general population. **(A)** Baseline full scores; **(B)** sex groups; **(C)** age groups; **(D)** educational groups; **(E)** monthly household income groups; **(F)** occupational groups ($n = 1347$); and **(G)** residential place groups ($N = 1,507$; *Indicates a significant difference).

TABLE 4 Factors associated with seeking medical advice in the general population when people had symptoms (logistic regression $N = 1507$).

Covariable	UOR[a] (95% CI[c])	*p*-value	ATOR[b] (95% CI[c])	*p*-value
Gender				
Male	1		1	
Female	1.040 (0.759–1.426)	0.807	1.189 (0.837–1.690)	0.334
Age	0.981 (0.966–0.997)	0.021	0.995 (0.978–1.011)	0.534
Educational background				
College degree and less	1	-	1	
Bachelor's degree	1.770 (1.272–2.465)	0.001	1.394 (0.969–2.006)	0.074
Master's or doctoral degree	1.074 (0.666–1.732)	0.771	0.985 (0.567–1.711)	0.956
Occupational background				
Non-medicine-related job	1		1	
Medicine-related job	1.133 (0.798–1.607)	0.485	1.498 (0.992–2.262)	0.055
Monthly household income				
< 10,000	1		1	
10,000-30,000	1.319 (0.904–1.925)	0.151	1.306 (0.868–1.966)	0.200
≥ 30,000	6.539 (2.644–16.173)	<0.001	4.621 (1.825–11.701)	0.001
Place of residence				
Countryside	1	-	1	
City	2.555 (1.700–3.838)	<0.001	2.789 (1.788–4.351)	<0.001
Scores in symptoms of OSA	1.004 (0.967–1.043)	0.831	0.995 (0.934–1.059)	0.866
Scores in examination of OSA	1.044 (0.955–1.142)	0.341	1.047 (0.913–1.201)	0.512
Scores in complications of OSA	1.062 (1.018–1.080)	0.006	1.042 (0.974–1.118)	0.229
Scores in treatment of OSA	1.057 (1.002–1.115)	0.043	1.016 (0.929–1.112)	0.725
Previous diagnosis of OSA				
No	1		1	
Yes	6.461 (3.378–12.360)	<0.001	4.872 (2.490–9.534)	<0.001
Demand for education in OSA				
No	1		1	
Yes	3.321 (2.257–4.885)	<0.001	2.301 (1.532–3.477)	<0.001

[a]UOR is the abbreviation of unadjusted odds ratio. [b]ATOR is the abbreviation of adjusted odds ratio. [c]CI is the abbreviation of confidence interval (Adjusted OR, CI, and *p*-value per multiple logistic regression model with medical practice as the outcomes).

pediatric patients, lateral radiography of the skull base is the most economical, convenient, and non-invasive examination method. Furthermore, the size of the adenoids and the degree of airway obstruction can be quantified by the N/A ratio of the nasopharyngeal airway. Therefore, it has become the first choice for clinicians to evaluate children suspected to have OSA. Compared with other knowledge sections (such as symptoms, examinations, and treatments), respondents showed lower average awareness of the complications of OSA (50.61%). This finding reflected that most people underestimated the potential risks to their health conferred by OSA. Among the complications of OSA, the most well-known were maxillofacial dysplasia (62.6%), such as adenoid face, micrognathia, dentition disorders, and protruding mouth. Owing to their obvious impact on appearance, these signs have received widespread attention among parents. During dental consultations, parents learn from the dentists that the concrete cause of OSA is adenoid/tonsil hypertrophy and receive a referral to an otolaryngologist for etiological treatment. However, spinal dysraphism (37.3%), diabetes (38.0%), and hyperlipidemia (38.8%) were commonly neglected morbidities by respondents. The relationships of OSA with endocrine, metabolic, and developmental diseases are well-documented and unequivocal (4). In addition, continuous positive airway pressure (CPAP) ventilation had the lowest rate of awareness among respondents compared with other treatments. Whereas, it is considered a first-line therapy for patients with symptomatic and moderate to severe OSA with promising clinical effects (27, 36), non-adherence and reduced compliance with CPAP have been widely seen in the literature (37, 38). The probable reasons for this question were chronic nasal congestion, intolerance to nasal masks, and

TABLE 5 Factors associated with seeking medical advice in general populations when people's children had symptoms (logistic regression $n = 1,237$).

Covariable	UOR[a] (95% CI[c])	*p*-value	ATOR[b] (95% CI[c])	*p*-value
Age	0.940 (0.913–0.967)	<0.001	0.989 (0.958–1.021)	0.5
Work status				
Unemployed	1		1	
Employed	4.962 (2.432–10.122)	<0.001	2.663 (1.101–6.443)	0
Monthly household income				
<10,000	1		1	
10,000–30,000	2.102 (0.976–4.527)	0.1	1.943 (0.867–4.358)	0.1
≥30,000	3.578 (1.098–11.666)	0	1.279 (0.362–4.521)	0.7
Place of residence				
Countryside	1	-	1	
City	0.512 (0.261–1.004)	0.1	1.331 (0.607–2.918)	0.5
Relationship with children				
Father	1		1	
Mother	1.490 (0.853–2.601)	0.2	2.115 (1.145–3.907)	0
Other	2.020 (0.468–8.720)	0.3	2.209 (0.391–12.463)	0.4
Have how many children ≤14 y	0.919 (0.836–1.011)	0.1	0.921 (0.841–1.009)	0.1
Scores in symptoms of OSA	1.029 (0.961–1.101)	0.4	0.994 (0.900–1.098)	0.9
Scores in examination of OSA	1.268 (1.069–1.503)	0	1.207 (0.953–1.527)	0.1
Scores in complications of OSA	1.146 (1.051–1.250)	0	1.041 (0.914–1.186)	0.5
Scores in treatment of OSA	1.200 (1.076–1.338)	0	1.105 (0.940–1.299)	0.2
Children with a prior diagnosis as OSA				
No	1		1	
Yes	41.284 (5.69–299.519)	<0.001	49.507 (6.474–378.611)	<0.001

[a]UOR is the abbreviation of unadjusted odds ratio. [b]ATOR is the abbreviation of adjusted odds ratio. [c]CI is the abbreviation of confidence interval (Adjusted OR, CI, and *p*-value per multiple logistic regression model with medical practice as the outcomes).

the expensive price of instruments (39). Finally, the results of the present study revealed that women, those >40 years old, those with a bachelor's degree or more, and those from cities are more likely to have higher knowledge scores for OSA than other groups. This finding suggested that men, younger individuals, those with a less educated background and those from the countryside were vulnerable to OSA and required more comprehensive healthcare education.

When they had presentations about OSA, most people chose to seek medical attention for intervention. Only 12.4% (187/1507) of respondents chose not to seek medical help when they became symptomatic. The most common reason for negative medical practice was that OSA was a non-fatal disease (54.4%), indicating that the rest of the people had poor awareness of the potential risks and comorbidities. Other reasons included a lack of confidence in current therapeutic options (40.2%) and fear of surgical risks (38.2%), reflecting a lack of knowledge or clarity about the disease leading to the rejection of medical evaluation. Approximately one in five respondents reported a previous diagnosis of OSA, similar to previous reports (11). Parents displayed a more motivated attitude and practice regarding OSA for their children compared to themselves. Among parents ($n = 1,237$), 95.6% would take their children to see a doctor if symptoms or signs appeared. However, a difficult problem is that, when parents are inexperienced or unable to distinguish between normal and abnormal conditions, there is a delay in the children's condition. Surprisingly, 42.0% of parents said that their children had ever been diagnosed with OSA. In comparison to the data reported by Burghard et al. (12), that 90% of children did not receive a previous diagnosis of OSA, this population was incredibly well diagnosed. The possibility is that parents concerned about children's conditions were more likely to participate in the survey. In addition, the ratio of previously diagnosed OSA in children was higher than that in adults in this survey. This finding suggests that people are more motivated to seek medical treatment for pediatric OSA, which might be because parents are concerned about cosmetic defects in children. In terms of accepted interventions for childhood OSA ($n = 519$), only 28.1% of children had undergone surgical treatments. Although many clinical trials have strongly proved that the impaired function of children with OSA would improve after adenotonsillectomy (33, 40), most parents tend to choose a conservative policy. The reason for not considering surgical treatment might be that parents

are worried that the removal of immune organs, such as tonsils or adenoids, would affect children's immunity. Another possibility is that they expect the spontaneous regression of OSA during the adolescent period since the adenoid atrophy is from 10 to 12 years old (41).

Almost nine in 10 (89.4%) respondents indicated that they were willing to receive health education. The etiology of OSA was a leading concern (74.9%), and knowledge about surgery, risks, and effects was secondary (68.2%). On the one hand, parents probably want to identify abnormalities in the early stage by learning the etiology and risk factors of OSA, such as obesity and genetic micrognathia. On the other hand, this is a possibility that there are more and more multi-child families in China with the introduction of the two-child policy, and parents are trying to prevent other children from OSA. The second hot spot is knowledge, risks, and effects of surgery, which may be a desperate consideration for solving health problems in time. In the blank of the "others" option, some parents also raised questions regarding how to distinguish between normal and abnormal snoring and whether there is an effective way to prevent OSA. These concrete data provided evidence to devise appropriate popular healthcare content. As Sia et al. (3) reported, traditional media were the most common sources of information about OSA in Singapore among the general population, followed by knowing an affected patient. In contrast, the most popular approach is the new multimedia approach (68.3%), followed by health education manuals (67.0%) in this study. With the rapid development of information technology, medical services have progressed from the traditional face-to-face mode to the current diversified medical mode. Especially after the outbreak of the COVID-19 epidemic, online outpatient clinics have rapidly increased in China (42, 43), making medical services more convenient and accessible (44). At the same time, the popular health science service does not adhere to traditional forms (such as books, brochures, and offline lectures) while creating a new internet media model with more efficient propagation and attracting content (such as short videos, interesting pictures, and WeChat subscription). These analytical outcomes suggest an increasing trend in the general population toward screening health risks by themselves, hoping to recognize abnormal conditions to prevent the occurrence and progression of the disease.

Sia et al. (3) reported that age, race, income, and education level were significant influencing factors for the ability to correctly define OSA. A Pomerania population-based survey conducted by Krüger et al. (45) in 2022 found that socioeconomic factors had no significant effects on OSA. In this survey, two regression models were established to determine the factors affecting medical practice for OSA and childhood OSA. It was illustrated that education background, household income level, place of residence, medical history, and knowledge level of OSA significantly influenced the practice of seeking medical help. For parents, work status, relationships with children, children's previous diagnosis with OSA, and overall OSA awareness were independent influencing factors for whether they would take children to the clinic. Although Krüger et al. (45) indicated that socioeconomic factors were not significantly correlated with the occurrence of OSA, the analysis in this survey confirmed the point that socioeconomic factors could modulate healthcare services. Those people who had a higher education level, household income, and lived in the city were more likely to have a positive attitude and practice toward OSA. Knowledge levels and attitudes showed predictive value for medical practice.

The theory of KAP suggests that correct understanding of diseases, developing positive attitudes, and forming healthy practices are three continuous processes of health education. In this study, the general population had a certain level of knowledge about OSA, but it was not sufficient, and positive practices were not forming completely. This outcome highlights expediting the promotion of popular science propaganda to raise awareness of OSA among the general population. As a consequence, their attitude and practices for seeking medical help could be transformed into an active mode in which the three sections promote each other. Correspondingly, the health impact on individuals and the public health burden on society would be relieved as well.

4.1. Limitations

As with any survey-based research, some possible limitations should be noted in this study. (1) Due to the limited objective conditions, there might be selection bias among participants due to the lack of randomization. Most of the data were collected from most areas of China without even and comprehensive distribution; therefore, the results might not represent the entire population well. (2) Urban residents and women with higher education levels were more likely to respond to the questionnaire, which might be cautiously generalized. (3) Although the researchers invited all general adult population who met the included criteria as much as possible, participation was voluntary. Therefore, people who volunteered to participate in this survey might have been more interested in healthcare knowledge than their counterparts. As mentioned above, the results need to be extrapolated prudently, especially in less educated groups and less economically developed areas. In these groups and areas, e.g., the insufficient KAP level due to OSA might be more severe. Nonetheless, data concerning the KAP and popular healthcare demand regarding OSA from nationwide samples in China supplemented the current sleep medicine studies.

5. Conclusion

The current study indicated that even though the higher educated and urban populations in China had a certain knowledge and positive attitudes about OSA, it was still insufficient. When symptoms or signs appeared, their limited awareness of complications and potentially severe adverse consequences hindered their inner motivation to undertake positive practice for it. The household income level, place of residence, medical history, and attitudes toward healthcare education can significantly affect people's decision to seek medical help. For parents, work status, relationships with children, and children's medical histories can be the influencing factors regarding medical practice. Economically developed factors and disparities between urban and rural areas

seem to be the key points influencing the medical practice pattern regarding OSA in populations. However, people's knowledge level about OSA had no specific influence on these patterns. The majority of people expressed active demand for popular healthcare education about OSA. Making full use of the new multimedia approach to expedite the provision of popular science information could be a promising way to improve medical practice in sleep medicine among the general 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

The studies involving human participants were reviewed and approved by the Ethics Committee on Biomedical Research of the West China Hospital of Sichuan University (Approval number: 2022.416). The patients/participants provided their written informed consent to participate in this study.

Author contributions

DL and ZP designed the research. TM reviewed the questions. QZ, TX, QR, and TL assisted in the process of collecting data. ZP and TM conducted the data analysis. ZP wrote the manuscript. DL edited and reviewed the manuscript. 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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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1128334/full#supplementary-material

References

1. Gottlieb DJ, Punjabi NM. Diagnosis and management of obstructive sleep apnea: a review. *JAMA*. (2020) 323:1389–400. doi: 10.1001/jama.2020.3514

2. Hu T, Gu Y, Xu Y, Yu J, Wu F, Chen R. Incidence of stroke and mortality in chinese patients with sleep-breathing disorders: a clinical population-based (CPB) study. *Med Sci Monit.* (2019) 25:10129–35. doi: 10.12659/MSM.918120

3. Sia CH, Hong Y, Tan LWL, van Dam RM, Lee CH, Tan A. Awareness and knowledge of obstructive sleep apnea among the general population. *Sleep Med.* (2017) 36:10–7. doi: 10.1016/j.sleep.2017.03.030

4. Martins FO, Conde SV. Gender differences in the context of obstructive sleep apnea and metabolic diseases. *Front Physiol.* (2021) 12:792633. doi: 10.3389/fphys.2021.792633

5. Senaratna CV, English DR, Currier D, Perret JL, Lowe A, Lodge C. Sleep apnoea in Australian men: disease burden, co-morbidities, and correlates from the Australian longitudinal study on male health. *BMC Public Health.* (2016) 16:1029. doi: 10.1186/s12889-016-3703-8

6. Butler RJ, Heron J. The prevalence of infrequent bedwetting and nocturnal enuresis in childhood. A large British cohort. *Scand J Urol Nephrol.* (2008) 42:257–64. doi: 10.1080/00365590701748054

7. Joosten KF, Larramona H, Miano S, Van Waardenburg D, Kaditis AG, Vandenbussche N. How do we recognize the child with OSAS? *Pediatr Pulmonol.* (2017) 52:260–71. doi: 10.1002/ppul.23639

8. Lo Bue A, Salvaggio A, Insalaco G. Obstructive sleep apnea in developmental age. A narrative review. *Eur J Pediatr.* (2020) 179:357–65. doi: 10.1007/s00431-019-03557-8

9. Thomas S, Patel S, Gummalla P, Tablizo MA, Kier C. You cannot hit snooze on OSA: sequelae of pediatric obstructive sleep apnea. *Children.* (2022) 9:261. doi: 10.3390/children9020261

10. Lyons MM, Bhatt NY, Pack AI, Magalang UJ. Global burden of sleep-disordered breathing and its implications. *Respirology.* (2020) 25:690–702. doi: 10.1111/resp.13838

11. Benjafield AV, Ayas NT, Eastwood PR, Heinzer R, Ip MSM, Morrell MJ. Estimation of the global prevalence and burden of obstructive sleep apnoea: a literature-based analysis. *Lancet Respir Med.* (2019) 7:687–98. doi: 10.1016/S2213-2600(19)30198-5

12. Burghard M, Brozek-Madry E, Krzeski A. Sleep disordered breathing in children - Diagnostic questionnaires, comparative analysis. *Int J Pediatr Otorhinolaryngol.* (2019) 120:108–11. doi: 10.1016/j.ijporl.2019.02.008

13. Young T, Evans L, Finn L, Palta M. Estimation of the clinically diagnosed proportion of sleep apnea syndrome in middle-aged men and women. *Sleep.* (1997) 20:705–6. doi: 10.1093/sleep/20.9.705

14. Finkel KJ, Searleman AC, Tymkew H, Tanaka CY, Saager L, Safer-Zadeh E. Prevalence of undiagnosed obstructive sleep apnea among adult surgical patients in an academic medical center. *Sleep Med.* (2009) 10:753–8. doi: 10.1016/j.sleep.2008.08.007

15. Kapur V, Strohl KP, Redline S, Iber C, O'Connor G. Underdiagnosis of sleep apnea syndrome in US communities *Sleep Breath.* (2002) 6:49–54. doi: 10.1055/s-2002-32318

16. Borsoi L, Armeni P, Donin G, Costa F, Ferini-Strambi L. The invisible costs of obstructive sleep apnea (OSA): systematic review and cost-of-illness analysis. *PLoS ONE.* (2022) 17:e0268677. doi: 10.1371/journal.pone.0268677

17. Tamay Z, Akcay A, Kilic G, Suleyman A, Ones U, Guler N. Are physicians aware of obstructive sleep apnea in children? *Sleep Med.* (2006) 7:580–4. doi: 10.1016/j.sleep.2006.04.004

18. Chan MTV, Wang CY, Seet E, Tam S, Lai HY, Chew EFF. Association of unrecognized obstructive sleep apnea with postoperative cardiovascular events in patients undergoing major noncardiac surgery. *JAMA.* (2019) 321:1788–98. doi: 10.1001/jama.2019.4783

19. Shaw R, McKenzie S, Taylor T, Olafiranye O, Boutin-Foster C, Ogedegbe G, et al. Beliefs and attitudes toward obstructive sleep apnea evaluation and treatment among blacks. *J Natl Med Assoc.* (2012) 104:510–9. doi: 10.1016/S0027-9684(15)30217-0

20. Al-Khafaji H, Bilgay IB, Tamim H, Hoteit R, Assaf G. Knowledge and attitude of primary care physicians towards obstructive sleep apnea in the Middle East and North Africa region. *Sleep Breath.* (2021) 25:579–85. doi: 10.1007/s11325-020-02137-7

21. Devaraj NK. Knowledge, attitude, and practice regarding obstructive sleep apnea among primary care physicians. *Sleep Breath.* (2020) 24:1581–90. doi: 10.1007/s11325-020-02040-1

22. Wang CL, Li XZ, Cai XL, Pan XL, Min J. Anesthesiologist's knowledge and attitudes about obstructive sleep apnea: a survey study. *Sleep Breath.* (2012) 16:41–6. doi: 10.1007/s11325-011-0482-4

23. Selvaraj S, Eusufzai SZ, Asif JA, Bin Jamayet N, Ahmad W, Alam MK. Comparison of knowledge level and attitude towards obstructive sleep apnoea amongst dental and medical undergraduate students of Universiti Sains Malaysia. *Work.* (2021) 69:173–80. doi: 10.3233/WOR-213466

24. Williams NJ, Nunes JV, Zizi F, Okuyemi K, Airhihenbuwa CO, Ogedegbe G. Factors associated with referrals for obstructive sleep apnea evaluation among community physicians. *J Clin Sleep Med.* (2015) 11:23–6. doi: 10.5664/jcsm.4356

25. Xu P, Zhang S, Yang J, Chu H, Li D, Zhao H. Survey of parental awareness of obstructive sleep apnea among children in Guangdong province, South China. *Auris Nasus Larynx.* (2021) 48:690–6. doi: 10.1016/j.anl.2020.10.018

26. Hong PC, Ou Q, Pan MX, Chen BX, Chen ZX, Hong ZG. Investigation on the awareness of snoring hazard and prevalence of obstructive sleep apnea among civil servants. *Zhonghua Jie He He Hu Xi Za Zhi.* (2020) 43:553–6.

27. Veasey SC, Rosen IM. Obstructive sleep apnea in adults. *N Engl J Med.* (2019) 380:1442–9. doi: 10.1056/NEJMcp1816152

28. Randerath W, Verbraecken J, de Raaff CA, Hedner J, Herkenrath S, Hohenhorst W. European Respiratory Society guideline on non-CPAP therapies for obstructive sleep apnoea. *Eur Respir Rev.* (2021) 30:162. doi: 10.1183/16000617.0200-2021

29. Natsky AN, Chai-Coetzer CL, Vakulin A, McEvoy RD, Adams RJ, Kaambwa B. Economic evaluation of diagnostic sleep studies for obstructive sleep apnoea in the adult population: a systematic review. *Sleep Med Rev.* (2022) 62:101608. doi: 10.1016/j.smrv.2022.101608

30. Chung SA, Jairam S, Hussain MR, Shapiro CM. How, what, and why of sleep apnea. Perspectives for primary care physicians. *Can Fam Physician.* (2002) 48:1073–80.

31. N. O'Flynn. Nocturnal enuresis in children and young people: NICE clinical guideline. *Br J Gen Pract.* (2011) 61:360–2. doi: 10.3399/bjgp11X572562

32. Caldwell PH, Deshpande AV, Von Gontard A. Management of nocturnal enuresis. *BMJ.* (2013) 347:f6259. doi: 10.1136/bmj.f6259

33. Snow A, Vazifedan T, Baldassari CM. Evaluation of nocturnal enuresis after adenotonsillectomy in children with obstructive sleep apnea: a secondary analysis of a randomized clinical trial. *JAMA Otolaryngol Head Neck Surg.* (2021) 147:887–92. doi: 10.1001/jamaoto.2021.2303

34. Chartier-Kastler E, Leger D, Comet D, Haab F, Ohayon MM. Prostatic hyperplasia is highly associated with nocturia and excessive sleepiness: a cross-sectional study. *BMJ Open.* (2012) 2:505. doi: 10.1136/bmjopen-2011-000505

35. Wang J, Zhao Y, Yang W, Shen T, Xue P, Yan X. Correlations between obstructive sleep apnea and adenotonsillar hypertrophy in children of different weight status. *Sci Rep.* (2019) 9:11455. doi: 10.1038/s41598-019-47596-5

36. Usmani ZA, Chai-Coetzer CL, Antic NA, McEvoy RD. Obstructive sleep apnoea in adults. *Postgrad Med J.* (2013) 89:148–56. doi: 10.1136/postgradmedj-2012-131340

37. Askland K, Wright L, Wozniak DR, Emmanuel T, Caston J, Smith I. Educational, supportive and behavioural interventions to improve usage of continuous positive airway pressure machines in adults with obstructive sleep apnoea. *Cochrane Database Syst Rev.* (2020) 4:Cd007736. doi: 10.1002/14651858.CD007736.pub3

38. Wang Y, Gao W, Sun M, Chen B. Adherence to CPAP in patients with obstructive sleep apnea in a Chinese population. *Respir Care.* (2012) 57:238–43. doi: 10.4187/respcare.01136

39. Zarhin D, Oksenberg A. Ambivalent adherence and nonadherence to continuous positive airway pressure devices: a qualitative study. *J Clin Sleep Med.* (2017) 13:1375–84. doi: 10.5664/jcsm.6828

40. Redline S, Amin R, Beebe D, Chervin RD, Garetz SL, Giordani B. The Childhood Adenotonsillectomy Trial (CHAT): rationale, design, and challenges of a randomized controlled trial evaluating a standard surgical procedure in a pediatric population. *Sleep.* (2011) 34:1509–17. doi: 10.5665/sleep.1388

41. Spilsbury JC, Storfer-Isser A, Rosen CL, Redline S. Remission and incidence of obstructive sleep apnea from middle childhood to late adolescence. *Sleep.* (2015) 38:23–9. doi: 10.5665/sleep.4318

42. Liu L, Gu J, Shao F, Liang X, Yue L, Cheng Q, et al. Application and preliminary outcomes of remote diagnosis and treatment during the COVID-19 outbreak: retrospective cohort study. *JMIR Mhealth Uhealth.* (2020) 8:e19417. doi: 10.2196/19417

43. Gong K, Xu Z, Cai Z, Chen Y, Wang Z. Internet hospitals help prevent and control the epidemic of COVID-19 in China: multicenter user profiling study. *J Med Internet Res.* (2020) 22:e18908. doi: 10.2196/18908

44. Ge F, Qian H, Lei J, Ni Y, Li Q, Wang S, et al. Experiences and challenges of emerging online health services combating COVID-19 in China: retrospective, cross-sectional study of internet hospitals. *JMIR Med Inform.* (2022) 10:e37042. doi: 10.2196/37042

45. Krüger M, Obst A, Bernhardt O, Ewert R, Penzel T, Stubbe B. Socioeconomic factors do not predict sleep apnea in a population sample from Mecklenburg-Western Pomerania, Germany. *Sleep Breath.* (2022) 29:1–9. doi: 10.1007/s11325-022-02614-1

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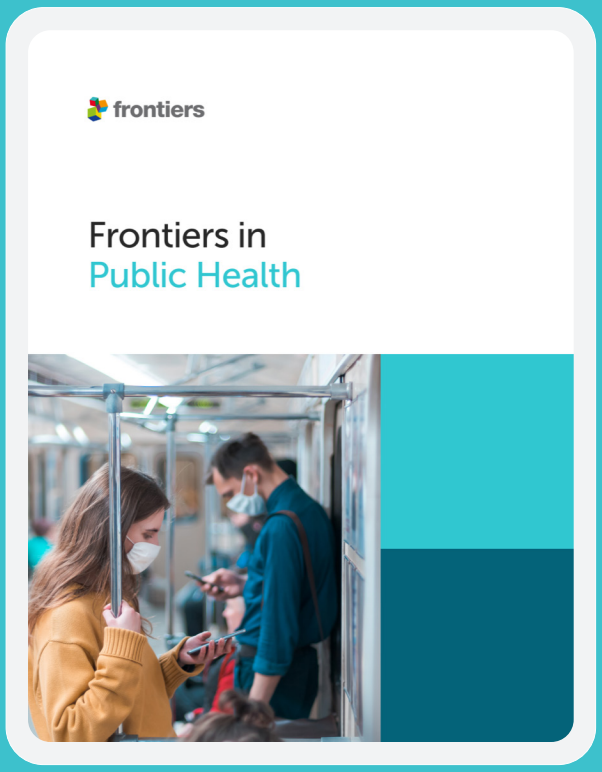

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