Iran J Public Health, Vol. 53, No.5, May 2024, pp.1009-1020

Review Article

Knowledge, Awareness and Perception towards Osteoporosis Risk in China: A Systematic Review

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(Received 24 Aug 2023; accepted 16 Nov 2023)

Abstract

Background: We aimed to evaluate the level of knowledge, awareness, and perceptions regarding osteoporosis (OP) and risk factors in China.

Methods: The databases of PubMed, Medline, Embase, Web of science, VIP, and CNKI were searched for papers published before December 2022 using Chinese and English keywords and their combinations: "knowledge", "osteoporosis", "risk factor", "bone health", "perception", "awareness". The levels of knowledge, awareness, and perception about OP, as well as risk factors, clinical symptoms, and health information sources were narratively synthesized.

Results: Sixteen papers were finally included for analysis. Participants all showed poor levels of knowledge and perception regarding osteoporosis and risk factors. Investigation of clinical symptoms was rarely involved in the included studies due to the asymptomatic features of OP. The findings also suggest a strong association between poor level of knowledge regarding OP and educational attainment, type of participant, and gender. The majority of participants are increasingly turning to the Internet and social media to access information about OP.

Conclusion: The findings of this paper provide useful information for intervention providers to prevent and control OP and encourage them to carry out health promotion campaigns to enhance knowledge and awareness of OP.

Keywords: Osteoporosis; Risk factors; Awareness; Risk perception; Knowledge

Introduction

OP is a systemic bone disease characterized by low bone mass and deterioration of the bone matrix, resulting in bone fragility and an increased risk of fracture (1). OP is also known as the "silent disease" because there aren't any symptoms until a fracture occurs (2). Osteoporotic fractures can lead to disability, poor quality of life, premature death, and a significant financial burden on families. The WHO has defined OP as a 21st century epidemic, along with obesity, diabetes, and cardiovascular disease (3).

OP has become a significant public health problem. In developed countries, the prevalence of OP ranges from 2 to 8 % among males and 9 to

38 % among females depending on the method of diagnosis (4), while the incidence of OP is now on the rise in Asia. Epidemiological studies suggest that by 2050 more than 50% of osteoporotic fractures will occur in Asia (5). It is therefore foreseeable that China will face serious health problems in the future due to a huge population and increased pension and healthcare cost. Especially with the increase of people's average life span and the change of diet habits, lack of physical exercise, sedentary behavior, OP will become more prevalent in China in future.

Despite the adverse effects of OP, the level of public awareness about OP is low (6). Improving public awareness, especially among young people, is a good way to ensure their future bone health. Increased awareness of the disease may also translate into greater awareness for older and at-risk family members. China has a large population, and modest progress in preventive management of OP could significantly improve health outcomes.

For these reasons, this systematic review was performed to evaluate the knowledge and awareness of OP across the general population living in mainland China, Hong Kong, Macau, and Taiwan. Another goal is to understand how people get such information.

Methods

We referred to the methods of work by Daniel Boateng (7) and conducted this review according to the procedures recommended in PRISMA2020 (8).

Search strategy

PubMed, Medline, Embase, Web of science, VIP, and CNKI were searched using Chinese and English keywords and their combinations: "knowledge" "osteoporosis", "risk factor", "bone health", "perception" and "awareness". The reference lists of full-text papers were manually searched to find more articles related to this review. Inclusion criteria of the studies were as follows: 1) conducted in mainland China, Hong Kong, Macau, Taiwan, published in English and in peer-reviewed journals or in Chinese indexed in the core journals of China; 2) any design and methodology: quantitative or qualitative, exploring knowledge, awareness and perception of OP and its risk factors. Studies that were carried out among Chinese populations outside of mainland China, Hong Kong, Macau and Taiwan were excluded.

Data extraction

Data extraction was done by two reviewers independently from the included studies. Disagreements were resolved by a third reviewer. The name of authors, year of publication, study design and population, research methods, findings on knowledge, awareness of and perception regarding OP, sources of information and risk factors were extracted from each eligible study when available.

Quality assessment

The Critical Appraisal Skills Programme (CASP) tool (9) was used for quality appraisal in health-related qualitative evidence synthesis, including the relevance of study objectives, appropriateness of experimental design, methodology, recruitment strategy, data collection and analysis, description of results, ethical considerations, and findings. The National Institute of Health (NIH) Quality Assessment tool (10) was used to appraise the reliability, validity, and generalizability of the quantitative study, including research questions, participants, sample size, exposure and outcome evaluation, follow-up and statistical analysis. The overall quality of the study was rated as good, fair, or poor.

Synthesis of findings

The thematic synthesis of qualitative research reflects a transparent link between the conclusions and the research text. This makes it possible to analyze and extract the results of abstract. A multi-source synthesis method (11) was used to incorporate those findings from quantitative studies by topic. It can also serve as a guide for synthesizing primary research data to form a

more meaningful and broader understanding of the topic. The findings from qualitative and quantitative research are further integrated by similar topics. Due to heterogeneity between studies, the data were not pooled and meta-analyzed.

Results

Search results and study characteristics

Among the 1296 articles initially retrieved, 16 articles were finally included in this study. The selection process of articles is shown in Fig. 1, and the characteristics of the included studies are shown in Table 1.

Quality assessment of included studies

Ten of the included studies were of good or high quality, which was attributed to the detailed description of the experimental methods and design, procedures and results, and detailed presentation of findings (12-19, 21, 26). Six studies were of fair or poor quality (20, 22-25, 27) due to failed to describe details of subject recruitment processes and other issues that could lead to a high risk of bias and undermine the generalizability of the study, detailed as shown in Table 1.

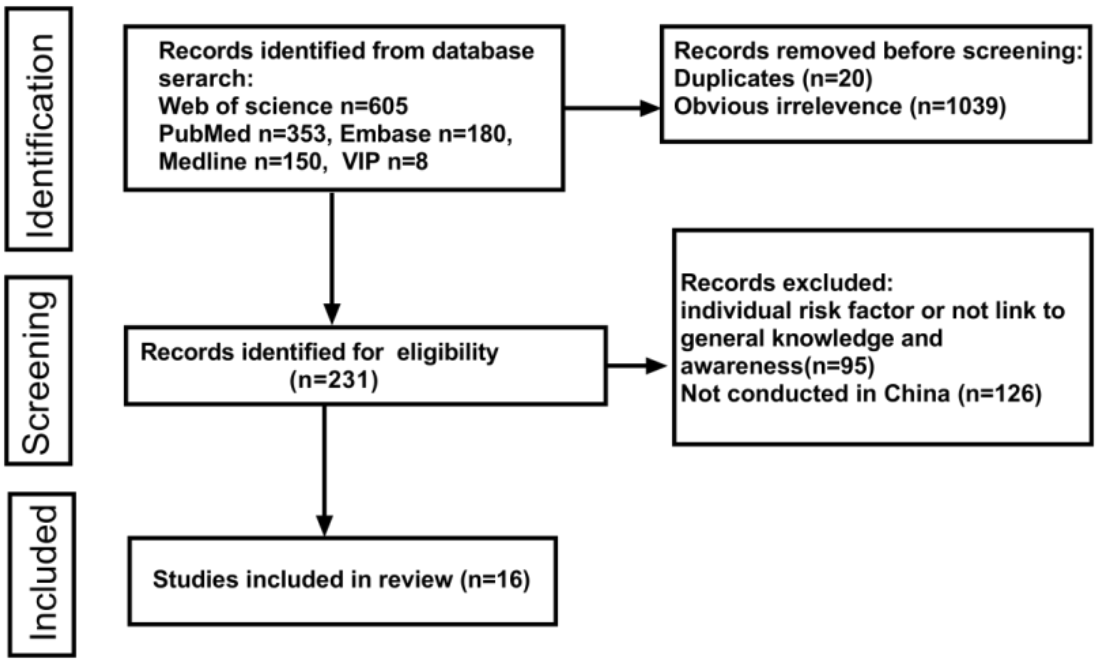

Fig. 1: The process of inclusion and exclusion of relevant articles

Table 1: Characteristics of included studies

1st author (Ref No.)/year	*Design and methods*	*Sample size*	*Study population*	*Quality assessment*
Oumer KS (12), 2020	Design: Cross-sectional study Methods: quantitative; random sampling	368 (195 M, 173 F)	General residents	Good
Ip TP(13),2004	Design: A postal questionnaire survey; Methods: quantitative; purposive sampling	204 (111 M, 103 F)	Hospital or clinic-based physicians	Good
Wong CP(14), 2014	Design: A questionnaire survey; Methods: quantitative; convenience sampling	937 (302 M, 635 F)	General people	Good
Zhang YP(15), 2014	Design: A cross-sectional study; Methods: quantitative; multi-stage sampling	259 (137 F, 122 M)	Non-academic community Chinese population	Good
Peng L (16), 2019	Design: A cross-sectional survey; Methods: quantitative; purposive sampling	530 F	Registered Nurse in mainland China	Good
Hsieh E (17), 2014	Design: A cross-sectional study; Methods: quantitative; purposive sampling	236 (178 M, 59 F)	Chinese individuals with HIV	Good
Fok M (18), 2008	Design: A cross-sectional questionnaire study; Methods: quantitative; purposive sampling	250 F	Postmenopausal women	Good
Xu J (19), 2013	Design: Questionnaire study: Methods: quantitative; random sampling	9049 (3058 M, 5991 F)	General population	Good
Lee LY-K (20), 2005	Design: A cross-sectional survey; Methods: quantitative; convenience sampling	52 M	Older men recruited from a community center	Fair
Zhang YP (21), 2012	Design: A quasi-experimental study; Methods: quantitative; purposive sampling	256 F	Chinese technical/professional pre-internship nurse students	Good
Xie B (22), 2014	Design: A questionnaire study; Methods: quantitative; purposive sampling	267 F	Postmenopausal women	Fair
Shen Y (23), 2006	Design: A cross-sectional study; Methods: quantitative; random sampling	840 (not stated)	People living in Kunming province	Fair
Du R (24), 2014	Design: A cross-sectional study; Methods: qualitative; purposive sampling	364 (245 M, 119 F)	Patients who underwent bone mineral density tests	Fair
Guo X (25), 2018	Design: A cross-sectional study; Methods: qualitative; purposive sampling	80 (32 M, 48 F)	Patients with abnormal bone mineral density	Fair
He B (26), 2012	Design: A cross-sectional study; Methods: quantitative; stratified sampling	225 F	Female residents	Good
Zheng W (27), 2015	Design: A cross-sectional survey and semi-structured interviews; Methods: quantitative; purposive sampling	590 (30 M, 560 F)	Nurses and nurse managers	Poor

Knowledge and awareness regarding OPs

Different criteria were used to measure and categorize the levels of knowledge and awareness of OP. In a study (12), the awareness level was evaluated by the percentage of correct answers under each domain, including definition, diagnosis, signs/symptoms, treatment, complications, prognosis, causes, risk factors and prevention of OP. Ip TP qualitatively describes the level of knowledge and awareness of OP from physicians' perspective (13). In other studies (14, 15), the author compared the knowledge level about OP between men and women from Macau and a Non-academic Community from Xi' an city, in which the level of knowledge was indicated by the scores of correct answers and there was no specific standard of "good", "medium" and "poor". The studies (16, 17, 20-23, 25-27) employed the similar methodology, in which participants' level of knowledge regarding OP was assessed by Osteoporosis Knowledge Assessment Tool (OKAT) or a similar questionnaire. The level of awareness regarding OP was evaluated by the percent of answers "Yes" or "No" to six simple questions concerning basic awareness (19). The findings regarding the level of knowledge and awareness of OP were summarized in Supplementary Table 1 (Not published. Readers may contact the authors if needed).

Knowledge of OP risk factors

To measure the knowledge of risk factors for OP, participants were required to correctly identify them from a list. Among the studies included, risk factors mentioned more frequently included smoking, alcohol consumption, physical exercise, dietary intake, age, ethnicity, and family history.

Smoking

The negative health effects of cigarette smoking have been widely recognized throughout the world. After years of publicity about the association of smoking and health in China, people's awareness of the dangers of smoking has greatly improved. In China, the government has implemented a ban on smoking in public places, such as on public transport, restaurants, and other places. Smoking as an OP risk factor was reported by 41.3% of participants in study (12), while 44.0% for male and 48.0% for female in study (14). In study (15), the percent of smoker in females and males was 7.3% and 62.3% respectively. 76% and 44.2% participants had a correct understanding of the association between smoking and OP in study (16, 23). Participants' correct perception of the link between smoking and OP rose from 31.6% to 75% before and after the educational program in study (21).

Alcohol consumption

In China, drinking is part of many traditional festivals and celebrations. However, drinking has been shown to have complex, and sometimes paradoxical, associations with different diseases (28). The link between alcohol consumption and specific diseases, such as OP, is hard for general people to understand. In study (16), drinking as a risk factor for OP was mentioned but not described in detail. The correct response rate to the question "Alcohol in moderation has little effect on osteoporosis" was 41.7% for men and 48% for women in study (14) and 40% for participants in study (16). In study (15), of the participants, 53.3% of men and 15.3% of women were current alcohol users. Almost all the women and 72.9% of the men had a history of moderate or low alcohol consumption, and 27.1% of the men had excessive alcohol consumption. "Current alcohol use" in study (17) was 26.8% and 12.3% for men and women, respectively. Participants (43.5%) had a correct understanding of the relationship between alcohol consumption and OP in study (23). Participants' correct response to the question "Alcohol in moderation has little effect on osteoporosis" rose from 21.1% to 36.3% after the educational program in study (21).

Physical activity

Due to evidences on the benefits of physical exercise for different diseases, general people have a good perception of the health benefits of physical exercise. To improve public health, China's expert panel has proposed an expert consensus on physical activity and health for children and

adolescents. Among the included studies, physical activity was identified as a risk factor for OP by 73.9% participants in study (12). The correct response rate to the association between physical activity and OP was 70.2% for men and 76.5% for women in study (14) and 59% for participants in study (16). In study (15), about 78.1% of women and 76.2% of men participated in a regular exercise routine that included weight-bearing exercises for 30 minutes, three times a week. In study (17), moderate or above physical activity were 70% for men and 71.4% for women. Participants (77.9%) had a correct understanding of the link between physical activity and OP in study (23). Participants' correct response to the question "Any type of physical activity is beneficial for osteoporosis" rose from 43.4% to 53.9% after the educational program in study (21).

Dietary intake

Many studies suggested a strong link between dietary habits and disease risk (29). It is widely believed that loss of calcium is associated with OP. However, calcium deficiency is a widespread nutritional problem all over the world, especially in China. Dietary intake is a protective factor in the prevention of OP, which was correctly recognized by 83.2% participants in study (12). In study (14), 53.7% men and 43.9% women don't think that calcium supplementation alone would prevent OP, and 46.7% men and 50.2% women considered sardines and broccoli as good sources of calcium for people who cannot eat dairy products. Dairy foods, soy products, meat, or eggs were evaluated as calcium source in study (15), in which 31.7% men and 32.1% women regularly consumed dairy products, less than one-third of them ate soybean food regularly and 19.3 % ate meat or eggs regularly, twice as many men as women. In study (16), the percent of correct responses for calcium intake, calcium food source, and salt intake were 70%, 83%, and 63%, respectively. In study (17), men and women were compared in detail on the frequency of dairy products (5.5±1.9 vs. 5.5±2.2), soy products (5.8±1.4 vs. 6.2±1.7), green leafy vegetables (6.7±1.6 vs. 7.1±1.5), nuts (5.1±1.6 vs. 5.1±2.2), seafood (5.1±1.5 vs. 5.0±1.9) and vitamin D-rich foods (5.9±1.5 vs. 6.3±1.6). Participants' correct perception of the association between calcium, salt intake, and OP rose from 29.7% to 52.0% and 34.8% to 62.5% after the educational program in study (21). In study (23), 88.7% participants had a correct understanding of the link between daily calcium supplementation and OP risk.

Gender and Menopause

Gender is an important factor for disease risk. Some diseases occur only in women or have a higher incidence or worse prognosis in women, such as OP, thyroid cancer, breast cancer, cervical cancer, ovarian cancer, and cardiovascular disease (30). In addition, changes in women's body during menopause can increase specific health risks. OP is a major health risk for menopausal women due to accelerated bone loss(31). Gender as a risk factor for OP was mentioned in study (14, 16, 21). The correct response for the link between gender and OP was 37.4% for males, 23.1% for females in study (14), 57% for females, 42.7% for males in study (23) and 64% for all participants in study (16). Similarly, a rising correct response from 23.4% to 72.7% was observed in study (21). Post menopause as a risk factor specifically for women was investigated in study (12), the correct recognition percentage of participants was 42.9%. In study (14), the authors conducted a statistic on the time of menopause (13.9% occurred before the age of 45). For women's understanding of bone loss after menopause, 65.2% and 28% correct responses were reported in study (14) and (16), and rising correct responses from 19.5% to 49.6% were observed in study (21).

Family history

Many studies have reported that family history is a strong risk factor for diseases such as cancer, cardiovascular disease, diabetes, and autoimmune diseases (32). Existed studies have shown a link between OP and family history (33). Among the included studies, the correct responses for the link between family history and OP were 41.1% for males and 39.5% for females in study (14)

and 76% for all participants in study (16). In study (15), 8.8% of women and 16.4% of men had a family history of minimal or non-traumatic fractures. A rising correct response for the association between family history and OP from 57.0% to 69.9% was observed in study (21).

Other risk factors

Other risk factors for OP mentioned in the included studies were age and ethnicity. For women, age is a high risk factor regarding OP. Experts recommend that women should be screened for OP after age 65. Included studies (14, 16, 21) identified age as risk factor for OP. For the question "By age 80, the majority of females have osteoporosis" and "From age 50, most females can expect at least one fracture before they die", participants in study (16) had a high correct response (89%) and a low correct response (22%). While in study (14), the correct response was 60.9% for males, 75.7% for females and 18.9% for males, 29.1% for females. A rising correct response from 60.2% to 75.0% and 21.9% to 33.6% was observed in study (21). Ethnicity is an important factor influencing the incidence of OP (34), although this issue should not be considered in the Chinese population. In order to evaluate participants' knowledge of the risk factors for OP, the link between ethnic differences and the incidence of osteoporosis was mentioned in a questionnaire designed for their studies (14, 21, 25). Perceptions of the relationship between ethnicity and OP didn't have a significant difference between men and women in study (14). After the educational program, the correct response rate for the link between ethnicity and OP increased from 21.5% to 65.6% in study (21).

Knowledge of symptoms of OP

Owing to a "silent disease", few studies included in this review involved knowledge investigation of clinical symptoms of OP. Two most common clinical symptoms including frequent fractures and pain were mentioned in the included studies (12, 14, 16, 21). For the relationship between frequent fractures and OP, the correct response rate was 84.8% in study(12), 80.5% for males and 83.0% for females in study (14), 99% participants in study (16) and 70.3% for pretest, 89.8% for post-test in study(21). Concerning pain, the included studies examined participants' perception of when and where pain occurred. In study (12), the correct response rate of participants to the location of pain was 84. 2%. About when the pain occurred, the correct response rate was 84.1% for males, 84.4% for females in study (14) and 68.8% for pretest, 84.4% for post-test in study (21).

Sources of information on OP

Among the included studies in this review, people accesses health information from radio, television, newspapers, magazines, brochures, networks, social media, family or relatives, and professional physicians. In study (12), health programs on radio or television (55.7%) were the main sources of knowledge about OP, followed by chatting with friends or family (40.5%), wechat APP (29.1%), newspaper and magazines (29.1%), and internet (22.6%). In study (25), the way people want to get information is medical institutions (41.3%), TV/newspaper/magazine/broadcast (26.3%), brochures (20%), and internet (12.5%). In study (23), health education activities accounted for 46.3%, physicians for 41.2%, newspapers/magazines for 40.3%, and TV for 25.9%.

Discussion

In China, the number of people with OP will increase greatly in the future due to the expanding aging population. However, studies on knowledge and awareness of OP and its risk factors are relatively insufficient. After the systematical review, the findings showed that participants have relatively low to moderate levels of knowledge and awareness about OP and its risk factors. In a study (12), participants' awareness of OP was moderate, and lower household income and education attainment were associated with lower awareness. A study performed in physicians from government hospitals and private clin-

ics in Hong Kong indicated that doctors have relatively good knowledge and awareness of the condition even though such conditions were still under-diagnosed (13). In other studies (14, 15), participants' level of knowledge and awareness of OP were different in gender variables. There were significant gender differences in perceived seriousness (P=0.03), barriers to exercise (P=0.004) and motivation (P=0.01) (15). People over the age of 55 years had significantly less knowledge, while men had less knowledge than women in the same age group (14). These findings suggest that gender differences should be considered in health education and primary OP interventions. A study (16) indicated a moderate to low knowledge level of OP among orthopedic nurses in Hunan Province, China. According to their study, variables including age (36–45 years), marital status (married), and education (bachelor degree or above) have a positive association with a better knowledge level. Therefore, single young nurses with low education level need to carry out in-depth education to enhance the level of knowledge and awareness, so as to improve the service quality and provide counseling for fracture patients. HIV patients have a higher risk for OP and bone fractures (17). The results showed that the knowledge level of OP in this group was generally low, and self-efficacy was directly related to the implementation of protective behavior. These findings imply the importance of adopting OP-related preventive behaviors in individuals with HIV. A study (21) investigated the effect of educational programs on the knowledge level of OP among nurse students; the results indicated that continuous education prior to clinical practice was necessary. In summary, increasing knowledge and awareness shall help decrease the overall fracture linked with OP. Some steps thus should be taken by the authority with the help of professional campaigns, health education, OP-related nutrition, causes, treatment, and celebration of World OP Day to improve their knowledge and awareness of this disease.

Influenced by history and culture, drinking has a long history in China. Almost all the women and 72.9% of the men had a history of moderate or low alcohol consumption, and 27.1% of the men had excessive alcohol consumption (15). Although perceptions of the relationship between drinking and health have improved, alcohol consumption, like smoking, is difficult to control effectively for long. In fact, the relationship between alcohol consumption and OP is also slightly different. There are conflicting reports on whether moderate drinking is good or bad for bone health. People who drank moderately daily had a lower risk of hip fracture than those who abstained from alcohol (35). Light-to-moderate alcohol consumption was beneficial in older adults because it slowed bone remodeling (36). However, recent study (37) has found a positive association between alcohol consumption and OP, i.e., alcohol consumption leads to a higher incidence of OP. Even though there are studies showing that moderate drinking is beneficial for some diseases, the practical application of such findings is limited. This could be attributed to an increased risk of some cancers and other adverse effects associated with moderate to heavy drinking (38). Taken together, the negative relationship between heavy drinking and health is well established. Relevant authorities should formulate and effectively implement interventions to limit heavy drinking.

Physical activity and dietary habits had a positive role in reducing cancer risk and overall mortality (39). However, dramatic lifestyle and dietary habit changes happened in China over the last two to three decades due to rapid urbanization, where high-fat diets became popular, while sedentary lifestyles replaced moderate physical labor. Classic risk factors for OP, such as obesity (40), low physical activity (41) and dietary habits (42), were highlighted. As a result, there has been a shift from diseases previously caused by undernutrition and active lifestyles to chronic diseases associated with over-nutrition and a sedentary lifestyle. Although participants in the included studies had a good perception of the relationship between physical activity and OP, there was no detailed description of the type of exercise that was beneficial to bone health. Some studies have shown that certain types of physical activity are

beneficial in reducing the risk of OP (43), while some common forms of physical activity are not significant in preventing OP (44). In terms of dietary habits, although only a few foods or nutrient types were investigated and analyzed in the included studies, there are actually many dietary factors that affect bone mineral density (BMD). Studies have demonstrated that dietary factors such as dairies (45), fruits and vegetables (46), seafood (47), tea (48), coffee (49), antioxidants (50), vitamins B and D (51), calcium (52), and protein play a role in promoting and maintaining bone density and bone mass; whereas colas (53) or caffeine (49) has an opposite effect on BMD. Clearly, such knowledge and awareness about the relationship among types of physical exercise, dietary habit, and OP needs to be improved through the widespread dissemination of professional knowledge among the general population.

This review also indicated that knowledge of OP was significantly associated with participant types and education level. Obviously, physicians' knowledge of OP was significantly higher than that of the general population (13), while orthopedic nurses with a bachelor's degree or above have significantly different levels of knowledge about OP than those with less education level (16). Other studies (22-24) have also shown a relationship between education attainment and risk perceptions of OP. These results point to the need for governments to continuously improve the educational attainment of general people.

Media communication is an important means of disseminating information. Therefore, media exposure can significantly affect people's risk perception and protective behaviors (54). Obviously, the information from physicians is the most direct and accurate. However, the communication of information between doctors and patients is often inadequate during the actual clinical practice, which may be attributed to the limitation of medical resources, the difference in knowledge level between doctors and patients, and the avoidance of psychological burden on patients (55). Although the investigation of sources of health information on OP was less involved among the included studies, the characteristics of access to health information were evident. With the rise of network technology and new media technologies, people are more likely to use the Internet and social media to accesses health information (56). This puts forward higher requirements for the authenticity, accuracy, and comprehensiveness of information. Information regulatory authorities should strengthen the release of information, especially health-related we-media and online advertisements (54).

Limitations should be mentioned here. First, meta-analysis could not be conducted due to the heterogeneity of the knowledge level evaluation criteria of the included studies. Second, as different evaluation criteria and study populations vary significantly across studies, levels of knowledge and awareness are difficult to compare among different participants.

Conclusion

Despite some limitations, this is the first systematic review that presents evidence regarding the knowledge and awareness of OP and its risk factors. Generally, the level of knowledge and awareness of OP was moderate to low in Chinese population. Knowledge levels of OP varied with the type of participants and were influenced by education level and gender. These findings provide valuable information for health promotional agencies and policy makers to implement tailored educational activities for different populations. In addition, risk behaviors associated with OP, such as smoking, unhealthy dietary habits, and sedentary lifestyles should be properly communicated through various media. In conclusion, the evidence provided in this review lays the foundation for the development of effective policy measures and surveillance mechanisms and the improvement of public health awareness in the future.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission,

redundancy, etc.) have been completely observed by the authors.

Acknowledgements

This work was supported by the Ministry of Education of the People's Republic of China under the Research Grant for Planning Foundation Projects of Humanities and Social Sciences (23YJAZH072), by Zhejiang Provincial Philosophy and Social Science Planning Project (24NDJC027YB) and by Huzhou Science and Technology Bureau (2020GZ29).

Data Availability

The data are available from the corresponding author on reasonable request and pending approval from the Institutional Review Board of the corresponding author's university.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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