

Knowledge, Attitudes, and Practices of Patients with Knee Osteoarthritis Regarding Osteoporosis and Its Prevention: A Cross-Sectional Study in China

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Background: Older age and female sex are risk factors for osteoarthritis and osteoporosis (OP). This study evaluated the knowledge, attitudes, and practices of patients with knee osteoarthritis (KOA) in China regarding OP and its prevention. This cross-sectional, questionnaire-based study enrolled patients with KOA at four grade-A tertiary hospitals in Shandong Province between 1st September and 20th November 2022.

Methods: The administered questionnaire contained 55 items across four dimensions (demographic information, knowledge, attitude, and practice). Logistic regression analyses were performed to identify factors associated with an overall questionnaire score $\geq 70\%$ of the maximum possible score. SPSS 26.0 was used for the analyses; $P < 0.05$ was considered significant.

Results: The analysis included 434 participants (261 females). The median knowledge, attitude, and practice scores were 7 (interquartile range: 5–10) (possible range, 0–17 points), 44 (interquartile range: 42–49) (possible range, 11–55 points), and 43 (interquartile range: 38–47) (possible range, 13–65 points), respectively. Multivariable logistic regression indicated that female sex (odds ratio [OR], 2.421; 95% confidence interval [95% CI] 1.558–3.762; $P < 0.001$), age 56–65 years-old (OR, 4.222; 95% CI, 1.763–10.109; $P = 0.001$ vs ≤ 55 years-old), age > 65 years-old (OR, 4.358; 95% CI, 1.863–10.195; $P = 0.001$ vs ≤ 55 years-old), middle/high/technical secondary school education (OR, 1.853; 95% CI, 1.002–3.428; $P = 0.049$ vs primary school or below), and having KOA for 4–5 years (OR, 2.682; 95% CI, 1.412–5.094; $P = 0.003$ vs ≤ 3 years) were independently associated with a high KAP score.

Conclusion: There is room for improvement in the knowledge and practices of patients with osteoarthritis in China regarding OP. The findings of this study may facilitate the design and implementation of education programs to increase awareness about OP prevention among patients with KOA.

Keywords: osteoarthritis of the knee, osteoporosis, disease prevention, surveys and questionnaires, health knowledge, attitudes, practice

Introduction

Osteoarthritis is a degenerative disease of joints that frequently involves the knee.¹ Osteoarthritis is a disease of a whole joint and involves all the articular tissues. Osteoarthritis is characterized by cartilage loss, subchondral bone remodeling, periarticular hyperosteoecy, fibrosis and synovial hyperplasia, meniscus degeneration, and infrapatellar fat pad inflammation and fibrosis.^{2–4} A recent study estimated the global prevalence and incidence of knee osteoarthritis (KOA) to be 16% and 203 per 10,000 person-years, respectively, although the prevalence and incidence varied substantially between different countries.⁵ KOA is common in China, with a prevalence of 21.5% in middle-aged and elderly people.⁶ The main clinical manifestations of KOA are chronic pain, stiffness, joint space narrowing, and limitation of joint motion.⁷ A variety of risk factors for incident KOA have been identified in different populations, including older age, female sex, overweight, smaller range of motion, family history, history of knee injury, and Kellgren and Lawrence grade 1 at baseline.^{8–13} The available

management options for KOA include exercise, weight loss, walking aids, thermal agents, tibiofemoral or patellofemoral bracing, topical and oral nonsteroidal anti-inflammatory drugs, intraarticular glucocorticoid injections, intraarticular hyaluronate, acetaminophen, duloxetine and tramadol.^{14,15} However, total knee replacement remains the only effective treatment method in patients with advanced symptoms and structural damage.¹⁶

Osteoporosis (OP) is a systemic bone disorder characterized by low bone mass, destruction of the bone microarchitecture, decreased bone strength, and increased risk of fracture.^{17,18} OP is associated with older age and female gender,¹⁹ and the prevalence of OP in women aged ≥ 50 years old is around 30%.^{20,21} The lifetime probability of a major osteoporotic fracture is approximately 40% in women aged 50 years old, and the most frequent fracture sites are the spine, hip, distal forearm, and proximal humerus.²² Early diagnosis and treatment of OP is critical to minimize the risk of osteoporotic fracture, which is associated with high morbidity and mortality.²³ The diagnosis of OP is based on the clinical history and examination, laboratory tests, imaging investigations, and measurements of bone mineral density (BMD).²⁴ Treatments for OP include bisphosphonates, denosumab, parathyroid hormone analogs, estrogen receptor modulators, menopausal hormone therapy, and calcium and vitamin D supplements.²⁵ However, it is recognized that OP is underdiagnosed and undertreated in China.²⁶

Since both OP and osteoarthritis are associated with increasing age and female gender, OP is common in people with KOA. For example, OP and osteopenia were detected in 17%–23% and 43%–46%, respectively, of patients scheduled for total knee arthroplasty.²⁷ Furthermore, comorbid OP further impairs physical function in patients with osteoarthritis.²⁸ The risk of OP in people with osteoarthritis is decreased if appropriate preventive measures are taken, such as regular exercise, dietary modifications, and calcium/vitamin D supplementation.^{4,29,30} However, although research has been conducted to evaluate the awareness of OP among the general population in China,^{31,32} to our knowledge, there are no data specifically for patients with KOA. Knowledge, attitude, and practice (KAP) surveys provide useful information about the baseline knowledge, attitudes, beliefs, misconceptions, and behaviors of people toward a health-related topic.³³ Additionally, the insights provided by KAP surveys can help inform the development and implementation of education and training programs to overcome issues and barriers that impair disease prevention, diagnosis, and treatment.³³ Therefore, the aim of this study was to evaluate the knowledge, attitudes, and practices of patients with KOA in China regarding OP and its prevention.

Methods

Study Design and Participants

This cross-sectional, questionnaire-based investigation enrolled patients with KOA who were admitted to an osteoarticular ward or attended a clinic at four grade-A tertiary hospitals in Shandong Province (China) between 1st September 2022 and 20th November 2022. The inclusion criteria were as follows: 1) medically confirmed KOA; 2) age ≥ 18 years; 3) considered to have sufficient communication ability and understanding to complete the questionnaire; 4) volunteered to participate in this study. The exclusion criteria were: 1) previously received or currently receiving treatment for OP; 2) severe cardiopulmonary disease affecting mobility; 3) previous cerebral infarction or cerebral hemorrhage; 4) history of fibromyalgia or rheumatic diseases; 5) limitation of limb movement. The study was approved by the Ethics Committee of the First Affiliated Hospital of Shandong First Medical University (approval # 【2022】 Ethics Application No. (S530) on August 31, 2022), and informed consent was obtained from all participants. The study was also performed in accordance with the Helsinki Declaration.

Questionnaire Design and Administration

The questionnaire was designed in Chinese and contained four dimensions: demographic information, knowledge, attitude, and practice. The demographic information dimension contained 13 items that collected the following data: gender, age, body mass index (BMI), education level, area of residence (urban or non-urban), annual income, duration of KOA, presence/absence of comorbid hypertension, presence/absence of comorbid diabetes mellitus, presence/absence of heart disease, medication history, daily salt intake and exercise level. The exercise level was categorized as low intensity, moderate intensity, or high intensity according to the International Physical Activity Questionnaire (IPAQ).³⁴ The knowledge dimension consisted

of 17 questions (K1–K17), each of which was scored 1 point for a correct answer and 0 points for an incorrect or unclear answer. The total score of the knowledge dimension ranged from 0 to 17 points. The attitude dimension consisted of 11 items (A1–A11), which were scored using a five-point Likert scale (“strongly agree” = 5 points, “agree” = 4 points, “neutral” = 3 points, “disagree” = 2 points, and “strongly disagree” = 1 point). The total score of the attitude dimension ranged from 11 to 55 points. For the analysis, “strongly agree” and “agree” were considered to indicate a positive attitude. The practice dimension was designed with reference to a previously published study³⁵ and consisted of 13 questions (P1–P13). Items P1 and P6–P13 were scored as 1 point for “never” or “once-A-year”, 2 points for “multiple times per year” or “once-A-month”, 3 points for “multiple times per month”, 4 points for “once-A-week” or “multiple times per week”, and 5 points for “once-A-day” or “multiple times per day”. The scoring system was reversed for items P2–P5 (which evaluated the frequency of smoking and consumption of coffee, alcohol, and carbonated drinks). The total score of the practice dimension ranged from 13 to 65 points. The Cronbach’s α coefficient of the questionnaire was determined to be 0.720, indicating good internal consistency (ie, good reliability).

Paper versions of the questionnaires were administered by master’s degree students during face-to-face meetings with the patients. The master’s degree students had received standardized training to ensure consistent administration of the questionnaire. The completed questionnaires were carefully checked on-site to ensure that no information was missing.

Statistical Analysis

The Kolmogorov–Smirnov test was used to assess continuous data normality. Quantitative variables are expressed as the mean $\pm$ standard deviation (SD) and were compared between groups using Student’s *t*-test (two groups) or one-way analysis of variance (ANOVA; three or more groups) if they were normally distributed; otherwise, they are presented as medians (interquartile range) and were compared between group using the Mann–Whitney *U*-test (two groups) or the Kruskal–Wallis *H*-test (three or more groups). Categorical data are expressed as *n* (%). Univariable and multivariable logistic regression analyses were used to identify factors associated with a higher overall KAP score, which was dichotomized using a threshold of 70% of the maximum possible score. Variables with $P < 0.05$ in the univariable analysis were entered into the multivariable analysis. Odds ratios (ORs) and 95% confidence intervals (95% CIs) were calculated. All statistical analyses were two-sided, and $P < 0.05$ was considered statistically significant. SPSS 26.0 (IBM Corp., Armonk, NY, USA) was used for the analyses.

Results

Demographic Characteristics of the Study Participants

A total of 434 patients with KOA (261 females, 60.14%) participated in the survey. The demographic characteristics of the study participants are shown in Table 1. Just over half the respondents (229/434, 52.76%) were aged >65 years old, and the vast majority were overweight or obese (349/434, 80.41%). Nearly two-thirds of the participants lived in non-urban areas (278/434, 64.06%). Around three-quarters of the respondents were educated to primary school level or below (325/434, 74.88%) and had an annual income <5000 Renminbi (330/434, 76.04%). Approximately half of the participants had lived with KOA for more than 5 years (231/434, 53.23%), and the comorbid diseases included hypertension (254/434, 58.53%), diabetes mellitus (49/434, 11.29%) and heart disease (19/434, 4.38%). Just over half the patients were taking long-term medications that might increase the risk of OP (231/434, 53.23%). Nearly 60% of the respondents exercised at low intensity (249/434, 57.37%), with only 5.07% of the patients (22/434) exercising at high intensity. Daily salt intake exceeded 6 g in 212 respondents (48.85%).

Knowledge

The median knowledge score was 7 (5–10) (possible range, 0–17 points), indicating that the patients with KOA had a poor level of knowledge about osteoarthritis and OP. The distribution of the responses to each of the 17 questions in the knowledge dimension is shown in Table 2. More than half of the patients were aware that risk factors for osteoarthritis development included cold weather (321/434, 73.96%; item K4) and overweight/obesity (295/434, 67.97%; item K5). However, only a minority of respondents knew that the risk of osteoarthritis is increased by female sex (177/434,

Table I Knowledge, Attitude, and Practice Scores, Stratified According to the Baseline Characteristics of the Study Participants

	N	%	Knowledge Score		Attitude Score		Practice Score	
			Median (IQR)	P	Median (IQR)	P	Median (IQR)	P
Total	434		7 (5, 10)		44 (42, 49)		43 (38, 47)	
Gender				0.786		0.591		<0.001
Male	173	39.86	7 (5, 10)		44 (42, 49)		40 (35.5, 45)	
Female	261	60.14	7 (4, 10)		44 (42, 48)		44 (40, 48)	
Age (years)				0.066		0.995		0.021
<55	47	10.83	6 (4, 7)		44 (43, 45)		39 (37, 46)	
56–65	158	36.41	7 (5, 10)		44 (42, 48.25)		41.5 (38, 47)	
>65	229	52.76	8 (4, 10)		44 (41.5, 49)		44 (39, 48)	
Body mass index (kg/m²)				0.141		0.812		0.492
≤18.5	4	0.92	9.5 (6.5, 11.75)		43.5 (42.25, 45.5)		40 (33.75, 44)	
18.6–23.9	81	18.66	6 (4, 9.5)		44 (42, 48)		42 (39, 48)	
≥24.0	349	80.41	8 (5, 10)		44 (42, 49)		43 (38, 47)	
Type of household registration				<0.001		0.065		0.074
Non-urban	278	64.06	7 (4, 10)		44 (42, 48)		42 (38, 47)	
Urban	156	35.94	8.5 (6, 11)		44 (42, 50)		43.5 (38, 48)	
Education				0.025		0.054		0.012
Primary school and below	325	74.88	7 (4, 10)		44 (42, 48)		42 (38, 47)	
Middle school / high school / technical secondary school	76	17.51	8 (6, 11.75)		44 (43, 50.75)		43.5 (40, 49)	
Junior college / university	33	7.60	9 (5.5, 11)		44 (43, 52.5)		45 (37.5, 50)	
Annual income (Renminbi)				0.451		0.637		0.040
<5000	330	76.04	7 (4, 10)		44 (42, 48)		42 (38, 47)	
5000–9999	90	20.74	8 (5, 11)		44 (42, 51)		45 (39.75, 49)	
≥10,000	14	3.23	7.5 (4.75, 11.5)		43.5 (42, 46.25)		40 (38.75, 45)	
Duration of KOA				0.163		0.589		0.067
≤3 years and less	130	29.95	50 (25, 75)		44 (43, 48)		41 (38, 47.25)	
4–5 years	73	16.82	7 (4, 9)		44 (42, 49)		44 (39.5, 49)	
>5 years	231	53.23	7 (5, 10)		44 (41, 49)		43 (38, 47)	
Hypertension	254		8 (4, 10)	0.805	44 (42, 49)	0.527	43 (39, 47.75)	0.044
Diabetes	49		8 (5, 10)	0.326	44 (42, 49)	0.421	46 (40, 49)	0.053
Heart disease	19		8 (4, 11)	0.417	45 (40, 48)	0.895	41 (35, 45)	0.166
Taking medications that affect OP for a long time?	231	53.23	8 (4, 10)	0.195	44 (42, 49)	0.729	43 (39, 48)	0.060
Exercise intensity according to IPAQ				<0.001		0.113		0.143
Low exercise intensity	249	57.37	6 (4, 9.5)		44 (42, 49)		43 (39, 48)	
Medium exercise intensity	163	37.56	9 (6, 11)		44 (42, 49)		42 (38, 47)	
High exercise intensity	22	5.07	8.5 (6.5, 10.25)		46.5 (43, 51)		40.5 (37.75, 44)	
Daily salt intake				0.002		0.448		0.010
≤6 grams	222	51.15	8 (5, 10.25)		44 (42, 49)		43 (39, 48)	
>6 grams	212	48.85	7 (4, 10)		44 (42, 49)		41.5 (37, 47)	

Abbreviations: IPAQ, International Physical Activity Questionnaire; KOA, knee osteoarthritis; OP, osteoporosis.

40.78%; item K1), persistent lower extremity weakness after an acute knee injury (200/434, 46.08%; item K2) and relevant family history (140/434, 32.26%; item K3). Although around two-thirds of the patients recognized that OP increases the risk of bone fracture (287/434, 66.13%; item K6), a similar number incorrectly believed that OP and osteoarthritis are different terms used to describe the same disease (277/434, 63.82%; item K8). Few respondents were aware that OP is usually asymptomatic (84/434, 19.35%; item K9), is an incurable disease (117/434, 26.96%; item K10), and can be diagnosed by bone density testing (168/434, 38.71%; item K11). Just over half the participants knew that calcium supplementation could help prevent OP (236/434, 54.38%; item K12), but more than two-thirds of the patients incorrectly believed that drinking more coffee and tea could help prevent OP (294/434, 67.74%; item K13). A slight majority of the patients correctly stated that older age (290/434, 66.82%; item K17) and overweight/obesity (243/434, 55.99%; item K14) were risk factors for OP, but far fewer respondents were aware that the risk was also elevated by

Table 2 Responses to the Questions in the Knowledge Dimension

Item	Correct Response, n (%)
K1. Males have a higher risk of KOA	177 (40.78)
K2. Persistent lower extremity weakness after an acute knee injury increases the risk of developing KOA	200 (46.08)
K3. A relevant family history increases the risk of developing KOA	140 (32.26)
K4. Cold weather increases the risk of developing KOA	321 (73.96)
K5. Being overweight or obese increases the risk of developing KOA	295 (67.97)
K6. OP increases the risk of fracture	287 (66.13)
K7. OP is more common in males	153 (35.25)
K8. OP and osteoarthritis are different terms used to describe the same disease	157 (36.18)
K9. OP is usually asymptomatic	84 (19.35)
K10. OP is an incurable disease	117 (26.96)
K11. Bone density testing is used to diagnose OP	168 (38.71)
K12. Calcium supplements can help prevent OP	236 (54.38)
K13. Drinking more coffee and tea can help prevent OP	140 (32.26)
K14. Being overweight or obese increases the risk of OP	243 (55.99)
K15. Hypnotics or antihypertensive drugs reduce the risk of OP	63 (14.52)
K16. Thyroid disease or gastrointestinal disease increases the risk of OP	61 (14.06)
K17. Older age increases the risk of developing OP	290 (66.82)

Abbreviations: KOA, knee osteoarthritis; OP, osteoporosis.

female sex (153/434, 35.25%; item K7), hypnotics or antihypertensive drugs (63/434, 14.52%; item K15), and thyroid disease or gastrointestinal disease (61/434, 14.06%; item K16).

Subgroup analyses revealed higher knowledge scores for patients who lived in an urban area ($P < 0.001$), had a higher level of education ($P = 0.025$), exercised at a higher intensity ($P < 0.001$), and consumed ≤ 6 g salt/day ($P = 0.002$). However, the knowledge score was comparable between subgroups stratified according to the other demographic characteristics (Table 1).

Attitude

The median attitude score was 44 (42–49) (possible range, 11–55 points), implying that the surveyed patients had a positive attitude toward the prevention of OP. The distributions of the responses to the 11 questions in the attitude dimension are summarized in Table 3. Most of the participants disagreed with the statement that they did not need to

Table 3 Responses to the Questions in the Attitude Dimension

Item	Positive Attitude, n (%)	Negative Attitude, n (%)
A1. I do not think that OP is related to KOA, so I do not need to know about it	84 (19.35)	350 (80.65)
A2. I think that it is important to prevent OP	379 (87.33)	55 (12.67)
A3. I already suffer from KOA, and I am afraid of developing OP	373 (85.94)	61 (14.06)
A4. I think that OP may aggravate my KOA	376 (86.64)	58 (13.36)
A5. I think that OP can be prevented through exercise	340 (78.34)	94 (21.66)
A6. I think that OP can be prevented through diet	364 (83.87)	70 (16.13)
A7. I am willing to change my current exercise habits to prevent OP	406 (93.55)	28 (6.45)
A8. I am willing to exercise every day to prevent OP, even though this would be hard to do	400 (92.17)	34 (7.83)
A9. I am willing to change my current diet to prevent OP	406 (93.55)	28 (6.45)
A10. Although I do not like foods with a high calcium content, I am willing to eat these foods to prevent OP	404 (93.09)	30 (6.91)
A11. I am willing to take regular bone density tests to better monitor the development of OP	368 (84.79)	66 (15.21)

Abbreviations: KOA, knee osteoarthritis; OP, osteoporosis.

know about OP because it was not related to osteoarthritis (350/434, 80.65%; item A1). More than 80% of the patients were worried about developing OP (373/434, 85.94%; item A3) and thought that OP might aggravate their KOA (376/434, 86.64%; item A4). The majority of patients believed that it is important to prevent OP (379/434, 87.33%; item A2) and that OP can be prevented through exercise (340/434, 78.34%; item A5) and diet (364/434, 83.87%; item A6). Notably, over 90% of the respondents indicated that they were willing to alter their current exercise habits (406/434, 93.55%; item A7), exercise every day (400/434, 92.17%; item A8), change their current diet (406/434, 93.55%; item A9) and eat foods with a high calcium content (404/434, 93.09%; item A10) in order to prevent OP. Furthermore, 368 patients (84.79%) said that they would be willing to take regular bone density tests to better monitor for OP (item A11).

Practice

The median score for the respondents was 43 (38–47) (possible range, 13–65 points), suggesting that there was room for improvement in the practices of the patients with KOA with regard to the prevention of OP. As shown in Table 4, only 71 patients (16.36%) took proactive measures to learn about OP more than once weekly (item P1). Only a small minority of respondents (12.44%–30.65%) reported smoking, drinking coffee/strong tea, consuming alcoholic beverages, or drinking carbonated beverages on a regular basis, ie, at least once weekly (items P2–P5). However, less than 40% of the patients took calcium supplements (160/434, 36.87%; item P6) or vitamin D supplements (109/434, 25.12%; item P7) at least once per week. Regular consumption (at least once per week) of beans/soy products, milk, nuts, seafood, lean meat, and preserved products was reported by 60.83%, 42.17%, 20.28%, 9.22%, 79.49% and 46.77% of respondents, respectively (items P8–P13). Subgroup analyses demonstrated that a significantly higher practice score was observed for patients who were female ($P < 0.001$), older ($P = 0.021$), educated to above primary school level ($P = 0.012$), and consumed ≤ 6 g salt/day ($P = 0.010$) (Table 1).

Logistic Regression Analysis of Factors Associated with an Overall KAP Score $\geq 70\%$

The univariable analysis identified female sex, older age, living in an urban area, moderate education level, moderate annual income, and having KOA for 4–5 years as factors associated with a high KAP score (ie, $\geq 70\%$ of the maximum possible score). The multivariable analysis indicated that female sex (OR = 2.421, 95% CI = 1.558–3.762, $P < 0.001$), being aged 56–65 years-old (OR = 4.222, 95% CI = 1.763–10.109, $P = 0.001$ vs ≤ 55 years-old), being aged > 65 years-old (OR = 4.358, 95% CI = 1.863–10.195, $P = 0.001$ vs ≤ 55 years-old), being educated to middle/high/technical secondary school level (OR = 1.853, 95% CI = 1.002–3.428, $P = 0.049$ vs primary school or below), and having KOA for 4–5 years (OR = 2.682, 95% CI = 1.412–5.094, $P = 0.003$ vs ≤ 3 years) were independently associated with a high KAP score (Table 5).

Table 4 Responses to the Questions in the Practice Dimension

Item	Once a Week or More, n (%)	Less Than Once-A-Week, n (%)
How often are you proactive in learning about OP?	71 (16.36)	363 (83.64)
How often do you smoke?	54 (12.44)	380 (87.56)
How often do you drink coffee or strong tea?	133 (30.65)	301 (69.35)
How often do you drink alcohol?	61 (14.06)	373 (85.94)
How often do you drink carbonated beverages?	9 (2.07)	425 (97.93)
How often do you take calcium supplements?	160 (36.87)	274 (63.13)
How often do you take vitamin D supplements?	109 (25.12)	325 (74.88)
How often do you eat beans and soy products?	264 (60.83)	170 (39.17)
How often do you drink milk?	183 (42.17)	251 (57.83)
How often do you eat nuts?	88 (20.28)	346 (79.72)
How often do you eat seafood?	40 (9.22)	394 (90.78)
How often do you eat lean meat?	345 (79.49)	89 (20.51)
How often do you eat preserved products?	203 (46.77)	231 (53.23)

Note: Data are presented as n (%).
Abbreviation: OP, osteoporosis.

Table 5 Logistic Regression Analysis of Factors Associated with a KAP Score $\geq 70\%$ of the Maximum Possible Score

Variable	Univariable Logistic Regression		Multivariable Logistic Regression	
	OR (95% CI)	P	OR (95% CI)	P
Gender				
Male	Reference		Reference	
Female	1.888 (1.269–2809)	0.002	2.421 (1.558–3.762)	<0.001
Age				
≤ 55	Reference		Reference	
56–65 years old	3.535 (1.603–7.798)	0.002	4.222 (1.763–10.109)	0.001
>65	3.703 (1.712–8.010)	0.001	4.358 (1.863–10.195)	0.001
Body mass index				
Underweight (≤ 18.5 kg/m ²)	Reference			
Normal	1.959 (0.195–19.671)	0.568		
Overweight or obese (≥ 24 kg/m ²)	2.397 (0.247–23.270)	0.451		
Type of residence area				
Non-urban	Reference		Reference	
Urban	1.798 (1.209–2.673)	0.004	1.345 (0.802–2.256)	0.261
Education				
Primary school and below	Reference		Reference	
Middle school/high school/technical secondary school	2.293 (1.378–3.814)	0.001	1.853 (1.002–3.428)	0.049
Junior college/university	1.678 (0.818–3.441)	0.158	2.449 (0.948–6.322)	0.064
Annual income (Renminbi)				
<5000	Reference		Reference	
5000–10,000	2.027 (1.264–3.251)	0.003	1.678 (0.939–2.998)	0.081
$\geq 10,000$	0.404 (0.111–1.475)	0.170	0.454 (0.113–1.823)	0.266
Duration of KOA				
≤ 3 years	Reference		Reference	
4–5 years	2.369 (1.319–4.257)	0.004	2.682 (1.412–5.094)	0.003
>5 years	1.176 (0.756–1.827)	0.472	1.093 (0.678–1.762)	0.715
Long-term medication use that increases OP risk				
No	Reference			
Yes	1.300 (0.887–1.904)	0.178		
Exercise intensity according to IPAQ				
Low intensity	Reference			
Medium intensity	0.882 (0.591–1.316)	0.538		
High intensity	1.264 (0.528–3.023)	0.599		
Daily salt intake				
≤ 6 g	Reference			
>6 g	0.690 (0.471–1.011)	0.057		
Hypertension				
No	Reference			
Yes	1.262 (0.859–1.855)	0.236		
Diabetes mellitus				
No	Reference			
Yes	1.556 (0.857–2.825)	0.146		
Heart disease				
No	Reference			
Yes	0.591 (0.220–1.586)	0.296		

Abbreviations: KOA, knee osteoarthritis; IPAQ, International Physical Activity Questionnaire; OR, odds ratio; 95% CI, 95% confidence interval; OP, osteoporosis.

Discussion

Previous studies have reported that OP is underdiagnosed and undertreated.^{10,29,30} This study found that patients with KOA in Shandong province had low levels of knowledge, good attitudes, and suboptimal practices regarding OP and its

prevention. Logistic regression revealed that female sex, older age, an intermediate education level, and having KOA for 4–5 years were independently associated with a high KAP score ($\geq 70\%$ of the maximum). To our knowledge, this is the first survey evaluating the knowledge, attitudes, and practices of patients with KOA regarding OP and its prevention.

The median knowledge score of 7 points indicates that the patients had a low level of knowledge regarding osteoarthritis and OP. Less than half the respondents identified female sex, persistent lower extremity weakness after an acute knee injury, and relevant family history as risk factors for osteoarthritis.^{8–13} Moreover, 63.82% of patients incorrectly assumed that OP and osteoarthritis are different terms for the same disease. Importantly, few respondents knew that OP is usually asymptomatic, essentially incurable, and detectable by bone density measurement.^{4,14} These findings agree with previous studies of general populations. For example, 54.47% of young adults in Saudi Arabia³⁶ and 54.5% of women aged ≥ 65 years old in Singapore³⁷ had poor knowledge of OP. The knowledge score of adults in Saudi Arabia was 56.6%,³⁸ while people aged ≥ 40 years old in Malaysia had only moderate knowledge about OP.³⁹ The OP awareness score was 67.8% in adults aged ≥ 30 years old in China.³¹ Only 30.7% of people aged ≥ 40 years old in Nanjing had heard of OP, and only 18.5% of them had heard of osteoporotic fracture.³² Knowledge of OP was also suboptimal in Hong Kong Chinese men⁴⁰ and Chinese people infected with human immunodeficiency virus (HIV).³⁵

In the subgroup analyses, the knowledge score was higher for patients who lived in an urban area, exercised at a higher intensity, and consumed ≤ 6 g salt/day. The former finding may be related to the urban-rural gap in China,⁴¹ while patients exercising at a higher intensity and consuming less salt may be doing so because they are more knowledgeable about the health benefits. Prior research has also identified factors associated with better knowledge about OP, including female sex,³⁹ younger age,^{32,36} higher level of education,^{31,32,37–39} higher income,^{31,38} employment status,³⁸ and previous osteoporotic fracture.³²

The median attitude score of 44 points suggests that the patients had a positive attitude toward OP prevention despite their low knowledge level. All items in the attitude dimension received positive responses from most respondents ($>78\%$). A survey in China found that HIV-infected men had moderately good attitudes toward preventing OP through exercise and diet, but attitudes were poorer regarding perceived susceptibility and seriousness of the disease.³⁵ Young adults in Saudi Arabia also had positive attitudes toward preventing OP through calcium supplementation and exercise, but most did not consider themselves susceptible to OP.³⁶ Another survey in Saudi Arabia that included older adults identified higher levels of perceived susceptibility among females (83%) and males (74%).³⁸ Persons aged ≥ 40 years old in Malaysia had strongly positive attitudes regarding the seriousness of OP and the benefits of calcium intake and exercise, although a lower score was obtained for perceived susceptibility.³⁹ Notably, a recent survey of Chinese men concluded that interventions are needed to enhance awareness about OP susceptibility and the benefits of lifestyle modification.⁴⁰

The median practice score of 43 indicates that the patients had suboptimal practices regarding OP prevention. Although most respondents did not regularly smoke or consume coffee/strong tea, alcoholic beverages, or carbonated drinks, less than 40% of them regularly took calcium or vitamin D supplements. In addition, less than half the respondents regularly consumed milk, nuts, seafood, and preserved products. Prior investigations have also revealed suboptimal practices for OP prevention. For example, regular milk consumption, calcium supplementation, vitamin D supplementation, and physical activity were performed by only 52.9%, 16.0%, 7.1%, and 47.2%, respectively, of people aged ≥ 40 years old in China.³² Furthermore, few Malaysian adults aged ≥ 40 years old consumed milk regularly (37.4%), took calcium supplements (15.0%), did not drink coffee/tea regularly (18.6%), and participated in health-enhancing physical activity (12.0%).³⁹ Other studies have also identified poor practices regarding OP prevention.^{36,38}

Subgroup analyses demonstrated a higher practice score for patients who were female, older, or consumed ≤ 6 g salt/day. Many people view OP as a health issue for women, especially postmenopausal women, which may explain the better practices among females. Moreover, older people may pay more attention to preventing OP because they are more likely to suffer from the disease. Published studies have also reported higher practice scores for females^{32,39} and older persons,^{32,39} although these associations were reversed in a study of young adults in Saudi Arabia.³⁶ Other factors associated with better practices include higher education level^{32,39} and prior osteoporotic fracture.³²

This study has some limitations. First, the sample size was small, so the analysis may have lacked sufficient statistical power to detect some real differences between groups. Second, although this was a multicenter study, all participants were recruited from a single province in China; hence, the generalizability of the results remains unknown. Third, although the questionnaire was developed based on published information, it may have had limitations regarding its

ability to evaluate perceptions of OP and its prevention. Fourth, this study did not investigate whether education programs would enhance the questionnaire scores. Finally, patients with KOA often have a number of comorbidities, but the drugs taken by the participants were not recorded.

In conclusion, this study provides new insights into the knowledge, attitudes, and practices of patients with KOA in China regarding OP and its prevention. Our analysis provides new insights that could facilitate the design and implementation of targeted education interventions to increase awareness about OP prevention among patients with KOA. The results may help guide the development and implementation of targeted education programs to improve the OP prevention practices of patients with KOA in China.

Bulleted Key Points

This cross-sectional study assessed the knowledge, attitudes, and practices (KAP) related to osteoporosis (OP) among Chinese patients with knee osteoarthritis (KOA). Female sex, older age, middle/high/technical secondary school education, and longer duration of KOA were independently associated with higher KAP scores. The average KAP scores indicated room for improvement in patient awareness and practices regarding OP prevention. The study highlights the need for targeted educational interventions to enhance OP-related knowledge and practices among individuals with KOA in China. The findings contribute to the development of tailored educational programs aimed at increasing awareness and preventive actions for OP in this patient population.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Ethics Approval

The study was approved by the Ethics Committee of the First Affiliated Hospital of Shandong First Medical University, and informed consent was obtained from all participants.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no competing interests in this work.

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