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A Cross-Sectional Study on Osteoporosis Knowledge and Awareness Among Medical Students in Holy Karbala

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Abstract

Osteoporosis is a major public health problem. Sufficient osteoporosis knowledge by medical students the future healthcare workers is essential to guaranteeing that they possess the abilities and skills to treat patients with osteoporosis effectively.

Objectives:

This study aimed to assess the knowledge and awareness of osteoporosis among medical students in holy Karbala.

Methods:

A cross-sectional study was conducted among medical students in collages of medicine in holy Karbala from October 1st, 2025, to February 1st, 2026. A self-structured questionnaire was used to collect data, including the sociodemographic characteristics of the participants and the Osteoporosis Knowledge Assessment Tool (OKAT) score. The collected data were analyzed using SPSS version 27.

Results:

A total of 664 medical students participated in this study. The mean age of the participants was 22.030 years (SD = 1.651). Most participants had moderated knowledge 483. Regarding awareness, 523 knew that osteoporosis is more common in women, also 419 knew that calcium supplements alone cannot prevent bone loss, just 155 identified that osteoporosis does not cause pain before a fracture, 209 knew that not all types of physical activity are useful for osteoporosis patients, and 590 were aware that age is a risk factors for osteoporosis.

Conclusions:

Most medical students have average knowledge of osteoporosis. There is a significant gap in knowledge among the participants regarding symptoms, risk factors, and treatment availability.

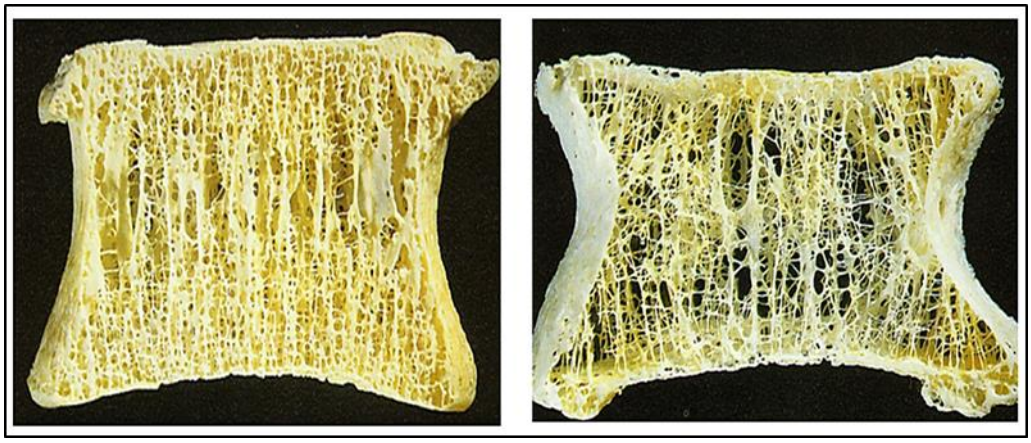
Keywords: osteoporosis, medical students, OKAT, knowledge.

1. Introduction

The word osteoporosis has Greek origin, which dates back to the 1820s and comes from the word osteon, which means bone, and poros, which means a small hole or pore [1].

Osteoporosis has defined by the World Health Organization as a "systemic skeletal disease characterized by low bone mass and microarchitectural deterioration of bone tissue which leads to bone fragility and susceptibility to fracture" [2,3].

Osteoporosis is a severe medical condition that not only lowers the quality of life but is also linked to increased risk of morbidity, death, and financial burden, as shown in Figure 1.



(A) Normal bone (B) Osteoporotic bone

Figure 1: Visual representation of healthy and osteoporotic bones. Adapted from [4].

It is the most common cause of bone fractures in the elderly population. Typically, there are no symptoms until a bone break. Bones might become so weak that they fracture readily with little pressure or on their own. After age 50, one in three women will develop an osteoporotic fracture [5].

Fragility fractures are a major contributor to the morbidity of chronic illnesses. For instance, fragility fractures overcome chronic obstructive

pulmonary disease and ischemic stroke to place as the fourth most common cause of death in Europe, after ischemic heart disease, dementia, and lung cancer [6,7].

When an osteoporotic fracture occurs, it seriously impacts the patient and the healthcare system, making it possible to consider osteoporosis a costly problem for the healthcare system and society [8].

Osteoporotic fractures resulted in roughly 5 billion $ in healthcare expenses in the 1990s [9]. Another study found that osteoporotic fractures cost roughly 19 billion $ in the United States in 2005, indicating that the cost is rising due to an aging population [10].

Osteoporosis is classified into primary and secondary categories. Primary osteoporosis is subdivided into postmenopausal osteoporosis (type I) and senile osteoporosis (type II) [11]. Secondary osteoporosis, as its term suggests, develops secondarily to a diverse group of medical disorders, which include hypogonadism, gastrointestinal diseases, liver disease, endocrinopathies, inflammatory conditions, immobilization, kidney diseases, and cancer. Some drugs, like heparin, glucocorticoids, antiepileptic drugs, cancer treatments, and thyroid hormone, can also affect bone metabolism and lead to bone loss [12,13,14,15].

The systemic skeletal illness known as osteoporosis was defined as a decline in bone mineral content and changes in the bone's microstructure, specifically a decrease in trabeculae or the loss of trabecular bridges, cortical thinning, and an increase in cortical porosity [16,2]. These changes are caused by a disruption in the bone remodeling cycle, resulting in an imbalance between bone loss and formation, which leads to increased bone loss. Thus, the process of bone mineral content loss is multifactorial, including an increase in the number of remodeling units with a local imbalance caused by a mismatch in bone resorption and production at each bone remodeling unit, leading to bigger resorption space due to excessive in resorption, in addition, newly created bone

being too small because of defect in bone formation or reducing turnover time due to rapid remodeling rate [17].

Bone mineral density (BMD) is used to diagnose osteoporosis; the most commonly employed test for assessing BMD is dual-energy X-ray absorptiometry (DEXA), which is a painless, quick, and non-invasive test. The DEXA scan gives the result as a number called a T-score, which represents the BMD of the patient compared to the average BMD in a healthy young adult. According to The World Health Organization classifies bone density as the following:

• If the T-score is (–1 or greater): the bone density considers normal.

• If the T-score is between (–1 and –2.5): it indicates low bone density, known as osteopenia, a possible precursor to osteoporosis.

• If the T-score is (–2.5 or less): it indicates osteoporosis, even if there is no broken bone [18,2].

Medications, hormone therapy, and lifestyle modifications are currently used as treatments for osteoporosis, combining these treatments frequently produces the best results. Osteoporosis treatment aims to slow bone loss and prevent fractures [19].

Osteoporosis is not curable, but it can be prevented by increasing the level of physical activity at all ages, cessation of smoking, reduction of alcohol consumption, adequate dietary calcium and vitamin D intake, and fall prevention. Osteoporosis treatment aims to slow bone loss and prevent fractures [20]. Numerous studies have found clear association between healthy behaviors or lifestyle and decreased risk of osteoporosis and related fractures. There is good evidence suggesting that osteoporosis knowledge is one contributor to osteoporosis preventive behavior [7].

The basic requirement for managing any chronic health disorder starts with evaluation of the awareness about the disease among the target subjects.

Determining their knowledge, beliefs and behaviors about osteoporosis can be helpful in developing effective interventions and guiding public health programs for osteoporosis prevention [5].

The Osteoporosis Knowledge Assessment Tool (OKAT) developed by Winzenberg and co-authors in 2003; which is a 20-item questionnaire, each item having “true”, “false” and “I don't know “options. OKAT focuses on three basic themes: (1) understanding (symptoms and risk of fracture) of osteoporosis also the knowledge of risk factors for osteoporosis (2) knowledge of preventive factors as physical activity and diet relating to osteoporosis and (3) treatment availability [21,22].

There is a lack of knowledge about osteoporosis among healthcare workers in many countries, as reported by emerging studies using various assessment tools [23,24]. The knowledge deficit of healthcare professionals is considered an important barrier to appropriate risk identification and management of this common health problem [25]. As a result, medical students the future healthcare workers must have sufficient osteoporosis knowledge to ensure that they have the aptitude and skills to treat people with this disease successfully [26].

Therefore, the present study aimed to assess the knowledge and awareness of osteoporosis among medical students to gain a clearer insight into how to address this issue rapidly.

2. Subjects and Method

- **Study design and setting**

An analytic cross-sectional study was conducted in collages of medicine in holy Karbala from October 1st, 2025, to February 1st, 2026. The collages were chosen randomly by simple random sampling. The selected collages included University of Karbala – College of Medicine, Al-Ameed University

College of Medicine, Warith Al-Anbiyaa University – College of Medicine, and Al-Sibtain University for Medical Sciences- College of Medicine.

Sample size

The sample size was calculated to be 350 according to the following formula [27].

$$n = \frac{Z^2 \cdot p \cdot (1-p)}{E^2}$$

A confidence interval equal to 95% (Z= 1.96) and 5% precision(E=0.05), and the prevalence of good osteoporosis knowledge among medical students was assumed to be 50% (P=0.5) to ensure an adequate sample.

- **Research instruments**

A questionnaire was used to collect the data, which assessed knowledge about osteoporosis using the OKAT questionnaire. The OKAT is a reliable questionnaire for evaluating osteoporosis knowledge. The OKAT is structured around three major themes: knowledge of osteoporosis symptoms and risk factors; knowledge of osteoporosis protective factors such as nutrition and exercise; and availability of treatment as shown in Table 3[21]. OKAT score calculation the responses are categorical (yes, I don't know, and no) and were applied with an item score of '1' for the correct response, and '0'for the incorrect response as well as I don't know response, a cumulative score of twenty, followed by a summation of the degree of the question answers and giving a score as follows: low knowledge (< 8), average knowledge (8-14), and high knowledge (> 14). A pilot study was conducted approximately two weeks before data collection, with a sample of 10 participants who were excluded from the study, to test the questionnaire for any difficulties and to determine the time needed for the collection of data [22].

- **Statistical analysis**

Statistical analysis SPSS (Statistical Package for Social Sciences) version 27 was used for data entry and analysis. Continuous variables are presented as means and standard deviations. Categorical variables are presented as frequencies and percentages. The chi-square test was used to test associations between knowledge scores and the sociodemographic features of participants. A p-value< 0.05 indicates statistical significance.

3. Results

The study participants included 664 students from the selected collages, whose mean age was 22.030 years (SD = 10.773), Figure 2 and Table 1provides further details.

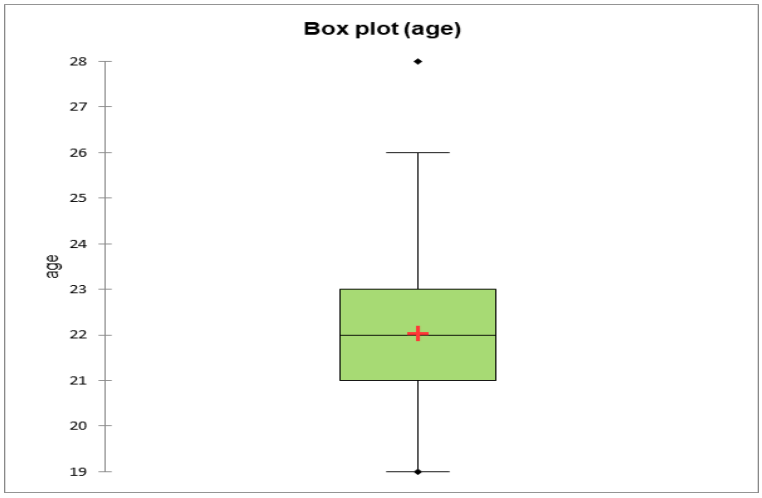


Figure 2: The age data variables of the participants.

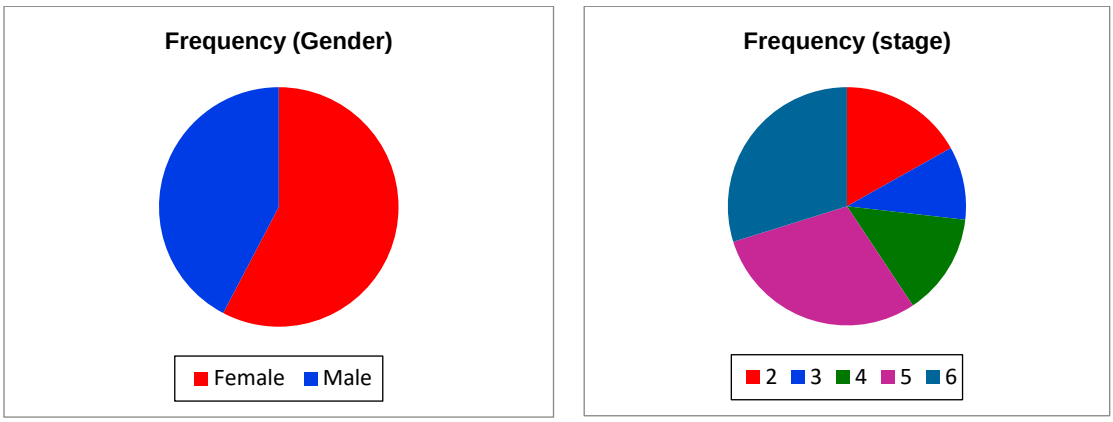
Table 1: The age data variables of the participants

Statistic	age
No. of observations	664
Minimum	19
Maximum	28
Range	9
1st Quartile	20
Median	22
3rd Quartile	23
Mean	22.030
Standard deviation	1.651

281 of participants were male and 383 of whom were female, considering the results according to stage, there are 112 pupils in the second stage, 66 in the third stage, 92 in the fourth stage, 196 in the fifth, and 198 in the sixth stage, Table 2 and Figure 3 provides further details.

Table 2: Sociodemographic variables of the participants

Variable\Statistic	Categories	Frequency per category	Rel. frequency per category (%)
Sex	Female	383	57.419
	Male	281	42.581
Stage	Second	112	16.867
	Third	66	9.939
	Fourth	92	13.855
	Fifth	196	29.518
	sixth	198	29.819



(A) (B)

Figure 3: A-Classification of medical students according to their sex, blue color for male 42.581% and red color for female 57.419%. B-Classification of medical students according to their stage, the red color for second stage 16.867%, the blue color for third stage 9.939%, the green color for fourth stage 13.855%, the purple color for fifth stage 29.518% and the gray color for sixth stage 29.819.

Regarding the osteoporosis knowledge assessment tool, as shown in Figure 4, the vast majority of participants had moderated knowledge 483, 103 had low knowledge only 78 had high knowledge.

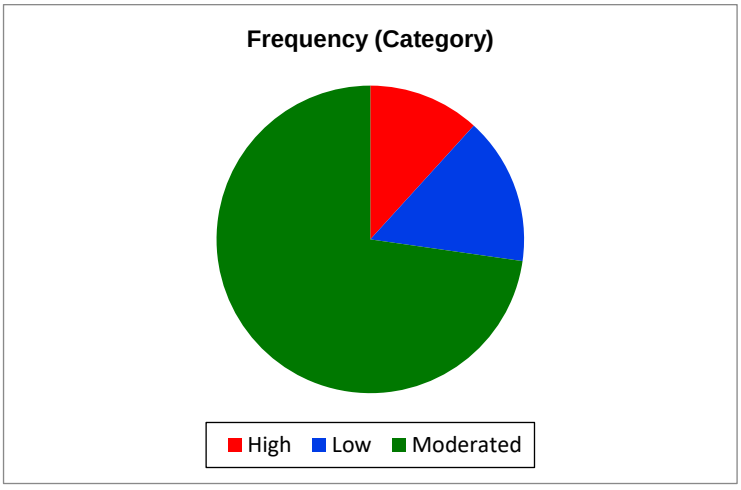


Figure 4: Classification of medical students according to their osteoporosis knowledge score, the red color for high knowledge, the blue color for low knowledge, the green color for moderated knowledge.

The percentage of correct responses to each item in the questionnaire is shown in Table 3. Knowledge and beliefs regarding osteoporosis were analyzed in three separate domains from the information available in OKAT questionnaire.

Table 3: Osteoporosis knowledge assessment tool according to participants' answers.

No.	OKAT Question	Correct answer n (%)	Incorrect answer n (%)
Q1	Osteoporosis leads to an increased risk of bone fractures	657(98.94)	7(1.05)
Q2	Osteoporosis typically leads to symptoms such as pain before fractures occur	155(23.34)	509(76.65)
Q3	Having a higher peak bone mass at the end of childhood does not necessarily protect against the development of osteoporosis in later life.	193(29.06)	471(70.93)
Q4	Osteoporosis is more common in men.	523(78.76)	141(21.23)
Q5	Cigarette smoking can contribute to osteoporosis.	424(63.85)	240(36.14)
Q6	White women are at highest risk of fracture when compared with other races.	364(54.81)	300(45.18)
Q7	A fall is just as important as low bone strength in causing fractures.	382 (57.53)	282 (42.48)

Q8	By age 80 years, a majority of women have osteoporosis.	590(88.85)	74(11.15)
Q9	From age 50 years, most women can expect at least one fracture before they die.	486(73.193)	178(26.807)
Q10	Any type of physical activity is beneficial for osteoporosis.	209 (31.476)	455 (68.524)
Q11	It is easy to tell whether I am at risk of osteoporosis by my clinical risk factors only.	114 (17.169)	550 (82.831)
Q12	Family history of osteoporosis strongly predisposes a person to osteoporosis.	500(75.301)	164 (24.699)
Q13	An adequate calcium intake can be achieved from two glasses of milk a day.	417(62.801)	247(37.199)
Q14	Sardines and broccoli are good sources of calcium for people who cannot take dairy products.	440(66.265)	224(33.735)
Q15	Calcium supplements alone can prevent bone loss.	419(63.102)	245(36.898)
Q16	Alcohol in moderation has little effect on osteoporosis.	192(28.916)	472(71.084)
Q17	High salt intake is a risk factor for osteoporosis.	256(38.554)	408(61.446)
Q18	There is a small amount of bone loss in the 10 years following the onset of menopause.	125(18.825)	539(81.175)
Q19	Hormone therapy prevents further bone loss at any age after menopause.	403(60.693)	261(39.307)
Q20	There are no effective treatments for osteoporosis available in Iraq.	304(45.783)	360(54.217)

Basic knowledge regarding osteoporosis (questions 1–12):

On analyzing the responses to these questions, as shown in Figure 5, it was seen that 98.94% (n = 657) were aware that osteoporosis leads to increased risk of bone fractures, and 29.06% understood the relationship between poor bone strength, falls, and fractures. Although about 73.193% knew that a majority of women would be affected with osteoporosis by the age of 80 years, 21.23% (n = 141) of the study subjects had a misconception that osteoporosis was more common in men than in women and 26.807% (n = 178) of students failed to understand the temporal relationship between advancing age and fracture risk. About 40% (n = 240) were unaware that cigarette smoking could contribute to osteoporosis. A majority of participants 75.301% (n = 500) were aware that the chances of developing osteoporosis were higher in the presence of a positive family history.

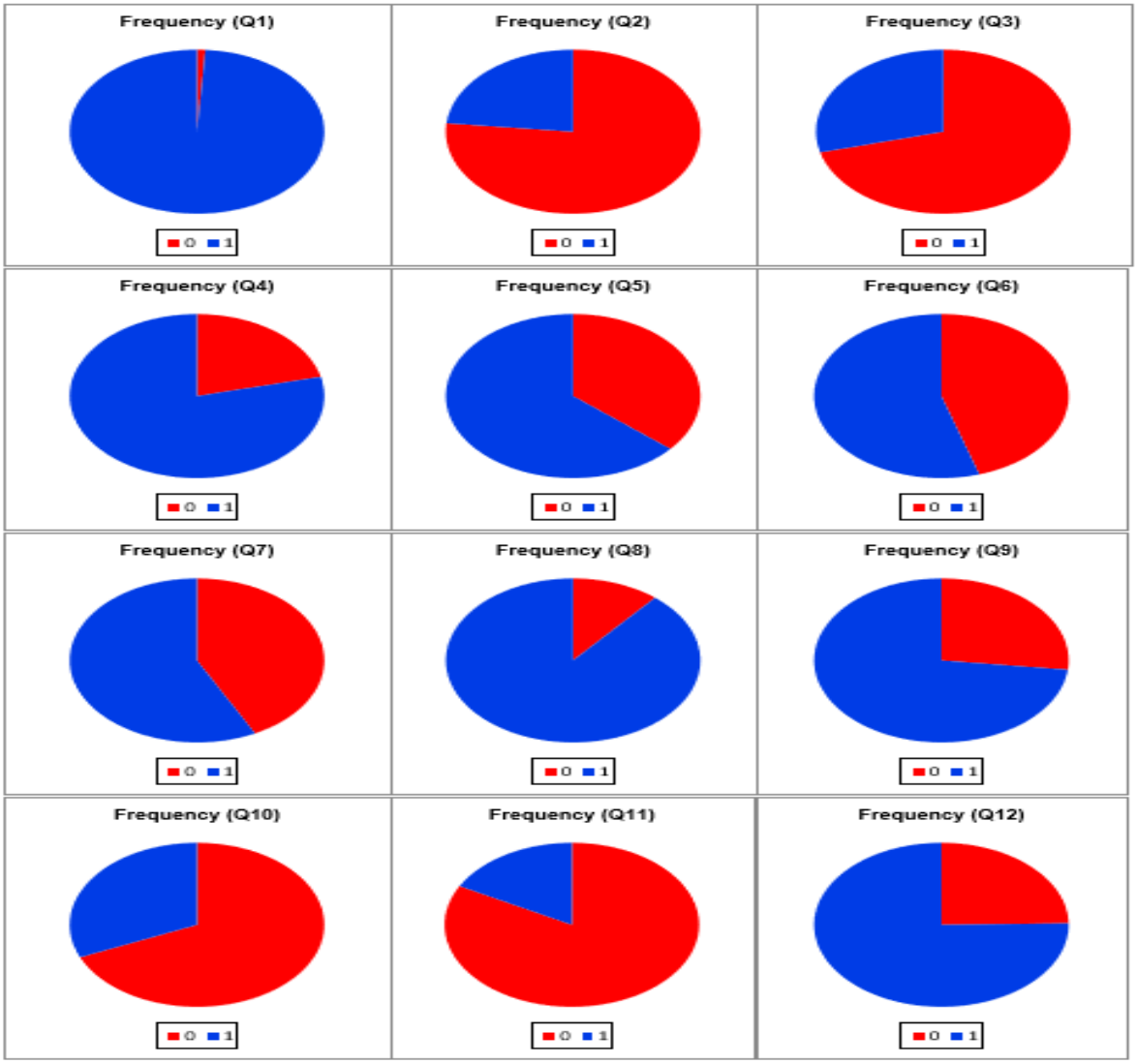


Figure 5: The percentage of correct responses to each question from 1–12, where the red color for incorrect response and blue color for correct response.

Sources of calcium and risk factors for osteoporosis (questions 13–17):

Excessive intake of alcohol and high salt intake as risk factors for osteoporosis was correctly recognized by 28.916% (n = 192) and 38.554% (n = 256), respectively. Also, most students 62.801% (n = 417) were aware that two glasses of milk yielded sufficient dietary calcium, only 66.265% (n = 440) identified sardines and broccoli as a good source of calcium, and an alarming

nearly 40% (n = 245) believed that calcium supplements alone could prevent the development of osteoporosis, as shown in Figure 6.

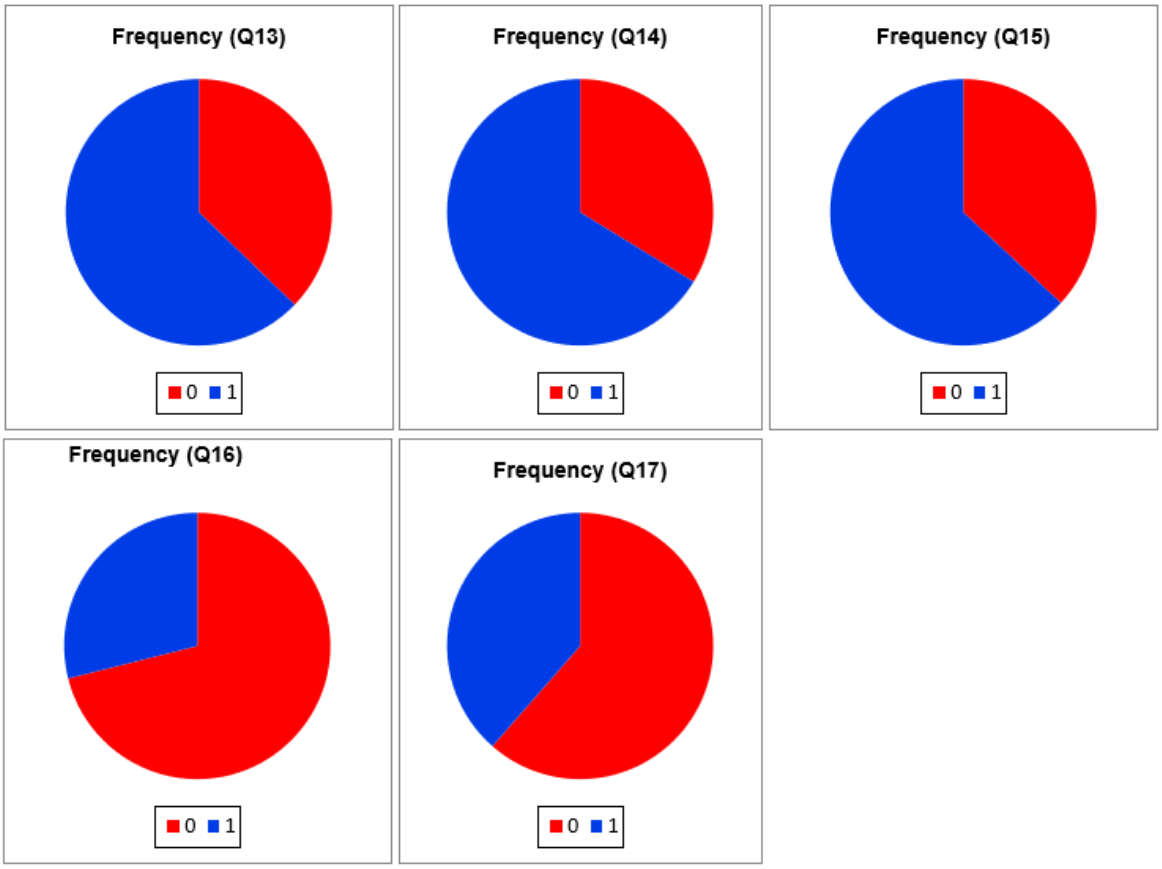


Figure 6: The percentage of correct responses to each question from 13–17, where the red color for incorrect response and blue color for correct response.

Perceptions about treatment (questions 18–20):

A majority of the students 60.693% (n = 403) were aware of the fact that hormone replacement therapy could help in preventing progression of osteoporosis. Only 45.78% (n = 304) students knew that effective treatments for osteoporosis existed in Iraq, as shown in Figure 7.

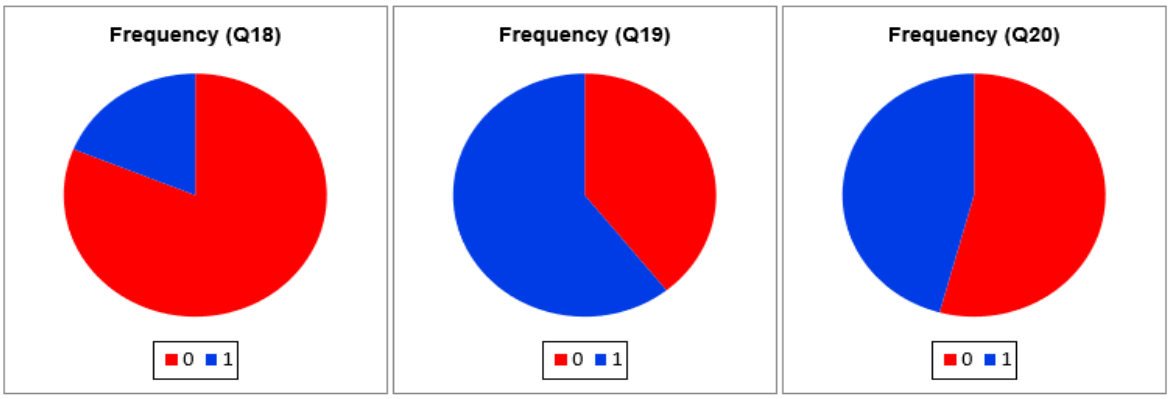


Figure 7: The percentage of correct responses to each question from 18–20, where the red color for incorrect response and blue color for correct response.

Table 4 reveals the statistically not significant association between gender and the category variable (high, low, moderate), as the p-value of 0.755is more than the commonly used significance level of 0.05.

Table 4: Relationship between gender and the participant's level of knowledge about osteoporosis.

Gender	High	Low	moderate	Total	p-value
Female	45	56	282	383	0.755
Male	33	47	201	281	
Total	78	103	483	664	

Among females, the majority fall into the "moderate" category (282 out of 383), with relatively fewer in "high" (45) and "low" (56) categories. For males, the pattern is similar—most are in the "moderate" category (201 out of 281), with even fewer in "high" (33) and "low" (47) categories. Overall, the "moderate" category dominates across both genders, as shown in Figure 8.

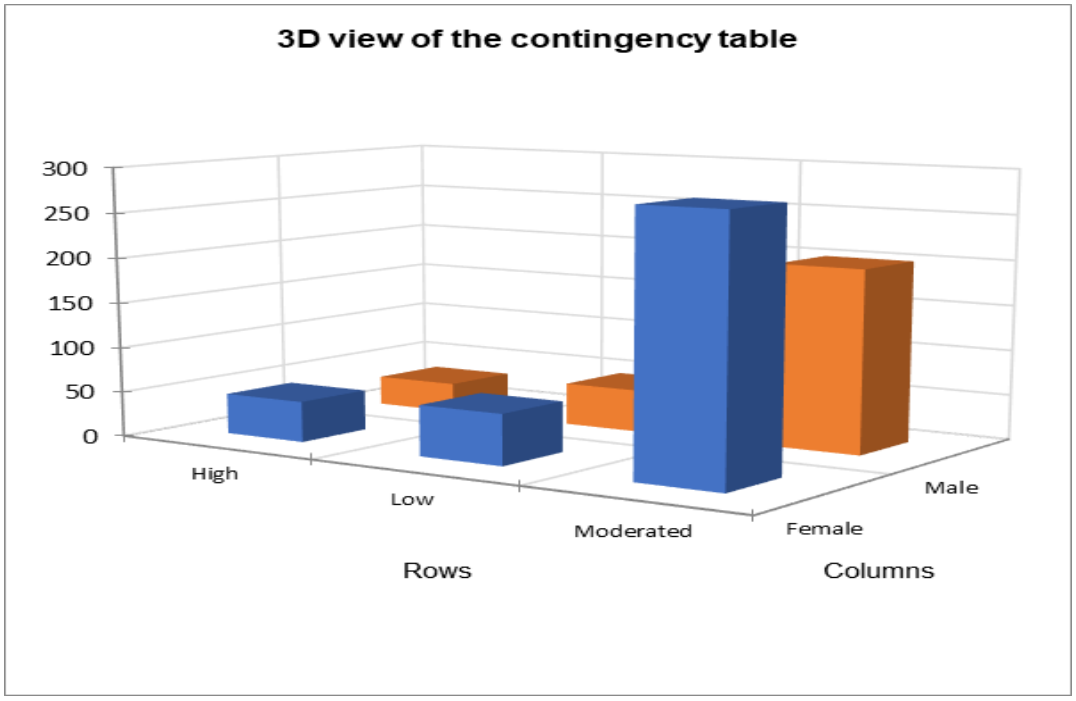


Figure 8: Relationship between gender and the participant's level of knowledge about osteoporosis.

There was a significant relationship between stage and category variables (high, low, moderate) as the p-value of 0.0001, where the students in sixth-stage had the highest percentage of good knowledge (30) followed by fifth-stage (22), second -stage (3), third-stage (10) while the four-stage had (3).

On the other hand, sixth-stage had highest moderated knowledge about osteoporosis (151) than other stages; followed by fifth-stage (149), four-stage (72), second-stage (67), and third-stage (44).

Table 5: Relationship between stage and the participant's level of knowledge about osteoporosis.

Stage	High %	low %	Moderate %	p-value
Second	13	32	67	0.0001
Third	10	12	44	
Fourth	3	17	72	
Fifth	22	25	149	
Sixth	30	17	151	
Total	78	103	483	

The second stage demonstrated the highest percentage of poor knowledge about osteoporosis (32), followed by the fifth (25), then sixth and fourth stages at (17), while the third stage had (12), as shown in Table 5 and Figure 9.

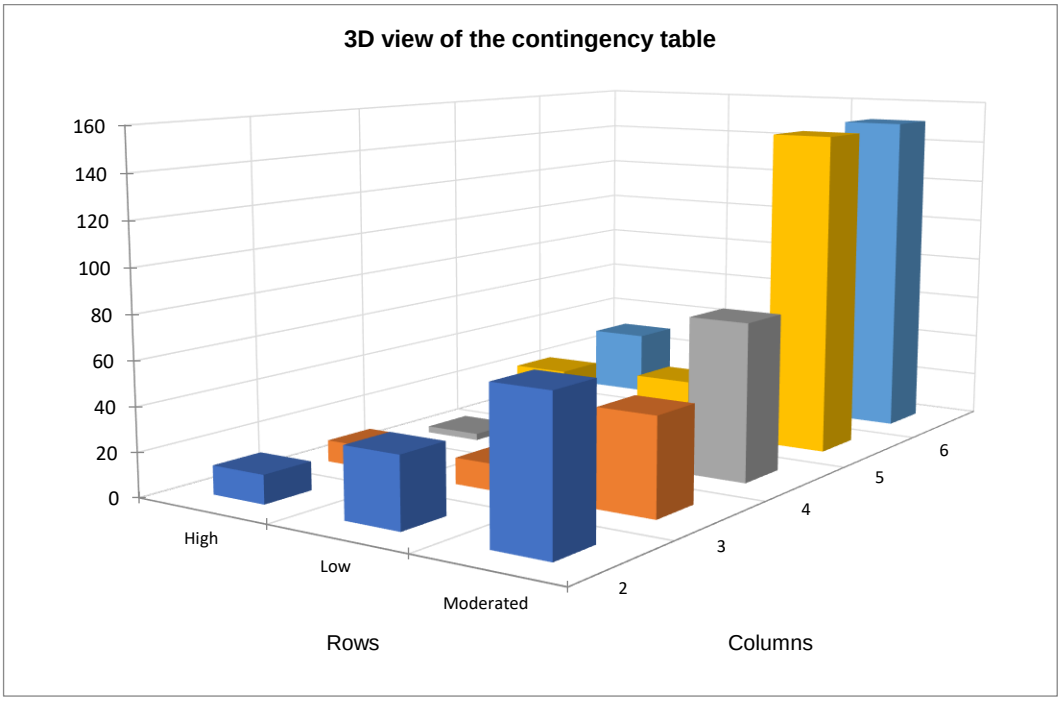


Figure 9: Relationship between stage and the participant's level of knowledge about osteoporosis.

4.Discussion

Osteoporosis is a significant health concern, especially with the increasing aging population [14]. Researchers from various countries have highlighted the lack of osteoporosis knowledge, risk factors, and prevention among the general population and healthcare workers [28,29].

The current study was conducted to evaluate the level of knowledge regarding osteoporosis among medical students at the colleges of medicine in holy Karbala

According to our knowledge this is the first study measure osteoporosis awareness among medical students in Karbala.

The majority of participants demonstrated moderated knowledge (483), (103) had low knowledge only (78) had high knowledge, this lack of knowledge considers a serious issue facing healthcare workers because they may not feel confident enough to discuss with their patients about osteoporosis. The patient should feel confident in the primary health care providers when seeking sound advice [30]. According to the previse studies indicated that the majority of the participants had low perceived osteoporosis severity and perceived osteoporosis susceptibility which explained why the majority of the participants do not have the sense that they are at risk of getting osteoporosis, also, they do not realize the severity of this disease [31]. Also, these findings are consistent with a previous study conducted at Al-Zahrawi University College of Pharmacy, which assessed the cognitive awareness of osteoporosis among pharmacy students and also reported a moderate level of knowledge regarding the disease. Such consistency between studies may indicate that the current educational approach provides basic information but may not sufficiently emphasize the importance of osteoporosis as a public health problem.

Additionally, there is a statistically no significant association between gender and the participant's level of knowledge about osteoporosis; This aligns

with findings by previous study, suggesting that academic exposure is a more potent determinant of clinical knowledge than gender [32].

Furthermore, the is a significant increase in level of knowledge about osteoporosis during stages because of deeper curricula, clinical training, exposure to real cases, and attending workshops, which enhance understanding and practical application [33].

The lack of osteoporosis awareness among the medical students and the low perception of osteoporosis susceptibility and severity considers a serious issue; Therefore, it is important to design educational programs targeting these groups to raise awareness and change their subsequent beliefs. Also, to increase the knowledge about the importance of adherence to osteoporosis protective behaviors (physical activity ad Ca intake).

- **Study limitations**

The convenience of sample selection in a single city limits this study's generalizability. However, to our knowledge, this is the first Iraqi study assessing osteoporosis among medical students.

5.Conclusions

Medical students have an average awareness of osteoporosis. The older age group was more knowledgeable than the younger age groupings. Medical students had a considerable knowledge gap about symptoms, risk factors, and treatment options.

6.Recommendation

The level of osteoporosis awareness among the medical students was insufficient, because of that, it is important to design educational programs targeting these groups to raise their awareness and change their subsequent beliefs. In addition, health professionals may have an important role in planning prevention education to raise the awareness of osteoporosis among the young adult groups. Therefore, future studies need to consider the quality of the standard questionnaires to evaluate knowledge, beliefs, and behaviors regarding osteoporosis. In addition, it is necessary to examine the relationships between the osteoporosis knowledge and health beliefs with the level of students' participation in the osteoprotective behaviors to evaluate the effect of the knowledge and beliefs on the level of the students' engagement in the osteoporosis preventive behaviors. Therefore, further research requires more attention to implementing effective strategies to enhance osteoporosis knowledge among medical students.

7.Acknowledgments

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8. Conflict of Interests

No conflict of interests was declared by the authors.

11.References

1. Grob GN. Aging bones: A short history of osteoporosis. JHU Press; 2014 Apr15.
2. Ferrari SL, Roux C, editors. Pocket Reference to Osteoporosis. Springer International Publishing; 2019 Mar 7.
3. Dempster DW, Cauley JA, Bouxsein ML, Cosman F, editors. Marcus and Feldman's osteoporosis. Academic Press; 2020 Oct 8.
4. Gullberg J. Aspects of osteoporosis and fracture risk assessment in primary dental care: attitudes, willingness to pay and evaluation of an automated software (Doctoral dissertation, Malmö universitet); 2021 Jan 20.
5. Salari N, Ghasemi H, Mohammadi L, Behzadi MH, Rabieenia E, Shohaimi S, Mohammadi M. The global prevalence of osteoporosis in the world: a comprehensive systematic review and meta-analysis. Journal of orthopaedic surgery and research. 2021 Dec; 16:1-20.
6. Kanis JA, McCloskey EV, Johansson H, Strom O, Borgstrom F, Odén A, National Osteoporosis Guideline Group. Case finding for the management of osteoporosis with FRAX®—assessment and intervention thresholds for the UK. Osteoporosis international. 2008 Oct; 19:1395-408.
7. De Villiers TJ, Goldstein SR. Bone health 2022: an update. Climacteric. 2022 Jan 2;25(1):1-3.
8. Berry SD, Kiel DP, Donaldson MG, Cummings SR, Kanis JA, Johansson H, Samelson EJ. Application of the National Osteoporosis Foundation Guidelines to postmenopausal women and men: the Framingham Osteoporosis Study. Osteoporosis international. 2010 Jan; 21:53-60.
9. Marshall D, Johnell O, Wedel H. Meta-analysis of how well measures of bone mineral density predict occurrence of osteoporotic fractures. Bmj. 1996 May 18;312(7041):1254-9.

10. Akinpetide GO. Osteoporosis knowledge, beliefs, and bone promotion behaviors of postmenopausal African American (AA) women.2014 Jan;22:55-65.
11. McLeod KM. Osteoporosis Care Gap. The University of Regina Canada; 2013.
12. Pitts CJ, Kearns AE. Update on medications with adverse skeletal effects. InMayo Clinic Proceedings; 2011 Apr 1.
13. Sheu A, Diamond T. Secondary osteoporosis. Australian prescriber. 2016 Jun 1;39(3):85.
14. Watts NB. Adverse bone effects of medications used to treat non-skeletal disorders. Osteoporosis International. 2017 Oct;28(10):2741-6.
15. Munnikhuysen S. The Pathology and Treatment of Osteoporosis.2022.
16. Zebaze RM, Ghasem-Zadeh A, Bohte A, Iuliano-Burns S, Mirams M, Price RI, Mackie EJ, Seeman E. Intracortical remodelling and porosity in the distal radius and post-mortem femurs of women: a cross-sectional study. The Lancet. 2010 May 15;375(9727):1729-36.
17. Kenkre JS, Bassett JH. The bone remodelling cycle. Annals of clinical biochemistry. 2018 May;55(3):308-27.
18. Kim R, Kim SW, Kim H, Ku SY. The impact of sex steroids on osteonecrosis of the jaw. Osteoporosis and Sarcopenia. 2022 Jun 1;8(2):58-67.
19. Lima LG, Tayfour NM, Lemos PC, Alves MF, Ferreira IM, Gomes EV. Hormone Replacement Therapy: Risks and Benefits. Integrative Journal of Medical Sciences. 2020 Nov 3;7.
20. Cooper C, Reginster JY, Cortet B, Diaz-Curiel M, Lorenc RS, Kanis JA, Rizzoli R. Long-term treatment of osteoporosis in postmenopausal women: a review from the European Society for Clinical and Economic Aspects of Osteoporosis and Osteoarthritis (ESCEO) and the International Osteoporosis Foundation (IOF). Current medical research and opinion. 2012 Mar 1;28(3):475-91.

21. Winzenberg TM, Oldenburg B, Frendin S, Jones G. The design of a valid and reliable questionnaire to measure osteoporosis knowledge in women: The Osteoporosis Knowledge Assessment Tool (OKAT). BMC musculoskeletal disorders. 2003 Dec; 4:1-7.
22. Riaz M, Abid N, Patel MJ, Tariq M, Khan MS, Zuberi L. Knowledge about osteoporosis among healthy women attending a tertiary care hospital. Journal of the Pakistan Medical Association. 2008;58(4):190.
23. Khan YH, Sarriff A, Khan AH, Mallhi TH. Knowledge, attitude and practice (KAP) survey of osteoporosis among students of a tertiary institution in Malaysia. Tropical Journal of Pharmaceutical Research. 2014 Feb 13;13(1):155-62.
24. Alghamdi, Mushabab Ayed, and Abdel Gaffar AbdelAllah Mohammed. Knowledge and Awareness of Osteoporosis among Saudi Physicians and Nurses: A Cross-Sectional Study. Open access Macedonian journal of medical sciences.2018 May 6,5: 913-916.
25. Pascarella G, Rossi M, Montella E, Capasso A, De Feo G, Botti G, Nardone A, Montuori P, Triassi M, D'Auria S, Morabito A. Risk analysis in healthcare organizations: Methodological framework and critical variables. Risk management and healthcare policy. 2021 Jul 8:2897-911.
26. Nguyen VH. Osteoporosis knowledge assessment and osteoporosis education recommendations in the health professions. Osteoporosis and Sarcopenia. 2016 Jun 1;2(2):82-8.
27. Charan J, Biswas T. How to calculate sample size for different study designs in medical research. Indian journal of psychological medicine. 2013 Apr;35(2):121-6.
28. AlHefdhi HA, Alshahrani MA, Alalyani RT, Alshamrani NS, Alqathanin MA, Asiri NA. Assessment of osteoporosis nowledge among the general population in Aseer region, Saudi Arabia. Med Sci. 2023; 27:138.
29. Aljohani DAE, Alharbi RA, Atik MA, Zakri AY, Almajnoni FS, Albajaly JM. Assessment of knowledge, attitude, and practice towards

osteoporosis screening among primary health care physicians in primary health care centers in Makkah Al Mokarramah City. 2023;11(10):42795.

30. Albergaria BH, Chalem M, Clark P, Messina OD, Pereira RM, Vidal LF. Consensus statement: osteoporosis prevention and treatment in Latin America—current structure and future directions. Archives of osteoporosis. 2018 Dec; 13:1-8.
31. DeRuiter-Willems L. Comparison of osteoporosis knowledge, beliefs, attitudes, and behavior among college students of various racial/ethnic groups. Doctoral dissertation, Indiana State University.2018 Nov 7;3
32. Nguyen VH. Osteoporosis-preventive behaviors and their promotion for young men. BoneKEy Reports. 2015 Aug 5; 4:729.
33. Althobiti ES. Knowledge, beliefs, and preventive behaviors regarding osteoporosis among university students: Scoping review. Evidence-Based Nursing Research. 2022;4(3):46-70.