



Knowledge, Attitude, and Practice Regarding Osteoporosis Among Allied Health Sciences Students in a Public University in Malaysia

ORIGINAL
ARTICLE

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ABSTRACT

Objective: Osteoporosis is usually asymptomatic until the first fracture occurs. The tendency of developing osteoporosis is higher in postmenopausal women. The purpose of the present study was to analyze the knowledge, attitude and practice (KAP) regarding osteoporosis among Allied Health Sciences students in a public university in Malaysia, its associated sociodemographic factors, and association between the KAP.

Materials and Methods: This was a cross-sectional study. The participants who were selected using convenience sampling were given a questionnaire that comprised four sections on sociodemographic and KAP regarding osteoporosis. Descriptive statistics, independent t-test, and correlation test were used accordingly to analyze data using SPSS version 20.

Results: The total KAP scores were 39.62 (SD=2.87), 35.82 (SD=4.72), and 20.34 (SD=2.86), respectively. There was no significant association between KAP regarding osteoporosis with sexes ($p=0.063$, $p=0.723$, and $p=0.162$, respectively) of the participants, neither between knowledge and attitude with age ($p=0.784$ and $p=0.366$, respectively), or year of study ($p=0.833$ and $p=0.468$, respectively) of the participants. However, there was a minimal significant negative correlation between practice with age and year of study of the participants ($r=-0.230$, $p=0.017$ and $r=-0.238$, $p=0.014$, respectively). Finally, there was also a significant fair positive correlation between attitude and practice regarding osteoporosis ($r=0.339$, $p<0.001$).

Conclusion: The participants in the present study had moderate/fair level of knowledge and attitude but poor practice regarding osteoporosis. Only age and year of study were found to be significantly negatively associated with practice, in addition to the fair positive correlation between attitude and practice.

Keywords: Knowledge, attitude, practice, osteoporosis, university students

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INTRODUCTION

Osteoporosis is a skeletal disorder distinguished by microarchitectural deterioration and rapid bone loss at the osseous tissue, increasing the risk for bone fracture especially at the hip, wrist, and spine (1). It is often referred to as a silent killer because there are no apparent early symptoms (2). It is a serious metabolic bone disorder that causes >8.9 million fractures per year affecting approximately 200 million globally (3, 4). It is a threat to the well-being of the human population where its related morbidity and mortality increase proportionally as the population ages. The awareness toward osteoporosis and the risk of getting fracture among public or medical sector in Malaysia had increased due to the Malaysian Osteoporosis Society efforts (5). On the other hand, osteoporosis is also becoming a common problem in Singapore as 1 in 3 individuals has become dependent on others and has loss of function due to femoral fracture, whereas 1 in 5 people dies within a year due to fracture at the proximal end of the femur (6). Furthermore, in the USA, the Surgeon General has distinguished that one of the crucial constituents that affect the overall quality life of Americans is bone health (7). Osteoporosis is not only restricted to bringing acute pain but also can cause serious medical complications and affect the total quality of life of a person with outrageous cost of treatment (8). Many studies reported that women have higher tendency in getting osteoporosis than men because of a decrease in estrogen after menopause, leading to rapid progression of bone loss (9-12). Caucasians and Asians are categorized in the high-risk groups of getting osteoporosis (13). However, there are many other risk factors associated with osteoporosis, such as gender, race, body mass index, genetics, diet, physical activity, and family history (14-17). Prevention is better than cure; therefore, the Malaysian population should take care of all these risk factors that can contribute to osteoporosis (18).

The purpose of the present study was to determine the level of knowledge, attitude and practice (KAP) regarding osteoporosis, in addition to exploring the possible sociodemographic factors associated with osteoporosis and the association between the KAP. The study was conducted among Allied Health Sciences (AHS) students in a public university in Malaysia. Knowledge is not stagnant; therefore, practice needs to keep pace. Hopefully, the present study would create awareness among the students regarding the benefit of healthy lifestyles to prevent osteoporosis.

MATERIALS and METHODS

Study Area: The study was conducted in a public university in Malaysia.

Source of Population: The targeted group was among AHS students enrolled in any undergraduate programs in the selected university.

Study Design: The cross-sectional study was conducted based on a structured questionnaire.

Sample Size Calculation: The sample size was calculated by the single proportion formula using 95% confidence interval, 0.10 level of precision, and $p=0.50$ based on the proportion of good knowledge regarding osteoporosis (19). After taking into consideration the 10% non-response rate, the sample size needed for the present study was 106.

Sampling Method: The sampling method used was convenient sampling due to its simplicity and time limitation of the study. Data collection was conducted from March to April 2016.

Inclusion Criteria: The participants should be undergraduate AHS students who were physically healthy, active, and voluntarily wanted to participate in the study.

Exclusion Criteria: Those with a history of chronic diseases, such as hypertension, diabetes, and bone diseases, were excluded from the study.

Research Tool: The questionnaire was divided into four parts (A, B, C, and D), including sociodemographic data and KAP regarding osteoporosis. Data on demographic characteristics from the participants in Part A included age, gender, and year of study. Parts B, C, and D were used to measure KAP regarding osteoporosis, respectively. The informed consent form and questionnaires were prepared only in the English language. Part B of the questionnaire was about the Osteoporosis Knowledge Assessment Tool to measure the knowledge score regarding osteoporosis and was adapted from a previous study (20). This part comprised four themes: general knowledge regarding osteoporosis, risk factors and preventive factors of osteoporosis, physical activity, and diet. All the 15 questions in Part B were given “true”, “false”, and “don’t know” answer choices with a maximum score of 45. On the other hand, Parts C and D were self-constructed questionnaire based on literature review. Part C comprised 11 questions with a five-point Likert scale type of answers from “strongly disagree” to “strongly agree” with a maximum score of 55. Part D comprised nine questions with four-point Likert scale type of answers from “everyday” to “never” with a maximum score of 36. Content validity of the questionnaire was checked by experts, and face validity was checked through a pilot study, from which a few corrections and amendment had been made to improve the questionnaire.

Scores of KAP Regarding Osteoporosis: The scoring system was adapted and modified from previous studies (21-24). Responses of “true”, “don’t know”, and “false” for knowledge in Part A were given the scores of 3, 2, and 1, respectively. Responses of “strongly disagree”, “disagree”, “neither agree nor disagree”, “agree”, and “strongly agree” for attitude in Part C were given the scores of 1, 2, 3, 4, and 5, respectively, whereas responses of

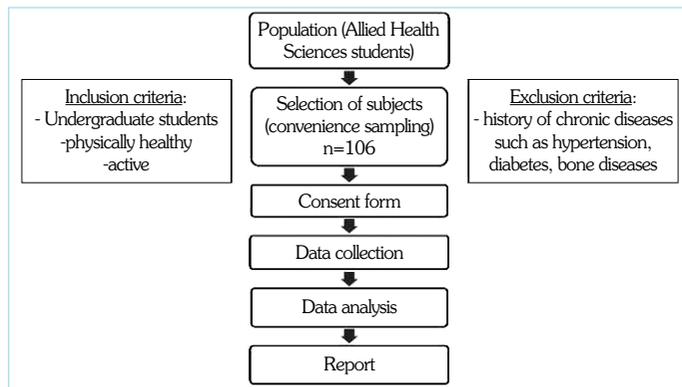


Figure 1. Flowchart of the research methodology.

Percentage of total scores (%)	Total scores of knowledge	Total scores of attitude	Total scores of practice	Level
80-100	38-45	44-55	29-36	Good
60-79	29-38	33-44	22-29	Moderate/fair
<60	0-28	0-32	0-21	Poor

Total scores	Male Mean (SD) (n=52)	Female Mean (SD) (n=54)	t-Statistics (df)	p
Knowledge	39.09 (3.38)	40.13 (2.18)	-1.878 (104)	0.063
Attitude	35.65 (4.80)	35.98 (4.65)	-0.355 (104)	0.723
Practice	19.94 (2.82)	20.72 (2.88)	1.408 (104)	0.162

Table 3. Association between age and year of study of the participants with total scores of knowledge, attitude and practice regarding osteoporosis using Pearson correlation test (n=106)

Variables	r	p
Age vs. knowledge	+0.027	0.784
-Attitude	+0.089	0.366
-Practice	-0.230	0.017
Year of study vs. knowledge	-0.021	0.833
-Attitude	0.071	0.468
-Practice	-0.238	0.014

Table 4. Association between total scores of knowledge, attitude and practice regarding osteoporosis (n=106)

Variables	r	p
Knowledge vs. attitude	0.008	0.938**
Knowledge vs. practice	0.128	0.192*
Practice vs. attitude	0.339	<0.001**

*Spearman correlation test

**Pearson correlation test

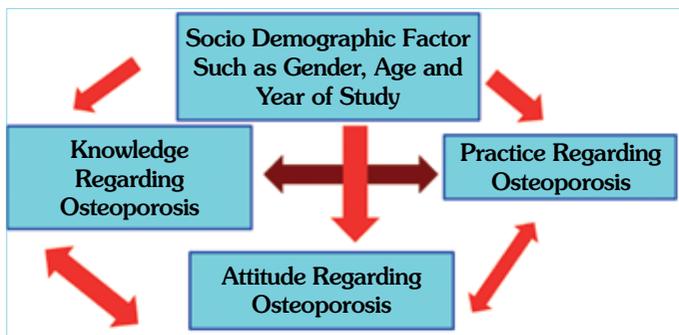


Figure 2. Conceptual framework on the relationship between knowledge, attitude and practice regarding osteoporosis and the sociodemographic factors.

“everyday”, “frequent”, “seldom”, and “never” for practice in Part D were given the scores of 4, 3, 2, and 1, respectively. On the other hand, Table 1 illustrates the classification of the total scores into good, moderate/fair, and poor levels of KAP.

Statistical Analysis

The data collected was analyzed using Statistical Package for Social Sciences, version 20 (IBM Corp.; Armonk, NY, USA). Descriptive statistics of frequency and percentage were used to describe the categorical data and mean with standard deviation (SD) for numerical data. In addition, independent *t*-test was used to compare the total scores of KAP between male and female, and correlation test to assess the association between two numerical variables. Figure 1 shows the flow of this research methodology.

Ethical Consideration: Approval for the study had been obtained from Kulliyah of AHS, International Islamic University Malaysia (reference no.: IIUM/310/G/13/4/4-178, date: February 1, 2016). Written consent was obtained from all participants to

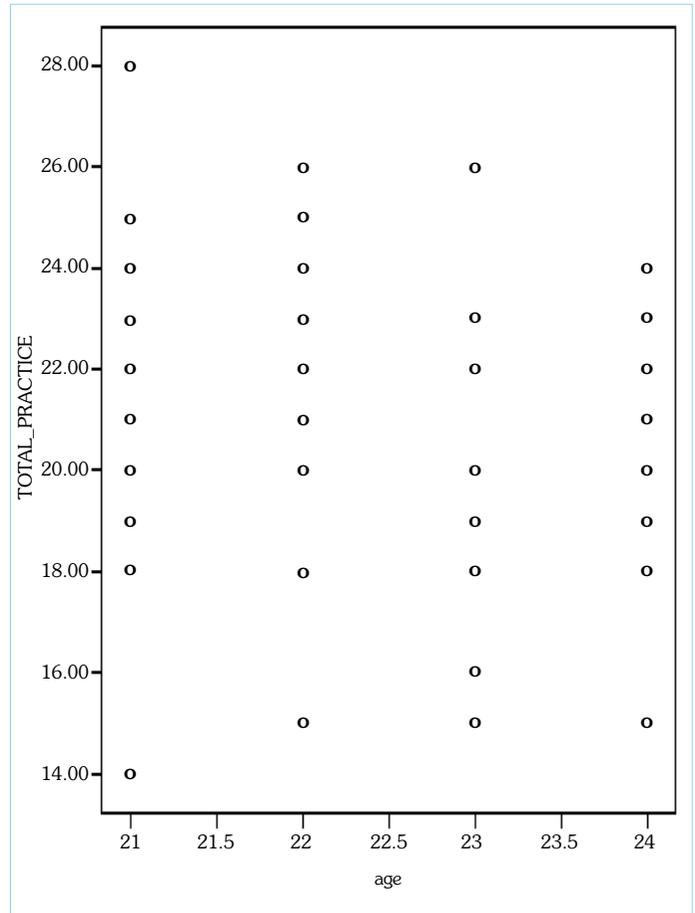


Figure 3. Association between age of the participants and total scores of practice regarding osteoporosis (n=106).

ensure voluntary participation, and all their information was kept confidential.

Conceptual framework: The conceptual framework regarding the relationship between KAP regarding osteoporosis and the sociodemographic factors (Figure 2).

RESULTS

Sociodemographic Characteristic of the Participants

Overall, 106 AHS students voluntarily participated in the study. The mean age of the participants was 22.39 (SD=1.168) years. There were 49.1% (52) male and 50.9% (54) female participants included in the study. Among the participants, 31.1% (33), 24.5% (26), 23.5% (25), and 20.8% (22) were 21, 24, 22, and 23 years old, respectively. Of the research participants, 34.0%, 19.8%, 19.8%, and 19.8% were from Years I, II, III, and IV, respectively.

KAP Regarding Osteoporosis

Knowledge of Participants Regarding Osteoporosis

The mean total score of knowledge regarding osteoporosis among the participants was 35.62 (SD=2.87), which was at the moderate/fair level. The results showed that 97.2% (103) of the participants knew that osteoporosis affects women more than men, and 95.3% (101) were aware that it can cause fracture in elderlies. In contrast, most of the participants stated that sedentary lifestyle

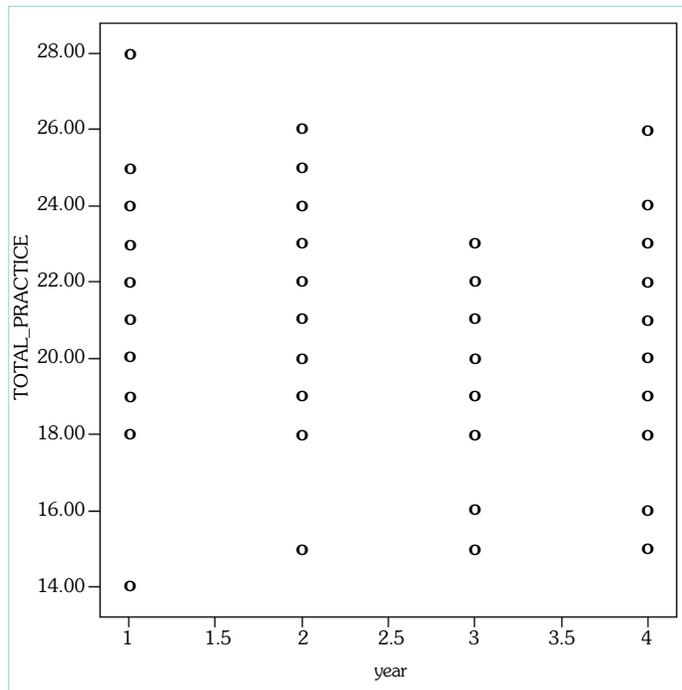


Figure 4. Association between year of study of the participants and total scores of practice regarding osteoporosis (n=106).

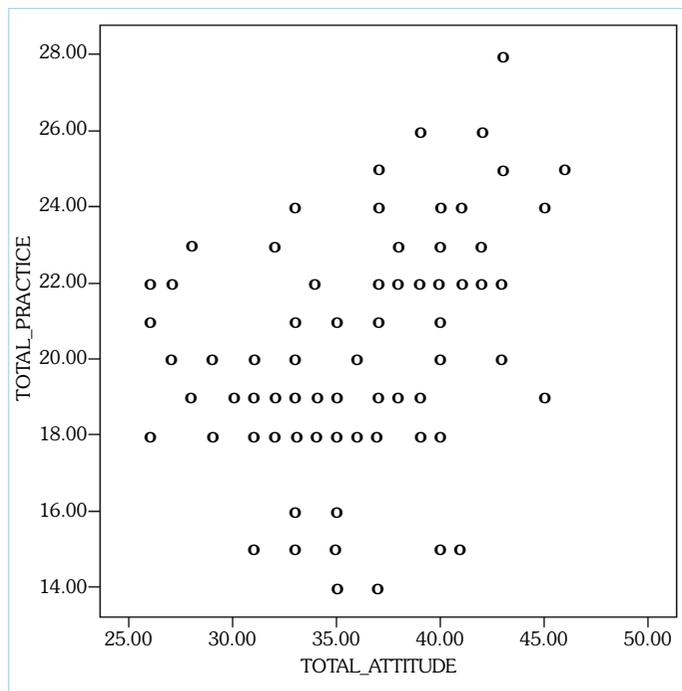


Figure 5. Association between total scores of attitude and practice regarding osteoporosis (n=106).

(96.2% (102)) and smoking (85.8% (91)) increase the risk of osteoporosis. In addition, 86.8% (91) of the participants believed that walking has great effects on health status including the bone. Surprisingly, 86.8% (92) of the participants knew that bone mineral density (BMD) is used as a measurement tool to diagnose osteoporosis. However, 68.9% (73) of the participants did not know that 17 years old is the age to build bone strength. Additionally, 38.7% (41) of the participants knew that osteoporosis cannot lead

to blindness. Only 16% (17) of the participants knew that regular intake of calcium and vitamin D decreases the risk. On the other hand, 24.5% (26) of the participants knew that hormone replacement therapy can help in slowing down the progression of bone loss, and 51.9% (55) of them knew that osteoporosis is different from osteoarthritis.

Attitude of Participants Regarding Osteoporosis

The results showed that the mean total score of attitude regarding osteoporosis for the participants was 35.82 (SD=4.72), which was at the moderate/fair level. It was also found that 67.0% (71), 43.4% (46), and 37.7% (40) of the participants did not believe that they had a high chance of developing osteoporosis, had weak bones, and will go for check-up voluntarily for osteoporosis, respectively. More than half (62.3% (66)) of the participants would go for medical counseling to prevent fractures, whereas 63.2% (67), 49.1% (52), and 100% (106) of them admitted that osteoporosis was scary, had the potential to cripple people, and vitamin D supplement was good to prevent osteoporosis, respectively. On the other hand, 35.8% (38) disagreed that stress can promote osteoporosis. Moreover, 38.7% (41) and 47.2% (50) of the research participants did not agree that doing exercise at least three times a week and for approximately 20 to 30 min each time, respectively, can prevent osteoporosis.

Practice of Participants Regarding Osteoporosis

The mean total score of practice regarding osteoporosis among the participants was 20.34 (SD=2.86). Among the participants, only 8.5% (9), 38.7% (41), 12.3% (13), and 6.6% (7) included vegetables and fruits in their diet, took vitamin D supplement, drank milk, and practiced a well-balanced diet according to the food pyramid, regularly daily, respectively. Of the participants, 10 (9.4%) admitted that they smoked every day. Favorably, all the participants never drank alcohol. On the other hand, only 12.3% (13) of the participants spent an average of 15 min per day outside in the sunlight every day. Finally, only 8.5% (9) of the participants exercised at least 20 min each time daily.

Association Between Sociodemographic Factors and KAP Regarding Osteoporosis

Comparison of KAP Regarding Osteoporosis Between Males and Females

Generally, even though the total scores of females were higher than males, there was no significant difference between sexes in KAP regarding osteoporosis (Table 2).

Association Between Age and Year of Study of the Participants with KAP Regarding Osteoporosis

There was no statistically significant correlation between knowledge and attitude regarding osteoporosis with the age and year of study of the participants (Table 3). However, there was a significant association between the total scores of practice with age and year of study of the participants showing minimal negative correlation ($r=-0.230$ and $r=-0.238$, respectively). This means that the lower the age and year of study of the participants, the higher was the total scores of practice regarding osteoporosis (Figure 3 and 4, respectively).

Association Between KAP Regarding Osteoporosis

There was no significant association between knowledge with attitude and practice regarding osteoporosis (Table 4). However, there was a significant correlation between attitude and practice regarding osteoporosis ($p < 0.001$), even though the correlation coefficient indicated only minimal positive correlation between the two variables ($r = 0.339$). This means that higher scores of attitude were associated with better practice regarding osteoporosis (Figure 5).

DISCUSSION

Knowledge of Participants Regarding Osteoporosis

The young adult sees the occurrence of fracture, getting shorter, and spinal compression as a natural sign of aging (25). The aging process is a biological process that humans undergo transition from healthy to wear and tear, and this phenomenon is beyond control (26). Although osteoporosis is related with the aging process, proper care can halt the progression of the disease, and the patient often leads a better quality of life (7). The study participants were considerably aware about the risk factors of osteoporosis, as most of them answered correctly about smoking and sedentary lifestyle promoting osteoporosis. A previous study reported that hereditary trait, race, and small figures are examples of genetic risk factor for osteoporosis; additionally, it was suggested for the younger age group that alcohol and caffeine consumption may promote such bone disorder (27). The finding of the current study was also in parallel with a previous study that showed good levels of knowledge about osteoporosis and its risk factors (28). The current research found that majority of the participants had high level of knowledge about the most common site of fractures occurring in patients with osteoporosis. Osteoporotic bone fractures are more common to occur at the hip, wrist, and spine; however, other parts of the bone can fracture too, and apart from causing pain, it could cause patients to lose their height (2). Many participants in the current study were not aware that hormone replacement therapy is an important treatment choice toward osteoporosis. One research reported that 30% of spinal fractures and 50% of hip fractures can be prevented via this convincing therapy (29).

Attitude of Participants Regarding Osteoporosis

Attitude is one of the imperative aspects in self-efficacy that is used especially in health intervention program. Self-efficacy can be defined as a person's strength of belief to achieve the target (13). Self-efficacy has been used in many human subjects to view the behavioral changes (30). The reliable information provided by health educators could increase patients' awareness and enhance their self-efficacy and, thereafter, improve the health status of the community (31). Additionally, motivation can lead to positive attitude regarding osteoporosis especially when people realize that the risk issues could be reduced by minimizing negative behavior (32).

In the present study, the finding shows moderate level of attitude of participants regarding osteoporosis. The reason behind this was probably because they lack awareness and did not pay much attention regarding osteoporosis. This was slightly different from a Saudi Arabian study that showed approximately two-thirds of the respondents is concerned about osteoporosis (33) or a study in Riyadh where majority of their participants have satisfactory attitude

score toward osteoporosis (34). On the other hand, this is in contrast with a study conducted in Turkey that showed that most of the participants have poor attitude level regarding osteoporosis (35). In contrast, a study that has been conducted in another public university in Malaysia showed an overall positive score (36). This was probably because the participants there had a strong idea about the severity of osteoporosis compared with the participants of the current study and in Saudi Arabia. Participants in Saudi Arabia and of the current study might not have perceived themselves to be susceptible to osteoporosis (33).

All of the current study participants agreed that healthy food can prevent osteoporosis. This finding had similarity with a Riyadh study that stated that healthy food can prevent osteoporosis (34). This result was also similar to an Iranian study (37). Therefore, a healthy eating habit should be practiced to improve bone health. A balanced diet could improve healthy life and reduce the incidence of fractures in older adults (38). A previous study reported that adolescents tend to consume carbonated beverages regularly that could result in Ca^{2+} displacement and promote osteoporosis (39).

All of the research participants surprisingly agreed that vitamin D supplements are good for maintaining bone health. Another study reported that vitamin D deficiency is the major cause of osteomalacia and osteoporosis (40). However, only a few foods are naturally enriched with vitamin D (41). Hence, it could be a problem to obtain adequate amount of vitamin D from dietary sources. Therefore, there is a relief when all participants in the present study realized the importance of vitamin D intake because a previous study showed that low intake of vitamin D is linked with low BMD that can increase the risk of fracture (42).

Practice of Participants Regarding Osteoporosis

The total mean score for the practice of the current study participants indicates poor practice regarding prevention of osteoporosis. This finding was equivalent to a study in Sri Lanka that also showed low level of preventive practice among their participants (43). This was probably because they perceived that they were not susceptible to osteoporosis and were not concerned regarding its preventive measures. This was again supported by a previous finding that knowledge does not always ensure preventive behaviors (44). Apart from that, a good number of respondents in the current study never smoked. This result was similar with the study conducted in Riyadh (34). Smoking has been identified as one of the risk factors of osteoporosis and proven to have a strong relationship to low bone density (45).

All of the current study participants never consume alcohol, which was in contrast with a previous study that reported that majority of the participants consume alcohol (46).

Additionally, alcohol consumption depletes calcium reserves and instigates osteoporosis. Moreover, alcohol damages the pancreas and leads to poor vitamin D and calcium absorption. Chronic alcohol intake destroys bone mass, reduces bone development, and prone to fissure formation (4). Another study reported that consumption of alcohol >207 mL per week can be a risk factor for osteoporosis (47).

Meanwhile, a minor portion of the participants in the current study negatively opined regarding exercise for the prevention of osteoporosis. This was in contrast with the study conducted in Riyadh because their participants knew the tremendous benefit of exercise (34). The quality of life could be improved by practicing healthy lifestyle and exercising regularly (48). BMD may be increased through routine exercise, and lack of exercise is ascertained to be one of the risk factors of osteoporosis. In Malaysia, it was reported that young people do not reach the adequate physical level (36). Another study claimed that some young adults chose not to be active even though they were quite active during their adolescents' phase (49). Therefore, a lower risk of getting osteoporosis could be achieved by avoiding sedentary lifestyle and be more active by exercising every day (50).

Association Between Sociodemographic Factors with KAP Regarding Osteoporosis

The present study found that females had a slightly higher level of knowledge than males, but it was not statistically significant. This was supported in another study (51) and a survey conducted in Huntsville, Texas, USA (52). The average age of the highest score was 21 years in the current study, which was not similar to a previous study (53). However, participants of Year IV students had the highest average score compared with Years I, II, and III. This was probably because fourth year students had learned a lot compared with their juniors in the lower years.

Correlation Between KAP Regarding Osteoporosis

The current study found that there was no significant association between knowledge with attitude and practice regarding osteoporosis. It was perceived that the participants should have better knowledge and positive attitude prior to entry to AHS school, which was a field of medicine that aims to improve health. In addition, it could be because the participants did not pay much attention toward osteoporosis. Another study hypothesized that education could not be effective enough if it is not accompanied with attitude and practice of the participants (54).

In contrast with a previous study conducted in Saudi Arabia, the result of the current study showed a statistically significant association between knowledge and attitude regarding osteoporosis (33). This was probably because the education programs related to health that have been implemented in Saudi Arabia were interesting and could motivate them to have good attitude regarding osteoporosis. This could also be due to the participants who realized that osteoporosis was more prevalent among women (47). Knowledge without application is pointless. Learning about osteoporosis only could not assure that participants would practice the preventive measures toward osteoporosis unless it comes with a strong determinant (55). However, the current study revealed that there was a significant association between the attitude and practice of participants regarding osteoporosis. This result shows that positive attitude is essential to implement the preventive measures. Furthermore, according to one earlier report, there was a positive relationship between attitude and practice toward healthy bone status. People who believe the consequences of osteoporosis tend to act to prevent it at all cost (7).

Limitation of the Study and Recommendations

Our study has some limitations. Despite its ease, the convenient sampling method used in the present study limits the generalization of the results to the population. The cross-sectional study design used means that causal inference cannot be made between the outcome and independent variables in the present study. In order to improve the results, random sampling and cohort or experimental study should be conducted to improve the generalization and causal inference made.

CONCLUSION

The current study used small community of a faculty setting that found the total scores showed that the participants had moderate/fair level of knowledge and attitude but poor practice regarding osteoporosis. In the present study, there was no significant difference in total KAP scores between different sexes, neither was there any significant association between total knowledge and attitude scores regarding osteoporosis with age and year of study of the participants. However, age and year of study of the participants were negatively associated with practice regarding osteoporosis, indicating that lower age and year of study were associated with better practice regarding osteoporosis, in addition to the fair positive correlation between attitude and practice, meaning that better attitude was associated with better practice regarding osteoporosis.

Ethics Committee Approval: Ethics committee approval was received for this study from the Post-Graduate and Research Committee of Kuliyah of Allied Health Sciences, International Islamic University Malaysia (01.02.2016-2015/ IUM/310/G/13/4/4-178).

Informed Consent: Written informed consent was obtained from the participants in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Conceived and designed the experiments or case: NR, NAAR, MH. Performed the experiments or case: NR, NAAR. Analyzed the data: NR, NAAR. Wrote the paper: NR, NAAR. All authors have read and approved the final manuscript.

Conflict of Interest: The authors have no conflicts of interest to declare.

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REFERENCES

1. Leali PT, Muresu F, Melis A, Ruggiu A, Zachos A, Doria C. Skelletal fragility definition. *Clin Cases Miner Bone Metab* 2011; 8(2): 11-3.
2. Available from: <https://cdn.nof.org/wp-content/uploads/2015/12/Osteoporosis-Fast-Facts.pdf> [Accessed July 22-2018]
3. Reginster JY, Burlet N. Osteoporosis: a still increasing prevalence. *Bone* 2006; 38(2 Suppl 1): 4-9. [CrossRef]
4. Watts NB, Adler RA, Bilezikian JP, Drake MT, Eastell R, Orwoll ES, et al. Osteoporosis in men: An Endocrine Society clinical practice guideline. *J Clin Endocrinol Metab* 2012; 97(6): 1802-22. [CrossRef]
5. Kastner M, Li J, Lottridge D, Marquez C, Newton D, Straus SE. Development of a prototype clinical decision support tool for osteoporosis disease management: a qualitative study of focus groups. *BMC Med Inform Decis Mak* 2010; 10(1): 40. [CrossRef]

6. Caro JJ, Ishak KJ, Huybrechts KF, Raggio G, Naujoks C. The impact of compliance with osteoporosis therapy on fracture rates in actual practice. *Osteoporos Int* 2004; 15(12): 1003-8. [CrossRef]
7. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK45513/> [Accessed July 22-2018]
8. Blau EM, Brenneisen SK, Bruning AL, Chen Y. Prevalence of vitamin D insufficiency in an osteoporotic population in Southern California. *J Bone Miner Res* 2004; 19 (Suppl 1): 342.
9. Cawthon PM. Gender Differences in Osteoporosis and Fractures. *Clin Orthop Relat Res* 2011; 469 (7): 1900-5. [CrossRef]
10. Riggs BL, Khosla S, Melton LJ. Sex steroids and the construction and conservation of the adult skeleton. *Endocr Rev* 2002; 23(3): 279-302. [CrossRef]
11. Riggs BL, Khosla S, Melton LJ. A unitary model for involutional osteoporosis: estrogen deficiency causes both type I and type II osteoporosis in postmenopausal women and contributes to bone loss in aging men. *J Bone Miner Res* 1998; 13(5): 763-73. [CrossRef]
12. Tella SH, Gallagher JC. Prevention and treatment of postmenopausal osteoporosis. *J Steroid Biochem Mol Biol* 2014; 142: 155-70. [CrossRef]
13. Lei SF, Chen Y, Xiong DH, Li LM, Deng HW. Ethnic difference in osteoporosis-related phenotypes and its potential determination. *J Musculoskelet Neuronal Interact* 2006; 6(1): 36-46.
14. Sözen T, Özişik L, Başaran NÇ. An overview and management of osteoporosis. *Eur J Rheumatol* 2017; 4(1): 46-56. [CrossRef]
15. Johnson AK, Ford MA, Jones TL, Nahar VK, Hallam JS. Predictors of Bone Mineral Density in African-American and Caucasian College-Aged Women. *Health Promot Perspect* 2015; 5(1): 14-23. [CrossRef]
16. Available from: file:///D:/Downloads/Ruffing_columbia_0054D_10246.pdf [Accessed July 23-2018]
17. Chin KY, Low NY, Dewiputri WI, Ima-Nirwana S. Factors Associated with Bone Health in Malaysian Middle-Aged and Elderly Women Assessed via Quantitative Ultrasound. *Int J Environ Res Public Health* 2017; 14(7): 736. [CrossRef]
18. Kanis JA, Melton LJ, Christiansen C, Johnston CC, Khaltaev N. The diagnosis of osteoporosis. *J Bone Miner Res* 1994; 9(8): 1137-41. [CrossRef]
19. ElTohami K, Sami W, AlEidan A, AlMubarak M, Alotaibi F. Study of Knowledge, Attitude and Practice of Osteoporosis among Adult Women in Majmaah City, Saudi Arabia. *International Journal of Health and Rehabilitation Sciences* 2015; 4(3): 185-92. [CrossRef]
20. Winzenberg TM, Oldenburg B, Freundin S, Jones G. The design of a valid and reliable questionnaire to measure osteoporosis knowledge in women: the Osteoporosis Knowledge Assessment Tool (OKAT). *BMC Musculoskelet Disord* 2003; 4: 17. [CrossRef]
21. Shrestha A, Bhattarai D, Thapa B, Basel P, Wagle RR. Health care workers' knowledge, attitudes and practices on tuberculosis infection control, Nepal. *BMC Infect Dis* 2017; 17(1): 724. [CrossRef]
22. Adhikari S, Paudel K, Aro AR, Adhikari TB, Adhikari B, Mishra SR. Knowledge, attitude and practice of healthcare ethics among resident doctors and ward nurses from a resource poor setting, Nepal. *BMC Med Ethics* 2016; 17(1): 68. [CrossRef]
23. Murad MAMR, Rahman NAA, Rahman NIA, Haque M. Knowledge, attitude and practice regarding exercise among people exercising in gymnasium and recreational parks around Kuantan, Malaysia. *J App Pharm Sci* 2016; 6(6): 47-54. [CrossRef]
24. Chen IJ, Yu S, Wang TF, Cheng SP, Huang LH. Knowledge about osteoporosis and its related factors among public health nurses in Taiwan. *Osteoporos Int J* 2005; 16(2): 2142-8. [CrossRef]
25. Lysen VC, Walker R. Osteoporosis risk factors in eighth grade students. *J Sch Health* 1997; 67(8): 317-21. [CrossRef]
26. Kessenich CR. Osteoporosis in elderly men. *Geriatr Nurs* 2000; 21(5): 242-4. [CrossRef]
27. Bartl R, Gradinger R. Current diagnosis and therapy of osteoporosis on the basis of "European guidance 2008". *Orthopade* 2009; 38(4): 365-79. [CrossRef]
28. Werner P. Knowledge about osteoporosis: assessment, correlates and outcomes. *Osteoporos Int* 2005; 16(2): 115-27. [CrossRef]
29. Fleming R, Patrick K. Osteoporosis prevention: paediatricians' knowledge, attitudes, and counselling practices. *Prev Med* 2002; 34(4): 411-21. [CrossRef]
30. Piaseu N, Schepp K, Belza B. Causal analysis of exercise and calcium intake behaviors for osteoporosis prevention among young women in Thailand. *Health Care Women Int* 2002; 23(4): 364-76. [CrossRef]
31. Blalock SJ, Currey SS, DeVellis RF, DeVellis BM, Giorgino KB, Anderson JJ, et al. Effects of educational materials concerning osteoporosis on women's knowledge, beliefs, and behaviour. *Am J Health Promot* 2000; 14(3):161-9. [CrossRef]
32. Lim LS, Hoeksema LJ, Sherin K; ACPM Prevention Practice Committee. Screening for Osteoporosis in the Adult U.S. Population. ACPM Position Statement on Preventive Practice. *Am J Prev Med* 2009; 36(4): 366-75. [CrossRef]
33. Barzanji AT, Alamri FA, Mohamed AG. Osteoporosis: A study of knowledge, attitude and practice among adults in Riyadh, Saudi Arabia. *J Community Health* 2013; 38(6): 1098-105. [CrossRef]
34. Alshammari KF. Women Knowledge, Attitude and Practices about Osteoporosis Prevention "Riyadh Saudi Arabia". *World J Med Sci* 2014; 11(3): 422-31.
35. Ungan M, Tümer M. Turkish women's knowledge of osteoporosis. *Fam Pract* 2001; 18(2): 199-203. [CrossRef]
36. Jamila WANW, Aziza ME, Huata FL. Knowledge, Attitude and Dietary and Lifestyle Practices on Bone Health Status among Undergraduate University Students in Health Campus, Universiti Sains Malaysia, Kelantan. *Health Environ J* 2010; 1(1): 34-40.
37. Rafraf M, Bazyun B. Food Habits Related To Osteoporosis in Women in Iran. *Health Promot Perspect* 2011; 1(2): 111-7.
38. Plawecki K, Chapman-Novakofski K. Bone Health Nutrition Issues in Aging. *Nutrients* 2010; 2(11): 1086-105. [CrossRef]
39. Koh LK1, Saw SM, Lee JJ, Leong KH, Lee J; National Working Committee on Osteoporosis. Hip fracture incidence rates in Singapore 1991-1998. *Osteoporos Int* 2001; 12(4): 311-8. [CrossRef]
40. Koutkia P, Lu Z, Chen TC, Holick MF. Treatment of vitamin D deficiency due to Crohn's disease with tanning bed ultraviolet B radiation. *Gastroenterology* 2001; 121(6): 1485-8. [CrossRef]
41. Khan YH, Sarriff A, Khan AH, Mallhi TH. Knowledge, attitude and practice (KAP) survey of osteoporosis among students of a tertiary institution in Malaysia. *Trop J Pharm Res* 2014; 13(1): 155-162. [CrossRef]
42. Melton LJ, Khosla S, Crowson CS, O'Connor MK, O'Fallon WM, Riggs BL. Epidemiology of sarcopenia. *J Am Geriatr Soc* 2000; 48(6): 625-30. [CrossRef]
43. Juby AG, Davis P. A prospective evaluation of the awareness, knowledge, risk factors and current treatment of osteoporosis in a cohort study of elderly subjects. *Osteoporos Int J* 2001; 12(8): 617-22. [CrossRef]
44. Jalili Z, Nakhuae N, Askari R, Sharifi V. Knowledge, attitude and preventive practice of women concerning osteoporosis. *Iran J Public Health* 2007; 36(2): 19-25.
45. Available from: <https://www.webmd.com/osteoporosis/smoking-and-osteoporosis#1> [Accessed July 23-2018]
46. Wyshak G. Teenaged girls, carbonated beverage consumption, and bone fractures. *Arch Pediatr Adolesc Med*. 2000; 154 (6): 610-661. [CrossRef]
47. Sadat AM, Al-Habdan IM, Al-Turki HA, Azam MQ. An epidemiological analysis of the incidence of osteoporosis and osteoporosis-related fractures among the Saudi Arabian population. *Ann Saudi Med* 2012; 32(6): 637-41. [CrossRef]

48. Hsieh C, Novielli KD, Diamond JJ, Cheruva D. Health beliefs and attitudes toward the prevention of osteoporosis in older women. *Menopause* 2001; 8(5): 372-6. [\[CrossRef\]](#)
49. Committee on Physical Activity and Physical Education in the School Environment; Food and Nutrition Board; Institute of Medicine; Kohl HW III, Cook HD, editors. *Educating the Student Body: Taking Physical Activity and Physical Education to School*. Washington (DC): National Academies Press (US); 2013 Oct 30. 3, Physical Activity and Physical Education: Relationship to Growth, Development, and Health.
50. Tlt AE, Barghash SS, Al-Salamah NI. Knowledge, Attitude and Practice (KAP) Regarding Osteoporosis among General Population in Saudi Arabia. *Br J Med Med Res* 2016; 13(4): 1-10. [\[CrossRef\]](#)
51. Rosenstock IM. The Health belief model and preventive health behaviour. *Health Educ Behav* 1974; 2: 328-35.
52. Ford MA, Bass MA, Keathley R. Osteoporosis Knowledge and Attitudes: A Cross-Sectional Study Among College-Age Students. *J Am Coll Health* 2007; 56(1): 43-47. [\[CrossRef\]](#)
53. Chen ST, Soo KL, Azriani AR, Van Rostenberghe H, Sakina H. Nutrition knowledge, attitude and practice of teachers in rehabilitation centres in Northern Malaysia. *Malay J Nutrit* 2012; 18(2): 185-205.
54. Redding CA, Rossi JS, Rossi SR, Velicer WF, Prochaska JO. Health behavior models. *Int Elec J Health Educ* 2000; 3 (Special Issue): 892-897.
55. De Villers MJ. Documentation of preventive education and screening for osteoporosis. *Outcomes Management* 2003; 7(1): 28-32.