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Assessment Of Knowledge, Physical Activity and Calcium Intake among Female University Students

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Abstract

Insufficient calcium intake and being physically inactive lead to osteoporosis. This study aimed to assess the level of knowledge about osteoporosis, physical activity levels and their correlation with calcium intake. 276 female undergraduate students participated in this study. A set of questionnaires was distributed. Majority students had low knowledge (76.1%), moderate physical activity level (47.1%) and did not meet the recommended calcium intake (79.0%). There was a moderate to strong positive correlation but not significant between knowledge ($r = 0.051$, $p = 0.121$) and physical activity ($r = 0.081$, $p = 0.181$) to dietary calcium intake. In conclusion, students had poor knowledge about osteoporosis.

Keywords: calcium; dietary; female; osteoporosis

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1.0 Introduction

Calcium is a micronutrient that is essential for maintaining bone health and preventing diseases such as osteoporosis, especially in women. Osteoporosis is often called the 'silent disease' because most people do not know they have osteoporosis until they break a bone in a minor fall or bump (International Osteoporosis Foundation, 2023). Therefore, maintaining bone health through adequate calcium intake and physical activity can help prevent osteoporosis. The Malaysian Dietary Guidelines (2020) recommend a minimum calcium intake of 1000 mg to optimise metabolic processes in the body (National Coordinating Committee on Food and Nutrition, 2021). However, many studies have shown that calcium intake in young adult females is below the recommended level, which increases the risk of osteoporosis at older ages. Lack of knowledge about osteoporosis is one factor leading to insufficient dietary calcium intake (Shawashi & Darawad, 2020). On the other hand, physical activity also plays an important role in maintaining long-term bone health. Resistance exercise, for example, can maintain bone integrity and strength (Compston et al., 2017). Therefore, to prevent osteoporosis, it is important to know the current calcium intake and level of physical activity. However, little is known about dietary calcium intake in female students, who are usually classified as young adults. Although several studies have been conducted on dietary calcium intake in female adults, little is known about calcium intake and its relationship with the knowledge of osteoporosis and level of physical activity

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among female students at Universiti Teknologi MARA, Puncak Alam Campus, Selangor. Therefore, the aim of this study was to find out the relationship between calcium intake, level of physical activity and knowledge about osteoporosis. This study is deemed necessary to understand the current scenario and suggest an intervention strategy for the future. Moreover, since osteoporosis is a preventable disease, it is cost-effective to encourage people to have adequate calcium intake to prevent osteoporosis. Besides, university students are considered the foundation of any community. Therefore, a cross-sectional study was employed to assess the knowledge, physical activity and calcium intake among female university students. The determination of university students' knowledge of osteoporosis will help set lifestyle and nutritional standards that will help in the prevention of this disease.

2.0 Literature Review

2.1 Dietary calcium

Approximately 99% of all calcium in the body is found in the bones, which provide rigidity and structure to the skeletal system and serve as a reservoir of calcium (Shlisky et al., 2022). Dietary calcium requirements vary by age group and gender. Based on the Recommended Nutrients Intake for Malaysia, women aged 19-50 must consume at least 1000 mg of calcium daily. This is because women at this age have reached the peak of their bone mass and therefore need to maintain the density of bone mass. Dietary calcium is found in many foods, such as milk, yogurt and cheese. Prolonged inadequate calcium intake reduces bone mineralisation and leads to osteopenia and osteoporosis in older adults (International Osteoporosis Foundation, 2023). Many studies have reported that calcium intake is below the recommendation. For example, a study by Suriawati et al. (2016) reported that calcium intake in 289 Malaysian adolescents was 377 mg per day. Another study by Fatimah and Nurul Hazirah (2020) found that calcium intake among 75 young female adults at the International Islamic University Malaysia (IIUM) was 378 mg per day, which is below the recommendation. However, the sample size of this study was small and could not be generalised to a larger population.

2.2 Physical activity

Physical activity is an umbrella term that includes leisure time, physical activity such as exercise and sport, activities of daily living, household tasks and work. Exercise and physical activity can improve bone strength and the risk of falls, which may offer benefits in the prevention and management of osteoporosis (Brooke-Wavell et al., 2022). The UK clinical guideline for preventing and treating osteoporosis highlighted that weight-bearing exercise has beneficial effects on bone mineral density (Compston et al., 2017). For example, walking, running and resistance exercise support bone health.

2.3 Osteoporosis

Over the years, osteoporosis has been a significant public health problem and becoming increasingly prevalent with the ageing of the world population. Osteoporosis, a silent disease, has afflicted over 200 million people worldwide (Tomishige-Mukai et al., 2016). By 2050, more than 30 million people in Europe will be affected by osteoporosis due to an ageing population and longer life expectancy (Martiniakova et al., 2022). The International Osteoporosis Foundation defined osteoporosis as an age-related disorder characterised primarily by decreased bone mineral density, microstructural quality and an elevated risk of fragility fractures (International Osteoporosis Foundation, 2023). This can lead to broken bones, which cause pain and disability, and make everyday activities extremely difficult. There are two types of osteoporosis-related risk factors: modifiable and non-modifiable. Non-modifiable risk factors include age, sex, ethnicity, presence or absence of osteoporosis in the family, date of first menarche and menopause. Modifiable factors include lifestyle habits such as smoking, alcohol consumption, lack of physical activity and a diet with inadequate calcium and vitamin D levels (El Hage et al., 2019). Osteoporosis is preventable and treatable using nutritional supplements and physical activity (Compston et al., 2017). Nutrition such as dietary calcium, plays a dominant role in skeletal health, achieving the highest BMD and maintaining bone health (Karpouzou et al., 2017).

2.4 Knowledge about osteoporosis

Knowledge about osteoporosis is one of the most influential factors in preventing osteoporosis, but it appears insufficient worldwide (Albrecht et al., 2022). Previous studies have shown that the level of knowledge about osteoporosis in the population varies according to the country of origin. For example, a study by Khired et al. (2021) found that out of 250 university students at Princess Nourah University, 84% of students did not have good knowledge about osteoporosis. This study used a similar measurement tool, the OKAT questionnaire, as the present study. On the other hand, another study by Khan et al. (2019) among university students in Saudi Arabia showed that young adult women had adequate knowledge about osteoporosis. In Malaysia, a study by Leng et al. (2017) found moderate knowledge of osteoporosis prevention among adults in Kuala Lumpur. However, a study by Alshareef et al. (2018) among young Saudi female students found that 79.4% of 1012 participants did not have adequate knowledge about osteoporosis. The mixed results of these studies motivate the researchers to investigate the level of knowledge on osteoporosis at Universiti Teknologi MARA, Malaysia.

3.0 Methodology

3.1 Study design and setting

This study was a cross-sectional study design that was carried out at Universiti Teknologi MARA, Selangor. Participants aged 18 to 26 years old were recruited using convenience sampling.

3.2 Data collection and procedures

A self-administered questionnaire was used to assess the socio-demographic data, knowledge of osteoporosis, calcium intake and level of physical activity. The Osteoporosis Knowledge Assessment Tool questionnaire (OKAT) (Winzenberg et al., 2003), International Physical Activity Questionnaire (IPAQ) (Lee et al., 2011) and Food Frequency Questionnaire from the Malaysian Adult Nutrition Survey (MANS) (Institute for Public Health, 2014) were adopted to assess all the variables.

A total of 450 questionnaires were distributed to four different faculties. 450 was determined based on the sample size calculation with reference to Krejcie and Morgan (1970). 400 were re-collected for evaluation. Of 400 questionnaires that were collected, 276 questionnaires were retained for analysis of knowledge, physical activity, and calcium intake after eliminating 124 questionnaires that were found to be incomplete. The IPAQ section was mostly incomplete could be due to the questions requiring respondents to recall their physical activity for the past 7 days, and it could be challenging and burdensome to some of them. Following data collection, responses from the questionnaires were coded and scored, and the data was entered into the database for further analysis.

3.2 Questionnaires

The Osteoporosis Knowledge Assessment Tool (OKAT) was used for this study to measure the knowledge of osteoporosis (Winzenberg et al., 2003). The questionnaire consists of four sections: indications and risk of fracture, risk factors of osteoporosis, prevention factors such as physical activity and diet relating to osteoporosis, and treatment availability. The scoring for the questionnaire was calculated based on one point for the correct answer, and the wrong answer or don't know the answer will get no mark. Respondents who score zero to ten will be classified as poor knowledge level, and participants who score 11 and above will be classified as good knowledge level. The participant's physical activity will be evaluated using the International Physical Activity Questionnaire – Short Form (IPAQ-SF). Data were analysed based on established guidelines (Lee et al., 2011). The Food Frequency Questionnaire was adapted from the National Health and Morbidity Survey 2014: Malaysian Adult Nutrition Survey (Institute for Public Health, 2014). This tool collects information on an individual's frequency of food consumption during the last 12 months. The FFQ consists of 154-item food frequency instrument that is widely used in nutritional epidemiology research.

3.4 Data analysis

All questionnaires were coded and entered in Statistical Package for the Social Sciences (SPSS) (version 21.0) for data analysis. Descriptive statistics were carried out using simple frequencies. The normality of the data was determined using the Kolmogorov-Smirnov Test. The correlation between knowledge of osteoporosis, physical activity and dietary intake was determined using the Spearman Pearson test. Correlations were interpreted using the following criteria: 0.00-0.10 = negligible, 0.10-0.39 = weak correlation, 0.40–0.69 = moderate correlation, 0.70-0.89 = strong correlation and 0.9-1.00 = very strong correlation (Schober et al., 2018). The UiTM Research Ethics Committee approved this study with reference number 600-IRMI (5/1/6). Consent forms were also signed and collected from all study participants.

4.0 Findings

4.1 Participant characteristics

A total of 276 female undergraduate students from the University Teknologi MARA Selangor participated in this study. The mean age was 21 years old. The median weight was 53 kg (IQR=15.0). The average height of the participant was 157 cm (IQR=8.0). Majority of the students had normal body mass index (BMI) (59.4%) followed by underweight (17.0%), overweight (16.3%), obese class I (4.3%) and obese class II (2.9%).

Table 1. Characteristics of the participants (n=276)

Characteristics	Age	Median (IQR)*
Age (SD)	21 (2.1)	
Weight (kg)	53	15.0
Height (cm)	157	8.0
BMI Category		
• Underweight	47 (17.0)	
• Normal	164 (59.4)	
• Overweight	45 (16.3)	
• Obese (Class I)	12 (4.3)	
• Obese (Class II)	8 (2.9)	
Finance		
• Scholarship	23 (8.3)	
• Student loan	154 (55.8)	
• Self-funded	99 (35.9)	

*Data was not normally distributed

4.2 Calcium Intake

Overall, the median amount of calcium intake among the participant was calculated, which is 421.4 mg per day (IQR = 763.7). The percentage of calcium inadequacy was 57.9% as compared to the recommended nutrient intake for Malaysia in 2017. Based on Figure 2, majority of the participants did not meet the recommendation of daily calcium intake (79.0%) followed by the participant who met the recommendation (21.0%).

Table 2. Estimation of calcium intake among participants (n = 276)

Characteristics	Median	IQR	% of inadequacy as compared to the recommendation*
Calcium intake (mg)	421.4	763.7	57.9

*Recommendation was set at 1000mg per day based on the RNI for Malaysia 2017

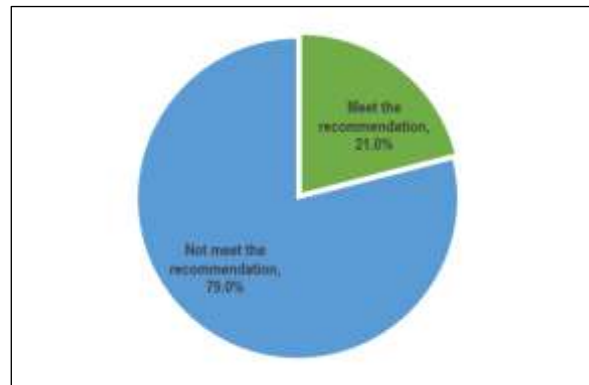


Figure 1. Calcium intake among participant as compared to the recommended nutrients intake (RNI 2017) (n=276)

4.3 Physical Activity

Based on Table 2, the majority of the participants' physical activity is moderate (47.1%), followed by a high level of physical activity (31.9%) and a low level of physical activity (21.0%).

Table 3. Physical activity level among participant (n=276)

Level of physical activity	n	%
High	88	31.9
Moderate	130	47.1
Low	47	21.0

4.4 Knowledge of Osteoporosis

Table 4. The score of knowledge on osteoporosis (n=276)

Characteristics	Median	IQR
OKAT score	9.0	4.0

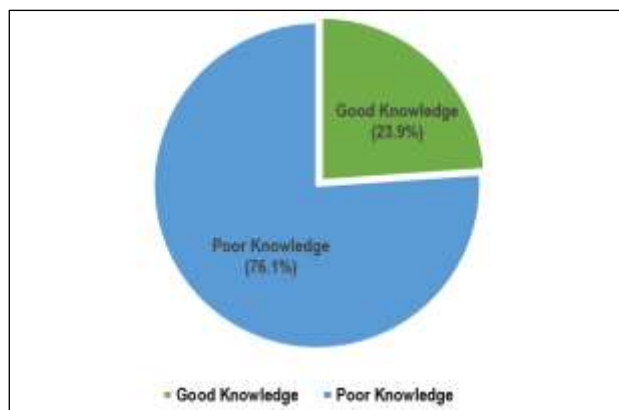


Figure 2. Level of knowledge on osteoporosis among participants (n=276)

Table 4 shows the median score of knowledge on osteoporosis among participants. The score was 9.0 (IQR = 4.0). Based on Figure 2, it can be categorised as the majority of the participant having poor knowledge about osteoporosis (76.1%), followed by good knowledge about osteoporosis (23.9%).

4.5 Correlation between knowledge of osteoporosis and physical activity with calcium intake

Based on Table 5, there are no significant differences in knowledge of osteoporosis and physical activity with calcium intake. The results indicate a moderate positive correlation between knowledge of osteoporosis and strong positive physical activity with calcium intake.

Table 5. Relationship between knowledge scores on osteoporosis and physical activity with calcium intake (n=276)

Variable	Calcium intake	
	r-value	p-value
Knowledge on Osteoporosis	0.051	0.121
Physical activity	0.081	0.181

Significant level was set at $p < 0.05$

5.0 Discussion

Osteoporosis is considered a global health problem and is common in women. University students are considered the cornerstone of any community. Therefore, knowledge about osteoporosis among university students will help set lifestyle and nutritional standards that will help prevent this disease (Khired et al., 2021). Ensuring adequate calcium intake is important, especially among university students. In this study, calcium intake among students was below the recommended level of 421 mg per day, compared to the requirement of 1000 mg per day. Similar results were found in other studies by Fatimah and Nurul Hazirah (2020) and Yap et al. (2019), where they found lower calcium intake among university students at 378 mg per day and 348 mg per day, respectively. Inadequate calcium intake leads to sleep problems, anxiety, depression, and musculoskeletal pain (Alkhatatbeh et al., 2021). One of the possible reasons for inadequate calcium intake is the unhealthy eating habits of university students and food insecurity (Jalloun & Maneerattanasuporn, 2021; Leung et al., 2019). These conditions can affect students' quality of life and academic performance. Moreover, unhealthy dietary habits have been reported to modulate inflammatory states, which may either reduce or increase anxiety, stress and depression (Muniandy et al., 2022). Another reason for the low calcium intake was that the participants in this study knew little about osteoporosis and the importance of calcium in preventing osteoporosis. This is supported by a study by Sham (2013), which found that more than half of the students at Universiti Teknologi MARA had low knowledge about dietary calcium intake. The low level of knowledge about calcium implies that the students had no idea about the recommended calcium intake and good sources of calcium. This is supported by Edmonds et al. (2012), who mentioned that students enrolled in a health science course could not correctly identify the recommended amount of calcium for adults. They were also unable to name alternative sources of calcium. In order to increase the knowledge about osteoporosis, the use of mass media was found to be effective (Khired et al., 2021). Healthcare practitioners should make full use of mass media such as using TikTok or Facebook to educate the public about osteoporosis.

Regarding knowledge about osteoporosis, this study found that the majority of students (76.1%) had inadequate knowledge. This result is in agreement with a study by Alshareef et al. (2018), where osteoporosis knowledge was found to be 79.4% out of 1012 participants among young Saudi female students. Another study by Almalki et al. (2016) using the OKAT questionnaire among medical interns in Saudi Arabia found that knowledge about osteoporosis was low. Shawashi and Darawad (2020) also found a low level of knowledge about osteoporosis among 260 female university students in Jordan. These results could be due to the fact that students were not adequately informed about osteoporosis, especially by healthcare providers (Puttakitpong et al., 2014). El Hage et al. (2019) found that women who had never heard of osteoporosis and had lower levels of education achieved lower knowledge scores about osteoporosis. Other than that, student education backgrounds, such as from non-science backgrounds or social sciences, also causes poor knowledge score (Shawashi & Darawad, 2020).

This study showed that female students had moderate (47.1%) and high (31.9%) levels of physical activity. This is consistent with a study by Çiçek (2018), who also used the IPAQ questionnaire among university students and found moderate levels of physical activity among them. However, this result contradicts a study by Barzanji et al. (2013), who included both genders and found that females were less physically active. Based on the current findings, it can be concluded that female students have moderate physical activity levels despite their low knowledge about osteoporosis. This result could be due to other factors, such as health maintenance. This is supported by Al-Naggar et al. (2011) study, which found that university students' perception of physical activity is due to the need to maintain health. In addition, factors such as the fact that women usually exercise to lose weight and have a good body shape lead to increase physical activity. Eichorn et al. (2018) also confirmed this by stating that university students exercise mainly due to the self-perception of being overweight. In addition, passion for sports and the availability of sports facilities motivate students to be physically active.

The Pearson correlation result showed no statistically significant relationship between knowledge about osteoporosis and calcium intake among female students ($p = 0.121$). Thus, even if a person knows about osteoporosis, this does not increase the likelihood that the female students will consume the recommended amount of calcium. The Pearson correlation also showed no statistically significant relationship between physical activity and calcium intake among female students ($p = 0.181$). However, there is a weak correlation between knowledge ($r=0.051$), physical activity ($r=0.081$) and calcium intake in relation to osteoporosis. This suggests that better knowledge about osteoporosis and physical activity was associated with calcium intake in female students. This is similar to Ramli et al.

(2018), who found no significant association between osteoporosis knowledge, attitude, and practise among allied health science students at a public university in Malaysia. However, the current findings contradict a study by Puttapitakpong et al. (2014), which showed a significant correlation between education level, knowledge and attitude towards osteoporosis among women aged 20-35 years. Women with higher education and sufficient knowledge were more likely to have good attitudes towards osteoporosis.

6.0 Conclusion and Recommendations

This study found that female university students had low calcium intake, poor knowledge of osteoporosis and moderate levels of physical activity. There was a positive correlation between knowledge, physical activity, and calcium intake, but it was insignificant. This study has some limitations. First, participants were recruited from a single centre using a convenience sampling technique which limits the generalisability of the results. Second, a self-administered questionnaire was used, so responses may be biased. For future studies, it is recommended to further explore the level of calcium intake and factors affecting the intake in a large sample size and use multiple centres to improve the accuracy of the studies. In addition, an assisted questionnaire can improve the validity of the data as the researcher can guide the participants in answering the questions. In conclusion, the results of this study suggest that women should be educated about osteoporosis during their first year of study. Adequate calcium intake can prevent osteoporosis and improve diet quality and quality of life.

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Paper Contribution to Related Field of Study

The present study showed that calcium intake, knowledge about osteoporosis and moderate levels of physical activity leave much to be desired. These results shed light on the nutritional status of students and the need to provide health education to undergraduate students. Efforts should be made to raise awareness of osteoporosis among university students through health education intervention programmes for all female university students, regardless of their university, department or course of study.

References

- Al-Naggar, Redhwan, A., & Osman, M. T. (2011). Perception towards Physical Exercise among University Students in Malaysia: A Medico-social Problem. *Indian Journal of Applied Research*, 3(7), 474-475. <https://doi.org/10.15373/2249555x/july2013/145>
- Albrecht, B. M., Stalling, I., Foettinger, L., Recke, C., & Bammann, K. (2022). Adherence to Lifestyle Recommendations for Bone Health in Older Adults with and without Osteoporosis: Cross-Sectional Results of the OUTDOOR ACTIVE Study. *Nutrients*, 14(12). <https://doi.org/10.3390/nu14122463>
- Alkhatatbeh, M. J., Abdul-Razzak, K. K., & Khwailah, H. N. (2021). Poor sleep quality among young adults: The role of anxiety, depression, musculoskeletal pain, and low dietary calcium intake. *Perspect Psychiatr Care*, 57(1), 117-128. <https://doi.org/10.1111/ppc.12533>
- Almalki, N. R., Alghatany, F., & Alswat, K. (2016). Osteoporosis knowledge assessment among medical interns. *American Journal of Research Communication*, 4(1), 1-14.
- Alshareef, S. H., Alwehaibi, A., Alzahrani, A., Fagihi, A., Alkenani, A., Alfentoukh, M., Almohaidb, M., Asebayer, Y., & Alasbali, M. (2018). Knowledge and Awareness about Risk Factors of Osteoporosis among Young College Women at a University in Riyadh, KSA. *Journal of Bone Research*, 06(02). <https://doi.org/10.4172/2572-4916.1000194>
- Barzanji, A. T., Alamri, F. A., & Mohamed, A. G. (2013). Osteoporosis: a study of knowledge, attitude and practice among adults in Riyadh, Saudi Arabia. *J Community Health*, 38(6), 1098-1105. <https://doi.org/10.1007/s10900-013-9719-4>
- Brooke-Wavell, K., Skelton, D. A., Barker, K. L., Clark, E. M., De Biase, S., Arnold, S., Paskins, Z., Robinson, K. R., Lewis, R. M., Tobias, J. H., Ward, K. A., Whitney, J., & Leyland, S. (2022). Strong, steady and straight: UK consensus statement on physical activity and exercise for osteoporosis. *Br J Sports Med*, 56(15), 837-846. <https://doi.org/10.1136/bjsports-2021-104634>
- Çiçek, G. (2018). Quality of Life and Physical Activity among University Students. *Universal Journal of Educational Research*, 6(6), 1141-1148. <https://doi.org/10.13189/ujer.2018.060602>
- Compston, J., Cooper, A., Cooper, C., Gittoes, N., Gregson, C., Harvey, N., Hope, S., Kanis, J. A., McCloskey, E. V., Poole, K. E. S., Reid, D. M., Selby, P., Thompson, F., Thurston, A., Vine, N., & National Osteoporosis Guideline, G. (2017). UK clinical guideline for the prevention and treatment of osteoporosis. *Arch Osteoporos*, 12(1), 43. <https://doi.org/10.1007/s11657-017-0324-5>
- Edmonds, E., Turner, L. W., & Usdan, S. L. (2012). Osteoporosis knowledge, beliefs, and calcium intake of college students: Utilization of the health belief model. *Open Journal of Preventive Medicine*, 2(1), 27-34. <https://doi.org/10.4236/ojpm.2012.21005>
- Eichom, L., Bruner, K., Short, T., & Abraham, S. P. (2018). Factors That Affect Exercise Habits of College Students. *Journal of Education and Development*, 2(1). <https://doi.org/10.20849/jed.v2i1.327>

- El Hage, C., Hallit, S., Akel, M., & Dagher, E. (2019). Osteoporosis awareness and health beliefs among Lebanese women aged 40 years and above. *Osteoporos Int*, 30(4), 771-786. <https://doi.org/10.1007/s00198-019-04901-2>
- Fatimah, A. A., & Nurul Hazirah, J. (2020). Assessment of Dietary Calcium Intake Among Femal University Students. *International Journal of Allied Health Sciences*, 4(5), 1440-1448.
- Institute for Public Health. (2014). *National Health and Morbidity Survey 2014: Malaysian Adult Nutrition Survey (MANS)*. <https://iku.moh.gov.my/images/IKU/Document/REPORT/NHMS2014-MANS-VOLUME-1-MethodologyandGeneralFind.pdf>
- International Osteoporosis Foundation. (2023). *What is Osteoporosis?* Retrieved 1 March from <https://www.osteoporosis.foundation/patients/about-osteoporosis>
- Jalloun, R. A., & Maneerattanasuporn, T. (2021). Comparison of diet quality among female students in different majors at Taibah University. *Nutr Health*, 27(2), 133-140. <https://doi.org/10.1177/0260106020967846>
- Karpouzou, A., Diamantis, E., Farmaki, P., Savvanis, S., & Troupis, T. (2017). Nutritional Aspects of Bone Health and Fracture Healing. *J Osteoporos*, 2017, 4218472. <https://doi.org/10.1155/2017/4218472>
- Khan, J. A., McGuigan, F. E., Akesson, K. E., Ahmed, Y. M., Abdu, F., Rajab, H., & Albaik, M. (2019). Osteoporosis knowledge and awareness among university students in Saudi Arabia. *Arch Osteoporos*, 14(1), 8. <https://doi.org/10.1007/s11657-019-0560-y>
- Khired, Z. A., El-Akabay, G., Alsebaik, R. A., Alotaibi, A. E., Alblawi, N. S., Albalawi, H. K., & Alrussayes, S. S. (2021). Osteoporosis knowledge, attitudes, and practices among female Princess Nourah University students in Riyadh, Saudi Arabia. *Arch Osteoporos*, 16(1), 1. <https://doi.org/10.1007/s11657-020-00865-7>
- Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, 30(3), 607-610.
- Lee, P. H., Macfarlane, D. J., Lam, T. H., & Stewart, S. M. (2011). Validity of the International Physical Activity Questionnaire Short Form (IPAQ-SF): a systematic review. *Int J Behav Nutr Phys Act*, 8, 115. <https://doi.org/10.1186/1479-5868-8-115>
- Leng, L. S., Ali, A., & Yusof, H. M. (2017). Knowledge, attitude and practices towards osteoporosis prevention among adults in Kuala Lumpur, Malaysia. *Malaysian Journal of Nutrition*, 23(2), 279-290.
- Leung, C. W., Wolfson, J. A., Lahne, J., Barry, M. R., Kasper, N., & Cohen, A. J. (2019). Associations between Food Security Status and Diet-Related Outcomes among Students at a Large, Public Midwestern University. *J Acad Nutr Diet*, 119(10), 1623-1631. <https://doi.org/10.1016/j.jand.2019.06.251>
- Martiniakova, M., Babikova, M., Mondockova, V., Blahova, J., Kovacova, V., & Omelka, R. (2022). The Role of Macronutrients, Micronutrients and Flavonoid Polyphenols in the Prevention and Treatment of Osteoporosis. *Nutrients*, 14(3). <https://doi.org/10.3390/nu14030523>
- Muniandy, N. D., Syed Azhar, S. N., Aulia Dewi, A. D., & Ibrahim, D. N. (2022). Dietary Behaviour and Mental Health Status among Students of Higher Education Institutes in Malaysia. *Environment-Behaviour Proceedings Journal*, 7(20), 455-464. <https://doi.org/10.21834/ebpj.v7i20.3394>
- National Coordinating Committee on Food and Nutrition. (2021). *Malaysian Dietary Guidelines 2020* (3 ed.). Technical Working Group on Nutrition Guidelines, Ministry of Health Malaysia.
- Puttapitakpong, P., Chaikittisilpa, S., Panyakhamlerd, K., Nimnuan, C., Jaisamram, U., & Taechakraichana, N. (2014). Inter-correlation of knowledge, attitude, and osteoporosis preventive behaviors in women around the age of peak bone mass. *BMC Womens Health*, 14(1), 35. <https://doi.org/10.1186/1472-6874-14-35>
- Ramli, N., Rahman, N. A. A., & Haque, M. (2018). Knowledge, Attitude, and Practice Regarding Osteoporosis Among Allied Health Sciences Students in a Public University in Malaysia. *Erciyes Tip Dergisi/Erciyes Medical Journal*, 40(4), 210-217. <https://doi.org/10.5152/etd.2018.18103>
- Schober, P., Boer, C., & Schwarte, L. A. (2018). Correlation Coefficients: Appropriate Use and Interpretation. *Anesth Analg*, 126(5), 1763-1768. <https://doi.org/10.1213/ANE.0000000000002864>
- Sham, F. (2013). Knowledge and Perception of Calcium Intake among Students in University Technology MARA. *International Journal of Public Health Research*, 3(2), 370-375.
- Shawashi, T. O., & Darawad, M. (2020). Osteoporosis Knowledge, Beliefs and Self-efficacy Among Female University Students: A Descriptive Study. *The Open Nursing Journal*, 14(1), 211-219. <https://doi.org/10.2174/1874434602014010211>
- Shlisky, J., Mandlik, R., Askari, S., Abrams, S., Belizan, J. M., Bourassa, M. W., Cormick, G., Driller-Colangelo, A., Gomes, F., Khadiikar, A., Owino, V., Pettifor, J. M., Rana, Z. H., Roth, D. E., & Weaver, C. (2022). Calcium deficiency worldwide: prevalence of inadequate intakes and associated health outcomes. *Ann N Y Acad Sci*, 1512(1), 10-28. <https://doi.org/10.1111/nyas.14758>
- Suriawati, A. A., Majid, H. A., Al-Sadat, N., Mohamed, M. N., & Jalaludin, M. Y. (2016). Vitamin D and Calcium Intakes, Physical Activity, and Calcaneus BMC among School-Going 13-Year Old Malaysian Adolescents. *Nutrients*, 8(10). <https://doi.org/10.3390/nu8100666>
- Tomishige-Mukai, E., Kawachi, A., Kiyohara, E., Esaki, F., Sonoda, J., Shinya, T., Narumi, K., Sato, K., & Motoya, T. (2016). Instructing students to measure their own bone density and prepare a simulated health class during pharmacy school improves their awareness and understanding of osteoporosis prevention. *J Pharm Health Care Sci*, 2, 11. <https://doi.org/10.1186/s40780-016-0045-8>
- Winzenberg, T. M., Oldenburg, B., Frendin, S., & Jones, G. (2003). The design of a valid and reliable questionnaire to measure osteoporosis knowledge in women: the Osteoporosis Knowledge Assessment Tool (OKAT). *BMC Musculoskelet Disord*, 4, 17. <https://doi.org/10.1186/1471-2474-4-17>
- Yap, S. Y., Aziz, Y., A. A., & Yusof, H. M. (2019). Ethnic variation in osteoporosis risk factors: dietary calcium, vitamin D intake and body mass index (BMI). *Food Research*, 741-748. [https://doi.org/10.26656/fr.2017.3\(6\).168](https://doi.org/10.26656/fr.2017.3(6).168)