

Knowledge, Attitude and Dietary and Lifestyle Practices on Bone Health Status among Undergraduate University Students in Health Campus, Universiti Sains Malaysia, Kelantan

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ABSTRACT: Dietary and environmental lifestyle factors play an important role in the development and maintenance of bone health throughout lifecycle. This study aims to assess the knowledge, attitude and, dietary and lifestyle practices of osteoporosis among 70 healthy undergraduate male and female students aged 18-21 years chosen by a simple random sampling at Health Campus, University Science Malaysia (USM). Several research protocols were used namely, a validated questionnaire on general characteristics, socio-demographic, questions pertaining to the knowledge, attitude and dietary and lifestyle practices towards bone health status, anthropometric profile measurements and dietary intakes intake assessment. Mean age of the subjects was 19.8 ± 0.9 years with 67% were females. The present finding indicates that mean score of knowledge pertaining to risk factors of bone health was low with majority of the subjects (82.6%) were scored below 80%. In contrast, three-quarters of subjects (77.1%) understood the importance of positive attitude of high calcium foods and physically active lifestyle towards positive bone health status and osteoporosis prevention. Dietary and lifestyle practices revealed that only 1.4% subjects met the daily recommended level of calcium intake and only 7.2% subjects were engaged in active (vigorous) physical activity of at least 2 hours weekly. Thus, the present findings highlight the need of formulating health education programs on bone health status and osteoporosis prevention among young adults in order to increase awareness of maintaining positive lifestyle behaviors associated with higher bone mass accretion and at the same time promote specific preventive behavior among collegiate students in Malaysia.

Keywords: knowledge, attitude, dietary and lifestyle practices, bone status, health

Introduction

Osteoporosis is technically defined as a systemic skeletal disease that is characterized by low bone mass and microarchitectural deterioration at bone tissue with subsequently increase risk in bone fragility and fractures, with common sites of osteoporotic fractures occur at the skeletal regions of hip, spine and wrist (WHO, 1994). Furthermore, it is regarded as the “silent disease” because bone mass loss occurs without any symptoms and it is known after fracture occurs (National Osteoporosis Foundation, 2007). Osteoporosis causes serious medical complications, not only restricted to the immediate pain resulted from fractures, but also may cause wide range of serious medical consequences and affects total quality of life. For instance, the surgical procedure of hip fracture may lead to

morbidity and even may cause death due to serious medical complications (Hannan *et al.*, 2001).

It is an estimated that up to 20% of mortality risk is associated with post hip fracture complication (Bonnick & Lewis, 2006). In addition, 40% of patients suffer sustained disability and loss of independence, which require long-term nursing care (Hannan *et al.*, 1995).

Osteoporotic fracture, especially the hip fracture, is considered to be a major public health problem and challenge in Asian countries (Lau *et al.*, 2001). The problem is further exacerbated as overall nutrition and economic situation in these regions have greatly improved over past few decades, more affluent lifestyles have led to greater vulnerability to this disease. It is projected that by the year 2050, 50% of all the worldwide hip fractures will occur in Asia (Cooper *et al.*, 1992), which will lead to excessive increase in health care burden and socioeconomic impact of osteoporotic fractures in Asia (Gullberg *et al.*, 1997).

Although it is general agreed that osteoporosis is considered as a disease that manifested during old age, however, a growing body of evidence indicate that osteoporosis may have its origins at an earlier

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stage in life by failure to achieve optimal peak bone mass during childhood and adolescence. For instance, the quantity of bone when reaching peak bone mass is regarded as a major determinant of the risk of osteoporotic fractures later in life (Bailey *et al.*, 1999). Indeed, the adolescence years determine lifelong skeletal health because this period represents the time of greatest skeletal growth, during which bone mass is largely accrued. Therefore, osteoporotic fractures related to bone loss in later life may perhaps be prevented by strategies to promote bone mineralization during adolescence. In addition, information pertaining to the level of knowledge and awareness of bone health status and its risk factors are still very limited among young adults. One sole study carried-out in collegiate university students found that most subjects did not practice any preventive health behaviors, which places them at a higher risk of low bone mass accruals, even though they aware that they are vulnerable to the risk of osteoporotic fractures in later life (Nguyen & O'Connell, 2002). A better understanding of the interactions of all these aspects of knowledge, attitude, dietary and lifestyle practices in relation to positive bone health status and osteoporosis prevention among young adults such as in university students will ultimately help them to make a better decisions on how to maximize their bone mass accretion during this stage of life in order to prevent the risk of osteoporosis in their later life. Therefore, the aim of the present study was formulated to determine the knowledge, attitude and preventives practices towards osteoporosis among undergraduate university students studying at the Health Campus, USM, Kelantan.

Methodology

This cross-sectional study was carried-out at the Health Campus, USM, Kubang Kerian, Kelantan from December, 2007 to February, 2008. The subjects were selected based on a random sampling from the student enrolment list obtained from School of Health Sciences. Several inclusion criteria were used namely; subjects were Malays, age between 18 to 21 years and were enrolled as full-time students at any undergraduate programs at the School of Health Sciences, USM. Subjects were excluded if they had been diagnosed with any disease and/or clinical signs of bone disease that could potentially prevent them from being physically active, or had received any medications known to interfere with bone metabolism and development. The study was approved by the Human Ethics Review Committee of University Science Malaysia in 2007. Written informed consent was also gathered from the subjects prior to participation in this study. At the end of the study, 70 subjects comprising of 23 males and 47 females agreed to participate in the study.

Questionnaire on knowledge on bone health status

A pre-tested questionnaire on knowledge on bone health status was used from a modified version of Ailinger and Emerson (1998), comprising 20 statements, ranging from three answers "true", "false" and "don't know" for each statement (Ailinger & Emerson, 1998). Out of 20 questions, seven were on general information of osteoporosis, six on dietary and lifestyle preventive behaviors and seven on risk factors of osteoporosis. "Don't know" answer was added to allow the subjects a choice without guessing. Classification of the mean score of knowledge levels was based on the classification recommended by Vered and his-colleagues (2008).

Questionnaire on attitude towards bone health status

Nine statements were used to assess the attitudes on bone health status, comprising three statements for physical activity behavior, four for nutrition and dietary behavior and the remaining were on lifestyle behaviors (Anderson *et al.*, 2005). These responses were in the form of five point Likert Scale, ranging from "strongly disagree" to "strongly agree", with one indicating lesser endorsement of the attitude and 5 indicating greater endorsement of the attitude (Anderson *et al.*, 2005). The sum of the score for all statements was then classified into the positive, neutral or negative level of attitude suggested by previous work of Steward and his-colleagues (2006).

Questionnaire on dietary and lifestyle practices on bone health status

A common calcium-rich foods consumed based on food components namely, animal-based products, eggs, fish and seafood, milk and dairy products, cereal products, soy-based foods, vegetables and fruits were gathered from the present cohort population during pilot study in order to assess the common and usual dietary calcium-rich food consumed to formulate the lists of common calcium-rich foods taken by the present subjects. Total amount of daily dietary calcium was then analyzed based on the lists of calcium-rich foods taken by each subjects using the Nutrient Composition Database of Malaysian Foods (Tee *et al.*, 1997). Adequacy daily calcium intake of the subjects was determined according to the New Revised Recommended Nutrient Intake (RNI) for Malaysian young people of their comparable age (NCCFN, 2005). In addition, consumption of regular caffeinated beverages such as coffee, tea and carbonated soft drinks were also obtained and the amount of caffeine intake was determined based on previous two studies of Foo & Zaitun (2000) and Weng *et al.* (2008).

Physical activity level was assessed using a modified version of the Short Questionnaire to Assess Health-

enhancing physical activity (SQUASH) (Wendel-Vos *et al.*, 2003), covering activities both at the campus and at the leisure time. Total physical activity status was expressed by number of hours spent weekly and then analyzed according to frequency, intensity and duration of each activity played. Cigarette smoking practice was expressed in number of cigarettes taken in a week.

The descriptive values of items were expressed as means and standard deviations (SD), percentages and frequency or otherwise stated. An independent *t*-test was used to determine the differences between knowledge, attitude and preventive practices between male and female subjects, whereas *Pearson* correlation was used to assess the relationship between the variables. Statistical analysis was carried-out using SPSS version 12 for Windows (SPSS Inc., Chicago, IL, US) and statistical significance for all the tests were set at *P*-value \leq 0.05.

Results

General characteristics of the subjects

TABLE 1 shows the general characteristics of the subjects. Mean age of the subjects was 19.8 ± 0.9 years. About two-thirds were females (67.1%), whereas only 32.9% males. Anthropometric measurements of the subjects showed that the mean body mass index (BMI) was 21.5 kg/m^2 ; indicating most of them were at the normal range based on classification by WHO Expert Consultation on Appropriate BMI for Asian Populations (WHO, 2004). There was no statistical significant difference between genders for BMI. In addition, mean non-dominant and dominant handgrip muscle strength of the subjects were 26.3 ± 10.1 kg and 29.6 ± 10.7 kg, respectively, with males had a significantly higher muscle strength for both dominant ($t = -9.661$, $P < 0.05$) and non-dominant hand ($t = -10.610$, $P < 0.05$) as compared to their female counterparts. Out of these subjects, only 4.3% had family history of osteoporosis.

Knowledge on bone health status

Mean score of knowledge among subjects towards positive bone health status and osteoporosis risk factors is presented in **TABLE 2**. The mean score of total knowledge was 11.6 ± 3.2 indicating low level of knowledge on bone health among the subjects. When the mean score was analyzed based on each component, low scores of knowledge on general information of osteoporosis (4.4 ± 1.2), osteoporosis risk factors (3.3 ± 1.9) and preventative behaviors on positive bone health status (3.8 ± 1.2) were observed.

Based on the classification of knowledge score, almost same proportion of subjects achieved moderate score (range between 60% and 80%) and low score ($< 60\%$) (42.9% vs. 45.7% , respectively). In contrast, only 11.4% of the subjects scored $> 80\%$ for their knowledge on bone health status. In general, there was no statistical significant difference on total knowledge score between male and female subjects. However, when each component of total knowledge was analyzed, female subjects had a significantly higher score on preventative behavior aspects on bone health as compared to their male counterparts ($t = 2.150$; $P < 0.05$).

Attitude towards osteoporosis

In general, an overall attitude score of the subject was positive with mean score of 38.8 ± 4.0 (**TABLE 2**). Based on the classification of attitude score, three-quarters of the subjects (77.1%) had a positive attitude, whereas only 22.9% was neutral. None of them have a negative attitude. There was no statistical significance differences between male and female on the mean score of attitude on bone health status ($P > 0.05$).

Relationship between knowledge and attitude on bone health status

An interaction between knowledge and attitude on bone health status was determined by *Pearson* correlation analysis. There was a significant positive association between knowledge and attitude on bone health status ($r = 0.419$; $P < 0.01$) (**FIG. 1**). A similar trend of position association was also found for male and female subjects respectively ($r = 0.482$; $P < 0.05$ vs. $r = 0.387$; $P < 0.01$) (Data not shown).

Dietary and lifestyles practices towards osteoporosis prevention

TABLE 3 shows the dietary and lifestyle practices of the subjects towards positive bone health status. Mean daily calcium intake was approximately $277.6 \pm 149.6 \text{ mg}$ with female subjects having a significantly higher daily intake of calcium than their male counterparts ($280.1 \pm 136.2 \text{ mg}$ vs. $272.4 \pm 176.9 \text{ mg}$), respectively. It is found that almost all subjects (98.6%) failed to achieve the recommended daily calcium intake of 800mg of their comparable age (NCCFN, 2005). On the other hand, only 1.4% of them achieved calcium intake above the recommended level.

Mean weekly consumption of coffee, tea and carbonated drink of the subjects were 2 cups ($\approx 250 \text{ ml/cup}$), 3 cups ($\approx 250 \text{ ml/cup}$) and 1 can (325 ml/can), respectively. Mean daily caffeine intake were about 219.5 mg/d , 171.9 mg/d and 27.9 mg/d for coffee, tea and carbonated drinks, respectively.

Males have a significantly higher mean caffeine intake of carbonated drinks compared to the female subjects ($t = -2.679, P < 0.05$).

Analysis of the total physical activity status showed that mean time spent in total physical activity levels

both in leisure time and in campus, regardless of their intensity levels, for male and female subjects was 32.8 hours/week (**TABLE 3**). Male subjects had significantly higher mean total time spent in physical activity level compared to the females (41.6 ± 29.1 hours/week vs. 28.4 ± 20.2 hours/week).

TABLE 1- General characteristics of the subjects (N=70)

Subjects characteristics	% (N)
Age ^a	19.8 ± 0.9 ^a
Gender (sex)	
Female	67.1 (47)
Male	32.9 (23)
Marital status	
Single	100.0 (70)
Weight, kg ^a	54.9 ± 12.2
Height, cm ^a	160.5 ± 8.3
Classification of BMI^b	
Underweight	28.6 (20)
Normal	40.0 (28)
Overweight	25.7 (18)
Obese	5.7 (4)
Handgrip muscle strength	
Dominant hand, kg ^a	29.6 ± 10.7
Non-dominant hand, kg ^a	26.3 ± 10.1
Family history of osteoporosis	
Yes	4.3 (3)
No	95.7 (67)

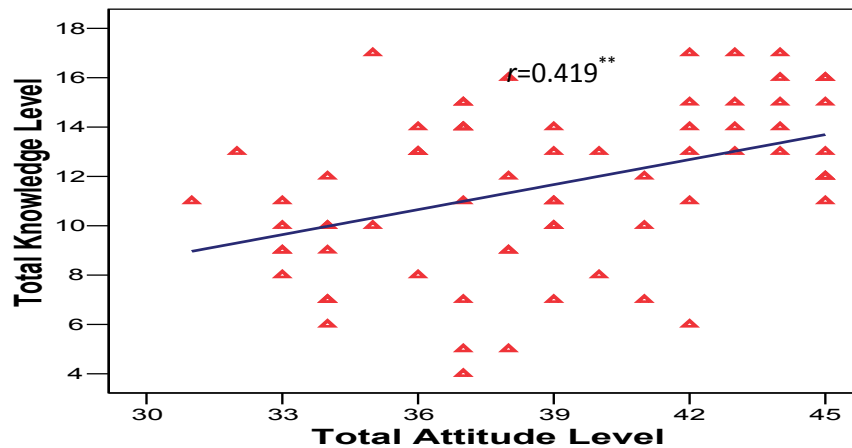
^aMean ± SD in parentheses

^bClassification based on WHO Expert Consultation on Appropriate BMI for Asian Populations (Yajnik & Yudkin, 2004)

TABLE 2- Mean score of knowledge and attitude towards osteoporosis among the subjects (N=70)

	Male	Female	Total
	(N=23)	(N=47)	(N=70)
	Mean ± SD		
Knowledge			
Total knowledge score	11.0 ± 3.4	11.9 ± 3.1	11.6 ± 3.2
General information	4.4 ± 1.3	4.5 ± 1.1	4.4 ± 1.2
Risk factors	3.1 ± 1.9	3.5 ± 1.9	3.3 ± 1.9
Preventative behaviors	3.5 ± 1.3	4.0 ± 1.1*	3.8 ± 1.2
Attitude			
Total attitude score	38.7 ± 4.0	38.9 ± 4.1	38.8 ± 4.0
Physical activity	13.2 ± 1.5	13.0 ± 1.7	13.1 ± 1.6
Nutrition	18.4 ± 1.6	18.4 ± 1.7	18.4 ± 1.6
Unhealthy lifestyle-Smoking	7.1 ± 1.8	7.6 ± 1.6	7.4 ± 1.6

*Significant differences between genders at $P < 0.05$



Significance association at $**P<0.01$

FIG. 1- Pearson correlation of total knowledge score and total attitude score among male and female subjects

TABLE 3- Dietary and lifestyle practices towards osteoporosis prevention of the subjects (N=70)

	Male (N=23)	Female (N=47)	Total (N=70)
	Mean \pm SD		
Calcium, mg	272.4 \pm 176.9	280.1 \pm 136.2 ^a	277.6 \pm 149.6
Calcium adequacy \geq RNI ^{ab}	4.3 (1)	0	1.4(1)
Calcium adequacy $<$ RNI ^{ab}	95.7 (22)	100.0 (47)	98.6 (69)
Beverage drink			
Coffee and tea intake			
Yes ^a	91.3 (21)	76.6 (36)	81.4 (57)
Carbonated drink intake			
Yes ^a	73.9 (17)	57.4 (27)	62.9 (44)
Caffeine intake, mg			
Total caffeine intake	475.0 \pm 367.0 ^a	392.0 \pm 446.5	419.3 \pm 421.2
Coffee	260.2 \pm 327.8	199.7 \pm 376.1	219.5 \pm 359.7
Tea	175.3 \pm 146.0	170.2 \pm 186.0	171.9 \pm 172.8
Carbonated beverages	39.6 \pm 32.4 ^{c*}	22.1 \pm 21.5	27.9 \pm 26.7
Activities at campus^d			
Light	23.1 \pm 24.4	19.4 \pm 21.1	20.6 \pm 22.1
Intense	2.3 \pm 3.9	1.1 \pm 1.9	1.5 \pm 2.8
Activities at Leisure time^d			
Vigorous (active)	4.1 \pm 2.5 ^{c**}	2.5 \pm 2.3	3.3 \pm 2.4
Moderate	2.9 \pm 2.6	4.1 \pm 4.5	3.5 \pm 3.7
Light	2.8 \pm 1.5	5.1 \pm 3.8	3.5 \pm 2.5
Sports participation status			
Yes ^a	65.2 (15)	44.7 (21)	51.4 (36)

^aPercentage and number of subjects in parentheses

^bRecommended Nutrient Intakes for Malaysia (2005)

^cSignificant difference between male and female ($*P<0.05$)

^dClassifications of physical activity based on metabolic equivalent score (METs): 2 to $<$ 4.0 MET (light), 4.0 to $<$ 6.5 MET (moderate), and \geq 6.5 MET (vigorous)

Discussion

The present findings among undergraduate students in Health Campus, USM clearly demonstrate the lack of knowledge towards positive bone health status and osteoporosis prevention. On the contrary, both male and female subjects showed positive attitudes of the importance of dietary and lifestyle practices

including sufficient physical inactivity, the risk of inadequate calcium intake and frequent cigarette smoking affecting bone health status and introducing risk of osteoporosis. Furthermore, health-risk behaviors were evident in the present subjects as most subjects consumed calcium below the recommended level of Malaysian young adults of their comparable age. The subjects engaged only in

low- to moderate-intensity exercise, while only the male subject (1.4%) was able to achieve the recommended daily calcium intake level of 800 mg and above (NCCFN, 2005). The present study also found that a significant positive relationship between the level of knowledge and attitude among the subjects. However, there was no association linking either knowledge or attitude level with any dietary and lifestyle practices. This finding is in line with several other studies carried-out among Caucasian subjects. A study among Caucasian adolescent girls aged 12 to 16 years indicated that levels of physical activity and daily calcium intake did not reflect the total knowledge or beliefs on osteoporosis risk factors (Anderson *et al.*, 2005). Similarly, there was no significant association between knowledge scores and total calcium intake and weight-bearing physical activity level in three age groups of young, middle-aged and postmenopausal women (Terrio & Auld, 2002). On the other hand, only one study amongst Iranian women aged 45 years and above reported a significant relationship between preventive behavior practices and total knowledge score on osteoporosis prevention (Jalili *et al.*, 2007). The discrepancy finding found in that study compared with our present subjects was probably due to the subject characteristics. Older women tend to have greater awareness and knowledge towards the prevention of osteoporosis compared to their younger counterparts.

Health Belief Model by Rosenstock (1966) also explained that perceptions and modifying factors such as knowledge can motivate individuals to take recommended preventive health action (Kozier *et al.*, 2004). As the subject's knowledge was inadequate, therefore this decreases the probability of doing preventive acts. In other words, an adequate knowledge on bone health status is particularly important to serve as a foundation for making informed healthy lifestyle choices. Present findings suggest that health and nutrition promotion on positive bone health status and osteoporosis prevention are particularly needed in order to increase their knowledge on overall positive bone health status when they are still in their early adulthood. More nutritional promotion and education are required to stress on the necessity of proactive healthy lifestyle modifications during early growing lifespan such as during childhood, adolescence and young adulthood in order to prevent the rapid bone mass and consequently the risk of osteoporotic fractures later in life. Furthermore, it is suggested, based on the present findings that several aspects of bone health status should be also included in osteoporosis prevention education materials such as general pathophysiology of osteoporosis, the onset and progression of bone loss, medical complications due to osteoporotic fractures and diagnosis and management of osteoporosis. Apart from that, an identification of modifiable and non-modifiable risk

factors of bone health status and osteoporosis prevention should also be focused in early adulthood.

An important part of curriculum development is not just giving information to the students but also helping them to change their behaviors by incorporating the practical healthy dietary and lifestyle approaches to increase their daily calcium intake and active and high physical activity of weight-bearing activities. It is hoped that based on these primary health care approaches, one could ultimately lower the risk of getting osteoporosis in their later life. In general, primary nutritional and health care is an approach comprising a wide range of services designed to ensure the general well-being and optimal health, from promoting of health and screening for disease to assessment, diagnosis, treatment and rehabilitation. Such positive integrative approaches on how to achieve and maintain positive bone health status in young adults, including university students could eventually lead to maximize peak bone mass accretion in early adulthood and consequent significantly reduce the risk of rapid bone loss and osteoporotic fractures later in life (Masterson, 2006).

Conclusion

An understanding of how knowledge, attitudes and practices of modifiable factors towards bone health status is a particularly important strategy for formulating appropriate, effective and innovative health and nutritional intervention programs to maximize higher bone mass accretion during young age. Ultimately, it could help to prevent the risk of osteoporotic fractures later in life. The present findings clearly suggest that regular and active engagement of healthier lifestyle practices such as continuous active participation in physical exercise and adequate intake of high calcium-rich foods should be encouraged among university students in order to achieve higher bone mass accretion during this critical period of growth. In addition, it is hoped that a future study of population-based, involving more comprehensive assessments on non-modifiable and modifiable factors that contributes to higher bone mass growth among growing children, adolescents and young adults in Malaysia will be formulated to enhance our understanding of how specific contributing factors to enhance higher bone mass accretion, with the ultimate goal of reducing the risk of osteoporosis-related fractures attributed to rapid bone loss in later life.

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