

# Inappropriate Use of Calcium Supplements among Patients with Low Risk for Osteoporosis and its Association with Knowledge on Calcium Supplements

FATHIMA BEGUM SM<sup>1</sup>, HIZLINDA T<sup>2</sup>, TEH ROHAILA J<sup>2</sup>, AIDA J<sup>3</sup>

<sup>1</sup>Family Medicine Unit, Faculty of Medicine and Health Sciences, Universiti Sains Islam Malaysia, Bandar Baru Nilai, 71800 Nilai, Negeri Sembilan, Malaysia

<sup>2</sup>Department of Family Medicine, Faculty of Medicine, Universiti Kebangsaan Malaysia Medical Centre, Jalan Yaacob Latif, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur, Malaysia

<sup>3</sup>Primary Care Unit, National Defence University of Malaysia, Kem Sungai Besi, 57000 Kuala Lumpur, Malaysia

## ABSTRAK

Penggunaan kalsium tambahan tanpa indikasi perubatan boleh dianggap tidak patut kerana ia menyebabkan kemudaratan. Kajian ini bertujuan untuk menentukan peratusan individu berisiko rendah menghadapi osteoporosis yang menggunakan kalsium tambahan dengan tidak sepatutnya. Amalan dan faktor pengaruh penggunaannya juga dikaji. Kajian keratan lintang ini telah dijalankan di sebuah klinik primer universiti yang melibatkan 125 pesakit berumur 18 sehingga 64 tahun, berisiko rendah menghadapi osteoporosis (berdasarkan 'Osteoporosis Self-assessment Tool for Asians', tiada sejarah peribadi atau keluarga menghidap osteoporosis atau patah tulang pinggul dan tiada penyakit sekunder osteoporosis). Kajian ini menggunakan borang soal selidik yang telah disahkan untuk memeriksa ciri-ciri peserta, pengetahuan mengenai kalsium tambahan (KnowCas-12) dan amalan pengambilan mereka. Seramai 46.4% mengambil kalsium tambahan dalam setahun lalu, di mana majoriti tidak pernah berbincang dengan doktor mengenainya (46.6%). Namun, hanya 25.9% peserta mengambilnya dengan patuh dan hampir semua (95%) tidak menggunakannya secara betul. Dua sebab utama pengambilan kalsium tambahan adalah "untuk mencegah patah" (70.7%) dan "tidak cukup kalsium dalam diet" (56.9%). Median (julat antara kuartil) skor KnowCas-12 adalah 6.0 (3.0) (julat mungkin: 0-12; titik-tengah: 6). Regresi logistik berbilang menunjukkan hanya skor KnowCas-12 mempunyai kaitan sendirian yang

**Address for correspondence and reprint requests:** Associate Professor Dr Hizlinda Tohid, Department of Family Medicine, Faculty of Medicine, Universiti Kebangsaan Malaysia Medical Centre, Jalan Yaacob Latiff, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur, Malaysia. Tel: +6019-2222109 Email: hizlinda2202@gmail.com

*bererti dengan penggunaan kalsium tambahan (nisbah ganjil selaras: 0.79; 95% sela keyakinan: 0.64-0.98; p=0.031). Kesimpulannya, penggunaan kalsium tambahan yang tidak patut adalah amalan biasa dalam kalangan individu berisiko rendah, tetapi ramai tidak patuh mengambilnya dan tidak menggunakannya secara betul. Pengetahuan mereka mengenai kalsium tambahan masih kurang. Oleh kerana pengetahuan ini boleh menentukan penggunaannya, intervensi pendidikan perlu diberikan bagi memastikan kelakuan perlindungan osteoporosis yang betul.*

*Kata kunci: kalsium, kelakuan pengurangan risiko, osteoporosis, pemakanan tambahan, risiko*

## ABSTRACT

Calcium supplement use without medical indications may be considered inappropriate as it could cause harms. This study aimed to determine the proportion of individuals with low risk for osteoporosis who used calcium supplements inappropriately. Their practice and factors influencing the use were also examined. This cross-sectional study was conducted at a university-based primary care clinic involving 125 patients, aged 18 to 64 years with low risk for osteoporosis (based on the Osteoporosis Self-assessment Tool for Asians, personal or family history of osteoporosis or hip fracture and diseases of secondary osteoporosis). A validated self-administered questionnaire was used to assess participants' characteristics, knowledge on calcium supplements (KnowCas-12) and its practice. About 46.4% took calcium supplements within the past one year, whereby many had never discussed the use with doctors (46.6%). However, only 25.9% were compliant and almost all (95%) with incorrect consumption. The two commonest reasons for its use were "to prevent from fracture" (70.7%) and "not enough calcium through my diet" (56.9%). The median (inter quartile range) KnowCas-12 score was 6.0 (3.0) (the possible range: 0-12; the mid-point: 6). Multiple logistic regression showed only KnowCas-12 score had a significant independent association with the use (adjusted odds ratio: 0.79; 95% confidence interval: 0.64-0.98; p=0.031). In conclusion, the inappropriate use of calcium supplements was common among the low-risk individuals, but most were non-compliant with incorrect consumption. Their knowledge of calcium supplements was still lacking. As it could influence the use, educational interventions should be imparted to ensure correct osteoprotective behaviour.

Keywords: calcium, dietary supplements, osteoporosis, risk, risk reduction behaviour

## INTRODUCTION

Calcium is a key mineral for bone formation and metabolism, which is mainly obtained from the consumption of calcium-rich food such as dairy products, green leafy vegetables, grains, and fortified foods (e.g. cereals, bread, and drinks) (Malaysian Osteoporosis Society [MOS] 2015). The recommended dietary allowance (RDA) and the estimated average requirement (EAR) for healthy individuals differ according to age (MOS 2015; Aloia 2011). Generally, the RDA is 1000 mg/day for all non-pregnant adults aged 19 to 50 years and males aged 51 to 70 years. However, the RDA is higher (1200 mg/daily) for females aged 51 to 70 years and all individuals above 70 years old (Plantz & Bittar 2020). Insufficient dietary calcium intake may lead to calcium deficiency that impairs the normal physiological function of the body, and results in osteoporosis and fractures (MOS 2015).

Calcium supplements are often promoted to supplement inadequate calcium intake. It also plays an essential role as an adjunct treatment of osteoporosis when combined with vitamin D and it is recommended for those with high risk for osteoporosis and fracture (MOS 2015; Eastell et al. 2019; Yeap et al. 2016). These high-risk individuals include the elderly, females, Asians, Caucasians and those with small and thin body size, family history of osteoporosis or hip fracture, sedentary lifestyle, vitamin D insufficiency, prolonged steroid use or secondary causes of osteoporosis

(e.g. hypogonadism, hyperthyroidism, hyperparathyroidism) (Yeap et al. 2016). The calcium supplements are to ensure calcium intake of at least 1000 mg/day among these high-risk group (MOS 2015; Yeap et al. 2016), particularly Malaysians who have poor daily calcium intake (an average of 500 mg/day) (Zainuddin et al. 2019; Chan et al. 2018). However, routine calcium supplementation for non-institutionalised healthy individuals with a low risk of osteoporosis is not advocated as the risks of harm outweigh its benefits; they should optimise their daily calcium intake through modifying consumption of calcium-rich foods (Yeap et al. 2016; US Preventive Services Task Force et al. 2018). Inappropriate use of calcium supplements may lead to overconsumption (Blumberg et al. 2017), resulting in gastrointestinal side effects particularly constipation, stroke, colorectal cancer, urinary stones, age-related macular degeneration and increased risk of cancer death (Chen et al. 2019; Li et al. 2018; Reid & Bolland 2020). Besides, a meta-analysis by Yang et al. (2020) showed that calcium supplement could increase the risk for myocardial infarction by 21%. Even when calcium supplements are consumed within the recommended dosage of the products, unwanted reactions can still occur (Li et al. 2018). Thus, before its use, risk assessment is pertinent to identify high-risk individuals to ensure the use is appropriate as indicated by the guidelines (MOS 2015; Eastell et al. 2019; Yeap et al. 2016; Zainuddin et al. 2019; Chan et al. 2018).

The use of calcium supplements is common in western countries with prevalence ranging between 22% and 71% (Cowan et al. 2018; Vatanparast et al. 2020). In Malaysia, the prevalence was only at 5.8% (Institute for Public Health [IPH] 2014). However, a substantial proportion of young individuals uses calcium supplements, which can be deemed inappropriate as their risk for osteoporosis is most likely low. In Malaysia and Canada, about 20 to 38% of calcium supplement users aged between 30-50 years (Vatanparast et al. 2020; IPH 2014). Concerns about safety and inappropriate use of calcium supplements, as well as the use of other nutrient or vitamin supplements, are greatly discussed in the mainstream media because of its widespread use by the general population. However, studies that specifically examine the inappropriate use of such supplements are still lacking. Thus, there is no standardised definition of 'inappropriate use of supplement' that is accepted by most researchers and physicians. In the current literature, inappropriate use of a supplement (either dietary, vitamin or nutrient supplements) is referred to as excessive intake or overconsumption of the supplement (e.g. the total intake above the RDA), concomitant use of various supplements with or without other medicines, use without any medical indications as per recommended by evidence-based guidelines (misuse), and use by those with no evidence of nutritional deficiency (Li et al. 2018; Chiba et al. 2015; Chen et al. 2019; Blumberg et al. 2017; Martini et al. 2020).

In general, the use of calcium supplements was found to be associated with female gender, older age, higher education, higher income, living in urban areas, food security, healthy lifestyle, having co-morbidities, and knowledge on osteoporosis and calcium (Chan et al. 2018; Chen et al. 2019; Cowan et al. 2018; Vatanparast et al. 2020). The commonest reason for use is to ensure bone health and prevent osteoporosis (Bailey et al. 2013; Marcinow et al. 2017).

This study aimed to identify the proportion of those with inappropriate use of calcium supplements among primary care patients with low risk for osteoporosis. Additionally, the practice, reasons and factors influencing the inappropriate use were examined. It is hoped that the findings could provide a better understanding of its prevalence and practice to inform future strategies on how to promote the safe use of calcium supplements.

## MATERIALS AND METHODS

This was a cross-sectional study conducted at a university-based primary care clinic in Kuala Lumpur, between March to December 2014. In this study, the inappropriate use of calcium supplements was defined as taking either commercially available calcium supplements or prescribed calcium tablets without any medical indications (Li et al. 2018; Reid & Bolland 2020; Chiba et al. 2015). Multivitamins containing calcium are not considered as calcium supplements in this study because consumers may not realise the multivitamins contain

calcium and the dosage of calcium in the multivitamins is usually small (<100 mg).

The study population were attendees of the primary care clinic with a low risk for osteoporosis. The inclusion criteria were those aged between 18 and 64 years, identified as having a low risk for osteoporosis (based on the Osteoporosis Self-assessment Tool for Asians [OSTA] and/or absence of personal or family history of osteoporosis or hip fracture) and able to read in English or the Malay language. OSTA was used as a screening tool to assess the patients' eligibility as it has been validated to identify postmenopausal women aged 40 and above with low, moderate or high risk for osteoporosis based on age and weight (Subramaniam et al. 2018). Attendees who were above 65 years of age were regarded to have a high risk for osteoporosis (Kling et al. 2014). The exclusion criteria were patients who took calcium supplement for underlying medical problems such as chronic kidney disease and osteoporosis (primary or secondary). The suitability for the participations was assessed through face-to-face interviews and examination of their case notes.

The sample size was 128, calculated using EpiINFO™ StatCalc based on 6% prevalence of calcium supplement use (Institute of Public Health 2014), 5% margin of error, 95% confidence interval (CI) and 20% non-response rate. Attendees of the clinic during the data collection period between July and August 2014 were screened for their eligibility. Those who met

the study criteria were briefed about the study and asked to complete a validated anonymous self-administered questionnaire once written consent was provided.

The bilingual questionnaire consisted of six sections that assessed: (i) sociodemographic and clinical characteristics (15 items), (ii) knowledge on calcium supplements, KnowCas-12 (12 items) (Tohid et al. 2016), (iii) practice of calcium supplement use (8 items), (iv) reasons for taking calcium supplements (1 item), (v) frequency of discussion with doctors regarding calcium supplements (1 item), and (vi) individuals who influenced the decision to use (1 item). As for practice, inappropriate use of calcium supplements (i.e. How frequent do you take calcium supplement in the past 1 year?), frequency of taking calcium supplements and correct methods of consumption were examined. The response for these items was in the form of a 5-Likert scale: 'Never take', 'Some days in a month', 'Less than 3 times in a week', 'More than 3 times in a week', and 'Everyday'. Reasons for taking calcium supplements was assessed via five answer options whereby the participants could choose more than one option. The response to the item assessing the frequency of discussion with doctors regarding calcium supplements was a 5-Likert scale response: 'Never', 'Rarely', 'Once in 3 visits', 'Once in 2 visits', and "Every visit".

The questionnaire was developed in English based on a literature review and discussions with primary care patients and physicians. Subsequently, it was

translated into the Malay language via a back-to-back translation process, involving four independent translators (Tohid et al. 2016). All sections were subjected to validity testing through content validation and face validation. Furthermore, the KnowCas-12 underwent discriminative validation, test-retest reliability testing and internal consistency which demonstrated good properties with a Cronbach alpha of 0.68 (Tohid et al. 2016). The participants took about 15 minutes to complete the whole questionnaire.

All respondents who met the study criteria were first briefed about the study and those who agreed to participate gave their written consent. Ethical approval to carry out this study was acquired from the Research Ethics Committee of Universiti Kebangsaan Malaysia (FF-2014-073). Permission from the clinic coordinator was also obtained.

Data obtained from this study were analysed using IBM SPSS Statistics version 22.0 (Armonk, NY USA). Frequency (n) and percentage (%) were used to describe the categorical variables, whereas for the numerical variables (not normally distributed), median with Inter Quartile Range (IQR) were used. The dependent variable for this study was inappropriate use of the calcium supplement (Yes versus No), and the independent variables were sociodemographic and clinical characteristics and the KNOWCAS-12 score. To compare the differences in the sociodemographic and clinical characteristics between those with and without inappropriate use of calcium supplement, Chi-

Square test (for the categorical variables) and Mann-Whitney test (for the numerical variables) were conducted. Subsequently, multiple logistic regression (MLR) analysis was performed to determine factors that were independently associated with the inappropriate use of calcium supplement when other confounding factors were controlled. Simple logistic regression (SLR) was initially done to identify independent variables with p-value <0.25 to be subjected to MLR analysis, which was performed using the 'Enter' method. The findings were considered significant if the p-value is <0.05.

## RESULTS

Out of 193 patients who were screened for study eligibility, 128 met the study criteria and were recruited. All returned their questionnaires (100% response rate), but three patients had incomplete items thus were excluded from the analysis

### Characteristics of the Participants

The median (IQR) age of the participants was 36.0 (23.0) years (Table 1). More than half of them were female (64.0%) and of Malay ethnicity (55.2%). A majority did not have the risk factors for osteoporosis as most were non-smoker or former smokers (88.0%), non-alcohol drinkers (98.4%) and non-menopausal females (87.5%).

### Inappropriate Use of Calcium Supplement

Table 1: Sociodemographic and clinical characteristics of participants

Variables	Total	Inappropriate use of calcium supplement		p-value
		No	Yes	
Age (years), [Median (IQR)]	36.0 (23.0)	35.0 (20.0)	37.5 (21.0)	0.393 <sup>a</sup>
Gender, [n (%)]				
Male	45 (36.0)	29 (64.4)	16 (35.6)	0.068 <sup>b</sup>
Female	80 (64.0)	38 (47.5)	42 (52.5)	
Ethnicity, [n (%)]				
Malay	69 (55.2)	34 (49.3)	35 (50.7)	0.470 <sup>b</sup>
Chinese	39 (31.2)	24 (61.5)	15 (38.5)	
Others	2 (1.6)	9 (52.9)	8 (47.1)	
Education level, [n (%)]				
No/primary	12 (9.6)	7 (58.3)	5 (41.7)	0.414 <sup>b</sup>
Secondary	52 (41.6)	31 (59.6)	21 (40.4)	
Tertiary	61 (48.8)	29 (47.5)	32 (52.5)	
Employment status, [n (%)]				
Unemployed	10 (8.0)	8 (80.0)	2 (20.0)	0.157 <sup>c</sup>
Employed	115 (92.0)	59 (51.3)	56 (48.7)	
Monthly household income (RM) (n=96), [Median (IQR)]	2500 (2825.0)	2000 (2000.0)	2800 (2500.0)	0.040 <sup>a</sup>
Smoking status, [n (%)]				
Non-smoker/former	110 (88.0)	59 (53.6)	51 (46.4)	0.982 <sup>b</sup>
Active smoker	15 (12.0)	8 (53.3)	7 (46.7)	
Alcohol drinking (≥3 drinks/day), [n (%)]				
No	123 (98.4)	65 (52.8)	58 (47.2)	0.541 <sup>c</sup>
Yes	2 (1.6)	2 (100)	0 (0)	
Menopause (n=80), [n (%)]				
No	70 (87.5)	33 (47.1)	37 (52.9)	0.866 <sup>c</sup>
Yes	10 (12.5)	5 (50.0)	5 (50.0)	
Presence of Comorbidity, [n (%)]				
No	83 (66.4)	43 (51.8)	40 (48.2)	0.572 <sup>b</sup>
Yes	42 (33.6)	24 (57.1)	18 (42.9)	

\*Significance: p-value &lt;0.05

<sup>a</sup>Mann-Whitney test; <sup>b</sup>Chi-square test; <sup>c</sup>Chi-square test with continuity correction

The proportion of participants who took calcium supplements within the past one year was 46.4% (58/125). Most users (58.6%) made their own decision to take calcium supplements; however, some users received suggestion for using calcium supplements from friends (36.2%), doctors (36.2%), family members (25.9%), sales promoters (15.5%) or pharmacists (13.8%). Less than half of the users either never

(46.6%) or rarely (48.3%) discussed about calcium supplements with the doctors.

### The Practice of Taking Calcium Supplements among the Users

Among the users, the majority were not compliant with calcium supplements (Figure 1). Only 25.9% of them took calcium supplements every day. About

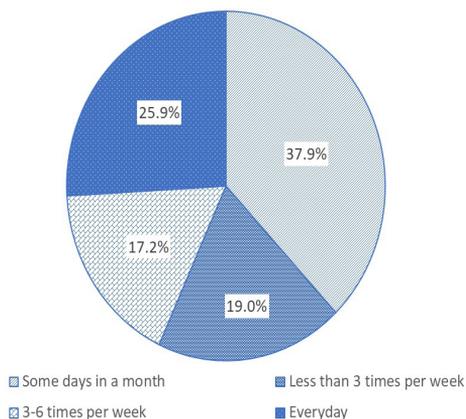


Figure 1: Frequency of taking calcium supplements in the past one year among users (n=58)

95% (55/58) of them incorrectly took the calcium supplements because they did not take it with vitamin D (55.2%), never or only sometimes consumed it with meals (60.4%) and/or took it together with coffee (36.2%), iron (43.1%) or alcohol (72.4%) (Figure 2).

The two commonest reasons for taking calcium supplements were ‘To prevent from fracture’ (70.7%) and ‘Not enough calcium through my diet’ (56.9%). Other reasons include: ‘To prevent from muscle cramping’ (39.7%), ‘For additional calcium intake’

(27.6%), and ‘To protect myself against cancer’ (17.2%).

### Knowledge of Calcium Supplements

The IQR of the total score for knowledge on calcium supplements (KNOWCAS-12) was 6.0 (3.0). As the range of possible score was between 0 and 12, this median indicates a moderate level of knowledge as it was at the mid-point score of 6. Figure 3 presents the proportions of the participants with the correct answer for each statement regarding calcium and its supplement. The three statements with the least correct answers were two statements related to the interaction of calcium supplements with iron if taken together (“Iron tablets do not reduce the benefits of calcium supplement when taken together” [16.0%]; “Foods with high iron content do not reduce the benefit of calcium supplement when taken together” [17.6%]) and a statement about a side effect of calcium supplements (“Constipation is a known side effect of calcium supplement” [20.0%]). The three

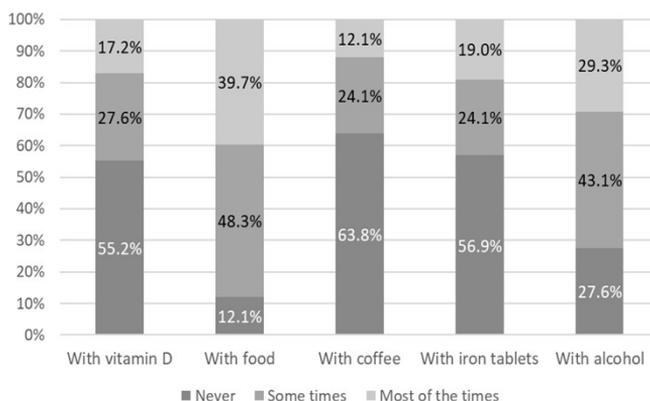


Figure 2: Practice of taking calcium supplements among users (n=58)

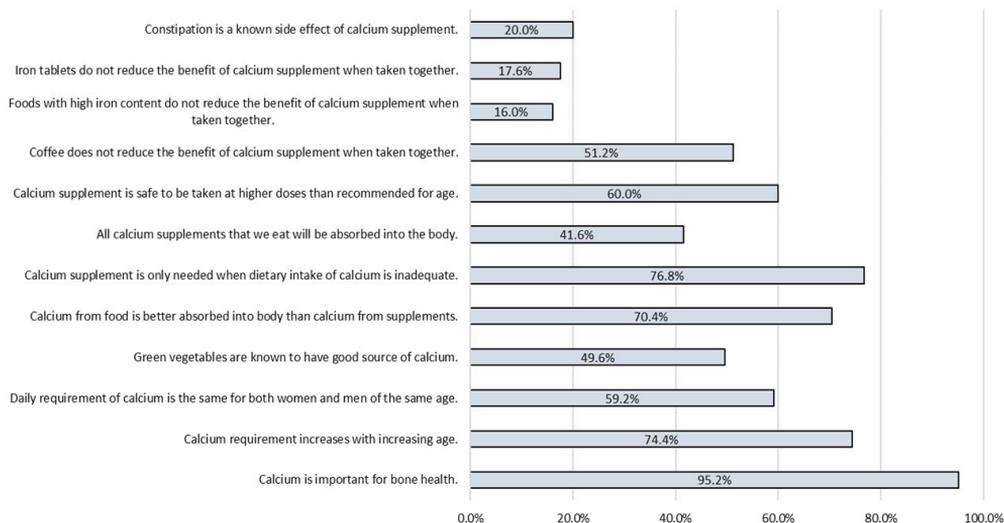


Figure 3: Proportions of participants with correct answers (N=125)

statements with the highest proportion of correct answers were related to the importance of calcium for bone health (95.2%), supplements only needed if dietary calcium is inadequate (76.8%) and higher calcium requirement with increasing age (74.4%).

### Factors for Inappropriate Use of Calcium Supplements

Based on the SLR, four factors which were gender ( $p=0.070$ ), employment status ( $p=0.101$ ), monthly household income ( $p=0.036$ ) and KNOWCAS-12 score ( $p=0.007$ ), had  $p$ -values of  $<0.25$  and were entered into the MLR analysis (Table 2). After adjusting for the confounding factors, only KNOWCAS-12 score ( $p=0.031$ ) was found to be independently associated with inappropriate use of calcium supplements (Table 2). The higher the KNOWCAS-12 score, the less likely the participants were to inappropriately

use calcium supplements (increase by 1 score, the odds for inappropriate use was 0.79).

### DISCUSSION

In this study, the inappropriate use of calcium supplements was defined in the context of unindicated use to prevent fracture or osteoporosis among individuals with low risk for osteoporosis. The participants were mainly young adults with an average age of 36 years, premenopausal females, not smoking or drinking alcohol, and without co-morbidities. These characteristics further support their low risk for osteoporosis. Despite this low risk, almost half of them used calcium supplement inappropriately. However, this percentage was higher than the national prevalence of calcium supplement use among young adults aged 30-50 years in Malaysia and Canada (20-38%), who

Table 2: Binary regression analysis: Factors for inappropriate use of calcium supplement

Variables	SLR			MLR <sup>a</sup>		
	Unadjusted odds ratio	95% CI	p-value	Adjusted odds ratio	95% CI	p-value
Age (years) [median (IQR)]	1.01	0.98, 1.04	0.468			
Male [n (%)]	1					
Female	2.00	0.95, 4.25	0.070	2.49	0.97, 6.41	0.059
Malay [n (%)]	1					
Non-Malay	0.68	0.33, 1.38	0.283			
No/primary education [n (%)]	1					
Secondary education	0.95	0.27, 3.39	0.935			
Tertiary education	1.55	0.44, 5.41	0.496			
Unemployed [n (%)]	1					
Employed	3.80	0.77, 18.66	0.101	2.30	0.35, 15.20	0.389
Monthly household income (n=96), [median (IQR)]	1.00	1.00, 1.00	0.036	1.00	1.00, 1.00	0.045*
Non/former smoker [n (%)]	1					
Active smoker	1.01	0.34, 2.99	0.982			
No co-morbidities [n (%)]	1					
Presence of co-morbidity	0.81	0.38, 1.70	0.572			
KNOWCAS-12 score [median (IQR)]	0.79	0.66, 0.94	0.007	0.79	0.64, 0.98	0.031*

\*Significance: p-value <0.05  
<sup>a</sup>Variables included in the MLR: Gender, Employment status, Monthly household income, KNOWCAS-12 score; Using ENTER method.

can be presumed to have a low risk for osteoporosis based on their age (Vatanparast et al. 2020; IPH 2014). In a study among students of a medical sciences university in Malaysia aged between 18 and 30 years, only 4.5% used calcium supplement (Chiang & Ahmad Jamal 2020). Another local study also showed a low prevalence of 12.7% among those aged 40-59 years old, with no family history of osteoporosis or previous fracture (Chan

et al. 2019). However, comparison between studies should be done cautiously as the proportions did not represent the actual prevalence of inappropriateness use.

The main reason for calcium supplement use in this study was to prevent fracture, and almost all participants knew about the importance of calcium for bone health. As previous studies have shown the significant influence of knowledge

about osteoporosis on calcium supplement use (Chan et al. 2019; Pon et al. 2006; Tyler et al. 2008), the current findings suggest that the participants were aware of osteoporosis and the role of calcium to prevent it. However, our young participants still used calcium supplement despite having a low risk for osteoporosis. This may indicate the presence of knowledge gaps or misperception regarding their own risk for osteoporosis. They might perceive susceptible to have fracture or osteoporosis, which was shown to lead to osteoprotective behaviour such as ensuring adequate calcium intake (Chiang & Ahmad Jamal 2020; Chan et al. 2019). Unfortunately, a majority did not or rarely discussed their practice with doctors, which was similarly seen in previous studies (Chan et al. 2010; Tarn et al. 2015); thus, any gaps in knowledge or misperception regarding their risk could not be addressed. Another possible reason for consuming calcium supplement is health motivation. The positive role of health motivation on calcium intake was also demonstrated in previous studies (Chiang & Ahmad Jamal 2020; Chan et al. 2019). However, neither perception of susceptibility nor health motivation were assessed in this study; thus, further studies are needed to explore the possible gaps in knowledge and misperception.

More than half of the participants in this study also admitted that they used calcium supplements because they perceived of having inadequate calcium through their diet. As almost four-fifths of the participants knew calcium supplement is only indicated when

dietary intake of calcium is inadequate, the findings suggest that poor dietary calcium intake was possible in this population. Furthermore, Malaysians have been proven to have inadequate calcium intake, based on a national survey that showed an average daily calcium intake of about 500 mg (Zainuddin et al. 2019), possibly due to low motivation, intolerance to dairy products, negative attitudes towards calcium-rich food, and poor knowledge on osteoporosis, dietary sources of calcium or the recommended daily dietary requirement of calcium (Chan et al. 2018; Chiang & Ahmad Jamal 2020; Rouf et al. 2019). If inadequate calcium intake was present, their use of calcium supplement may be justified as calcium supplement can be consumed in addition to other dietary sources to ensure adequate daily calcium intake (Yeap et al. 2016). This may explain why almost two-fifths of the participants received the suggestion to take calcium supplement from doctors even though they had no other medical indications for its use. Even if the use was justified, non-compliance and incorrect consumption by most of them could render the effort to improve the calcium intake as ineffective (Blumberg et al. 2017).

In this study, the common use of calcium supplements, the non-compliance and the incorrect consumption of calcium supplement by most participants suggest gaps in knowledge related to calcium supplements. Their level of knowledge on calcium supplements was only moderate. A majority knew the importance of calcium for bone health

and increased requirement with age. However, their knowledge on the side-effects of calcium supplements and the correct consumption was lacking. As previous studies mainly focus on assessing knowledge on osteoporosis (Chan et al. 2018; Chiang & Ahmad Jamal 2020; Chan et al. 2019; Leng et al. 2017), these knowledge gaps on calcium supplement are overlooked. However, previous studies did highlight the significant positive influence of knowledge on one's belief and attitude, leading to osteoprotective behaviour (Chiang & Ahmad Jamal 2020; Chan et al. 2019; Pon et al. 2006; Leng et al. 2017; Evenson & Sanders 2016). Similarly, this current study also showed that the higher the knowledge of calcium supplements, the less likely the young adults with low risk of osteoporosis to use calcium supplement inappropriately. Due to the importance of knowledge in determining correct osteoprotective behaviour and a "double-edged sword" effect of calcium supplementation (Li et al. 2018) educational intervention to address the gaps in knowledge should be provided to the young adults. Emphasis should be given to improve their knowledge on the indications of calcium supplement use, its side-effects, and its correct consumption. Besides, knowledge of various dietary sources of calcium, the recommended daily requirement of calcium intake and the risk factors for osteoporosis and fracture should also be imparted. Since friends and family members were the primary sources of information about calcium supplement, the information should be able to reach laymen to allow

greater dissemination of knowledge among the general population (Leng et al. 2017). With the involvement of healthcare providers, campaigns through community programs and educational interventions through popular media, e.g. internet, television and social media, can be carried out (Chan et al. 2018).

As this study was one of the few that examined the appropriateness of calcium supplement use, the findings could provide a basic understanding of the practice. However, the study has several limitations mainly related to the study design and the definition of 'inappropriate use'. Thus, the causal relationship between knowledge and practice could not be determined and direct comparison of the findings with other studies could not be made. Moreover, incomplete assessment to exclude all indications for calcium supplement use, such as confirmed calcium deficiency and inadequate daily dietary calcium intake, could affect the accuracy in determining the inappropriate calcium supplement use among these individuals with low risk for osteoporosis.

## CONCLUSION

Inappropriate use of calcium supplements was common among individuals with low risk of osteoporosis, although most of them were non-compliant and did not consume it correctly. The commonest reasons for its use were for prevention of fracture and belief of having inadequate dietary intake. The participants' knowledge of calcium supplements was still lacking,

where the gaps are mainly on the side-effects of calcium supplements and the correct method of consumption. As having better knowledge on calcium supplements reduced the chances of its inappropriate use, educational interventions to increase awareness regarding calcium supplements should be imparted to ensure correct osteoprotective behaviour and improve their perception on the indications of calcium supplementation. Future studies should explore the reasons for inappropriate use of calcium supplements and their impacts on the users and the healthcare system.

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