

Attitude of Asians to Calcium and Vitamin D Rich Foods and Supplements: A Systematic Review

(Sikap Orang Asia terhadap Makanan yang Kaya dengan Kalsium dan Vitamin D dan Penambahan Mutu Makanan)

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ABSTRACT

The prevalence of osteoporosis is increasing in Asian countries. Optimum calcium intake and vitamin D level are important to prevent osteoporosis. The attitude of the society towards calcium food sources and supplements, as well as sun exposure, influence their bone health practices. This review aimed to summarize the current literature on the attitude of Asians on calcium and vitamin D rich foods and supplements to understand the barriers among the Asians in achieving adequate calcium intake and vitamin D level. Studies showed that most Asians have a negative attitude towards calcium-rich foods, mainly dairy products due to lactose intolerance, aversion to the taste of dairy products or the absence of motivation. Although they took supplements to fill the gap in their diet, they were not aware of the daily recommended intake of calcium. Besides, the majority of them have a negative attitude towards sun exposure due to the fear of getting skin cancer or tanning. As a conclusion, most of Asians are still not aware of the importance of calcium and vitamin D for their health and their negative attitude must be corrected to prevent the rise of osteoporosis.

Keywords: Barrier; bone; osteopenia; osteoporosis; perception; 25-hydroxyvitamin D

ABSTRAK

Kelaziman osteoporosis semakin meningkat di negara-negara Asia. Pengambilan kalsium dan vitamin D yang optimum adalah penting untuk mencegah osteoporosis. Sikap masyarakat terhadap sumber makanan kalsium dan suplemen, serta pendedahan kepada cahaya matahari, boleh mempengaruhi kesihatan tulang mereka. Ulasan ini bertujuan untuk merumuskan kajian terkini tentang sikap orang Asia terhadap suplemen dan makanan kaya kalsium serta vitamin D demi pengenalpastian sekatan mereka untuk mencapai tahap pengambilan kalsium dan vitamin D yang mencukupi. Kajian lepas telah menunjukkan kebanyakan orang Asia mempunyai sikap yang negatif terhadap makanan kaya kalsium, terutamanya produk tenusu, kerana mereka mengalami intolerans laktosa, tidak suka rasa produk tenusu atau kekurangan motivasi. Walaupun mereka mengambil suplemen untuk mengisi kekurangan dalam diet, mereka tidak mengetahui tahap pengambilan kalsium yang disyorkan. Di samping itu, kebanyakan mereka mempunyai sikap yang negatif terhadap pendedahan cahaya matahari kerana takut mendapat kanser kulit atau kulit gelap. Secara kesimpulannya, kebanyakan orang Asia masih tidak mengetahui kepentingan kalsium dan vitamin D untuk kesihatan mereka dan sikap ini harus diperbaiki untuk menghalang peningkatan osteoporosis.

Kata kunci: Osteopenia; osteoporosis; pandangan; sekatan; tulang; 25-hidroksivitamin D

INTRODUCTION

Calcium and vitamin D are nutrients essential for optimal bone health (Tai et al. 2015). They can be obtained from the diet, but vitamin D is mostly acquired through cutaneous synthesis when human skin is irradiated with ultraviolet B (280–320 nm). The recommended dietary intakes of calcium (1000 mg/day) and vitamin D (600 IU/per) to maintain bone health in human adults are well-established (Laird et al. 2010; Lehmann & Meurer 2010; Lips & Schoor 2011). The reference dietary intake of calcium and vitamin D purposed by Institute of Medicine are followed globally (Table 1) (Institute of Medicine 2011). However, calcium and vitamin D deficiency is still a worldwide epidemic. In the tropical Asian countries receiving abundant sunlight, the problem of vitamin D deficiency does exist. A study on 1139 Singaporean Malays, Chinese and Indians (624

males and 515 females) aged 40–80 years found that the prevalence of vitamin D insufficiency and deficiency were 28.4% and 47.8%, respectively. Overall, Singaporean women had a higher prevalence of suboptimal 25(OH) D level compared to men (88.7% vs. 65.7%) (Man et al. 2017). Pregnant and lactating women have a higher requirement for vitamin D and calcium to provide for their babies and themselves (Dawodu & Tsang 2012; Wagner et al. 2012). However, Wang et al. (2010) found that the prevalence of vitamin D and calcium insufficiency in pregnant women and neonates in Chengdu, China was high even when the mothers were compliant with prenatal vitamin supplementation (Wang et al. 2010). In the same study, calcium and vitamin D intake was uniformly low, although it was higher among urban women (1010±450 mg/d, 237±169 IU/d) than rural women (320±210 mg/d,

62±66 IU/d) (Wang et al. 2010). Nutritional calcium deficiency is also prevalent in Southeast Asian countries, such as Indonesia (Green et al. 2008), Malaysia (Green et al. 2008) and Bangladesh (Islam et al. 2003).

The Asians face unique challenges in overcoming calcium and vitamin D deficiency. There is an increasing number of young adults in Southeast Asia countries working indoor due to rapid economic development. Meanwhile, the number of retired elderly having the leisure time to enjoy outdoor increases (Choi et al. 2011). This leads to a higher vitamin D level among the elderly compared to the younger generation as observed in Thailand (Chailurkit et al. 2011), Malaysia (Chin et al. 2014) and Korea (Choi et al. 2011). Furthermore, Asians usually have skin type 4 or 5 (darker) compared with Caucasians (mostly skin type 2 or 3) (Webb & Engelsen 2006). Thus, Asians required a greater duration of sun exposure than Caucasians to synthesise comparable amount of vitamin D. Besides, dark skin pigmentation also put Asian adults at risk of vitamin D deficiency (Mitchell et al. 2012). The low vitamin D level among Asians is also associated with religious, lifestyle and nutritional factors. A study among Malaysian Muslim females found that they have low 25(OH)D levels due to fully covered attires (long sleeves, long skirts and veil), use of umbrella, avoidance the sunlight or working indoors (Moy 2011). Rahman et al. (2004) found that levels of 25(OH)D were significantly lower in the Malaysian Malay women (44.4 nmol/L) compared to the Malaysian Chinese women (68.8 nmol/L) (Rahman et al. 2004). Approximately 71% of the Malay women had vitamin D insufficiency (25-50 nmol/l)

compared to 11% of the Chinese women. Lastly, children and adolescents in Asia have relatively low calcium intake in comparison to the Western counterparts (Gibson et al. 2007; Wu et al. 2007). This could be partly contributed by the non-dairy diets, poor dietary habits, inadequate information and knowledge about calcium-rich foods and poor calcium absorption from plant foods (Tupe & Chiplonkar 2010).

It is important to understand the attitudes of the Asian population towards calcium and vitamin D to overcome the problems of inadequacy. It is recognized that awareness and a positive attitude towards health problems provide a powerful motivation for an individual to adopt healthy dietary behaviour (Brewer et al. 1999; Glasman & Albarracin 2006). This review aimed to examine perception, attitude and beliefs of Asians on calcium- and vitamin D-rich foods, supplements and sun exposure.

MATERIALS AND METHODS

A literature search was performed from 30/8/2017 to 18/12/2017 with PubMed and Scopus using keywords '(perception OR attitude OR belief) AND (calcium OR vitamin D) AND (food OR supplement OR sun exposure)'. All original research articles published from the year 2000 onwards were considered to provide an up-to-date view of the attitudes of Asian populations on the subject matter. Our literature search identified 1371 records from Pubmed and 144 records from Scopus. After removing duplicated articles ($n = 64$), each title and abstract for

TABLE 1. Dietary Reference Intake for Calcium and Vitamin D

Life stage group	Calcium			Vitamin D		
	Estimated average requirement (mg/day)	Recommended dietary allowance (mg/day)	Upper level intake (mg/day)	Estimated average requirement (IU/day)	Recommended dietary allowance (IU/day)	Upper level intake (IU/day)
Infants 0 to 6 months	*	*	1000	**	**	1000
Infants 6 to 12 months	*	*	1500	**	**	1500
1-3-year-old	500	700	2500	400	600	2500
4-8-year-old	800	1000	2500	400	600	3000
9-13-year-old	1100	1300	3000	400	600	4000
14-18-year-old	1100	1300	3000	400	600	
19-30-year-old	800	1000	2500	400	600	4000
31-50-year-old	800	1000	2500	400	600	4000
51-70-year-old males	800	1000	2000	400	600	4000
51-70-year-old females	1000	1200	2000	400	600	4000
>70 years old	1000	1200	2000	400	800	4000
14-18 years old, pregnant/ lactating	1100	1300	3000	400	600	4000
19-50 years old, pregnant/lactating	800	1000	2500	400	600	4000

*For infants, Adequate Intake is 200 mg/day for 0 to 6 months of age and 260 mg/day for 6 to 12 months of age.

**For infants, Adequate Intake is 400 IU/day for 0 to 6 months of age and 400 IU/day for 6 to 12 months of age.

potential inclusion was screened. Only articles written in English or Mandarin were retrieved. Only original research articles with the main objective to study the perceptions, attitudes and beliefs on calcium and/or vitamin D foods and/or supplements and/or sun exposure among Asians were included in this review. If the article was potentially eligible for inclusion, the full text was examined. Two reviewers decided articles to be included in the review. Any discrepancies were resolved by discussion. Data extraction on authors (year), subjects' characteristics, study design, major findings were performed by the same person. A total of 15 articles fulfilled the criteria and provided sufficient information for data extraction and were included for this review (Figure 1).

RESULTS

PERCEPTIONS, ATTITUDES AND BELIEFS OF ASIANS ON DIETARY CALCIUM

Dairy products are a good source of dietary calcium but lactose intolerance is prevalent among the Asians (Qiao et al. 2011; Saha et al. 2016). A study by Asmawi et al. (2006) found that 88% Malays, 91% Chinese and 83% Indians in Malaysia were hypolactasic. The attitude of Chinese urban population ($n=1714$, from 18 years old to above 65 years old, 34% men, 66% women) on dairy products has been investigated by Zhao et al. (2017). They found that 42.7% subjects had a self-perceived insufficient intake of dairy products (Zhao et al. 2017). Only 15.2% of the subjects mentioned that they experienced lactose intolerance symptoms after consuming dairy products in this study (Zhao et al. 2017). This prevalence was much lower than the estimated prevalence of lactose intolerance previously reported in China (92.3% in Han Chinese) (Wang et al. 1984). Among those experiencing the symptoms, 29.5%

were unsure of the reasons, 21.7% considered the cause was lactose intolerance, while 48% speculated other gastrointestinal conditions (Zhao et al. 2017).

This reason, along with the lack information on the recommended daily calcium intake might prevent Asians from obtaining sufficient calcium. A cross-sectional survey of 1475 Thai adults aged 20 years or above expressed a positive attitude towards the essential role of calcium in health and the need to fulfil the intake requirement (Sriring et al. 2014). However, only 10.9% fulfilled the recommended calcium intake level (800 mg/day) (Sriring et al. 2014). This might be attributed to the fact that only 4.6% of them were aware of this value in the survey (Sriring et al. 2014). Despite using a multistage randomized sampling method, this study focused on the north-eastern part of Thailand, which might not be representative of the whole country.

With respect to Asians living in the Western countries, Reicks et al. (2011) reported that among 661 parents recruited in nine states in the USA, being Asian and having an Asian spouse contributed to lower calcium intake. Another similar study also indicated that Asian parents were least likely to be a dedicated milk drinker and provider (Reicks et al. 2012). A qualitative survey conducted among adolescent girls from Asian, Hispanic or Caucasian ethnicity showed that more Asian subjects disliked the taste of milk compared to other ethnicities (Auld et al. 2002). However, they could accept other dairy food products, such as cheese, pizza and ice-cream (Auld et al. 2002). They also thought that there was a lack of expectation within their families to drink milk and milk was not compatible with Asian food (Auld et al. 2002). Across ethnicities, the subjects associated milk with musculoskeletal benefits but thought that it was more important to the boys (Auld et al. 2002). Overall, the attitude of Asian adolescent girls towards milk was less negative compared to the Hispanics

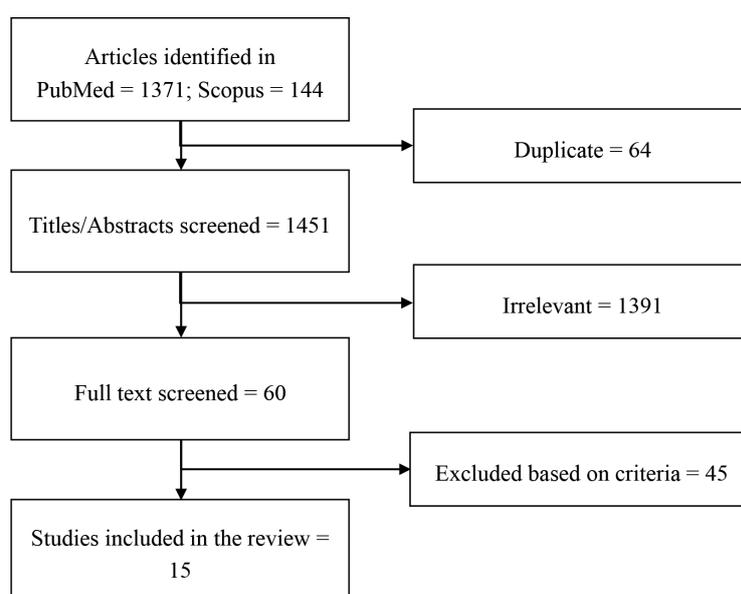


FIGURE 1. Flow diagram of the stepwise selection of relevant studies

but less positive compared to the Caucasians (Auld et al. 2002). The readers should note that these studies were performed in conveniently sampled subjects (Auld et al. 2002; Reicks et al. 2011), therefore, generalization of the results should be done with cautions.

A summary of the literature on the attitudes of Asians on calcium-rich food is listed in Table 2.

PERCEPTIONS, ATTITUDES AND BELIEFS OF ASIANS ON CALCIUM AND VITAMIN D SUPPLEMENTS

Calcium supplements are recommended for individuals who cannot achieve daily recommended calcium intake. Only one study on the attitudes of Asians on calcium supplementation was found. A multinational survey by Chan et al. (2010) studied the attitudes of physicians ($n=237$) and patients ($n=1463$) on calcium supplementation. The proportion of physicians with positive attitudes on calcium in descending order was the Philippines (80%) > Korea (50%) > Singapore (38%) > Taiwan (30%) > Malaysia (27%). Meanwhile, the proportion of patients with positive attitudes on calcium in descending order was the Philippines (90%) > Korea (70%) > Malaysia (69%) > Taiwan (58%) > Singapore (55%) (Chan et al. 2010). Similar trends in attitudes were found for vitamin D supplement, whereby the Philippine physicians (72%) and patients (73%) had the most positive attitudes compared to the other countries. The positive attitude on calcium and vitamin D supplements in the Philippines was contributed by frequent discussions about supplementations between the physicians and the patients, denoted by 81% of the respondents. In other countries studied, more than half

of the patients had no or infrequent discussion with the doctors about supplementation (Chan et al. 2010). Despite being a rare multinational study in the Asian region and the numbers of the physicians and patients recruited were relatively large, the representation of the samples might be hampered by the non-randomized sampling method.

Vitamin D deficiency was a serious problem among the neonates (Wu 2014). Without proper immediate intervention, it could lead to rickets and fracture. With regards to this issue, the attitude of Turkish paediatricians on vitamin D supplementations in their clinical practice was examined (Karabulut et al. 2016). The results showed that only 8.7% subjects would recommend beginning vitamin D prophylaxis soon after birth probably due to the misconception that maternal transfer of vitamin D could protect against deficiency for the first three weeks of life (Karabulut et al. 2016). Besides, 19.9% of the subjects would stop vitamin D supplementation immediately in infants with small anterior fontanelle due to the false belief that it would delay its closure (Karabulut et al. 2016). A small percentage of subjects would recommend vitamin D in babies with delayed tooth eruption (7.8%, daily dose) and walking (2.4%, 300 IU every two months) (Karabulut et al. 2016). These indications could lead to intoxication because vitamin D at 300 IU is available over the counter in Turkey (Karabulut et al. 2016). It should be noted that the response rate of this survey was quite low (167/1800) and the aspects of vitamin D supplementation studied were limited.

A summary of the literature on the attitude of Asians on calcium supplement is listed in Table 3.

TABLE 2. Perceptions, attitudes and beliefs of Asians on dietary calcium

Studies	Primary objective	Populations	Study design	Findings
Zhao et al. (2017)	To determine the knowledge, attitude and practice of dairy products in Chinese urban population	1714 subjects aged from 18-65 years and above from first-tiers and non-first tiers cities of China	Cross-sectional study using the Semi-Quantitative Food Frequency Questionnaire (semi-FFQ)	42.7% self-perceived insufficient dairy intake 15.2% experiencing lactose intolerance symptoms but only 21.7% thought it was related to lactose intolerance
Sriring et al. (2014)	To determine the knowledge and attitudes of Thai adults towards calcium and predictors of calcium consumption	1475 Thai adults from 20 provinces in the northeastern region of Thailand	Cross-sectional study using structured interview questionnaire	Positive attitude: role of calcium in health and the need for regular intake Only 4.6% could specify the value of the daily requirement for calcium
Reicks et al. (2011)	To determine the influence of parental perception on calcium-rich food on calcium intake on adolescence	Non-Hispanic white, Hispanic, and Asian ($n=661$) parents from nine states	Cross-sectional study using 14 scales questionnaire & food frequency questionnaire	Having an Asian spouse or being Asian was associated with reduced calcium intake
Auld et al. (2002)	To determine factors influencing milk consumption among adolescent girls	Female adolescent (11 to 12 or 16 to 17 years) (Ethnic: Asian, Hispanic, white)	Cross-sectional qualitative study using focus group discussion	Most Asian subjects had a negative attitude to milk due to absence of expectation within Asian families for drinking milk

TABLE 3. Perceptions, attitudes and beliefs of Asians on calcium supplements

Studies	Primary objective	Populations	Study design	Findings
Chan et al. (2010)	To determine the attitude of Asian physicians and patients on calcium and vitamin D supplements	237 physicians and 1463 osteoporosis patients from Malaysia, Taiwan, Philippines, Korea and Singapore	Cross-sectional study. Physicians are selected conveniently from the registry and patients were the first seven they met at their setting. Telephone interview with the physicians and patients were performed. 16 questions were asked	Proportion subjects perceiving vitamin D supplement as important: Physicians: Philippines > Korea > Singapore > Malaysia > Taiwan Patients: Philippines > Malaysia > Singapore > Taiwan > Korea Proportion of subjects perceiving calcium supplement as important: Physicians: Philippines > Korea > Singapore > Taiwan > Malaysia Patients: Philippines > Korea > Malaysia > Taiwan > Singapore
Karabulut et al. (2016)	To determine the attitudes of Turkish paediatrician on vitamin D supplementation in preventing deficiency	167 paediatricians from Turkish National Pediatrics Association network	Cross-sectional study using online questionnaire	8.7 % started vitamin D supplementation immediately after birth 19.9% stopped vitamin D supplementation immediately in infants with small anterior fontanelle 7.8% recommended daily vitamin D in babies with delayed tooth eruption (7.8%, daily dose) 2.4% recommended 300 IU every two months for babies with delayed walking

PERCEPTIONS, ATTITUDES AND BELIEFS OF ASIANS ON
OBTAINING VITAMIN D VIA SUN EXPOSURE

The tendency to avoid sunlight due to aesthetic reasons is prevalent among the Asian populations. A study by Kung and Lee (2006) in Hong Kong population ($n=547$) showed that despite having good awareness about vitamin D, middle-aged women tended to have a negative attitude towards sunlight compared with elderly women. Many of them took measures to avoid sun exposure whenever possible, these might be due to the current cultural trend to maintain a paler skin (Kung & Lee 2006). The awareness of the harmful effects of sunlight (for example, skin ageing and cancer) exerted a greater influence on sun exposure behaviour among middle-aged women than the knowledge about the benefits of sunlight (Kung & Lee 2006). Another study among medical university students in Northeast China ($n=385$) found a significant gender disparity in their attitude towards tanning. Men showed a positive attitude towards tanning (looked healthier and attractive), but women showed a negative attitude (looked older) (Gao et al. 2014). Similarly, a study among medical university students ($n=515$) in Nanjing, China found out that the main reason for preventing sun exposure was to avoid tanning (males 43.2% and females 75.0%) (Zhou et al. 2016). The lack of sun exposure was further validated in the use of sun protection, especially in female students (30.2%) (Zhou et al. 2016). This finding is similar to another study among students in an Indian university, whereby 64.2% respondents did not like going in the sun (women>men) (Arora et al. 2016). Half of them (49.7%) thought that sun exposure was harmful and 43% would always use a sunscreen when going out (women>men) (Arora et al. 2016). Besides, 60% of the subjects also self-perceived to be sufficient in vitamin D (men>women) (Arora et al. 2016). The subjects of this study were from the same department of a single university and with biotechnology background. Hence, the results might not be generalized to other young adult populations in India.

The attitude of the populations in Middle-east may be different from the rest of Asia. Aljefree et al. (2017) performed a qualitative study to assess the attitude to vitamin D in Saudi Arabia. The interviewed subjects showed that they were only willing to expose themselves to sunlight in the morning or late evening, and limit the exposure to face and hands. They also thought that hot climate, the design of modern house (close, high-rise, without balcony), limited public recreational areas for outdoor activities and certain physical conditions, physical inactivity and religious practices inhibited them to obtain sufficient sunlight. In another study which was also conducted in Abu Dhabi, Saudi Arabia among a limited number of conveniently sampled young women ($n=193$) with an average age of 25 years, 'being in sunlight was bad for health' was the strongest predictors of sun avoidance (Thomas et al. 2010). In contrast, Mousavi et al. (2011) found out that most citizens of Shahrak-E-Gharb ($n=400$; conveniently sampled), an area in northwest Tehran have a positive attitude about sun exposure. Only 15% of them

were concerned about skin cancer due to sun exposure and 61.8% of them believed skin cancer could be prevented by sun protection. 78.5% of them thought tanning made them more charming (Mousavi et al. 2011).

The attitude of Asian immigrants in New Zealand had been studied by Von Hurst et al. (2010). The respondents were 140 South Asian women living in Auckland aged 20 years or above. Most subjects (69%) never sunbathed and 24% wore a sunscreen when going out (Von Hurst et al. 2010). The reasons they avoided sunlight included public health messages (30%), avoid tanning (19%) and health reason (15%) (Von Hurst et al. 2010). On improving their sunlight exposure, 29% subjects indicated that would never want to spend more time under the sun, 49% would increase exposure if skin cancer was not a concern, 24% would increase if they had more time and 9% would if they had more privacy (Von Hurst et al. 2010). This study only involved South Asian women conveniently sampled from Auckland, therefore, the results should not be extrapolated to other Asian immigrants.

Asians with health conditions might be more incline to improve their health status through sunlight exposure. In a case-control study among patients with coronary heart disease, the cases ($n=130$) had a more positive attitude towards sun exposure, evidenced by higher willingness to expose themselves to sunlight, not avoiding sunlight, higher concern about their vitamin D level and not using parasol to shade themselves compared to control ($n=195$) (Aljefree et al. 2017). However, their positive attitudes were not associated with vitamin D level (Aljefree et al. 2017). Only patients with a coronary heart disease were studied so far, thus we did not know whether patients with other conditions would share the same attitude on sun exposure.

A summary of the literature on the attitudes of Asians on vitamin D supplement is listed in Table 4.

PERSPECTIVES

The attitude of Asians towards calcium-rich food is influenced by a myriad of biological and cultural factors. Public education plays an important role in eliminating ignorance and biases towards calcium-rich foods. Given the importance of calcium for healthy development and growth, individuals with lactose intolerance should be made aware of lactose free-dairy products, which can help them to obtain the complete nutritional value of the milk (Beto 2015). Besides, parents are equally important in ensuring family members have access to calcium-rich foods. Edlefsen et al. (2008) suggested that parents should always make calcium and vitamin D-rich foods or beverages available at home for their children. Furthermore, parents should take a proactive role in emphasizing the health benefits of maintaining a calcium and vitamin D-rich diet to their children at different stages of their development (Edlefsen et al. 2008).

Populations at the highest risk for dietary calcium deficiency, such as women (amenorrhoeic, athlete triad,

TABLE 4. Perceptions, attitudes and beliefs of Asians on sun exposure and vitamin D

Studies	Primary objective	Populations	Study design	Findings
Aljefree et al. (2017)	To determine the relationship between knowledge, attitudes and behaviours related to vitamin D status among adults with and without coronary heart disease (CHD) in Saudi Arabia	130 CHD cases and 195 controls from three hospitals in Saudi Arabia	Case-control study using a structured questionnaire and vitamin D level was measured	More positive attitude in cases to sun exposure
Aljefree et al. (2017)	To determine the social and cultural factors contributing to vitamin D deficiency in Saudi Arabia	Subjects from another quantitative study from three hospitals in Saudi Arabia	Qualitative study utilised in-depth, face-to-face interview, semi-structured, with open-ended questions	Prefer sun exposure only in the morning or late evening and to hands and faces Barriers to sun exposure: hot climate, the design of the house, limited public outdoor recreational areas, physical inactivity, and religious practices
Zhou et al. (2016)	To determine the knowledge, attitude and practice of Chinese students on vitamin D	515 medical students from a medical university in Nanjing, China	Cross-sectional study. The subjects answered a questionnaire related to vitamin D and sun exposure	Reasons students avoided sun exposure: Male: avoiding dark skin (43.2%), no desire to go out (18.2%) and skin cancer (13.6%) Female: avoiding dark skin (75.0%), skin cancer (16.1%) and accelerating ageing (12.1%)
Arora et al. (2016)	To determine the knowledge, practice of vitamin D and attitudes toward sunlight among Indian students	599 students between 18 and 25 years of age studying biotechnology at a university in India	Cross-sectional study using a self-administered questionnaire	64.2% did not like going in the sun (female>male) 49.7% thought sunlight was harmful 43% used a parasol as sunscreen (female>male)
Gao et al. (2014)	To determine the knowledge, attitude and practice of medical students on UVR and sun exposure protection	385 medical undergraduates from Shenyang, Northeast China	Cross-sectional study using a self-report questionnaire	60% thought they were sufficient in vitamin D (male>female) Women had more tendency to decreased sun exposure compare to men 6.6% felt that tanning was attractive
Mousavi et al. (2011)	To determine the knowledge, attitude, and practice of Iranian adults to sun protection	400 citizens of Shahrak-E-Gharb, an area in northwest Tehran	Cross-sectional study using a questionnaire comprising 24 questions	15% concerned about skin cancer 61.8% thought skin cancer could be prevented by sun protection A more positive attitude towards tanning was associated with higher education
Thomas et al. (2010)	To develop a Sun Avoidance Inventory (SAI) for the population of United Arab Emirates	193 Emirati females living in Abu Dhabi aged 25 years	Cross-sectional study. Subjects answered a questionnaire on sun avoidance	Being in the sun for even for a brief period was bad for health was the strongest belief that predicted sun avoidance
Kung and Lee (2006)	To determine the attitude and behaviour of Hong Kong women to vitamin D	Chinese female household members aged 50 years or older living in Hong Kong	Telephone interviews using the computer assisted telephone interview technique	Attitude to sunlight was negative Middle-aged women with good awareness of vitamin D took measures to avoid sunlight

postmenopausal), individuals with milk allergy or lactose intolerance, adolescents and elderly (National Institute of Health Osteoporosis and Related Bone Diseases National Resource Centre 2015), should seek nutritional and medical consultation in starting calcium supplementation. This is important because either under or over-supplementation will not be beneficial to health. In addition, under-supplementation is a waste of resources and over-supplementation could induce other medical conditions. The physicians, especially those involved in primary care, should communicate with their patients on the benefits and appropriate use of calcium and vitamin D supplements.

With regards to vitamin D and sunlight, the attitude of Asians is influenced by cultural and religious factors. Ambient ultraviolet radiation (UVR) distribution and temperature are a major concern in the population who avoided sun exposure due to aesthetic reasons and fear of skin cancer. Thus, it is recommended that they performed outdoor activities in the early morning or evening to prevent skin damage from UVR (Cheng et al. 2010). Public health message should also strike a balance between benefits and risks for sun exposure (Thomas et al. 2010). This is to ensure the public does not shun from sunlight totally. For those susceptible to vitamin D deficiency due to religious clothing, older adults, individuals with a dark skin tone or obesity, supplementation may be required.

Lastly, the updated literature on the attitudes of Asian populations is limited. Most studies were performed among the Chinese and Middle-eastern populations and fewer for other ethnicities. More intensive studies should be performed to understand the barriers among the Asians to achieve adequate calcium intake and vitamin D level. One of the concerns is that the elderly population in Asia is expanding exponentially. Concurrently, the prevalence of age-related diseases, like osteoporosis, is also increasing. It is estimated that the percentage of global hip fracture in Asia will increase from 24% in 1990 to 45% in 2050 (Gullberg et al. 1997). Slowing down the increase through nutritional strategies, for instance, ensuring adequate calcium and vitamin D intake, is essential in reducing the burden of diseases like osteoporosis.

CONCLUSION

Asians have certain negative attitudes towards calcium-rich foods, especially dairy products, due to the prevalence of lactose intolerance, absence of family motivation and aversion driven by taste and misconceptions. Despite their willingness to take supplementation, they are not equipped with the knowledge of recommended daily calcium intake, often resulting in under-supplementation. Similarly, they have a negative attitude towards sun exposure, mostly driven by aesthetic reasons and fear of skin cancer. These negative attitudes should be corrected through public health education to ensure sufficient calcium intake and vitamin D level in preventing health problems.

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