

ORIGINAL ARTICLE

Awareness of medical students about vitamin D deficiency at Ahfad University for women, Sudan

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ABSTRACT

Vitamin D deficiency is not only associated with rickets and osteomalacia, but also with several chronic diseases, such as cancer, ischaemic heart disease, and type 1 and 2 diabetes mellitus. Worldwide, an estimated one billion people suffer from vitamin D deficiency. The prevalence of this problem is unknown in Sudan due to scarcity of research in this particular area of concern. The present study aimed to assess the awareness of vitamin D deficiency through the knowledge of the importance of vitamin D, the link to diseases, vitamin D resources and the importance of dietary supplements, in addition to assessing the sun exposure habits in a sample of female Sudanese medical students. It is a descriptive cross-sectional community-based study, conducted at Ahfad University for Women, Omdurman, Sudan. More than half (56 %) of the participants were aged 21–25 years and 30% were in the second academic class. The majority of the participants were aware

of the importance of vitamin D; however, the awareness of relating it to the chronic diseases was poor. Overall, 61.9% declared that vitamin D supplementation is important, and sun exposure habits were good (64.5% didn't use sunblock and 87.6% get exposed for more than 10 minutes/day). There was significant association between the age categories and exposure to the sun without sunblock on a daily basis (p value = 0.007).

KEYWORDS

Vitamin D; Awareness; Sunblock; Medical students; Ahfad University for Women; Sudan.

INTRODUCTION

Vitamin D is important for calcium homeostasis and for optimal skeletal health. The major function of vitamin D is to increase the efficiency of calcium absorption from the small intestine. The maximum calcium absorption occurs at levels of

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25-hydroxyvitamin D (25[OH] D) greater than 32 ng/ml. Vitamin D also enhances the absorption of phosphorus from the distal small bowel. Adequate calcium and phosphorus absorption from the intestine is important for proper mineralization of the bone. The second major function of vitamin D is involvement in the maturation of osteoclasts, which resorb calcium from the bones [1].

There is no formal definition for vitamin D deficiency, but generally, a normal level of vitamin D is defined as a 25OHD concentration greater than 30 ng/ml (75 nmol/l). The term “vitamin D insufficiency” is sometimes used and it’s defined as a 25OHD concentration of 20 to 30 ng/ml (50 to 75 nmol/l). Vitamin D deficiency is defined as a 25OHD level less than 20 ng/ml (50 nmol/l) [2].

Vitamin D deficiency in children can manifest as rickets which presents as bowing of the legs [3]. It has always been associated with rickets in children and osteomalacia in adults; but recent studies have suggested a link to a number of illnesses, including multiple sclerosis, coronary artery disease, type 1 and 2 diabetes mellitus, rheumatic arthritis, hypertension, Alzheimer’s disease and several types of cancer [4]. Maternal vitamin D level during pregnancy was also postulated to have lifetime implications on the foetus, in which levels below the normal result in decreased bone density, increased occurrence of asthma and susceptibility towards type 1 diabetes [5].

Rickets and osteomalacia [6] result from inadequate mineralisation of bone matrix (osteoid bone). This is due to either low vitamin D level or an underlying metabolic cause. The growth plate in children is elongated with distortion of the arrangement of chondrocytes. In addition, calcification is delayed and vascularisation is impaired. In adults, bone biopsy shows increased osteoid width, increased mineralisation time and lack of uptake of double tetracycline labelling in osteoid seams. Vitamin D deficiency is usually due to inadequate sunlight exposure and/or dietary insufficiency.

Osteomalacia manifests in the form of vague symptoms of muscle pain and tenderness. Marked proximal myopathy leads to a characteristic ‘waddling gait’. [7]. Pathological fractures, tetany

or other hypocalcaemia conditions may occur. Neonatal rickets may present as craniotabes (thin deformed skull). In early childhood, widened epiphysis at the wrists and Harrison’s sulcus are seen. In older children, lower limb deformities occur in the form of bowed legs. Myopathies and hypocalcaemic tetany may also occur.

Investigations reveal increased serum alkaline phosphatase, indicating increased osteoblast activity. Plasma calcium is usually normal, but maybe low in severe cases, and serum phosphate may be low. Serum 25OHD is usually low, except in vitamin D-resistant rickets. X-rays are often normal in adults, but may show defective mineralization with pseudo fractures or ‘Looser’s zones’—linear areas of low density surrounded by sclerotic borders. Radiological features in children include metaphyseal widening, cupping or fraying.

Treatment of vitamin D deficiency should be directed towards correction of the underlying cause when possible, with increase in vitamin D intake and sunlight exposure. Multiple formulations of vitamin D and its metabolites are available. When deficiency is nutritional, ‘replacement doses’ of the vitamin are needed. High doses, sometimes administered parenterally, may be needed in some patients with gastrectomy, malabsorption or liver disease. Treatment with calcitriol or alfacalcidol is indicated in defective 1alpha-hydroxylation. Monitoring of serum calcium, alkaline phosphatase and renal function should be undertaken regularly to screen for hypercalcaemia. Normalization of alkaline phosphatase is a good measure of healing.

Vitamin D deficiency has been recognised lately as a global epidemic. A study conducted on Saudi Arabian males discovered that 87.8% were deficient and 9.7% were insufficient [8]. Regarding female college students, a study carried in Qatar University showed a remarkably high prevalence of vitamin D deficiency and insufficiency (97.2%) among healthy college female subjects; 50.7% showed severe vitamin D deficiency and, 46.5% showed vitamin D insufficiency [9]. Another study conducted on male adolescents in Al Ain in the United Arab Emirates discovered that 19.7% were deficient and 45.4% were insufficient [10]. The prevalence in developed countries was relatively

high as reported from the United State that the overall rate was 41.6% with the highest rates seen in blacks (82.1%) followed by Hispanics (69.2%) [11]. In Ireland, more than 75% of older females were found to be vitamin D insufficient [12].

Globally, it has been estimated that one billion people worldwide suffer from vitamin D deficiency [13]. There are no statistics available in Sudan but considering the global prevalence, it is most likely to be involved in this epidemic. Sudan is lacking research in this particular area of concern hence the magnitude of this problem is yet to be known. The present study aimed to assess the awareness of vitamin D deficiency through the knowledge of the importance of vitamin D, the link to diseases, vitamin D resources and the importance of dietary supplements, in addition to assessing the sun exposure habits in a sample of female Sudanese medical students.

MATERIALS AND METHODS

Study design and study area

This is a descriptive cross-sectional community-based study about the awareness of vitamin D deficiency conducted in September 2014 at School of Medicine, Ahfad University for Women. Ahfad University for Women is a private women's university in Omdurman, Sudan that was founded in 1966. The students come from all regions of the Sudan and several neighbouring countries.

Participants

All female medical students present in the University at the time of data collection, including second through sixth years students; and excluding first year students, as they don't possess enough medical knowledge qualifying them to answer the questions.

Sample size and technique

First systematic random sample was used, and then non-probability convenient sampling. The sample size was calculated by the formula as follows:

$$n = \frac{NZ^2 pq}{Nd^2 + Zpq}$$

where:

n = Sample size, N = Population size, Z = Standard score, p = Prevalence, $q = 1 - \text{prevalence}$ and d = Desired margin of error.

Noting that $N = 869$, $Z = 1.96$ (in 95% confidence), $p = 50\% = 0.5$, $d = 5\% = 0.05$.

$$n = \frac{869 \times 1.96^2 \times 0.5(1-0.5)}{869 \times 0.05^2 + 1.96^2 \times 0.5(1-0.5)} = 267$$

The total number of students was 869. Proportionally and according to the number of students in each grade, certain number of students was taken from each grade. As a result of errors during the questionnaire distribution, a total of 278 questionnaires were obtained.

Data management and analysis

Structured, self-administered questionnaire was used. After checking the data thoroughly for mistakes, Statistical Package for Social Sciences program version 20 was used to enter and analyse the data. Then, the data was presented using Microsoft Office Word 2007. Mean and standard deviation were calculated for continuous variables and proportions for categorical ones. A p -value of <0.05 was considered as significant. The chi-squared test was used to determine whether there is a significant difference between the expected frequencies and the observed frequencies in one or more categories.

RESULTS

More than half (56.1 %) of the participants fall in the category of 21–25 years, and 30% of them belonged to the second academic class (Table 1). Regarding the awareness of the medical students about vitamin D deficiency (Table 2), 89% mentioned that vitamin D is an essential part of the daily diet, while 52% thought that it is important for calcium metabolism and bone health. About three quarters (76%) of the participants believe that vitamin D can cause other diseases as well as rickets.

Approximately, one third (37%) of the students used sunblock and 57% stated that sunblock does not interfere with vitamin D formation in the skin.

Table 1. The sociodemographic characteristics of the participants at School of Medicine, Ahfad University for Women (n = 278).

Variable	Category	Frequency	Percentage
Age	16–20 years	114	41.0
	21–25 years	156	56.1
	More than 25 years	8	2.9
	Total	278	100
Academic grade	Second Year	86	31
	Third Year	50	18
	Fourth year	53	19
	Fifth year	39	14
	Sixth year	50	18
	Total	278	100

Table 2. Awareness of the medical students about vitamin D deficiency at Ahfad University for Women (n = 277).

Variable	Category	Frequency	%
Whether vitamin D is an essential part of the daily diet or not	Not essential	31	11.2
	Essential	246	88.8
	Total	277	100.0
Why students thought vitamin D is important	-Important for calcium metabolism and bone health	144	52
	-Can cause certain disease	128	46
	-Don't know	6	2
Does vitamin D deficiency cause only bone diseases?	Can cause other diseases	206	76
	Can only cause bone diseases	65	24
	Total	271	100
Diseases linked to vitamin D deficiency according to the students' opinions	Rickets	247	37.9
	Osteomalacia	232	35.6
	Multiple sclerosis	25	3.8
	Diabetes mellitus	7	1.1
	Alzheimer's disease	23	3.5
	Rheumatic arthritis	57	8.8
	Hypertension	11	1.7
	Coronary artery disease	13	2.0
Usage of sunblock	Yes	103	37
	No	175	63
Does sunblock interfere with vitamin D formation in the skin?	Yes	119	43
	No	159	57
Whether the participant is veiled or not	Yes	22	8
	No	256	92
percentage of girls who take vitamin supplements	Take	47	17
	Don't take	231	83
Frequency of pupils who thought vitamin D supplements are important	Yes	169	61
	No	104	39

The reasons to why sunblock is used revealed that 47.9% used it to protect from skin darkening, 26.8% to protect their skin from skin cancer and 25.4% to protect from wrinkles or other skin conditions. The majority of students (92%) were not veiled,

and an overwhelming majority experienced more than 10 minutes of continuous exposure to the sun per day (Figure 1). About two thirds (64.1%) of students thought that dairy products are rich in vitamin D and 68.6% were taking them (Table 3).

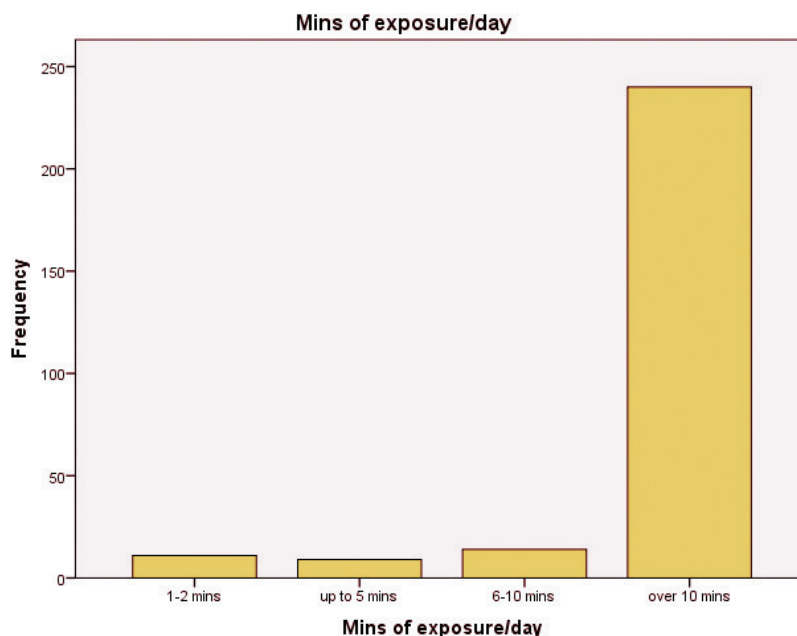


Figure 1. The number of minutes (Mins) of continuous exposure by the participants to the sun per day.

Table 3. Awareness of the participants regarding the food items that were thought to be rich in vitamin D and the consumption of those different food items.

Variable	Category	Frequency	%
Food items that were thought to be rich in vitamin D	Fatty fish	98	35.9
	White beans	20	7.3
	Green vegetables	115	42.1
	Beef liver	105	38.5
	Dairy products	175	64.1
	Egg yolk	99	36.3
	Egg white	31	11.4
Consumption of different food items	Fatty fish	22	9.1
	White beans	9	3.7
	Green vegetables	97	40.1
	Beef liver	20	8.3
	Milk products	166	68.6
	Egg yolk	59	24.4
	Egg white	51	21.1

The usage of both ordinary and vitamin D supplements was assessed, whereas 47 students (17%) reported to use ordinary vitamin supplements, only 16 (6.1%) consumed vitamin D supplements. Nevertheless, 61.9% declared that they are important. Ordinary vitamin supplements were used for cosmetic reasons by 19 (44.1%), to supply any missing vitamins in the diet by 33 (70.2%) and for both reasons by 43 (91.4%) students.

There was a strong significant association (p value = 0.002) between the age and whether the participants think sunblock interferes with vitamin D formation (Table 4), a strong significant association (p value=0.009) between the academic grade and whether the participants think sunblock interferes with vitamin D formation (Table 5), and significant association (p value = 0.007) between the age categories and exposure to the sun without sunblock on a daily basis (Table 6).

DISCUSSION

This study was conducted in an all-girls University, with the majority of participants aged 21–25 years. All the candidates agreed to the fact that vitamin D is important for our general health and 88.8% confirmed that vitamin D is an essential part of the daily diet. Establishing the above information, 96.4% stated that vitamin D is important for its role in bone health and calcium metabolism and that it's deficiency can cause chronic diseases. Considering that these girls would be classified as highly educated, such high results are expected, depicting their high awareness regarding this matter of vitamin D.

Recent studies have demonstrated that vitamin D deficiency is linked to several chronic diseases other than that of musculoskeletal origin [5] and the awareness of this was demonstrated in this

Table 4. Association between the age and whether the participants think sunblock interferes with vitamin D formation*.

Age categories	Do you think sunblock interferes with vitamin D formation?		Total
	Yes	No	
16–20 years	62	50	112
21–25 years	55	98	153
More than 25	1	6	7
Total	118	154	272

*There was a strong significant association between the age and whether the participants think sunblock interferes with vitamin D formation, p value = 0.002.

Table 5. Association between the academic grade and whether the participants think sunblock interferes with vitamin D formation*.

Academic categories	Do you think sunblock interferes with vitamin D formation?		Total
	Yes	No	
Second Year	50	34	84
Third Year	19	30	49
Fourth year	18	33	51
Fifth year	12	27	39
Sixth year	19	30	49
Total	118	154	272

*There was a strong significant association between the academic grade and whether the participants think sunblock interferes with vitamin D formation, p value = 0.009.

Table 6. Association between the age and exposure to the sun without sunblock on a daily basis*.

Age categories	Exposure to the sun without sunblock everyday		Total
	Yes	No	
16–20 years	45	34	111
21–25 years	39	38	151
More than 25 years	1	1	7
Total	85	73	269

*There was a significant association between the age categories and exposure to the sun without sunblock on a daily basis, p value =0.007.

study, in which 76% of participants indicated that vitamin D can cause diseases other than that of the bone. This result was unexpected as studies that demonstrated this fact are fairly recent and it wouldn't be expected for undergraduates to be familiar with them [5]. However, when further details were investigated regarding the nature of these diseases (Table 2), few respondents agreed that deficiency is related to other chronic diseases (e.g., multiple sclerosis, coronary artery disease and hypertension). An overwhelming majority (94.2%) confirmed that vitamin D deficiency can cause rickets and osteomalacia, which is expected considering the fact that it's included in the literature. It was also asked whether Parkinson's disease was related or not, but this was only added to eliminate bias and 3.5% of candidates stated that it is related to deficiency.

The main source of vitamin D is the sun [5], however, certain food items are rich in the vitamin and these include fatty fish like tuna, beef liver, dairy products and egg yolk [14]. The students were asked to identify the sources of food rich in vitamin D, in which green vegetables, white beans and egg white were added to eliminate bias. As showed in Table 3, the response to this was not good, as less than half of the participants identified the right items as being rich in vitamin D, with the exception of dairy products, in which 64.1% agreed for it to be a source. Regarding the consumption of the items, as displayed in Table 3, similar results were seen, in which 68.6% consumed dairy products on a daily basis.

As stated above, sun exposure is the most efficient way to obtain the daily needs of vitamin D [5] and the exposure among these medical students

declared to be sufficient as 87.6% stated that they get exposed continuously for more than 10 minutes every day (Figure 1). The current advice is continuous exposure for 10–15 minutes before applying sunblock. Considering the cultural dress code in Sudan, which allows for the exposure of the face and hands only, this exposure is likely to be insufficient. For a white woman, 12 minutes of summer mid-day sun with bare arms and legs would produce approximately 3,000 IU of vitamin D. In contrast, a similarly dressed woman with black skin would need 2 hours of sun exposure to produce the same [5]. The Sudanese population is dark-skinned, including mid to dark brown complexion.

Sunblock usage is stated to decrease the absorption of vitamin D, as it blocks UV-B rays which when absorbed are converted to vitamin D [5]. The majority of the participants claimed not to use sunblock (64.5%). In countries where campaigns were initiated to prevent skin cancer by promoting the usage of sunblock with high Sun Protection Factor, it would be expected for the usage to be higher [5]. In Sudan, such campaigns don't exist, which might explain the low consumption of such products. A lower usage might also be explained by financial limitations, considering the fact that sunblock products can be quite expensive.

Forty three % confirmed to knowing that sunblock does interfere with vitamin D formation in the skin, and 82.2% claimed to expose themselves without sunblock every day. Again considering the high education these girls are receiving, these results are not surprising. The reasons to why sunblock is used were also exposed, in which 47.9% reported to use it to protect from skin darkening,

26.8% to protect from skin cancer and 25.4% from wrinkles or other skin conditions. Similarly, veiling is considered to be a risk factor for vitamin D deficiency [15] and studies conducted on veiled girls showed low levels [16]. Only 8% of students in the present study were veiled.

Vitamin D supplementation is crucial in optimizing the levels of the vitamin in the management of deficiency [6] and it also serves in its prevention with regard to the general population [17]. The usage of both ordinary and vitamin D supplements were assessed, in which 17% reported to use ordinary vitamin supplements and only 6.1% consumed vitamin D supplements. However, despite the low usage of vitamin D dietary supplements, 61.9% declared that they're important. This low usage and moderate awareness might be accounted for by the lack of awareness of the current vitamin D deficiency epidemic. Reasons for using ordinary vitamin supplements were explored, in which 91.5% of those who consumed used them for cosmetic purposes and to supply any missing vitamins in their diets.

An association was found between the age and academic level of the students, respectively, and whether they think sunblock interferes with vitamin D formation in the skin (p value = 0.002, p value = 0.009 for age and academic level, respectively). This might be owed to the fact that as age and the grade increase, the medical knowledge also rises, making the students more aware of vitamin D and its metabolism.

An association was also found between the age and the daily exposure without sunblock and it was noticed to decrease as age increased (p value = 0.007). This might be explained by the fact that as age increases, the students become more aware of the harmful effects of the sun, owing again to the increase in medical and scientific knowledge, so sun protection is sought by the use of sunblock.

In addition, an association was also found between the knowledge of whether vitamin D is essential or not and the importance of vitamin D supplements (p value = 0.014). For a medical student, it's very likely that she'll be aware of the essentiality of vitamin D in the daily diet and she would also know that deficiency would require

vitamin D fortification. This is probably why a high proportion displayed the knowledge of such information.

CONCLUSIONS

The majority of participants were aware of the importance of vitamin D. The awareness regarding linking of vitamin D deficiency to other chronic diseases, apart from rickets and osteomalacia, was poor. Knowledge of the food sources of vitamin D was not good and so was the consumption. However, most of the students declared vitamin D supplementation is important. The sun exposure habits were good, in which the majority didn't use sunblock and most of the participants got exposed for more than 10 minutes/day. The exposure might seem enough but considering the dress code and dark skin, this might be insufficient. Further research studies are needed to determine the prevalence of vitamin D deficiency and to assess the awareness among other sectors of the community.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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ETHICAL APPROVAL

The study was approved and received ethical clearance from the Faculty of Medicine,

University of Khartoum and Ahfad University for Women. Written informed consent was obtained from the participants.

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