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HYPOVITAMINOSIS D IN FEMALE MEDICAL AND PARA-MEDICAL STUDENTS AT KING ABDULAZIZ UNIVERSITY IN JEDDAH, SAUDI ARABIA

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ABSTRACT

Vitamin D deficiency is a prevalent health problem worldwide. Several factors determine vitamin D status including ethnicity, nutrition, and extent of adiposity. Well-educated medical students are expected to have higher levels of vitamin D than that reported in the general population. The aim of this study was to determine vitamin D status in female medical and paramedical students studying at King Abdulaziz University, Jeddah, Saudi Arabia. A total of 118 female medical and para-medical students were randomly recruited from the college of Medicine and Applied Medical Sciences in a cross-sectional study design. Anthropometric measurements were taken for all participants and a self-administered questionnaire was completed by each student. Fasting blood samples were obtained for serum 25-hydroxyvitamin D and parathyroid hormone measurements. Almost 50% of the study group were either overweight or obese. Vitamin D deficiency was highly prevalent among the study group with 99.2% of students having levels less than <50nmol/L, and 72% with levels less than 25 nmol/L. The combination of limited outdoor activity, excessive heat, conservative clothing, and dark skin may contribute for the reduced cutaneous synthesis of vitamin D. Future studies measuring the vitamin D binding protein and free 25-hydroxyvitamin are required to ascertain that this high prevalence is genuine and not inflated.

INTRODUCTION

Vitamin D plays an important role in calcium homeostasis. Its main function is to enhance intestinal absorption of calcium and phosphorus that are needed for the mineralization of new bone matrix (osteoid). Exposure to sunlight (UVB rays between 290-310 nm) is the main source of vitamin D (providing more than 80%) since few food products are naturally rich in vitamin D, mainly fatty fish. Food fortified with vitamin D and vitamin D supplements, that are available over the counter, are other sources of vitamin D. Vitamin D status is best assessed by the measurement of the serum 25-hydroxyvitamin D [25(OH)D] concentration (Zitterman, 2003). Vitamin D deficiency is a prevalent health problem worldwide(Mithal *et al*., 2009) with the highest prevalence of vitamin D deficiency being recorded in the Middle East (El-Hajj Fuleihan, 2009). Several factors determine vitamin D status including ethnicity, nutrition, and extent of adiposity (lips, 2010). Over the past few years, awareness about the non-skeletal health benefits of vitamin D and the high prevalence of its deficiency had increased among the medical communities. Many health practitioners now frequently request determination of vitamin D level. As a consequence, vitamin D supplements may also be currently prescribed more than any other time before (Al-Daghri *et al*., 2012). Poor intestinal calcium absorption due to vitamin D deficiency results in low extracellular ionized calcium, which leads to increased parathyroid hormone (PTH) secretion to correct the resultant hypocalcemia. This is achieved through the action of PTH on its target tissues. In the kidney, PTH stimulates tubular reabsorption of calcium and increases urinary phosphate excretion. It also stimulates 1-αhydroxylase enzyme to convert 25(OH) D into the active form, 1,25-dihydroxyvitamin D. This in return, will act on the intestine to

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increase calcium absorption. PTH also increases plasma ionized calcium by stimulating bone resorption. If persistent, secondary hyperparathyroidism, due to vitamin D deficiency, leads to reduced bone mineral density. In older people, it is a cause of osteoporosis with increased risk of fracture (Lips, 2001). Medical students, being well educated about the ill consequences of vitamin D deficiency, are expected to have higher levels of vitamin D than that reported in the general population. Therefore, the aim of this study was to determine vitamin D status in female medical and paramedical students studying at King Abdulaziz University (KAU), in Jeddah, Saudi Arabia.

MATERIALS AND METHODS

Study subjects

This was a cross-sectional study undertaken in the physiology laboratory during the years 2009 and 2010, in which a total of 118 female medical and para-medical students were randomly recruited from the college of Medicine and Applied Medical Sciences at King Abdulaziz University in Jeddah, Saudi Arabia. Informed consent was obtained from all subjects and the study was approved by the Ethics committee of KAU Hospital (KAUH). Exclusion criteria were inflammatory diseases, hepatic and renal diseases, impaired glucose tolerance and/or diabetes, and obesity secondary to genetic or metabolic disorders. Students taking medications that affect vitamin D metabolism (e.g. phenytoin), were also excluded.

Data collection

A self-administered questionnaire was completed by each student inquiring about age, demographic data, past medical history, menstrual history, and family history of chronic diseases, and medications use.

Anthropometric analysis

Weight was measured to the nearest half kilogram (kg) using an electrical scale while subjects were wearing light clothes and shoeless. Using a stadiometer, height was measured to the nearest half centimeter (cm). Body mass index (BMI) was then calculated using the formula weight (kg)/height (m^2).

Collection and storage of blood samples

Blood samples were obtained from the antecubital vein of subjects after a 12hour fast using a disposable siliconzed syringes and needles into trace element-free Vacutainer™ tubes (Beckton Dickinson, Rutherford). They were centrifuged at 3000g for 10 minutes. The plasma obtained was separated and frozen at -80^{o}C until the time of analysis.

Laboratory methods

Serum 25(OH)D and PTH were measured in “The Center of Excellence for Osteoporosis Research” (CEOR) with the DiaSorin Liaison chemiluminescent immunoassay system (DiaSorin Inc., Stillwater, MN, USA). The intra- and inter-assay coefficients of variation (CV) were 7.8 and 3.8 % for serum 25(OH)D and 5.1 and 4.3 % for serum-intact PTH, respectively.

Statistical Analysis

Data were examined for normal distribution by Kolmogorov-Smirnov statistic. Data are presented as means ± standard deviations (SD) for normally distributed variables and as median (inter-quartile ranges) for non-normally distributed variables. Categorical variables were expressed as frequency (percentage). Spearman’s and partial correlations (adjusting for age and BMI) were done to examine the association between 25(OH)D and PTH. Data results were analyzed using SPSS statistical package version 16.0 (SPSS, Chicago, IL, USA).

RESULTS

The study group consisted of 118 students. Mean age ±SD was 20.3±1.6 years, (age range 18-27 years) and mean BMI ± SD was 25.8 ± 6.6 kg/m^2.Almost 50% of the study group were either overweight (28%) or obese (17.8%).Biochemical characteristics of the study group are presented in Table 1. Vitamin D deficiency was highly prevalent among the study group with 99.2% of students having levels less than 50nmol/L, and 72% with levels less than 25 nmol/L. Almost 19% of the study group had severe deficiency with levels <12.5 nmol/L (Figure 1). Despite the high frequency of vitamin D deficiency, only 36% of the study subjects had PTH levels above the normal limit of 6.89 pmol/L (range 2.0-17.9 pmol/L). There was a significant negative correlation between 25(OH)D and PTH (r=-0.206, P=0.038) which was attenuated after controlling for age and BMI (r=-0.197, P=0.05).

Table 1. Biochemical characteristics of the study group (n=118)

Variables	Mean ± SD	Median (IQR)
25(OH)D (nmol/L)	21.1 ± 10.1	17.90 (14.0-25.77)
PTH (pmol/L)	6.5 ± 2.7	5.80 (4.50-8.03)

25(OH)D; 25-hydroxyvitamin D, PTH; parathyroid hormone, SD; standard deviation, IQR; interquartile range.

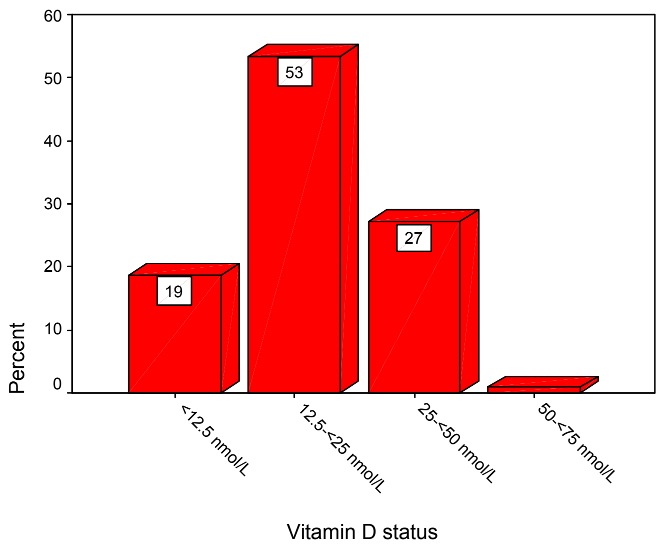

Figure 1. Vitamin D status among the study group (n=118)

DISCUSSION

Despite the fact that the recruited subjects were medical and paramedical students who are expected to be well educated about the high prevalence of vitamin D deficiency in the Saudi population and its morbid consequences, vitamin D deficiency was highly prevalent among this study group. One of the earliest studies that determined vitamin D status in Saudi non-medical students was conducted in Riyadh city by Sedrani *et al*, (1983), the reported mean 25(OH) D was slightly higher (28.75 ±10nmol/L) than the one found in our study (21.75 ±10.1 nmol/L). The sample size was smaller (33) and they measured 25(OH)D using high performance liquid chromatography (HPLC), which may explain the discrepancy. A recent study conducted in the Eastern province of Saudi Arabia on 103 female medical students reported a prevalence of 99%, which is similar to the prevalence of vitamin D deficiency among our study group (Al-Elq, 2012). The major source of vitamin D is through cutaneous synthesis after exposure to sunlight. Risk factors for vitamin D deficiency among young women in Jeddah, include lack of adequate exposure to sunshine. Outdoor activity is not popular in the Saudi community, probably due to excessive heat and the unavailability of many recreational outdoor facilities.

Veiling had been assumed to be playing a role in women of the Muslim world (Hatun *et al*., 2005), but this does not explain the high frequency of vitamin D deficiency in Saudi male subjects (Ardawi *et al*., 2012) and that observed in this study group. This is because the faculty of Medicine campus at KAU, where the students spend most of the day (8:00 am-5:00 pm), 5 days a week from September-June, is a female only campus and the students move around without wearing a veil. However, even if unveiled, conservative clothing is a cultural behavior among Saudi women in public. Despite the fact that these students spend most of the day indoors in their classrooms or laboratories, they have a break at noontime for one hour where they can go out and seek the sun. However, avoidance of the sun due to the high temperatures and possibly fear of getting darker, as was reported in a qualitative study on Saudi students (Christie and Mason, 2011), could explain these lower levels. For those who go out in the sun during the break time, these low levels may be related to skin color. It is well known that dark-skinned people require higher dose of ultraviolet radiation exposure to reach their maximum cutaneous vitamin D production (Clemens *et al*., 1982). However, other genetic influences besides phenotypic skin pigmentation cannot be ruled out.

Lack of fortified food is probably another major issue when it comes to a population with limited sun exposure. Considering that vitamin D enrichment of dairy products is routinely done in Western countries, perhaps it is time to adopt this simple yet beneficial means of supplementation in Saudi Arabia. On the other hand, this high prevalence of vitamin D deficiency could be overestimated. The fact that 64% of the study subjects had normal PTH despite the low levels of 25(OH)D may suggest that the definition of vitamin D deficiency may need revisiting. In a recent study, Powe *et al*. (2013) reported a racial difference in total 25(OH)D and vitamin D binding (VDB) protein among two ethnic groups. Both 25(OH)D and VDB protein were lower in Black Americans as compared to White Americans, but similar concentrations of bioavailable 25(OH)D were found among the two groups. These differences were secondary to higher prevalence of common genetic variant in VDB protein. Their data suggest that low vitamin D status does not necessarily mean vitamin D deficiency and could possibly be due to lower levels of VDB protein. Future studies assessing the vitamin D status in any studied group should include VDB protein and free 25(OH) D assessment. Given the nature of the current study design, a few limitations must be acknowledged. Self-administered questionnaires are inherently subjected to recall bias. Other important data, such as the dietary intake of vitamin D or vitamin D supplements, calcium intake, exact duration of sunlight exposure and the amount of skin area exposed, were also not obtained. In conclusion, vitamin D deficiency was prevalent among young otherwise apparently healthy female medical students. The combination of limited outdoor activity, excessive heat, conservative clothing, and dark skin are probably contributing factors for the reduced cutaneous synthesis of vitamin D. Therefore, it can be assumed that hypovitaminosis D may be widespread among young youth in our community and its possible roles in predisposing to certain chronic conditions warrants further investigation. Future studies should determine VDB protein and free 25(OH)D to rule out the possibility that the prevalence of vitamin D deficiency may be overestimated.

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