

## The prevalence of vitamin D deficiency among female college students at Qatar University

Elham A. Sharif, PhD, Nasser M. Rizk, PhD.

Nowadays vitamin D deficiency is considered a common problem among many Arab countries including Lebanon, Qatar, the Kingdom of Saudi Arabia, United Arab Emirates, and other European countries as documented by many studies.<sup>1-4</sup> Vitamin D is a fat-soluble steroid hormone that is crucial for many tissues and organs in the body for instance, skin, heart, kidney, and muscles. Vitamin D deficiency has been shown to play a role in almost every major disease, including: osteoporosis, rickets, and osteopenia, several types of cancer (including breast, prostate, and colon), heart disease, obesity, diabetes, autoimmune diseases, multiple sclerosis, rheumatoid arthritis, hypertension, infertility and postmenopausal syndrome (PMS), Parkinson's, depression, Alzheimer's, and chronic fatigue syndrome.<sup>5</sup> Factors that contribute to the deficiency of vitamin D are: limited exposure to sunlight, low dietary intake of foods that contain vitamin D, overdressed, high altitude and cold countries, and skin color.<sup>5</sup> In the last few years, vitamin D deficiency has become a common problem among Qatari generations and Qatari residents. Additionally, there is raising awareness that vitamin D adequacy is essential for optimal health.

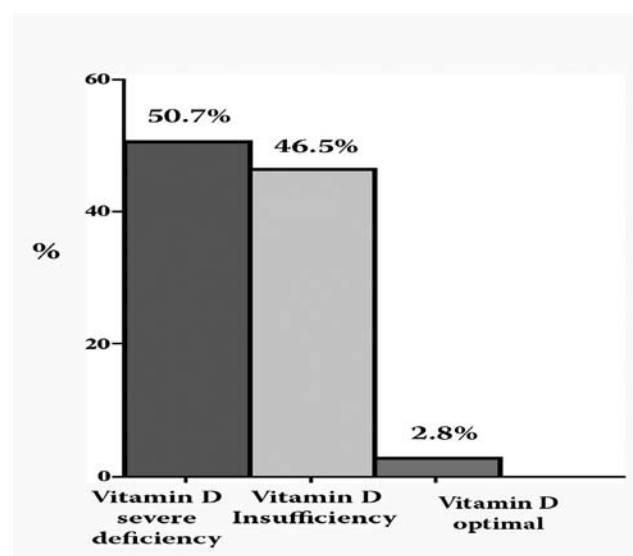
This study is the first to investigate the prevalence of vitamin D among female college students in the state of Qatar. Bener et al<sup>2</sup> reported that the prevalence of vitamin D deficiency among Qatari children aged between 11 and 16 years was 68.8%, more among girls (51.4%) than boys (48.6%).<sup>2</sup> Another study<sup>3</sup> was conducted at the Rheumatology Clinic Practice at Hamad Medical Corporation on 204 health professional females, mean aged 35.9 years. This study showed that 26% of females had vitamin D level below the detection limit (<3 ng/ml), 38% had severe deficiency (vitamin D <10 ng/ml), 25.1% had mild deficiency in vitamin D (<20 ng/ml) and 8.9% had a level below 30 ng/ml, and only 2% had an optimal level of vitamin D (>30 ng/ml).<sup>3</sup>

To date there is no documented study to assess the vitamin D level among female college students. Therefore, the objective of this study was to define

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the prevalence of vitamin D insufficiency/deficiency in female college students at Qatar University. The secondary objective was to assess the associations of biochemical, anthropometric, skin color and exposure to sun with the concentration of vitamin D. A cross sectional study was conducted between October and December 2010 on female students at Qatar University, aged between 19-27 years old, in good general health, and selected based on randomized sampling. Subjects were originally from Qatar, Bahrain, Oman, Yemen, Syria, Palestine, Jordan, Egypt, Iran, Pakistan, Sudan, and Eritrea. Most of the study subjects had covered heads and wore clothes with long sleeves. Those who were taking vitamin D, or calcium supplementation, pregnant females, and who had conditions like anemia and kidney disease were excluded from the study. Anthropometric measurements were made and the mean ( $\pm$  SD) body mass index (BMI) was  $23.24 \pm 4.33$  kg/m<sup>2</sup>, and waist circumference  $72.79 \pm 9.65$  cm. The project was approved by the Institutional Review Board of Qatar University and granted a Research Ethics Review Exemption Approval number (QU-IRB 42-E/10), and all volunteer subjects gave written informed consent. The designed questionnaire included information dealing with the skin color, dietary intake, sun exposure time, and site of body exposed. Analysis of vitamin D, parathyroid hormone, serum alkaline phosphatase, corrected calcium, creatinine, and albumin concentrations were carried out at Hamad Medical Corporation, Doha, Qatar.

Data were expressed as mean and standard error for continuous data, and percentages for categorical data. Data was explored for outliers, skewness, and



**Figure 1** - Vitamin D status among female college students at Qatar University, representing the portions of each group in percentage (%) to all studied subjects.

normality. The level  $p$ -value  $<0.05$  was considered as the cut-off value for significance. All statistical analysis was performed using the Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) program for Windows Version 19.

The results indicate a remarkably high prevalence of vitamin D deficiency and insufficiency (97.2%) among healthy college female subjects; (50.7%) showed severe vitamin D deficiency (25(OH)D  $<10$  ng/ml); and (46.5%) showed vitamin D insufficiency (25(OH)D (10-30) ng/ml), only 2.8% were found to have an optimal level of vitamin D (25(OH)D  $>30$  ng/ml) (Figure 1).

The anthropometric and demographic characteristics of the overall 71 female students were categorized by vitamin D status (deficiency, insufficiency, and optimum levels). Chi-square test revealed no significant association between vitamin D categories and nationality categories ( $p=0.76$ ). Also, no significant association between vitamin D categories and exposure to sun categories was observed ( $p=0.83$ ). The biochemical parameters were also categorized based on vitamin D status among the different groups. There were no significant difference between all groups and between individual groups with respect to parathyroid hormone (PTH), creatinine, albumin, calcium, and alkaline phosphatase.

Multiple regression analysis models with vitamin D as the dependent factor and the BMI, waist circumference, PTH, serum calcium, albumin, skin color and exposure to sun as independent variables were investigated. Only skin color ( $p=0.032$ ) and serum calcium ( $p=0.021$ ) were significant determinants for vitamin D level ( $R^2=0.370$ ). The values of skin color and serum calcium explain 37% of the variation in the response variable [vitamin D]. Other independent factors (BMI, waist circumference, exposed to sun time, PTH, and albumin) remained insignificant predictors of vitamin D level in this study.

No significant correlations between vitamin D deficiency and obesity indicators (waist circumference and BMI) were observed. These findings conflict with previous studies<sup>5</sup> that showed an inverse relationship between obesity indicators; BMI and waist circumference, and vitamin D deficiency. This was explained due to the fact that vitamin D is a fat-soluble hormone and normally stored in fat tissue, and because the obese subjects had more surface area, vitamin D would penetrate more in the larger body mass of the fat tissue of the obese subjects. In our study however, we show the opposite, as the average body mass index was  $23.24 \pm 4.33$ . The discrepancy between our findings and the other studies is due to the fact that most of our study subjects were lean, presented with normal BMI, and waist circumference. The other limiting factor could be attributed to the small sample size of study subjects.

In addition, our results show that 100% of the study subjects suffered from mild hypocalcemia. Vitamin D regulates calcium homeostasis; it is well known that vitamin D deficiency decreases the intestinal calcium absorption, resulting in hypocalcemia and a secondary increase in PTH level.<sup>5</sup> Although our findings showed that 100% of the studied subjects were suffering from hypocalcemia, no compensatory rise in PTH secretion (secondary hyperparathyroidism) was observed except for one case in this study that was severely vitamin D deficient and hypocalcemic.

In our study we observed a significant relation between vitamin D deficiency, skin color and hypocalcemia as the 2 significant predictors of vitamin D level. Many studies showed that skin color is a powerful predictor of serum vitamin D.<sup>5</sup> Melanin as a natural sunscreen that competes for absorption of ultraviolet B photon, and accordingly leads to a decrease in efficiency of pre-vitamin D photosynthesis and can be considered a risk factor for vitamin D deficiency. There were some limitations to the study, one limitation is the small sample size, and also the subjective nature of the questionnaire did not provide comprehensive investigation form. Further investigations should be carried out on larger scale of Qatari population in the future.

In summary, we have demonstrated a high prevalence of vitamin D insufficiency/deficiency among female college students. This was accompanied with low level of calcium and a normal PTH level. Skin color and calcium seems to be significant predictors of vitamin D level.

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From the Clinical Chemistry Laboratory, Biomedical Sciences Program, Department of Health Sciences, Qatar University, Doha, Qatar. Address correspondence and reprints request to: Dr. Elham Sharif, Clinical Chemistry Laboratory, Biomedical Sciences Program, Department of Health Sciences, Qatar University, PO Box 12223, Doha, Qatar. Tel. +974 55556328. E-mail: e.sharif@qu.edu.qa

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