Original Article

Vitamin D deficiency in the population of Karachi, Pakistan; A cross-sectional study.

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Abstract

Background: Vitamin D deficiency affects over one billion people globally, which results in the progression of severe health consequences and chronic diseases. Literature indicates high rates of vitamin D deficiency in the Pakistani population. Thereby, this current study was aimed to determine the status of vitamin D deficiency in the population of Karachi.

Methodology: This descriptive cross-sectional study was conducted during January to December 2017 at the Dadabhoy Institute of Higher Education (DIHE). A total of 1159 healthy individuals aged between 18-72 years were selected for the study. Data was collected through a questionnaire seeking the demographics of the participants. For the quantitative colorimetric immune-enzymatic determination of 25(OH) vitamin D concentrations in the human plasma level, venous blood was collected and was analyzed using a vitamin D Enzyme-Linked Immunosorbent Assay (ELISA) kit. Statistical analysis was carried out using SPSS version 20.0.

Results: A total of 1159 participants were included in the study with the mean age of 40.1±15.2 years. It was observed that 59.1% of participants had deficient vitamin D levels, while 22.6% of participants had sufficient vitamin D levels. There was a significant association between gender and vitamin D status ($p < 0.05$), as the majority of females (68.5%) were vitamin D deficient as compared to males (31.5%). In contrast, no significant association was found between age and vitamin D levels, with the most deficient age group being 18 to 28 years.

Conclusion: It is concluded from the study results that vitamin D deficiency was prevalent in the studied population, despite increased exposure to sunlight. The initial screening for early detection and correction of the condition must be considered as an essential component of the national health strategy, as there is a need to detect and combat the burden of vitamin D deficiency in the country.

Keywords

Vitamin D Status, Hypovitaminosis D, Determinants, Pakistani Population.

Introduction

Subcutaneous synthesis of vitamin D majorly depends upon a variety of factors, including latitude, time and duration of sunlight exposure, in addition to skin pigmentation, pollution, religious taboos, clothing and genetic factors¹. Vitamin D deficiency is a global health care problem affecting around one million individuals². Estimation of Serum 25-hydroxyvitamin D (25OHD) is the most sensitive method for measuring vitamin D status. Recent studies suggested that the volumes of vitamin D required for optimal health are probably much higher than previously reported³. Over the past years, the importance of 25OHD is well-identified, in sustaining the health, wellbeing, and functions of the skeletal, muscular, reproductive, immune, and integumentary systems of individuals of all age groups and races⁴.

Vitamin D deficiency increases the risk of chronic diseases; it is evident that young people with low vitamin D levels are at increased risk of developing musculoskeletal and other chronic disorders^{5,6}. Moreover, it is also involved in adipogenesis and weight gain leading to obesity⁷ and also causes hypercalcemia⁸ and result in other related health consequences. Nonetheless, it is important to identify Vitamin D deficiency to control the incidence of osteoporosis⁹. Presently, there is no agreement on the optimum levels of serum 25OHD worldwide; nevertheless, vitamin D deficiency is defined by most experts as 25OHD levels of less than 50 nmol/L¹⁰⁻¹³. Most of the people with vitamin D insufficiency and/or deficiency are asymptomatic; thereby, it becomes hard to be detected. Most scientists take serum 25(OH) D levels less than 20 ng/ml as vitamin D deficiency cut-off levels¹⁰.

Generally, there are three foremost causes of Vitamin D deficiency, including lack of exposure to sunlight, dietary insufficiency as well as problems with vitamin D absorption¹⁴. Moreover, associated factors might include race (non-white), age (80 years), use of medications that affect vitamin D metabolism, body mass index (BMI greater than 30 kg/m²), physical inactivity, and education level¹⁵. It is recommended that the serum 25(OH) D levels >

30 ng/mL are necessary to increase the intestinal calcium absorption and reduce the secondary skeletal conditions induced by hyperparathyroidism^{8,16,17}.

According to the International Osteoporosis Foundation (IOF), the Asian population has a high prevalence of vitamin D deficiency as compared to the European population. Pakistan is one of the most sunlit countries of the world, and its citizens are thought to have plenty of sunlight exposure, enough to sustain sufficient vitamin D status¹⁸. On the contrary, a vast number of vitamin D deficiency cases are reported in Pakistan, where malnutrition and poverty continue to prevail and exacerbate the magnitude of such deficiencies¹. It appears to be one of the most under-diagnosed and under-treated insufficiencies concerning the dietary habits of individuals^{19,20}. Thus, this study aimed to determine the prevalence of vitamin D deficiency in the population of Karachi, Pakistan and its association with age and gender.

Methodology

This descriptive cross-sectional study was conducted from January to December 2017 at the Dadabhoy Institute of Higher Education (DIHE) in Karachi. A questionnaire seeking demographics and other details of the participants was used for data collection. A total of 1500 healthy individuals aged between 18-72 years were approached and screened for eligibility, out of which 1159 were selected for the study. All the healthy individuals with no signs or symptoms of any chronic disease and from various socio-economic statuses were included. Whereas, individuals aged below 18 years or those consuming any kind of supplements and non-consenting participants were excluded from the study. The participants were enrolled only after obtaining written informed consent.

Blood sampling and laboratory analysis

Venous blood samples were collected through venipuncture using 10 ml syringes, transferred into 10 ml EDTA tubes, left for clotting for about 5–10 minutes, and then centrifuged at 5000 rpm for 5 minutes. The serum was collected in a separate tube and stored at –70°C until analysis. Vitamin D

levels were evaluated using ELISA. The samples were numbered with reference identity.

Measurement of vitamin D levels

Quantitative colorimetric immune-enzymatic determination of 25(OH) vitamin D concentrations in human plasma level were measured by an automated EIA analyzer CODA, Bio-Rad Laboratories, Hercules, CA, USA using DIA source 25-OH Vitamin D total ELISA Kit, with Inter-assay CV at 26.3 ng/ml is 4.9% and at 42.0 ng/ml is 4.5%. The kit was a solid competitive phase enzyme-linked immunosorbent assay (ELISA). Samples were analyzed according to the manufacturer guidelines.

The records were maintained, and collected data was analysed using SPSS version 20.0. Descriptive

statistics for the socio-demographic characteristics and vitamin D deficiency was calculated, and all the qualitative variables were displayed as frequency and percentages. However, the association of vitamin D deficiency with age and gender was estimated using the Chi-square test, where p-value < 0.05 was considered statistically significant.

Result

A total of 1159 participants were included in the study, with the mean age of 40.1 ± 15.2 years. It was observed that 30.4% of participants had a joint family system, whereas 69.5% had nuclear families. According to socio-economic statuses, the participants were subdivided into three classes, and most of them (70%) were from the middle class.

Table 1: Demographic profile of the participants

Variables		n=1159
Age (years)		40.1±15.2
Age Groups	18-28	313(27)
	29-39	277(23.9)
	40-50	284(24.5)
	51- 61	154(13.3)
	62- 72	131(11.3)
Gender	Male	373(32.2)
	Female	786(67.8)
Ethnicity	Urdu Speaking	1097(94.7)
	Other	62(5.3)
Family structure	Joint family	352(30.4)
	Nuclear family	972(69.5)
Education	Matric	81(6.95)
	Inter	222(19.13)
	Graduation	312(26.95)
	Post-Graduation	544(46.95)
Socio-economic Status	Lower Class	116(10.0)
	Middle Class	812(70.0)
	Upper class	231(19.9)

*Values are given as mean $\pm$ SD or n(%)

It was observed that most of the studied population had vitamin D deficiency (59.1%), while 22.6% had sufficient vitamin D levels, and 18.3% had insufficient levels of vitamin D.

Table 2: Vitamin D level among the study participants

Vitamin D Level		n(%)
Sufficient	> 30 ng/ml	262(22.6)
Insufficient	20-30 ng/ml	212(18.3)
Deficient	< 20 ng/ml	685(59.1)

Of the factors associated with vitamin D level, we studied age and gender effects. No significant association between age and the vitamin D levels was observed ($p = 0.06$). The result showed that a greater number of female participants were vitamin D deficient as compared to males, i.e. 68.5% vs. 31.5%, respectively, with a strong association between the two variables ($p = 0.005$).

Table 4: Distribution of Vitamin D level based on age and gender

Variables		Vitamin D levels			p-value
		Sufficient	Insufficient	Deficient	
Age Group (Years)	18-28	24	24.1	29.1	0.06
	29-39	23.3	24.5	23.9	
	40-50	24.8	21.7	25.3	
	51-61	16	15.6	11.5	
	62-72	11.8	14.2	10.2	
Gender	Male	31.3	35.4	31.5	0.005*
	Female	68.7	64.6	68.5	

*Values are given as percentages (%)

*p-value < 0.05 is considered significant

Discussion

The prevalence of Vitamin D deficiency has risen globally, and the associated economic and health outcomes further elaborate on the need to address this significant public health issue⁵. Developing nations like Pakistan are more susceptible to the damaging effects of deficiency of Vitamin D for plenty of reasons including lack of education and awareness, poverty, and cultural and socio-economic behaviour of people. Pakistan is striving for developmental progress both in health and education sector; hence, serious global, as well as local efforts, are required to overcome this public health issue of tremendous significance⁸.

In the current study, it was observed that the majority of the participants had deficient vitamin D levels (59.1%). These results were in agreement with a number of the previous studies¹⁹. A local study conducted by Akhtar concluded that a high proportion of the Pakistani population was

impacted with vitamin D deficiency, including infants, neonates, adolescents and both adult males and females¹. Another study was conducted on a total of 4830 randomly recruited citizens, and it was observed that there was a high prevalence of vitamin D deficiency among people of all areas, various socio-economic statuses, gender and age groups, with 31.2% reported having insufficient Vitamin D levels and 53.5% participants had Vitamin D deficiency⁹.

Based on the gender-wise distribution, the vitamin D deficient levels were more common among females (68.5%) as compared to males (31.5%), and the relationship was significant ($p = 0.005$). These results were in parallel with the previous research of Roomi et al., it was concluded that mean vitamin D levels were significantly lower in females as compared to males²¹. One of the reasons for relatively lower levels of vitamin D among females might be the lesser exposure to sunlight. Moreover, the clothing also plays an important role

as the majority of females opt for a complete hijab, which further decreases the intensity of sunlight. Besides gender, vitamin D levels were deficient in all age groups, with no significant association between the two. These results were consistent with another study¹. In contrast, an inverse association between Vitamin D deficiencies and age is also observed⁶, i.e. older adults had higher levels of vitamin D as compared to young ones.

Stable Public health strategies are required to address these high levels of Vitamin D deficiencies in the local Pakistani population, emphasizing the impact of both sources i.e. sunlight and dietary supplementation. In addition, awareness campaigns related to the damaging effects of vitamin D deficiency will be helpful to combat this health issue. Concerted efforts of the health and academic sectors are required to enhance the monitoring and surveillance of vitamin D levels in order to devise therapies for deficiency of vitamin D in Pakistan.

Conclusion

In conclusion, vitamin D deficiency and insufficiency are highly prevalent in the population of Karachi, Pakistan. These deficiencies were prominent in all age groups, and both the genders. Thus, health awareness programs promoting lifestyle modifications for developing healthy nutritional habits are recommended. Furthermore, the inclusion of initial screening of vitamin D levels to the country's national health strategy will help prevent such deficiencies.

Conflicts of Interest

None.

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