

Original Article

Prevalence of Vitamin-D Deficiency in Urban Population: A Retrospective Analysis

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ABSTRACT

Introduction: To determine the levels of vitamin D deficiency in a selected population of Islamabad, Pakistan.

Place and Duration: The study conducted at the Islamabad Diagnostic Centre, Islamabad from October 2011 to December 2011.

Study Design: Retrospective study.

Methodology: A total of 500 subjects were enrolled during the study period. ELISA based methodology was used to perform vitamin D measurement in serum. Data regarding baseline characteristics and laboratory findings was collected retrospectively from patients record maintained in laboratory.

Results: Out of total 500 subjects tested for vitamin D, there were 71% females. The average age of respondents was 45.4 ± 15.9 years (age range 1.6 to 92 years). Vitamin D levels showed that 60% of the individuals were deficient while insufficiency was found in 27.6% individuals. The rest of the subjects (11%) were normal and few (1.4%) had toxic levels of vitamin D.

Conclusion: A significantly low serum vitamin D levels have been observed among both males and female population of Islamabad. The determination of Vitamin D level in our population will help clinicians and nutritionist to understand importance of Vitamin D diagnosis and its association with certain clinical conditions.

Key Words: Vitamin D, Vitamin D deficiency, Osteomalacia, Rickets, Sun Exposure, 25-hydroxyvitamin D

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Introduction

Vitamin D is a group of fat-soluble secosteroids. The vitamin D, first identified in 1921, has five forms, vitamin D₁, D₂, D₃, D₄, and D₅. The two forms that seem to matter to humans the most are vitamins D₂ (ergocalciferol) and D₃ (cholecalciferol). Both these types are collectively termed as calciferol.¹ Vitamin D for humans is obtained from sun exposure, food and supplements. It is biologically inert and has to undergo two hydroxylation reactions to become active in the body. The active form of vitamin D in the body is called Calcitriol (1, 25-Dihydroxycholecalciferol). Vitamin D performs the important function of intestinal absorption of calcium and phosphate. The most important effect of

vitamin D is to facilitate absorption of calcium from the small intestine.²

The D₂ is produced by invertebrates (animals without a spine, vertebral column), fungus and plants in response to sunlight (UV irradiation). Humans and other vertebrates do not produce vitamin D₂. It is a synthetic product which is predominantly absorbed by fortified foods. Vitamin D₃ is made in the skin when 7-dehydrocholesterol reacts with ultraviolet light at 270-300 nm wavelengths - peak vitamin D₃ production occurs between 295-297 nm. In the liver, the vitamin is hydroxylated to 25-hydroxyvitamin D (25(OH)-vitamin D), the major circulating metabolite of vitamin D. Although 1,25-(OH)-vitamin D portrays the biological

active form of vitamin D, which is synthesized in the kidney, it is widely accepted that the measurement of circulating 25(OH)-vitamin D provides better information with respect to patients vitamin D status and allows its use in the diagnosis of hypovitaminosis.³ It is estimated that most of the vitamin D which is measured in serum is of D₃ type whereas D₂ is less than 5% and only increased in individuals who are on vitamin D₂ supplements⁴. The amount of vitamin D recommended for all infants, children, and adolescents has recently increased – from 400 to 600 IU per day.

Vitamin D deficiency is now recognized as a pandemic. It can result from inadequate exposure to sunlight; malabsorption; accelerated catabolism from certain medications; and, in infants, the minimal amount of vitamin D found in breast milk. In children, vitamin D deficiency can result in rickets, which presents as bowing of the legs while in adults, it results in osteomalacia, which presents as a poorly mineralized skeletal matrix.⁵ In addition, reduced vitamin D levels have also been found associated with reduced bone mineral density.⁶ Several studies link low vitamin D levels with an increased risk of fractures in older adults, and they suggest that vitamin D supplementation may prevent such fractures—as long as it is taken in a high enough dose.⁷⁻⁹

The number of cases with deficiency of vitamin D in Pakistan is on the rise yet the issue has not been given due attention by the concerned government authorities nor by the population itself. Inadequate vitamin D is frequent and deficiencies can be found in all countries in all ethnic groups, and across all ages. The current study was designed to determine the prevalence of vitamin D deficiency in general population of Islamabad, Pakistan.

Materials and Methods

This was a retrospective study conducted from October 2011 to December 2011, at the Department of Pathology, Islamabad Diagnostic Centre, Islamabad. During the study period, 500 subjects were selected who presented for vitamin D investigation. The inclusion criteria included all subjects referred to the centre for vitamin D investigations during the study period. About 3 ml blood from all the study subjects was collected in gel tubes and serum was separated via centrifugation at 4,000 rpm for 5 minutes. The immunodiagnostic ELISA was used for quantitative determination of the 25(OH)-vitamin D in serum and plasma. The assay utilizes a competitive ELISA technique with a selected

monoclonal antibody recognizing 25(OH)-vitamin D.¹⁰ Ranges of Vitamin D by society of osteology, it is considered seriously deficient when its level is <12 ng/ml and it is insufficient when the level is between 12-29 ng/ml, while it was considered normal when the level is >30 ng/ml and toxic when its level is >100 ng/ml. Patients were placed in different categories depending on results i.e., Deficient, Insufficient, Normal and Toxic. All the results were analyzed using SPSS software. Descriptive statistics was applied to calculate frequency and percentages from categorical variables and mean and standard deviation were measured from continuous numerical variables.

Results

In this study a total of 500 subjects who had their vitamin D investigations during the study period were analyzed. The average age of study cases was 45.4 ± 15.9 years ranging from 1.6 to 92 years. Almost 80.0% of study population was above 30 years of age. Age stratification showed that 19 (3.8%) cases were in pediatric age, 29 (5.8%) were between 13 and 20 years. Moreover, 72 (14.4%) were found in their 3rd decade of life, 105 (21.0%) in 4th decade, 92 (18.4%) in 5th decade, 95 (19.0%) in 6th while 67 (13.4%) cases were in their 7th decade of life and 21 (4.2%) cases were above 71 years of age. In this study, majority of the patients were females 355 (71.0%) while remaining 145 (29.0%) were males. The female to male ratio was found to be 2.4: 1. Further details can be seen in table I.

Table I: Baseline characteristics of study population (n = 500)

Age categories (years)	Number	%age
Up to 12	19	3.8%
13-20	29	5.8%
21-30	72	14.4%
31-40	105	21.0%
41-50	92	18.4%
51-60	95	19.0%
61-70	67	13.4%
71-92	21	4.2%
Gender		
Male	145	29.0%
Female	355	71.0%

The study subjects were categorized in four classes as deficient, insufficient, normal and toxic depending on their vitamin D levels. Overall 300 (60.0%) patients were

vitamin D deficient, 138 (27.6%) were insufficient and 55 (11.0%) were found to have normal levels. Toxic vitamin D level was found in 7 (1.4%) study cases. No statistically significant difference was noted in the prevalence of vitamin D deficiency or insufficiency among male and female cases. The gender wise distribution of vitamin D classes is shown in table II. Comparable data on prevalence of vitamin D deficiency from different countries and regions is presented in table III.

Table II: Prevalence of Vitamin D deficiency in the study (n = 500)

	Male (n = 145)	Female (n = 355)	Total
Deficient*	85 (58.0%)	215 (60.5%)	300 (60.0%)
Insufficient	46 (31.7%)	92 (25.9%)	138 (27.6%)
Normal	14 (9.6%)	41 (11.5%)	55 (11.0%)
Toxic	0 (0.0%)	7 (2.0%)	7 (1.4%)

* p-value = 0.68

Table III: Prevalence of vitamin D deficiency in different countries of world

Country	City	Age Group	Ref	Prevalence of Hypovitaminosis D
Mongolia	Ulaanbaatar	Preschool Children	25	50%
Indonesia	Jakarta	Women 18-40 years	26	60%
Malaysia	Kuala-Lumpur	Postmenopausal women 50-65	27	71%
Turkey	Ankara	Neonates and mothers 18-38	28	46% 80%
Iran	Zanjan	Mothers and Neonates(summer)	29	46% 35%
Morocco	Rabat	Women 24-77	30	91%
Lebanon	Beirut	Children 10-16	31	55-74%
		Men and Women 30-50 years	32	30.7-61.8%
Jordan	Amman	Men and Women 18-45 years	33	62.3%
India	North India	Neonates	7	96%
		Healthy School girls		91%
		Healthy Hospital staff		78%
		Pregnant Women		84%
Pakistan	Karachi	Mothers and Infants	34	55% 45%
	Islamabad	Males	Current study	58%
		Females		60.5%
Bangladesh	Nandail	Adult Women 16-40 years	35	38-50%

Discussion

The serum vitamin D level reflects exogenous intake in diet as well as endogenous production from exposure to

sunlight. The current study was done to determine the levels of vitamin D in healthy population of Islamabad, Pakistan. We enrolled a total of 500 cases and majority were living in urban areas. An alarmingly very high prevalence of vitamin deficiency (60%) and insufficiency (27.6%) was found in this study. A previous local report on the prevalence of vitamin D levels showed deficiency in (41.1%) children.¹¹ Another study on healthy Pakistani population found a high prevalence (76%) of vitamin D deficiency.¹² Some previous studies conducted on general population show high level of deficiency of vitamin D. These reports on vitamin D levels are comparable to the current study findings.¹³⁻¹⁴

In South Asia the prevalence of vitamin D deficiency is quite high. A similar study from India reported 90% prevalence.¹⁵ In another study in North India, 96% of neonates, 91% of healthy school girls, 78% of healthy hospital staff and 84% of pregnant women were found to have vitamin D deficiency¹⁶. Studies carried across different countries in South and South East Asia showed a similar trend. In a study from Afghanistan, 73% of 107 preschool children randomly sampled in winter had low 25-hydroxyvitamin D levels.¹⁷ A trial in Bangladesh

noted that serum 25-hydroxyvitamin D levels were low in 78% of 36 university students and in 83% of 30 veiled women.¹⁸ It has been observed that South Asian region has UVB radiation levels that are sufficient for vitamin D synthesis for almost whole year, however, low serum

25-hydroxyvitamin D levels have been reported in more than 50% of the infants, children and women studied.^{17,18}

Many previous studies have found comparable data on gender distribution of vitamin D levels. In the current study males and females were equally affected by vitamin deficiency (58.0% and 60.5%) respectively. Comparatively a study from Lebanon found (56.0%) females to be deficient of vitamin D.¹⁹ A very recent study from Islamabad by Khan et al reported prevalence of vitamin D deficiency as high as 71% with more females being affected (56%).²⁰ However, there are contrary results as well, one study from Iran reported a high prevalence of severe and moderate vitamin D deficiency in men.²¹ As most of the reports on vitamin D deficiency have revealed female preponderance.

The current findings of high vitamin D deficiency and insufficiency shows a deteriorated health condition of general population in Northern Pakistan. This could be due to the indoor living conditions of the urban community and also the working hours and environment of people. Moreover, increased indoor activities like mobile games, internet and TV could also be a source of deranged vitamin D levels.

It is well known that vitamin D deficiency is a frequent presentation in developed countries and is not limited to the under developed regions of the world. In the United States, it is equally affecting the children and adults.²²

There is scientific evidence which confirms the association of vitamin D deficiency with high possibility of other morbidities such as osteoporosis, heart disease, diabetes, some cancers, and multiple sclerosis, as well as infectious diseases, such as tuberculosis and even the seasonal flu.²³ The results of vitamin D levels are also used as an aid for the assessment of bone metabolism. In cases where the level of vitamin D falls below 10 ng/ml, intravitreal or oral management is opted.²⁴

Pakistan is a developing country where health services and resources are limited. It is very difficult to address the health needs of every individual due to poor patient doctor and patient health facility ratio in Pakistan. The issue of vitamin D deficiency can be curtailed using preventive measures by education and awareness. There is a need to aware the population to get reasonable exposure from sun and also to adopt a life style which in turn could balance the natural life cycle. The infants born to vitamin D deficient mothers are at risk of severe morbidity, along with general vit D

deficient population they should be investigated in time and supplemented accordingly.

Conclusion

The current study revealed a high prevalence of vitamin D deficiency. We conclude that in our settings where females remain indoors and male working in the covered areas are more prone to develop vitamin D deficiency. The findings reported in the current study are important for programmatic implications from the public health point of view. These can be correlated with whole region due to similar skin complexion, dress code and body surface area exposure.

There is a need to advocate the general population regarding the importance of sunlight exposure, specially, when it comes to vitamin D levels. There should be campaigns for vitamin D deficiency supplementation.

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