Original Article

Low Levels of Vitamin D_3 in People of Karachi – Needs to be Readdressed

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ABSTRACT

Objective: The aim of this study is to see the frequency of vitamin D and its impact on the sample population.
Study Design: Descriptive / cross sectional study
Place and Duration of Study: This study was conducted at Trauma and General Hospital, Karachi from January 2014 to June 2015.
Materials and Methods: 205 patients were included in the study. Participants were assessed according to predesigned questionnaire. All patients were subjected to have complete blood count, serum calcium, phosphorous, albumin, alkaline phosphatase, SGPT, vitamin D and parathyroid hormone levels along with X-rays of hip joint and femur.
Results: Out of total 205 patients, 12.7% were males and 87.3% were females. Mean age was 41.32±15.225 years. 5.9% had normal levels of Vitamin D_3, while 60.5%, 27% and 6.5% showed mild, moderate and severe deficiency. Serum calcium and phosphorous were deficient in 20.4% and 31.9% respectively. Serum alkaline phosphatase and parathyroid hormone were normal in most of the participants. The deficiency of Vitamin D_3 was mostly due to reduced sun exposure and excessive clothing (86.8%) while 8.3% showed malabsorption. This deficiency caused bone pains, and muscle pains in 55.6%, and 17.6% respectively. But none of the patient had any fracture.
Conclusion: Levels of Vitamin D_3 are low in most of the people of Karachi but without any gross deformity. It is advisable to readdress the daily requirement of vitamin D bring the awareness among people regarding sun exposure and daily use of vitamin D supplements.
Key Words: vitamin D, Parathyroid hormone, vitamin D deficiency, Karachi

Citation of article: Jabeen R, Shafi S, Haroon H, Khan S, Faraz A, Mobin A. Low Levels of Vitamin D_3 In People of Karachi – Needs to be Readdressed. Med Forum 2016;27(10):26-29.

INTRODUCTION

Vitamin D (cholecalciferol) is normally synthesized in the skin under the influence of sunlight in a non-enzymatic manner. It is ingested by certain foods including fish and plant sources then hydroxylated in the liver to 25-hydroxyvitamin D (clacidiol) which is the major circulating form and best index of vitamin D sufficiency. There are several reasons for vitamin D deficiency including impaired availability that is deficient diet, malabsorption or decreased coetaneous synthesis. There may be impaired hydroxylation or catabolism of 25 hydroxyvitamin D and either impaired renal production or increased loss of vitamin D or vitamin D binding proteins. There may be hereditary end organ insensitivity to vitamin D, although rare.

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Received: July 24, 2016; Accepted: August 29, 2016

Vitamin D sufficiency is estimated by measuring 25 hydroxyvitamin D, although the optimal requirement is still controversial. Based on trials of vitamin D supplementation, most of the authors favor maintaining it between 30-40 ng/dl. (75-100 nmol/L).[1] Almost every author agrees that level lower than 20 ng/ml are suboptimal for skeletal health.[2] The upper limit of vitamin D is also inconclusive, and there is not enough data regarding safe upper limit of vitamin D.[3]Certain expert foundation recommended a minimum level of 30 ng/dl in older adults to minimize the risks of fall and fracture.[4,5]However there are some concerns at concentration above 50 ng/ml (125 nmol/l) as well. It has been seen that there is increased risk for fractures, and certain cancers including pancreatic or prostate in patients treated with higher dosage of vitamin D.[6]There are several criteria by which one can define the optimal requirement of vitamin D including low calcium, increased parathyroid hormone and increased chances of spontaneous fractures.

The aim of this study is to see the impact of vitamin D deficiency in people of Karachi. Majority of people of Pakistan are dark skinned or have multiple shades of brown. Despite the extensive sun exposure, people of Karachi are deficient in vitamin D_3. [7]Recently various studies were done in different parts of country and

almost all studies emphasized decreased vitamin D in different populations of country, but none of the study elaborated different complications associated with low vitamin D level. This study is done to see the impact of decreased vitamin D, and its associated complications especially spontaneous fracture and bone pains. It may also help in treating patients with much lesser dose of vitamin D.

MATERIALS AND METHODS

It was a cross sectional descriptive study, conducted in Trauma and General Hospital, Karachi. The study was approved by the administration of Trauma and General Hospital. Sample technique was non-probability and purposive sampling. Sample size was calculated by Open Epi to be 203, with 95% confidence interval and 5% margin of error.

205 patients were included in the study who presented in outpatient department of the Hospital, with general illness from January 2014 to June 2015. All adults above the age of 13 years either male or females were included in the study. Informed consent was taken from the patients or their attendants orally. The subjects were interviewed according to a pre-designed questionnaire.

The questionnaire contained questions regarding the general demographic features of the patients, e.g. age, gender, ethnic origin and income. History about the marital status, number of children and duration of breastfeeding were also asked. There were also questions regarding diet, vitamin D3 boosters, causes and effects of vitamin D, smoking and alcohol.

Investigations were done which included complete blood count, serum calcium, phosphorous, albumin, alkaline phosphatase, SGPT, vitamin D and parathyroid hormone levels. X-rays of hip joint and femur were also done to exclude any deformity due to the deficiency of this vitamin.

Data was analyzed using SPSS software (version 16.0).

RESULTS

Two hundred and five patients were included in the study. There were 87.3% females and 12.7% males Mean age was 41.32±15.225 years. Out of 205 patients 60.5 % had mild deficiency of vitamin D, i.e. level of vitamin D between 21-30 ng/dl, while severe deficiency i.e. level <10ng/dl was seen in 6.5% of the participants. (table 1).

Table No.1: Vitamin D_3 Levels

Vitamin D3 Levels	Percentage
Mild Deficiency	60.5%
Moderate Deficiency	27%
Severe Deficiency	6.5%
Normal	5.9%

In relation to vitamin D serum calcium, phosphorous, alkaline phosphatase and parathyroid hormone were checked. Among these patients only 20.4% had marginal deficiency of calcium, and phosphorous was deficient in 31.9%. (table. 2) Alkaline phosphatase and parathyroid hormone were normal in most of the patients. (table 3)

Table No.2: Levels of calcium, phosphorous, alkaline phosphatase and parathyroid hormone

Investigations	Low	Normal	High
Calcium	20.4%	77.4%	2.2%
Phosphorous	31.9%	57.1%	10.9%
Alkaline phosphatase	0%	92.19%	7.8%
Parathyroid Hormone	0%	94.1%%	5.9%

Vitamin D_3 deficiency may be due to chronic liver disease (CLD), chronic kidney disease (CKD), malabsorption, reduced sun exposure or excessive clothing which secondarily causes decreased exposure to the sun. The percentage of these variables is given in Table 3and their correlation with Vitamin D_3 is shown in Table 4.

Table No.3: Percentage of Causes of Deficiency of Vitamin D_3

Causes of Deficiency	Percentage in Sample Population
CKD	2%
CLD	2%
Malabsorption	8.3%
Reduced Sun exposure	86.8%
Excessive Clothing	86.8%

Table No.4: Correlation between Deficiency of Vitamin D_3 and its Effects

Effects of Deficiency	Percentage in Mild Deficiency	%age in Moderate Deficiency	Percentage in Severe Deficiency
Bone Pains	2.92%	14.63%	30.73%
Muscle Weakness	0.48%	5.85%	9.26%
Infections	1.46%	3.41%	8.78%
CVD	0.97%	2.43%	3.90%
GIT Disorders	2.43%	5.85%	12.19%
Lung Disorders	0.97%	2.43%	3.41%
Diabetes	0.48%	4.87%	8.29%
Hypertension	1.95%	8.29%	11.70%

DISCUSSION

The prevalence of vitamin D is increasing globally.[8,9] Although low levels of vitamin D is common in every part of the world but more significant in South Asia and Middle East.[10] The analysis done by NHANES in 1988-

2004, showing vitamin D level from 24-30 ng/dl, reducing to 19.9-24 ng/dl in analysis done between 2004-2006.[11] It is more common in people without sun exposure that is people living in cold climates or who follows strict religious constraints. There is a multivariate study done in USA showing much decreased level of vitamin D in non-white race, obese individuals, not college educated, decreased HDL, poor health and no daily consumption of milk.[12] Pakistan is an Asian country and majority of its people are dark skinned or have multiple shades of brown. Despite the extensive sun exposure, it is seen that deficiency of vitamin Dis commonly seen in the people of Karachi regardless of the healthy diet and nutritional supplements they take. There is a study conducted in Karachi showing 83.4% people to be deficient but still remained asymptomatic.[13] Vitamin D deficiency can occur without symptomatology, although if symptomatic then it's usually associated with severe deficiency.[14] In our study out of 194 patients 55.6% had bone pain while muscle weakness was present only in 17.6%. Among 194 patients included in the study, 60.5% had mild deficiency of vitamin D, but only 2.92% of these patients had bone pain. While in patients with severe deficiency, it was present in 30.73%. The same pattern is seen in a study conducted in Faisalabad, Pakistan, which has further proving the insignificant relationship between vitamin D deficiency and bone pains.[15]The same pattern was seen in another complication like muscle weakness, which was present in only 9.26% of severely deficient patients, hence the concept that musculoskeletal symptoms are associated with vitamin D deficiency is negating in our study.[16] The more serious complications like osteopenia or spontaneous fracture was not seen in any patients included in our study. Although osteopenia was only radiologically assessed. There is a study done in USA showing Black Americans have lower fracture risks, higher bone density and lower vitamin D level than other races [17]and it has been attributed to genetic factors. This genetic polymorphism might be one of the reasons of low vitamin D in our population as well.

There are certain factors by which effects of vitamin D can be assessed and it includes low calcium and phosphorous, and high alkaline phosphatase and parathyroid hormone. In the study we conducted showed decreased calcium and phosphorous in 20.4% and 31.9% respectively. While alkaline phosphatase and parathyroid hormone were increased in 16 and 12 patients respectively. The level of PTH was marginally raised in all patients. Literature is also emphasizing the fact that vitamin D deficiency has no relation to the calcium, phosphorous or alkaline phosphatase levels[14] and our study is further proving it. But vitamin D deficiency remains a frequent cause of secondary hyperparathyroidism, and there are about 200 genes whose expression has been altered with vitamin D level.[18] Serum Parathyroid hormone, have been reported to be elevated in as many as 40-51% of patients with vitamin D <20 ng/ml and 10 ng/ml, respectively. [19] This higher level of parathyroid hormone also accelerated bone loss and fracture. [20]Although it is not seen in our study.

Over 200 of human genes have receptors for vitamin D, making vitamin D deficiency a contributory factor in a wide variety of illnesses including diabetes mellitus, metabolic syndrome, hypertension, cancers, autoimmune illnesses and multiple sclerosis.[21] In our study hypertension was present in 26.3% of the patients while diabetes and metabolic syndrome was seen in 17.6%. But it is difficult to ascertain whether hypertension or Diabetes are due to vitamin D deficiency or it is just aggravating tem.

Karachi is the city of hot climate but women of this city especially of middle and lower socioeconomic group either stays at home or draped pardah religiously. In our study there were 179 females and most of them were either from lower or middle class. Among these females 86.6% either had decreased sun exposure or they follow strict pardah. It has been suggested that approximately 30 min of sun exposure without sun screen daily is enough for the daily requirement of vitamin D.[22]Although there is a study done in Hawaiian population in whom even 11.1 hour of sun exposure per week was not enough to prevent the low vitamin D status.[23]This shows that vitamin D synthesis by skin is affected by certain factors yet unknown. Thus oral supplementation is mandatory to correct the hypovitaminosis D. The recommended dietary allowance of vitamin D by IOM for children between 1-18 years, pregnant woman and non-pregnant adults till the age of 70 years is 600 IU, while above age 70 years it has increased to 800 IU. [24] Unrecognized vitamin D deficiency is also seen in post menopausal osteoporotic females who were taking vitamin D < 400 IU as compared to those who were taking ≥ 400 IU. [25]

It is advisable to achieve optimal vitamin D concentrations levels of 28 to 40 ng/dl to decrease risk fracture.[26] However in another trial, there was a highest risk of fracture in patients treated with a single high dose of vitamin D, yearly causing chronic serum level of >40 ng/dl.[1]

CONCLUSION

Vitamin D deficiency in South Asia has acquired epidemic proportion. It is surprising that 80% of the healthy population of South Asia is deficient in vitamin D, which is further contributing to the burden of disease in this region. It is suggested that Government should implement a mandatory vitamin D supplement programme along with awareness of sun exposure. It will not only decrease the burden on the health care but also reduce the anxiousness in the population regarding vitamin D deficiency.

Conflict of Interest: The study has no conflict of interest to declare by any author.

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