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Research Article

Epidemic of Vitamin-D Deficiency and Awareness among Patients Presenting with Cardiac Complaints at a Single Adult Cardiac Private Clinic Malakand Division Khyber Pakhtoonkhwa, Pakistan

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Abstract

Background: Vitamin D deficiency is a common problem around the globe and approximately, one billion people are predicted to be deficient in vitamin D levels and various factors contribute to this phenomenon including climatic, geographical, and personal factors. Aim of this study was to assess the vitamin D status and awareness among the patients visiting to a private cardiac clinic at Malakand Division, Khyber Pakhtoonkhwa, a province of Pakistan.

Material and Methods: This was a cross-sectional study with convenient sampling technique conducted from January 2015 to January 2018 at a private adult cardiac clinic at Malakand division Khyber Pakhtoonkhwa Pakistan after taking ethical approval. All patients aged 12 years or above presenting with specific or non-specific symptoms of cardiac diseases were included. Vitamin D level was declared deficient if less than 20 ng/ml and sufficient when level 30 to 100ng/ml. The study variables like age, sex and vitamin D levels were documented. The awareness of vitamin D was also recorded subjectively through the proforma. SPSS version 21. was used for data analysis. Mann-Whitney U and Kruskal-Wallis were used to assess the mean difference. Chi-square test was used to evaluate the association. P-value of < 0.05 was set as significant level.

Results: Out of 2,848 patients, 1837 [64.5%] were female. Mean age was 48.10 ± 17.52 years with1122 [39.4%] of the study sample comprises of patients between 12 to 40 yrs. Out of total number of patients 2249 [79.0%] patients were found to suffer from vitamin D deficiency and 682 [23.9%] patients were having severe deficiency and 691 [24.3%] of patients were having very severe deficiency . Only 9 [0.3%] patients were aware of vitamin D, its sources, and hazards due to its deficiency.

Conclusions: It was predicted that most of the patients were having the vitamin D deficiency and half of the patients were having severe deficiency. Furthermore, the awareness of source of vitamin D and hazards of vitamin D deficiency was extremely low among these patients.

Keywords: *Epidemic; Vitamin D; Pakistan*

Introduction

Deficiency of Vitamin D is a common problem around the globe, approximately, one billion people around the globe do not have optimum level of vitamin D [1]. In 1932 Vitamin D was discovered by Windaus and Linsert [2]. Esvelt., *et al.* in 1978 isolated and identified vitamin D3 by mass spectrometry [3]. In 1977 it was proved that previtamin-D3 is formed in the skin from 7-hydrocholesterol irradiation by ultraviolet (UV) rays from sun [4]. Moreover, it was proved in 1977 that pre-vitamin-D3 is formed from 7-dehydrocholesterol when the UV rays of sun fall on the skin. Evolving studies in the world also predicted the significant range of non-skeletal problems including prostate cancer, neuromuscular disorders, multiple sclerosis and colorectal cancer [5]. In USA and Europe people above 50 year of age, it was found that approximately 40% of the population are vitamin D deficient [6]. Osteoporosis is directly linked to vitamin D deficiency [7]. The main natural source of vitamin D is sun light UVB rays falling on the epidermis to produce vitamin D from cholesterol, but due to many factors including sunscreens, clothing practices that are causal in nature, dark skin and indoor jobs in most of the day time, people are not exposed to sun light [8,9]. Human epidermis endogenously synthesize vitamin D after exposure to the sunlight [10]. Secondary sources include diet, such as fortified food or oily fish, and supplements [10,11]. It has been approximated that from all over the world, over a billion people suffer from low levels of vitamin D [12].

The reported prevalence of low levels of vitamin D (< 20 ng/dL) in Pakistan ranges from 85 - 98%, as observed by numerous authors. A cross sectional study done in Karachi Pakistan, in a tertiary care center revealed 90% of the employees having low vitamin D levels [12].

Obese people and people with dark skin have low level, as adipose tissues store vitamin D, while darker skin people synthesize vitamin D very slowly compare to fair skin people. Provided that there is insufficient evidence to screen for deficiency of vitamin D, some factors indicate reasons that may enhance the risk of deficiency of vitamin D, including people with less intake of vitamin D, reduced absorption of vitamin D and very less exposure to sun light (for instance, due to seasonal changes, high altitudes, or avoidance of the sun altogether) are at risk for developing deficiency of vitamin D [13].

Currently, vitamin D assays calculate total serum 25-(OH) D level to evaluate the vitamin D level present in the body. There are various methods that are presently available for evaluating vitamin D levels, including chromatography of high-performance liquid, protein binding that is competitive and mass spectrometry. Nevertheless, due to a lack of studies that have incorporated internationally recognized standard levels, the understanding and specificity of these tests are unclear. The amount of variation between various methods of assay and between labs using similar techniques have a range varying from 10 to 20% and determination of samples which are classified as deficient or non-deficient may range from 4 to 32% depending on the utilization of the assay.

A 92% occurrence of deficiency of vitamin D was noted by Zuberi., *et al*. in asymptomatic ambulatory endocrinology patients that came to a tertiary care center in Karachi [14]. In India 80 to 85% vitamin D deficiency is found in local hospital staff and postmenopausal women [15,16]. In urban Tehran among healthy young adults, the frequency of deficiency of vitamin D was calculated to be around 80% [17]. The majority of the literature that is published on vitamin D levels in Pakistan is determined from relatively small outpatient settings or individual centers, only including particular groups and small portions of the overall population. In large urban centers like Karachi, there is a paucity of published data on deficiency of vitamin D.

A number of studies of varying sample size have been performed in different parts of the Pakistan highlighting the significance of Vitamin D. Although, this is the largest study conducted in malakand division of Pakistan, but the study population also included patients belonging to other cities of Pakistan and had multiple check-ups with multiple doctors within Pakistan and outside of Pakistan. Therefore, this study was conducted to assess the vitamin D status, awareness about vitamin D, its sources and hazards due to vitamin D deficiency among the patients visiting to a private cardiac clinic at Malakand Division of Khyber Pakhtoonkhwa, a province of Pakistan.

Methods

This was a cross-sectional study conducted from January 2015 to January 2018 at a private adult cardiac clinic at Malakand division Khyber Pakhtoonkhwa Pakistan with the utilization of convenient sampling technique. All patients aged 12 years or above presenting with specific or non-specific symptoms of cardiac diseases were included in the study. Informed consent was taken by principal investigator from all enrolled patients with complete confidentiality of data. Patients who did not give consent were excluded from the analysis. Data was collected on predefined structural questionnaire. Demographic profile of the patients was documented and patient's awareness regarding vitamin D, sources of vitamin D, and hazards due to deficiency of vitamin D were also recorded. Approximately 3-5 ml venous blood was collected in gel tubes from 9 am to 8 pm and serum separated via centrifugation at 4000 rmp for 5 minutes for all patients. Patients were classified into six groups based on vitamin D level, Group 1; very severely deficient group with vitamin D level less than 4 ng/ml, Group 2; severe deficient group with vitamin D level of 4 to 9.9 ng/ml, Group 3; deficient group with vitamin D level of 10 to 19.9 ng/ml, Group 4; insufficiency group with vitamin D level of 20 to 29.9 ng/ml, and Group 5; sufficiency group with vitamin D level 30 to 100 ng/ml and Toxicity when level more than 100 ng/ml. All the results were analyzed by using SPSS version 21. Mean and standard deviation(SD) were calculated for quantitative variables such as age (years) and vitamin D level (ng/ml). Frequency and percentages were calculated for categorical variables such as gender, age group, and vitamin D. Kolmogorov-Smirnov test was applied to assess the normality of vitamin D levels. Mann-Whitney U and Kruskal-Wallis were used to assess the mean difference. Chi-square test was used to evaluate the association. P-value of < 0.05 was set as significant level

Results

Out of 2,848 patients 1837 [64.5%] were females and 1011 [35.5%] were males. The mean age of all patients was 48.10 ± 17.52 years. 1122 [39.4%] of patients were found to be in the age groups of 12 to 40 years, 1477 [51.9%] patients were between 41 to 70 years of age, and remaining 249 [8.7%] patients were having age of above 70 years.

Only 9 [0.3%] of the patients were aware of vitamin D, its sources, and hazards due to its deficiency. Out of total number of patients, 2249 [79.0%] patients were found to be vitamin D deficient, with very severe deficiency in 691 [24.3%] patients, severe deficiency in 682 [23.9%] patients, deficiency in 876 [30.8%] patients, insufficiency in 527 [18.5%] and sufficiency in only 72 [2.5%] patients. So 97.5% patients were not having the optimal level of vitamin D (Figure 1).

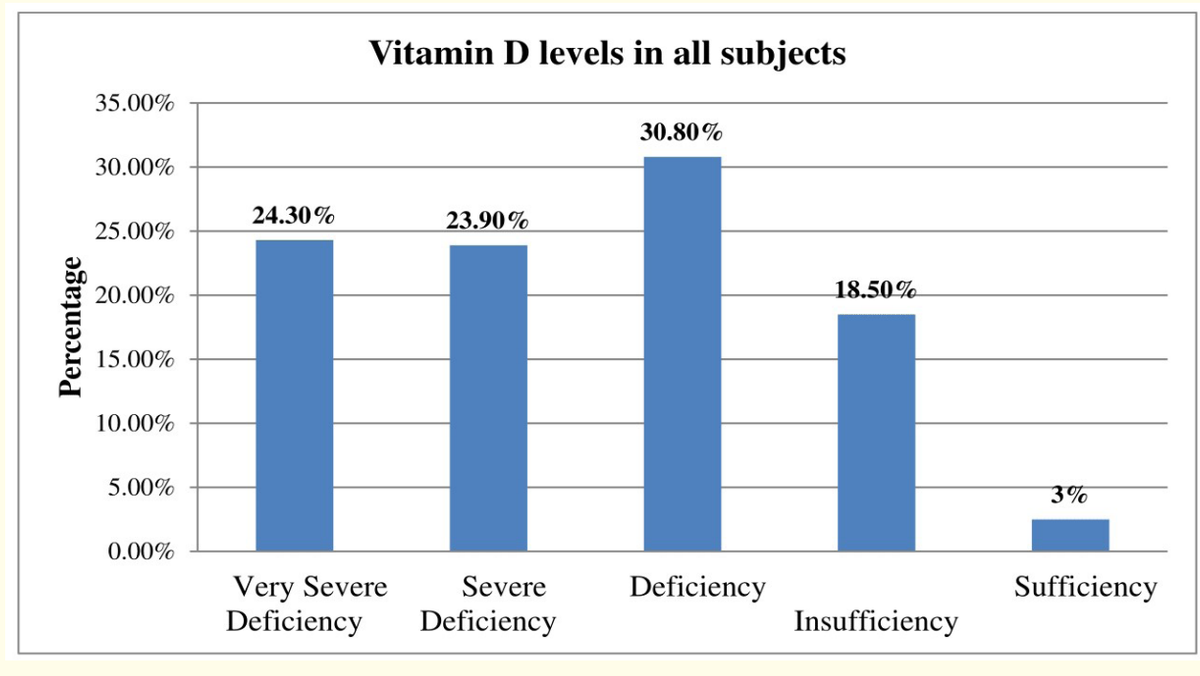

Figure 1: *Showing the vitamin D levels in all subjects.*

Vitamin D level in males was observed to be 13.04 ± 0.29 ng/mL while, it was found to be 10.8 ± 0.19 ng/mL in females with a significant difference (p =< 0.001). Vitamin D level was observed to be strongly associated with gender, (p-value < 0.001) (Table 1).

	Total (n = 2,848)	Male (n = 1011)	Female (n = 1837)	**P-value
Vitamin D Level (ng/mL)	**11.6 ± 0.16**	**13.04 ± 0.29**	**10.8 ± 0.19**	**< 0.001***
Vitamin D deficiency frequency [%]				
Very Severe Deficiency	691 [24.3]	190 [18.8]	501 [27.3]	< 0.001*
Severe Deficiency	682 [23.9]	233 [23]	449 [24.4]	
Deficiency	876 [30.8]	316 [31.3]	560 [30.5]	
Insufficiency	527 [18.5]	235 [23.2]	292 [15.9]	
Sufficiency	72 [2.5]	37 [3.7]	35 [1.9]	

Table 1: *Vitamin D deficiency by gender.*

***p-values are based on Mann-Whitney U test for vitamin D level and chi-square test for deficiency levels*

**Statistically significant at 0.05 level of significance*

The mean of vitamin D levels in different age groups was similar and no significant difference was observed between them (p = 0.797). Likewise, no significant association of vitamin D level with age groups was observed (p = 0.673) (Table 2).

	12 to 40 years (n = 1,122)	41 to 70 years (n = 1,477)	> 70 years (n = 249)	**P-value
Vitamin D Level (ng/mL)	**11.58 + 0.26**	**11.52 + 0.23**	**12.12 + 0.57**	**0.797**
Vitamin D Status frequency [%]				
Very Severe Deficiency	273 [24.3]	355 [24]	63 [25.3]	0.673
Severe Deficiency	266 [23.7]	369 [25]	47 [18.9]	
Deficiency	348 [31]	445 [30.1]	83 [33.3]	
Insufficiency	206 [18.4]	274 [18.6]	47 [18.9]	
Sufficiency	29 [2.6]	34 [2.3]	9 [3.6]	

Table 2: *Vitamin D deficiency by age.*

***p-values are based on Kruskal-Wallis test for vitamin D level and chi-square test for deficiency levels*

**Statistically significant at 0.05 level of significance*

Discussion

Geographic location of Malakand Division is blessed with abundant sunshine for the major part of the year. Despite its geographic advantage in our study vitamin D deficiency was observed in 79% of the study subjects from Malakand Division, with around 1/4th of the patients severely deficient. Vitamin D deficiency in this locality is similar as compared to the reported frequency for other localities of Pakistan. There is 76.2% deficiency of vitamin D among healthy adults recruited from different hospitals of Karachi [18]. In Combodia (a luminous country like India and Pakistan) 21.1 to 39.2% women are vitamin D deficient and no significant differences of the median vitamin D level were noted between socioeconomic groups and living areas (urban vs rural) [19]. About 52% Indian medical undergraduates were unaware of the fact that direct sunlight on skin without sunscreen and cloths is needed for the conversion of 7-dehydrocholesterol to previtamin D3 in the epidermis [20]. Iqbal R., *et al.* [7] observed Vitamin D deficiency in 73.7% of the patients assessed at the Clinical

Laboratory of a major private sector hospital in Karachi. Khan AH., *et al.* [21] conducted a community based study with randomly selected premenopausal females in Karachi and reported vitamin D deficiency in 91.50% of the recruited females. Similarly, Sheikh A., *et al.* [22] conducted a population based survey in adult population of Karachi and reported deficiency of vitamin D in 57.7% of the subjects. In another population based study conducted by Riaz H., *et al.* [23] on the population of Pakistan reported 53.5% of prevalence of vitamin D deficiency. Alarming deficiency in our population can be attributed to a number of underlying demographic, social, and cultural factors but lack of awareness of vitamin D, its sources, and health hazards due its deficiency may have aggravated the scenario. In our study only 0.3% of the study subjects were found to be aware of vitamin D, its sources, and hazards due to its deficiency. Owing to the low literacy rate of 39.5% [24] it is imperative to spread the awareness and educate the population regarding vitamin D and its importance and functions in human body. In our study severe and very severe deficiency was observed in 23.9% and 24.3% of the study subject respectively indicating the ignorance of the alarming and potential health hazard due to its deficiency Furthermore this deficiency was found to be dominant in females as compared to males which might be due to the fact that females in Pakistan usually are not exposed to the ultraviolet rays in contrast to males. On contrary, the studies conducted by Mahmood K., *et al.* [18] and Sheikh A., *et al.* [22] in Karachi, found no statistically significant difference between male and female subjects on both vitamin D level and severity of deficiency. While, Iqbal R., *et al.* [7] found significantly higher vitamin D levels in female patients. These contradictory finding in our study are the reflection of the fact that almost all of the females living in these areas, as per the religious and cultural norms, after a certain age wear "Burqa"; which is an outfit covering from head to toe which extremely reduces their exposure to sunlight [25].

In adults who suffer from persistent vitamin D deficiency, there is a high risk of developing complications such as weakness of the muscles, osteomalacia, osteoporosis and an increased danger of fall and long bone fractures. In the older population, it is particularly common to find fractures of the hip bone with trivial trauma [26].

The high rates of vitamin D deficiency observed in our study were comparable to other studies being conducted previously in Pakistan and in the neighboring countries, combined with studies performed on Pakistani women in other countries [22,27,28]. To prevent deficiency of vitamin D in Pakistan, supplements are needed to be given including bisphosphonates which are used to avoid fractures in people who suffer from osteoporosis [29]. The present suggested intake of vitamin D as recommended by the Institute of Medicine is 15 mg up to the age of 70 years and this recommendation increases to 20 mg for people aged beyond 70 years of age [30]. Given the high percentage of vitamin D deficiency in Pakistan, a deeper understanding of the underlying factors needs to be taken into account [22].

Policy makers in Pakistan are required to develop initiatives provided the high percentage of the population which suffers from vitamin D deficiency in Pakistan across all age groups [31]. To start with, these could include a strategy involving knowledge sharing and food fortification programs with vitamin D developing on the recommendation on the 1965 Food Act. Along with that, intake of vitamin D supplements is needed to be encouraged among the population which suffers from the deficiency [32]. This would provide a positive support on to the already existing concerns in Pakistan with regards to the development of osteoporosis and purchasing of bisphosphonates and vitamin D will help in the reduction of disease burden. The strategy of vitamin D synthesis via sunlight will definitely terminate vitamin D dependent rickets, osteomalcia and premature osteoporosis and this will significantly decrease the huge financial loss of public and government sector costing on management for these health problems.

Limitation of the Study

This study was conducted at private adult cardiac clinic including patients presented with specific or non-specific symptoms of cardiac diseases. Therefore, generalize-ability of the study findings is limited, so an extensive study is needed to test the level of vitamin D in patients presenting at orthopedic, endocrinology and rheumatology clinics. Also this study included patients with age above 12 years, it is important for future studies to address the deficiency of vitamin D among the patients visiting to pediatric clinics.

Conclusion

It was predicted that most of the patients were having the vitamin deficiency and half of the patients were having severe deficiency. This deficiency was found to be more pronounced in female patients as compared to males. Furthermore, the awareness of source of vitamin D and hazards of vitamin D deficiency was extremely low among these patients.

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