Section: Miscellaneous

Original Research Article

TO STUDY THE VITAMIN D STATUS AND FACTORS ASSOCIATED WITH VITAMIN D DEFICIENCY IN CHILDREN OF FACTORY WORKERS: A HOSPITAL BASED CROSS SECTIONAL STUDY

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ABSTRACT

Background: Vitamin D is a prohormone that regulates the absorption of calcium and phosphorus from the gastrointestinal tract, and facilitating normal immune function. An insufficient sunlight exposure, dark skin, obesity, malabsorption, geographic latitude and multiple other factors are associated with vitamin D deficiency. The aim of the study is to study the Vitamin D status and factors associated with Vitamin D deficiency in children of factory workers. **Materials and Methods:** It is a hospital based descriptive cross-sectional study, total of 150 children of factory workers were enrolled in the study. Those having co-morbid conditions that affect Vitamin D metabolism, on Vitamin D supplementation and/or on chronic drug treatment were excluded from the study. **Result:** The statistically significant difference was found between BMI, sunlight exposure, skin tone, oral vitamin D supplementation, non-veg diet and serum vitamin D levels. **Conclusion:** Vitamin D deficiency is more prevalent in children with less sun exposure, so prudent sun exposure must be encouraged by outdoor lifestyle by parents at home and teachers in school.

INTRODUCTION

Vitamin D is a prohormone that has several important functions such as regulating the absorption of calcium and phosphorus from the gastrointestinal tract, and facilitating normal immune function. Vitamin-D is important for normal growth and development of bones and teeth, as well as improved resistance against certain diseases.[1]

Only 10% of vit-D is derived from dietary sources and supplements and major quantity of vitamin D is synthesized by a cutaneous reaction in the skin after exposure to ultraviolet radiation, specifically UVB.[2] An insufficient exposure to sunlight is a major cause of vitamin D deficiency. Other causes are sunscreen sun protection,[3] dark skin, body mass index (BMI) greater than 30,[4] malabsorptive conditions, geographic latitude, duration of sunlight exposure, seasonal fluctuations and age also determine the vitamin D levels,[1] and multiple other factors.

The development of vitamin-D deficiency is associated with deteriorating bone health and in severe cases, hypocalcemia, rickets, and osteomalacia in children and adults.[5] Although a majority of pediatric patients are asymptomatic, less severe deficiency has been associated with secondary hyperparathyroidism, increased bone turnover, enhanced bone loss and risk of fracture with minor trauma.[6]

Families of factory workers in India usually reside in urban slums. They have low socio-economic status and education. Moreover, they usually do not get adequate nutrition. All these factors makes children of factory workers more susceptible to vitamin-D deficiency and consequently to poor growth and health. There is paucity of data about vitamin-D status and factors associated with Vitamin D deficiency in children of factory workers in India.

Hence this study has been planned to evaluate vitamin-D status in children of factory workers and to assess association of vitamin-D deficiency with various sociodemographic, clinical and biochemical parameters in children of factory workers.

MATERIALS AND METHODS

The present study is hospital based descriptive cross-sectional study conducted at a tertiary care Centre in North India from December 2020 to December 2021. A total of 150 children of factory workers of either sex of age between 6 months to 12 years attending outpatient and inpatient (after recovering from illness) were randomly enrolled in the study. All the children with co-morbid conditions that affect Vitamin D metabolism like chronic liver disease, chronic kidney disease, those on Vitamin D supplementation and/or on chronic drug treatment

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including anticonvulsants, anti-tuberculous treatment, steroids were excluded from the study.

The aim of the study is to assess the Vitamin D status and factors associated with Vitamin D deficiency in children of factory workers. The objectives of the study are to assess the Vitamin-D status in 6 months to 12-year-old children of factory workers and also to analyze clinical, sociodemographic and biochemical parameters associated with Vitamin-D deficiency in children of factory workers.

Parents and children were interviewed with the help of detailed standardized questionnaire prepared to assess the personal information of the children, sociodemographic profile, mother's education, feeding history, food habits, sun exposure, pattern of clothing, time spent for outdoor and physical activity. The nutritional status of the children was assessed with respect to height, weight and BMI using WHO growth charts and tables for children aged 6 months to 5 years and IAP charts and tables for children aged more than 5 years to 12 years. Dietary nutrition intake was assessed by a 24 hour recall of the food intake. Children were examined for clinical features of vitamin D deficiency and skin pigmentation. Serum Calcium, Serum Phosphorus, Serum Alkaline Phosphatase, Serum Albumin and 25(OH) Vitamin D were assessed after taking written consent from parents.

Vitamin D reference range was taken as US endocrine society classification: Deficiency <20 ng/ml, Insufficiency 21-29 ng/ml, Sufficient> 30ng/ml and Risk of toxicity >150 ng/ml.

The continuous variables were analyzed using ANOVA (for normally distributed data) and Kruskal Wallis test (for not normally distributed data) whereas categorical were analyzed using Chi- Square test. The Statistical Package for Social Sciences (SPSS) software,21.0 was used.

RESULTS

A total of 150 children participated in the study. Among the participants, 11 children (< 2 years), 39 (2-5 years), 45 (5-8 years) and 55 children (8-12 years), respectively. Gender distribution was balanced across the study population (n =75).

Present study noticed that mother of 43.7% participants having deficient vitamin D levels were illiterate while majority of the participants with Vitamin D level more than 20 ng/dL had mother's education of secondary level and above.

There was no significant difference between the various groups in terms of distribution of Residence, socio-economic status and IAP Classification.

There was a significant difference between the three groups in terms of BMI with the median BMI being highest in the Vitamin D having >30 ng/dL group.

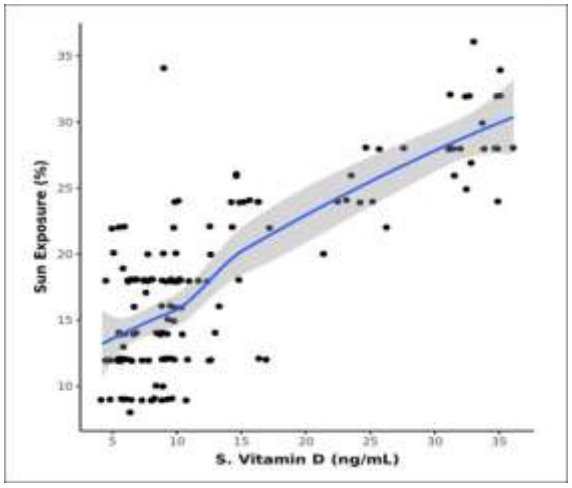

Figure 1: showing correlation between S. Vitamin D and sun exposure (%)

The above scatterplot depicts strong positive correlation between serum Vitamin D (ng/mL) and Sun Exposure (%), and this correlation was statistically significant (p = <0.001).

There was a significant difference between the various groups in terms of distribution of Diet. Majority of the study population with vegetarian diet (73.9%) had serum Vitamin D <20 ng/dL while majority of the study population with non-vegetarian diet (90.5%) had serum Vitamin D >30ng/dL.

There was a significant difference between the various groups in terms of distribution of Skin Color. Majority of the participants with dark skin color had S. Vitamin D <20 ng/dL (59.7%) while majority of the participants with fair skin color had S. Vitamin D 30 ng/dL (76.2%).

There was a significant difference between the 3 groups in terms of Vitamin D Intake, with the median Vitamin D Intake being highest in the Vitamin D >30 ng/dL group.

There was a significant difference between the various groups in terms of distribution of Lifestyle. Participants in the serum Vitamin D: <20 ng/dL group had the largest proportion of indoor lifestyle whereas participants in the group Vitamin D: 20-30 ng/dL had the largest proportion of Outdoor lifestyle.

Table 1: Association between lab findings and Serum vitamin D levels

Parameters	S. Vitamin D			p value
	<20 ng/dL (n = 119)	20-30 ng/dL (n = 10)	>30 ng/dL (n = 21)	
Corrected Calcium (mg/dL)	9.29 ± 0.99	9.74 ± 1.09	9.34 ± 0.83	0.2011
Corrected Calcium				0.9582
<8.1	15 (12.6%)	1 (10.0%)	2 (9.5%)	
<8.1-10.4	89 (74.8%)	7 (70.0%)	17 (81.0%)	
>10.4	15 (12.6%)	2 (20.0%)	2 (9.5%)	
S. PO4 (mg/dL)	4.69 ± 1.20	4.82 ± 1.36	4.76 ± 1.19	0.9331
S. Albumin (g/dL)***	4.02 ± 0.24	3.97 ± 0.07	3.85 ± 0.31	0.0081

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S.ALP (U/L)	273.62 ±121.25	299.00 ±97.47	287.90 ±123.37	0.4521
S. Vitamin D (ng/mL)***	8.83 ± 3.14	24.39 ± 1.84	33.14 ± 1.60	<0.0011

Among the above parameters, Serum albumin and Serum Vitamin D were significantly associated with Serum Vitamin D levels.

DISCUSSION

The increasing prevalence of vitamin D deficiency, combined with widespread reports of the involvement of vitamin D in various aspects of health, makes vitamin D status an important public health problem. Deficiency of vitamin D may result in rickets in an infant or adolescent or osteomalacia and muscle weakness in an older child/adolescent. Vitamin D deficiency may also have a negative impact on the peak bone mass resulting in low bone mineral density in childhood, which may subsequently result in osteoporosis in adulthood.[7] Recognizing the sociodemographic and lifestyle determinants of vitamin D status is important to better identify high-risk children and define strategies for improving vitamin D status.

Age and Serum Vitamin D status: In the present study, out of 150 children of factory workers between the ages of 6 months to 12 years, the majority of them belonged to the age group of 8-12 years (36.7%). Similarly, a study conducted by Bindusha S et al had the majority of children in the age group of 8-10 years (54.3%).[8]

The current study showed that 33.5% of children having S. Vitamin D levels <20 ng/dL belong to age group of 6-12years which is in resonance with another study conducted by Feng Wei et al. in China among 795 children who were outpatients aged 0–12 years.[9]

Mothers Educational Status: Upon comparing the educational status of mothers in our study, the present study showed a significant difference in illiterate (40%) and literate mothers (36% secondary, 24% above secondary education) of Serum vitamin D deficient & sufficient children. Education of mothers has a direct impact on the overall nutritional status of the child as illiterate parents do not have sufficient knowledge about the importance of vitamin D supplementation in their children.

Gender and Associated Serum Vitamin D Status: In the present study female children had lower levels of serum Vitamin D (5.3%) as compared to male children (8%). This can be attributed to the fact that female children had a higher risk of vitamin D deficiency due to more clothing of the body and lesser participation in outdoor activities. Similar findings were observed by Vasudeen J et al. where female children were 1.9 (95% CI 1.3 to 4.0) times more at risk of having vitamin D deficiency when compared to males.[10]

Socio- economic Status: In the present study, 73.2% and 84.8% of the participants belonging to the Upper Middle class and lower Middle class had Vitamin D levels <20 ng/dL. This depicts that children from low-income families have less access to vitamin D-rich foods. This is contrary to the study by Linhares et al where he did not find any significant differences in the mean vitamin D concentration between the various socio-economic groups.[11]

Urban vs Rural Residence: The present study showed that children who were residents of urban areas had a lower concentration of Vitamin D (<20 ng/dL) as compared to those residing in rural households, however the difference was not statistically significant. This may be due to the fact the urban-educated families live in their covered pucca houses and have minimum sun exposure.

Body Mass Index with Reference to Serum Vitamin D: This study shows there was a significant difference between the 3 groups in terms of BMI, with the median BMI being highest in the S. Vitamin D: >30 ng/dL group. In a study by Vasudeven J et al. obese children (47.1%) were at a greater risk of developing vitamin D deficiency.[12] It has been determined that a hierarchical relationship between Vitamin D status and BMI, or specifically adiposity, exists within the general population. Plausible explanations embody sequestration in fat tissue, volumetric dilution or negative feedback mechanisms from accrued current 1,25- dihydroxy-vitamin D3.[13]

Effect of Sun Exposure: In the current study, significant association between Sun Exposure and S. Vitamin D was found. Voortman et al observed higher vitamin D concentrations in children who played outside and were more exposed to sunlight than the ones watching television.[14]

Dietary Intake of vitamin D and Vitamin D Deficiency: Few reasons being put forth for the widespread prevalence of Vitamin D deficiency among Indians are negligible dietary vitamin D intake because of primarily vegetarian diets and lack of guidelines and programs for the fortification of food with Vitamin D. In the present study there was a significant association between the various groups in terms of distribution of Diet (p = <0.001). Similarly in a cross-sectional study conducted by Baig JA et al in Pakistan, it was seen that the vegetarians of urban compared to rural had low vitamin D. Owing to their dietary restrictions, vegetarians exhibited Vitamin D insufficiency irrespective of urban and rural status.[15]

Serum Vitamin D and Serum Albumin: In the present study there was a significant difference between the groups in terms of serum albumin, with the mean serum albumin being highest in the Vitamin D: <20ng/dL group. The study also observed significant positive correlation between Vitamin D and albumin and the plausible cause given can be attributed to poor nutrition may cause a low albumin level as well as poor Vitamin D intake. Patients with poor nutrition may also have low levels of VDBP

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(Vitamin D Binding Protein), further contributing to low serum Vitamin D levels.[16]

Serum Phosphorus, Serum corrected Calcium and ALP: In our current study, there was no significant association between Serum Phosphorus, corrected calcium, serum alkaline phosphatase and serum Vitamin D levels. Similarly, Roh YE et al. observed that the mean serum phosphorus and ALP levels, were not statistically different, between the 2 groups. However, there was a tendency that ALP level was higher in the vitamin D deficiency group which had a lower calcium level. In the same study the mean serum calcium levels were significantly lower in the deficiency group (p=0.018).[17]

Skin Pigmentation and VDD: The statistically significant difference was observed in the serum vitamin D levels in the current study, showing that darker skin tones have more melanin reduces the ability to synthesize vitamin D from the sun, resulting in lower 25-hydroxyvitamin D levels. Similar observation was noted by Richard A et al. that women with light skin color had the highest vitamin D levels in summer and the lowest in winter. For women with dark skin color, these levels in summer and winter were lower.[18]

Life Style and association of Vitamin D level: In the present study, 62.2% of children staying indoor had lower levels of vitamin D (<20 ng/dL) pressing the importance of outdoor exposure and sun bathing in children. Pagels et al reported that outdoor environment, due to exposure to the sun even at high latitudes helps students to acquire vitamin D. Therefore, reasonable exposure to ultraviolet rays in open-air environment during school days in northern European countries has a positive effect on the immune system, bone mineralization and, possibly, mental health.[19]

Pubertal Stage and vitamin D deficiency: The fact that vitamin D deficiency is more common in adolescents than in prepubertal children suggests that puberty may be involved in deficiency. The current study showed that pubertal stages have no significant impact on the S. vitamin D levels. In another study, differences in vitamin D levels in Tanner II and III-IV with regards to Tanner Stage I were present in the obese group. However, no differences in vitamin D levels among the different stages in the lean control group were observed.[20]

CONCLUSION

Despite of ample amount of sunshine in India, vitamin-D deficiency is present in sizeable share of general population which in itself seems to be a paradox. A number of factors are known to influence Vitamin D levels and it is the need of time to fully understand the role of each of these factors in regulation of level of vitamin D and its metabolites in populations at risk of vitamin D deficiency and insufficiency. Vitamin D deficiency is more prevalent in children with less sun exposure, so prudent sun exposure must be encouraged by outdoor lifestyle by parents at home and teachers in school. Also, there must be promotion of food intake rich in vitamin D and food fortification should be encouraged. Knowledge about data of vitamin-D status and factors associated with vitamin-D deficiency in children of factory workers will enable us for early intervention of both for prevention and treatment.

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