

A hospital based prospective study of vitamin D deficiency in a selected group of apparently healthy children one to five years of age

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Abstract

Objective: To study the presence of vitamin D deficiency in a selected group of apparently healthy children 1-5 years of age

Method: A hospital based prospective cross-sectional study was carried out at the Sri Guru Ramdas Institute of Medical Sciences and Research (SGRDIMSR), Amritsar on a selected group of apparently healthy children of age group 1 to 5 years, attending the paediatrics outpatient department for minor ailments or immunization from December 2012 to June 2014. Venous samples from these children were collected in two separate red topped vials (with clot activator), one for vitamin D and the other for alkaline phosphatase and calcium. These vials were sent to the Biochemistry Department of SGRDIMSR hospital. Data so obtained was statistically analysed.

Results: Out of a total of 100 apparently healthy children, 78 were found to be deficient in Vitamin D. Vitamin D levels were tested by the Direct ELISA method. Vitamin D deficiency was found most commonly in the age group 4-5 years. Gender wise, 79.4% of boys and 75.7% of girls were found to be vitamin D deficient. Of breast fed children 76.6% were found deficient in vitamin D. Of the children who spent less than 30 minutes per day in the sun 73.1% were vitamin D deficient. Most (80%) cases of vitamin D deficiency were found in the upper middle class. Urban population was found to be more deficient in vitamin D as compared to rural. Fifty four percent of the children with vitamin D deficiency were of wheatish complexion. Dietary insufficiency was found in 67% of the children, of whom 82% were found to be vitamin D deficient. Clinical features of vitamin D deficiency found in our study were frontal bossing, parietal bone prominences, widening of wrist epiphyses and pot belly.

Conclusion: In the selected group of apparently healthy children 1-5 years of age vitamin D deficiency was found in 78%.

(Key words: vitamin D deficiency; children; India)

Introduction

In India vitamin D deficiency has been reported to be present in the majority of children in spite of the wide availability of sunlight. Mild or subclinical vitamin D deficiency escapes diagnosis because of its nonspecific symptomatology¹.

Objective

To study the presence of vitamin D deficiency in a selected group of apparently healthy children 1-5 years of age

Method

A hospital based prospective cross-sectional study was conducted in the Department of Paediatrics in collaboration with the Department of Biochemistry at Sri Guru Ram Das Institute of Medical Sciences and Research Centre, Amritsar from December 2012 to June 2014 on children of age group 1 - 5 years attending the paediatric outpatient department for minor ailments or immunization or admitted to the paediatric ward for minor ailments. Children on steroids, children suffering from bronchial asthma, chronic renal disease, chronic / acute liver disease and acutely ill children were excluded from the study. Of the eligible children, only those whose parents could afford the cost of the investigations were included in the study.

Venous samples from these apparently healthy children with normal anthropometric parameters were collected under aseptic conditions in two separate red topped vials (with clot activator) and sent for estimation of serum 25 OH vitamin D, serum calcium and alkaline phosphatase levels. Direct ELISA with immunodiagnostix kit was used for estimation of 25 OH vitamin D levels in serum. Data so obtained was statistically analyzed by Microsoft SPSS, Version 18.0. For inferential analysis, Chi-square and independent t-test were done at the level of significance $p=0.05$ (Confidence interval=95%). The normal value of vitamin D was taken as more than 30ng/ml, vitamin

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D insufficiency as 20-30 ng/ml and vitamin D deficiency as less than 20 ng/ml².

Results

Out of the 100 apparently healthy children included in the study, 78 were found to be deficient in Vitamin D (levels <20 ng/ml). Vitamin D deficiency was found in 90% of children 4–5 years old, 86.7% of children 2–3 years old, 72.7% of children 1-2 years old, 66.7% of children 3-4 years old and 57% infants (Figure 1).

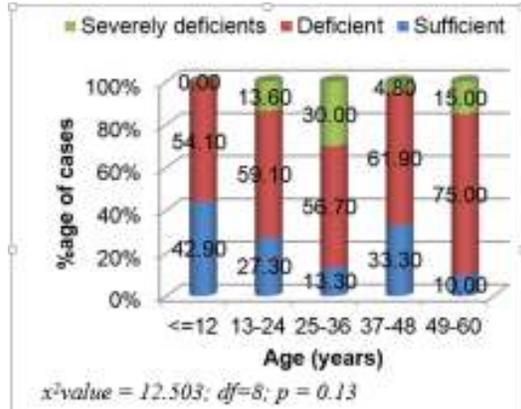


Figure 1: Association of age with vitamin D deficiency

When compared with children with normal vitamin D levels, no significant difference was found in age distribution of both groups (p = 0.13).

Dietary insufficiency was found in 67% of the children, 82% of whom were found to be vitamin D deficient (Figure 2). The results were statistically significant (p=0.03).

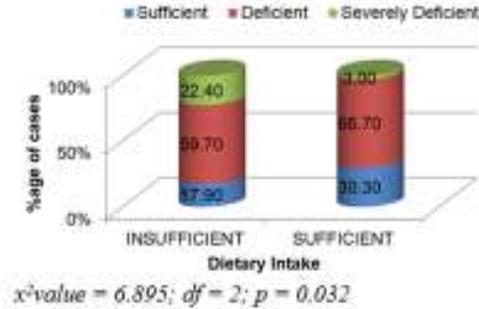


Figure 2: Association of dietary intake with vitamin D deficiency

Out of a total of 63 boys 50 (79.4%) were vitamin D deficient and 28 girls out of 37 (75.7%) were vitamin D deficient (Table 1). The difference was not statistically significant (p = 0.902). Out of 90 breast fed children 69 (76.6%) were found to be deficient in Vitamin D (Table 2). The results were not statistically significant (p = 0.08).

Table 1: Association of gender with vitamin D deficiency

Sex	Sufficient	Deficient	Severely deficient	Total
Male	13 (20.6%)	40 (63.5%)	10 (15.9%)	63 (100%)
Female	09 (24.3%)	22 (59.5%)	06 (16.2%)	37 (100%)
Total	22(22.0%)	62(62.0%)	16 (16.0%)	100 (100%)

χ^2 value = 0.207; df = 2; p = 0.902

Table 2: Association of breast feeding with vitamin D deficiency

Breast feeding	Sufficient	Deficient	Severely Deficient	Total
No	01 (10.0%)	05 (50.0%)	04 (40.0%)	10 (100%)
Yes	21(23.3%)	57 (63.3%)	12 (13.3%)	90 (100%)
Total	22 (22.0%)	62 (62.0%)	16 (16.0%)	100 (100%)

χ^2 value = 4.9; df = 2; p = 0.08

Of the children who spent less than 30 minutes per day in the sun 73.1% were vitamin D deficient (Figure 3). Results were not statistically significant (p = 0.117)

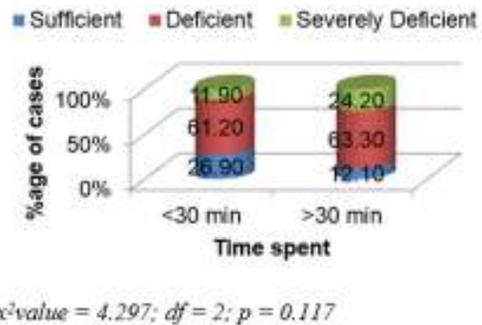


Figure 3: Association of time spent in sunlight per day with vitamin D deficiency

The distribution of cases according to the socioeconomic status (Kupuswamy scale) is shown in Figure 4.

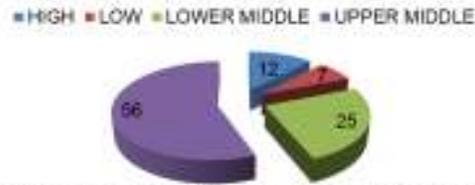
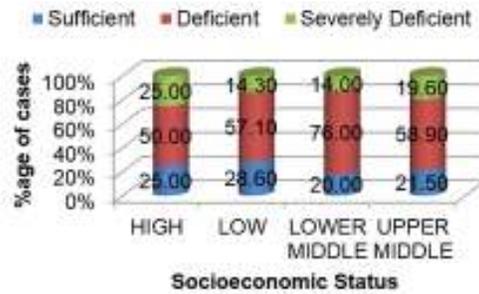


Figure 4: Distribution of cases according to socioeconomic status (Kupuswamy scale)



χ^2 value = 4.756; *df* = 6; *p* = 0.575

Figure 5: Association of socioeconomic status with vitamin D deficiency

Most (80%) cases of vitamin D deficiency were found in the upper middle class (Figure 5). However, this was not statistically significant (*p* = 0.575).

Urban population was found to be more deficient in vitamin D when compared to rural (Table 3). This was not statistically significant (*p* = 0.055).

Table 3: Association of background with vitamin D deficiency

Background	Sufficient	Deficient	Severely Deficient	Total
Rural	12 (24%)	26 (52%)	12 (24%)	50 (100%)
Urban	10 (20%)	36 (72%)	04 (08%)	50 (100%)
Total	22 (22%)	62 (62%)	16 (16%)	100 (100%)

χ^2 value = 5.795; *df* = 2; *p* = 0.055

Fifty four percent of the children with vitamin D deficiency were of wheatish complexion. This was not statistically significant (*p*=0.06). No child in our study deficient in vitamin D was getting vitamin D supplements. The only clinical features of vitamin D deficiency found in our study were frontal bossing, parietal bone prominences, widening of wrist epiphyses and pot belly (Figure 6).

months, with a median age of 15.5 months. In our study, vitamin D deficiency was found in 90% of children 4–5 years old. In 2008 Marwaha RK et al studied vitamin D and bone mineral density of healthy school children in northern India and found that insufficient dietary intake is associated with vitamin D deficiency². In our study dietary insufficiency was found in 67% of the children, 82% of whom were found to be vitamin D deficient. A study conducted by Shin YH et al in 2013 revealed that vitamin D deficiency in children is more prevalent in the female gender⁴. In our study vitamin D deficiency was found equally in both sexes. In 2006, Ziegler EE et al studied vitamin D deficiency in breastfed infants in Iowa. Vitamin D deficiency was common among breastfed infants in Iowa⁵. In our study 76.6% of breast fed children were found to be deficient in Vitamin D.

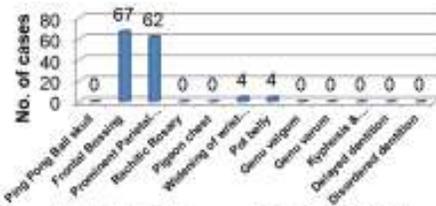


Figure 6: Clinical features of vitamin D deficiency found in our study

Of the vitamin D deficient cases, 98% had normal serum calcium levels and only 2% cases had decreased serum calcium levels (*p* =0.73). Of the vitamin D deficiency cases, 2.5% showed increased levels of alkaline phosphatase (ALP) but this was statistically insignificant (*p*=0.23).

Discussion

Krieter SR et al in 2000 studied characteristics of infants and children diagnosed with nutritional rickets at two medical centres in North Carolina in the 1990s³. The age at diagnosis was 5 to 25

Bener A et al conducted a cross-sectional study at the Primary Health Care from August 2007 to March 2008⁶. Lack of exposure to sunlight, outdoor activities under the sun, and physical activity and vitamin D intake were the main associated factors for vitamin D deficiency in the young population of Qatar. Various studies done by Sahu, Balasubramaniam, Harinarayan and Goswami also revealed that vitamin D deficiency is more prevalent in those who have lesser exposure to sunlight⁷⁻¹¹. In our study, of the children who spent less than 30 minutes per day in the sun 73.1% were vitamin D deficient. A study conducted by Shin YH et al revealed that vitamin D deficiency in children

is more prevalent in low socioeconomic status⁴. In our study, 80% cases of vitamin D deficiency were found in the upper middle class. C.V. Harinarayan in March 2008 conducted a population based study in Anthra Pradesh⁹. The quality of diet in the rural subjects was low in calcium and high in phytate/calcium ratio compared to that of urban diet. Hence the rural subjects were more affected. In another study done by Harinarayan, it was found that urban population was more deficient¹⁰. In our study the urban population was found to be more deficient in vitamin D when compared to rural but this difference was not statistically significant. In 2008, Rovner AJ et al studied hypovitaminosis D among healthy children in the United States and found that children with dark complexion had higher prevalence of vitamin D deficiency¹². In our study 54% of the children with vitamin D deficiency were of wheatish complexion. In 2007 Ward LM et al studied vitamin D deficient rickets among children in Canada. Vitamin D-deficiency rickets was persistent among those who were breast-fed without appropriate vitamin D supplementation¹³. None of the children in our study deficient in vitamin D were getting vitamin D supplements. A study done by Heaney RP in 2003 showed that there exists no relation between levels of 25 (OH) vitamin D and serum calcium levels¹⁴. In our study, of the vitamin D deficient cases, 98% had normal serum calcium levels. A study done by Maha MMHK showed positive correlation between vitamin D deficiency and increased ALP levels¹⁵. In our study only 2.5% of the vitamin D deficiency cases had increased levels of ALP.

Conclusion

In a selected group of apparently healthy children 1-5 years of age vitamin D deficiency was found in 78%.

Limitation of Study

The major limitation of this study was that only eligible children whose parents could afford the cost of investigations were included in the study.

Despite the above limitation, the finding of vitamin D deficiency in 78% of apparently healthy children 1-5 years old is a matter for concern and warrants further study.

References

1. Lips P. Relative value of 25(OH) D and 1, 25(OH) D2 measurements. *Journal of Bone and Mineral Research* 2007; **22**:1668-71. <http://dx.doi.org/10.1359/jbmr.070716> PMID: 17645404

2. Marwaha RK, Sripathy G. Vitamin D & bone mineral density of healthy school children in northern India: *Indian Journal of Medical Research* 2008; **127**(3):239-44. PMID: 18497437
3. Kreiter SR, Schwartz RP, Kirkman HN, Charlton PA, Calikoglu AS, Davenport ML. Nutritional rickets in African American breast-fed infants. *Journal of Pediatrics* 2000; **137**(2):153-7. <http://dx.doi.org/10.1067/mpd.2000.109009> PMID: 10931404
4. Shin YH, Shin HJ, Lee YJ .Vitamin D status and childhood health. *Korean Journal of Pediatrics* 2013; **56**(10):417-23. <http://dx.doi.org/10.1067/mpd.2000.109009> PMID: 10931404
5. Ziegler EE, Hollis BW, Nelson SE, Jeter JM. Vitamin D deficiency in breastfed infants in breast fed infants in Iowa. *Paediatrics* 2006; **118**(2):603. <http://dx.doi.org/10.1542/peds.2006-0108> PMID: 16882813
6. Bener A, Ali-Ali M, Hoffman GF. High prevalence of vitamin D deficiency in young children in a highly sunny humid country: a global health problem. *Minerva Pediatrica* 2009; **1**:15-22.
7. Sahu M, Bhatia V, Aggarwal A, Rawat V, Saxena P, Pandey A et al. Vitamin D deficiency in rural girls and pregnant women despite abundant sunshine in northern India. *Clinical Endocrinology (Oxf)* 2009; **70**(5):680-4. <http://dx.doi.org/10.1111/j.13652265.2008.03360.x> PMID: 18673464
8. Balasubramanian K, Rajeswari J, Gulab, Govil YC, Agarwal AK, Kumar A. Varying role of vitamin D deficiency in the aetiology of rickets in young children vs. adolescents in northern India. *Journal of Tropical Pediatrics* 2003; **49**(4):201-6. <http://dx.doi.org/10.1093/tropej/49.4.201> PMID: 12929879

9. Harinarayan CV, Ramalakshmi T, Prasad UV, Sudhakar D. Vitamin D status in Andhra Pradesh: a population based study. *Indian Journal of Medical Research* 2008; **127**:211-8.
PMid: 18497434
10. Harinarayan CV, Ramalakshmi T, Prasad UV, Sudhakar D, Srinivasarao PV, Sarma KV et al. High prevalence of low dietary calcium and low vitamin D status in healthy south Indians. *Asia Pacific Journal of Clinical Nutrition* 2004; **13**:359-64.
PMid: 15563441
11. Goswami R, Kochupillai N, Gupta N, Goswami D, Singh N, Dudha A. Presence of vitamin-D deficiency in rural north Indian village despite abundant sunshine. *Journal of the Association of Physicians of India* 2008; **56**:755-7.
PMid: 15563441
12. Rovner AJ, O'Brien KO. Hypovitaminosis D among healthy children in the United States. *Archives of Pediatrics and Adolescent Medicine* 2008; **162**(6):513-9.
<http://dx.doi.org/10.1001/archpedi.162.6.513>
PMid: 18524740
13. Ward LM, Gaboury I, Ladhani M, Zlotkin S. Vitamin D-deficiency rickets among children in Canada. *Canadian Medical Association Journal* 2007; **177**(2):161-6.
<http://dx.doi.org/10.1503/cmaj.061377>
PMid: 17600035 PMCID: PMC1913133
14. Heaney RP, Dowell MS, Hale CA, Bendich A. Calcium absorption varies within the reference range for serum 25-hydroxyvitamin D. *Journal of the American College of Nutrition* 2003; **22**:142-6.
<http://dx.doi.org/10.1080/07315724.2003.10719287>
PMid: 12672710
15. Mansour MMHK, Alhadidi KM. Vitamin D deficiency in children living in Jeddah, Saudi Arabia. *Indian Journal of Endocrinology and Metabolism* 2012; **16**(2):263-9
<http://dx.doi.org/10.4103/22308210.93746>
PMid: 22470865 PMCID: PMC3313746