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Research Article

Vitamin D Status Among Children and Adolescents with HIV Infection

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Abstract

Background: Children and adolescents with HIV infection are known to be wasted and underweight but it is also important to find out whether there is an effect of HIV infection on vitamin D levels among these patients.

Methods: HIV positive, Antiretroviral therapy (ART) naive patients from the age 2 to 18 years were randomly selected with consent. Healthy age and gender matched control in the ratio of 2:1 were selected. The vitamin D test was done by ELISA method. Nutritional status was determined by WHO growth standards. SPSS 16.0 was used for statistical analysis with which tests like mean median,t test and bivariate correlation was done.

Results: In a span of two years 92 cases and 58 controls were selected 65% of the study population was females and the rest were males and ages ranged from 2 to 17 the mean being 9.22 + 3.9 years. Wasting was not related to low vitamin D levels (p = 0.72) exposure to sunlight and HIV infection was significantly correlated to low vitamin D levels (p = 0.2 and p = 0.4) respectively. Among cases vitamin D levels were statistically correlated with CD4 percentage and WHO clinical staging (p = 0.01 and p = 0.00) respectively.

Conclusion: Hence from the above study it may be concluded that HIV infected children and young adults do have a reduced vitamin D level compared to their healthy counterparts. It is also important to note that progression of the HIV disease process lowers the vitamin D level which r evident in terms of CD4 percentage and WHO clinical staging. It requires further research to understand the exact reason and mechanism behind this finding.

Keywords: Vitamin D; HIV; Children; Adolescent; CD4

Abbreviations

HIV: Human Immunodeficiency Virus; AIDS: Acquired Immunodeficiency Syndrome; CLHIV: Children Living with HIV

Introduction

HIV infection is a manageable chronic Disease. Subjects with HIV infection are at increased risk of osteopenia and osteoporosis [1-3]. Immune activation and antiretroviral therapy may underlie this phenomenon. Changes in vitamin D metabolism due to HIV infection may also be a factor [4], be-cause vitamin D is required for bone health maintenance [5] and for adequate immune function [6]. Vitamin D affects the development and function of cells of the immune system that help control HIV infection, including macrophages and T lymphocytes. However, few studies have examined the vitamin D status of subjects living with HIV infection [1,4]. For these reasons, we examined the dietary intake and plasma concentrations of 25-hydroxyvitamin D [25(OH)D] were examined. The association between HIV status and markers of immune activation and plasma 25(OH)D were examined to determine whether HIV infection is associated with poor vitamin D status.

Objectives

- To enumerate Vitamin D levels in HIV positive Children and adolescents
- To compare the Vitamin D levels of HIV infected with non infected group
- To correlate the vitamin D levels with the CD4 levels.

Vitamin D deficiency is common in older adults, with recent studies describing deficiency in18–25% of adult postmenopausal women [1]. Vitamin D deficiency results from several factors including inadequate sun exposure, reduced cutaneous vitamin D synthesis, poor nutrition and certain medications and co-morbid diseases such as anticonvulsants and celiac sprue [3]. The increasing measurement of serum 25(OH)D in older people arises from an increasing awareness of the prevalence of hypovitaminosis D and the role of vitamin D in both the prevention and management of osteoporosis [4]. However, the prevalence of hypovitaminosis D and its impact on health is less certain in adults under age 50 years. Healthy young adults may develop vitamin D deficiency for several reasons. First, the daily vitamin D intake of young adults is often below the recommended intake of 200 international units (IU) daily [5]. Second, young adults spend less time outside than young adults one decade ago [6]. Third, the increasing use of sunscreen to reduce skin damage or cancer may decrease or eliminate cutaneous vitamin D synthesis [6]. Finally, many young adults drink carbonated beverages in place of milk, thereby decreasing the intake of both calcium and vitamin D and potentially increasing the risk of fracture [7]. Despite mounting evidence that young adults are at risk for vitamin D deficiency, no specific recommendations exist regarding evaluation of their vitamin D status. Such lack of guidelines may result from limited information on either the impact of vitamin D on the development of peak bone mass [8] or the long-term safety of increasing serum 25(OH)D levels in young adults. Although epidemiologic data suggests that improved vitamin D status may decrease the risk of certain cancers and autoimmune diseases [9], a true cause-effect relationship has not been established. Subjects with HIV infection are at increased risk of osteopenia and osteoporosis [10]. Immune activation and antiretroviral therapy may underlie this phenomenon. Changes in vitamin D metabolism due to HIV infection may also be a factor [11], because vitamin D is required for bone health maintenance and for adequate immune function [10]. Vitamin D affects the development and function of cells of the immune system that help control HIV infection, including macrophages and T lymphocytes. However, few studies have examined the vitamin D status.

Methods

The patients whose age is from 2 to 18 years were be included in the study. They cases must be were all ART naïve and HIV positive. The controls were age and gender matched, the case and control was taken in the ratio 2:1. A questionnaire was prepared to enumerate the factors that may affect the vitamin D status. This questionnaire was translated in two different languages Hindi and Bengali for different patients. This questionnaire was administered to all the patients. The tools used for the study were questionnaire, Vitamin D enumeration by ELISA method with the same kit at Medical College and Hospital. The vitamin D levels have been categorised according Horlicks et al 2011 [12] as shown in table 1.

Vitamin D status	The serum level of vitamin D in ng/ml
Deficiency	<20
Insufficiency	21-29
Sufficiency	>30
Toxicity	>150

Table 1: Diagnostic cut-offs of levels of serum Vitamin D.

Statistical analysis involved Mean, median, standard deviation of vitamin D level in respect to gender residence age, race and different CD4 levels. T statistics was applied to find out the causal relation of low vitamin level with other independent variable, correlation pearson's r was used for understanding correlation between independent variables affecting vitamin D levels.

Results and Discussions

In a span of two year 150 patients were recruited in the study among them 92 were HIV positive patients and 58 were control. All the HIV positive patients were ART naive and their age ranged from 2 to 17 the mean being 9.22 ± 3.9years. The control was age and gender matched in the ratio of 1:2. The patients were from ART centre of Medical College and Hospital, Kolkata. 65% of the study population was females and the rest were males. More than a quarter (29.3%) of the population was illiterate and the rest 70.6% were primary or higher educated. Most of the population was children and all children do not start school from 2 years especially those belonging to lower socio-economic background. Most of the patient's and control's family members were working. It is important to note that the mean per capita income per month was Rs 2885 ± 739.3. However there were a few patients who did not have family and were taken care by NGO's , hence their per capita income could not be calculated. Only the cases has infections or other health problems , tuberculosis being one of them. All the HIV infected children and adolescents were clinically staged according to WHO clinical staging, the details are provided in Table 2. The controls were healthy and did not complain of any health issues at the time of data collection. The nutritional status of the children and adolescents have been assessed , children from 2 to 5 years have been assessed with the help of weight according to height by WHO and children from 5 to 18 have been assessed with WHO BMI for age standards. The z scores have been noted and hence the coding has been done. According to the interpretation by WHO growth standards HIV positive children show much more wasting , than their HIV negative controls [13] as reflected in the Table 1. It should be noted than these children do catch up growth once given inter-

vention with the help of ART and nutritional support. Another important aspect is that even 6.9 % control children are severely wasted, this can be attributed to the lower socio economic group they belong to as 85.7 percent belong to below poverty level.

Variable		CLHIV n (%)	Control n (%)	Total n (%)
Gender	Male	28 (34.4)	24 (41.4)	52 (34.7)
	Female	64 (69.6)	34 (51.6)	98 (65.3)
Educational status	illiterate	18 (19.6)	26 (44.8)	44(29.3)
	literate	74 (80.4)	32 (45.2)	106 (70.6)
Per capita	≤ 2000	64 (64.8)	48 (85.7)	112 (81.7)
	>2000	17 (35.2)	8 (14.3)	25 (18.3)
Nutritional Status	Severely wasted	16 (17.4)	4 (6.9)	20(13.3)
	wasted	22 (23.9)	10 (17.2)	32(21.3)
	normal	48(52.2)	28 (48.3)	76 (50.6)
	Over weight	06 (6.5)	16 (27.6)	22 (14.6)
	Obese	0	0	0
Active Tuberculosis	present	6 (6.5)	0	6 (6.5)
	absent[r]	86(93.5)	0	86(93.5)
WHO Clinical stage	Stage IV & III	6 (6.5)	NA	6 (6.5)
	Stage I&II	86(93.5)	NA	86(93.5)

Table 2: Sample characteristics.

Source: Primary survey, 2018-19 Kolkata.

Vitamin D levels were assessed and it was found that the percentage of patients having vitamin D deficiency was higher in the HIV infected population as compared to their healthy counterparts. vitamin D levels , this is very evident from figure 1. Again the percentage of patients having insufficient vitamin D levels was higher among healthy controls which may be because the controls who were deficient in Vitamin D levels did not culminate into severe deficiency but remained at the level of insufficiency. The different independent factors which may affect the vitamin D levels among the children were noted in the questionnaire and a t test was done to assess the effect of the variables on the cases and the controls, there was no statistically significant difference in the way the independent variables affected the vitamin D levels among both case and control as pointed out in table 3.

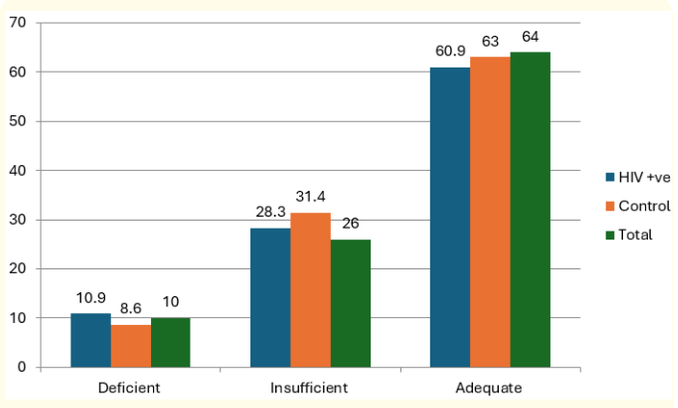

Figure 1: Percentage of subjects according to vitamin D levels.

Variables	P value
Nutritional status	.37
Use of sunscreen	.15
Sea side visit	.15
Exposure to sunlight (in minutes)	.07
Milk consumption	.23
Multi vitamin consumption	.03
Fish oil consumption	.18

Table 3: T test between case and control of the independent variables affecting vitamin D levels.

The different independent factors which may affect the vitamin D levels among the children were noted in the questionnaire and a t test was done to assess the effect of the variables on the cases and the controls. This analysis was crucial to understand if any of the independent variables affected the vitamin D levels differently in the case or the control group. There was no statistically significant difference in the way the independent variables affected the vitamin D levels among both case and control as pointed out in table 3. This could be because the control was selected from similar socio demographic and economic background. Mostly healthy siblings of infected cases were selected as healthy control.

A bivariate correlation was done with all the independent variables and it can be observed from table 4 that 2 variables were significantly associated with vitamin D levels. Firstly sun exposure in minutes was directly positively correlated with the increase in vitamin D levels, this is in line with the thought that sun light promotes vitamin D synthesis in human being [14]. It may also be noted from the table that multi vitamin consumption which did not contain vitamin D or calcium was not correlated with vitamin D levels. Lastly it is important to note that the presence of HIV infection was negatively associated with vitamin D levels. That means the vitamin D levels in HIV positive children and adolescents were significantly less (p = 0.04) in compared to their controls. Similar results were also found in other studies in Africa but there was no control in that study [15]. In this study all the HIV patients were ART naive hence we can say that HIV itself may have some vitamin D lowering property or may be some effect on vitamin D synthesis. This requires some research in cellular level to find out the exact path of action.

Variables	Pearsons r	P value
Nutritional status	.02	.72
Use of sunscreen	.05	.51
Sea side visit	.09	.24
Exposure to sunlight (in minutes)	.12	.02*
Milk consumption	.06	.53
Multi vitamin consumption	.14	.05
Fish oil consumption	.02	.73
HIV infection	-.16	.04*

Table 4: Correlation between factors affecting Vitamin D levels.

*: Correlation is significant at the 0.05 level.

**: Correlation is significant at the 0.01 level.

A subset analysis was done to enumerate the relationship between CD4 percentage of CLHIV and vitamin D levels, this was only done with the cases and it has been portrayed in Table 5. It is evident here that vitamin D levels are directly and significantly correlated with CD4 percentage and WHO staging of the disease of the cases. For children CD4 percentage is taken as a gold standard for determining immunosuppression hence it is important to state that in this study the progression of HIV disease has a direct effect on the vitamin D level of the patient.

Variables	Pearsons r	P value
Nutritional status	.06	.52
CD4 percentage	.27	.01**
CD4 count	.18	.08
WHO clinical staging	-.27	.00**
TB active	.19	.06

Table 5: Correlation between Vitamin D levels and HIV disease markers.

*: Correlation is significant at the 0.05 level.

**: Correlation is significant at the 0.01 level.

Conclusion

The study was done on ART naive patient and HIV negative controls were selected from similar economic background and age hence this study was designed to enumerate the true effect of HIV on vitamin D levels. The factors that affect vitamin D levels in humans have not affected the case and control differently. Hence from the above study it may be concluded that HIV infected children and young adults do have a reduced vitamin D level compared to their healthy counterparts. It is also important to note that progression of the HIV disease process lowers the vitamin D level which r evident in terms of CD4 percentage and WHO clinical staging. It requires further research to understand the exact reason and mechanism behind this finding.

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Conflict of Interest

No conflict of Interest exists.

Bibliography

1. Holick MF., *et al*. "Prevalence of Vitamin D inadequacy among postmenopausal North American women receiving osteoporosis therapy". *The Journal of Clinical Endocrinology and Metabolism* 90.6 (2005): 3215-3224.

2. Lips P., *et al*. "The prevalance of vitamin D inadequacy amongst women with osteoporosis: an international epidemiological investigation". *Journal of Internal Medicine* 260 (2006): 245-254.

3. Vieth R. "Vitamin D supplementation, 25-hydroxyvitamin D concentrations, and safety". *The American Journal of Clinical Nutrition* 69.5 (1999): 842-856.

4. Bischoff-Ferrari HA., *et al*. "Fracture prevention with vitamin D supplementation: a meta-analysis of randomized controlled trials". *JAMA* 293.18 (2005): 2257-2264.

5. Gartner LM and Greer FR. "Prevention of rickets and vitamin D deficiency: new guidelines for vitamin D intake". *Pediatrics* 111.4 (2003): 908-10.

6. Misra M., *et al*. "Nutrient intake in community-dwelling adolescent girls with anorexia nervosa and in healthy adolescents". *The American Journal of Clinical Nutrition* 84.4 (2006): 698-706.

7. Hartman JJ. "Vitamin D deficiency rickets in children: prevalence and need for community education". *Orthopaedic Nursing* 19.1 (2000): 63-67. quiz 67-69.

8. O'Brien KO., *et al*. "Bone mineral content in girls perinatally infected with HIV". *The American Journal of Clinical Nutrition* 73 (2001): 821-826.

9. Madeddu G., *et al*. "Bone mass loss and vitamin D metabolism impairment in HIV patients receiving highly active antiretroviral therapy". *Quarterly Journal of Nuclear Medicine and Molecular Imaging* 48 (2004): 39-48.

10. Mondy K., *et al*. "Alendronate, vitamin D, and calcium for the treatment of osteopenia/osteoporosis associated with HIV infection". *Journal of Acquired Immune Deficiency Syndromes* 38 (2005): 426-431.

11. Haug CJ., *et al*. "Severe deficiency of 1,25-dihydroxyvitamin D3 in human immunodeficiency virus infection: association with immunological hyperactivity and only minor changes in calcium homeostasis". *The Journal of Clinical Endocrinology and Metabolism* 83.11 (1998): 3832-3838.

12. Holick MF., *et al*. "Evaluation, treatment, and prevention of Vitamin D deficiency: An endocrine society clinical practice guideline". *The Journal of Clinical Endocrinology and Metabolism* 96 (2011): 1911-1930.

13. McHenry MS., *et al*. "Growth of young HIV-infected and HIV-exposed children in western Kenya: A retrospective chart review". *PLoS ONE* 14.12 (2019): e0224295.

14. Joy A. "Weydert Vitamin D in children's health". *Children (Basel)* 1.2 (2014): 208-226.

15. Ayesha M., *et al*. "Vitamin D Deficiency in HIV-Infected Children". *South Medical Journal* 109.11 (2016): 683-687.