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Kuchay Gulzar
Registrar, Orthopaedic
Department, Govt. Medical
College Srinagar, Jammu and
Kashmir, India

Farooq Lone
House Surgeon, Orthopaedic
Department, Govt. Medical
College Srinagar, Jammu and
Kashmir, India

Rameez Raja
Registrar, Orthopaedic
Department, Govt. Medical
College Srinagar, Jammu and
Kashmir, India

Mir Samiula
Registrar, Orthopaedic
Department, Govt. Medical
College Srinagar, Jammu and
Kashmir, India

Corresponding Author:
Farooq Lone
House Surgeon, Orthopaedic
Department, Govt. Medical
College Srinagar, Jammu and
Kashmir, India

Prevalence of vitamin D insufficiency in Kashmiri teenagers with appendicular fractures

Kuchay Gulzar, Farooq Lone, Rameez Raja and Mir Samiula

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Abstract

Objective: This study has been done to assess the significance and prevalence of subclinical vitamin D deficiency in the development of fractures in children and adolescents of Kashmiri Origin.

Materials and Methods: Three groups of children were recruited into a cross-sectional study for assessment of serum 25 hydroxyvitamin D [25(OH)D]. These included 100 upper limb fractures (group 1), 100 lower limb fractures (group 2) and 100 healthy controls (group 3). The level of serum 25 hydroxyvitamin D [25(OH)D] was assessed by electrochemiluminescence immunoassays.

Results: 14 % of the injured teenagers in the study were vitamin D deficient (<20 ng/mL) and 38 % had insufficient levels (20 to 30 ng/mL), whereas the respective values of vitamin D deficiency and insufficiency among healthy controls were 7 and 36 %.

Conclusions: Significant proportion of Kashmiri Children recruited for study were vitamin D insufficient, independent of limb fracture status. There was a slight but statistically insignificant increase in prevalence of Vitamin D deficiency in fractured children compared to healthy controls.

Keywords: vitamin D, insufficiency, teenagers, fracture, immunoassays

Introduction

The major biological function of Vitamin D is calcium-phosphate homeostasis. Vitamin D maintains skeletal calcium balance by promoting calcium absorption in the intestine and, therefore plays an important role in bone development and remodeling [1, 2, 3, 4]. The active vitamin D metabolite, 1,25(OH)2D3 has many established direct and indirect effects, leading to a positive impact on bone mineralization. The best known marker of the vitamin status in the body is the circulating levels of 25(OH)D with a long half-time of approximately 30 days. Most of the literature suggest that an optimal level of 25(OH)D in circulation is 30 ng/mL or more and the lower limit is 20 ng/mL [4]. There are studies which shown high prevalence of subclinical vitamin D deficiency in adolescents in Europe [5, 6, 7, 8] and the United States [9, 10, 11]. Fractures are very common in the pediatric population, with an incidence of approximately 50 % in boys and 40 % in girls [12, 13]. Fracture rate is highest between ages 11 and 15 years, which corresponds to the period of maximum postnatal growth velocity [13, 14, 15]. The fracture risk in children can be increased by lower bone mineralization due to genetic [16, 17] and environmental factors, such as poor diet and physical inactivity [18, 19, 20, 21]. Although relationship between low vitamin D levels and fracture risk in infants with rickets [22, 23, 24] and for osteoporotic fractures in adults [25, 26, 27]. Has been well documented in literature, its significance in children and adolescents has been investigated to a lesser extent. Few studies have documented the relationship between vitamin D deficiency and decreased bone density in youth [28]. Some studies have demonstrated a relationship between vitamin D deficiency and fracture risk in children, whereas the study by Conteras *et al.* [29]. 2014 found no relationship between vitamin D deficiency and fracture risk in children.

The main purposes of this study was to determine the prevalence of vitamin D insufficiency in Kashmiri children having an appendicular fracture. Low levels of vitamin D decreases bone mineral density (BMD) and can render teenagers more susceptible to fractures.

Materials and methods

This prospective study was carried out at Bone and Joint Hospital Srinagar Kashmir between

April 2018 to March 2019. Informed consent for the study was taken from the parents/ guardians and ethical clearance for the study was sought from the institutional Ethical Committee. Two hundred teenagers of Kashmir province (India) aged between 10 and 15 years with an appendicular fracture were taken up for the study. These included 100 upper limb and 100 lower limb fractures. In addition a control group of 100 healthy children of same age group was formulated. These were children of either hospital staff or the attendants of the patient. Only those patients were selected who were admitted from outpatient Department for orthopedic intervention of their fracture (closed reduction with or without stabilization by percutaneous wires or screws). Polytrauma patients and patients with fracture due to high velocity trauma were excluded from the study. Any patient or the control child having some chronic disease; congenital or acquired bone disease or any condition limiting physical activity were also excluded from the study.

Blood samples were collected from the basilic vein and centrifuged (1,580×g for 10 min at 20 °C) within 30 min of collection. The obtained seras were stored at -80 °C until further analysis. Serum 25(OH)D were measured by electrochemiluminescence immunoassays at hospital laboratory. Serum 25(OH)D concentrations were stratified as follows: vitamin D deficient (<20 ng/mL); vitamin D insufficient (20 to 30 ng/mL); and vitamin D sufficient (≥30 ng/mL) [30].

The difference between group characteristics in terms of sex

(M/F), age (years), height (cm), weight (kg), BMI (kg/m²) and serum 25(OH)D concentration was verified using one-way analysis of variance (ANOVA). If a significant difference (defined as $p < 0.05$) existed between groups, Tukey's post hoc tests were conducted. Pearson correlations were conducted in order to investigate the influence of serum 25(OH)D levels on other variables.

Results

The three groups were comparable as far as sex, age, height, weight, and BMI are concerned. No significant group effect was found for serum 25(OH)D, ($p = 0.216$). The mean (±SD) 25(OH)D level was 31.5 (±7.8) ng/mL for healthy controls, 30.6 (±8.3) ng/mL for the upper limb fracture teenagers, and 29.2 (±6.8) ng/mL for those with lower limb fractures. Seven (7%) healthy controls were vitamin D deficient and 36 subjects (36 %) were insufficient, hence, 43 % of the healthy group can be considered to display abnormal 25(OH)D levels. fourteen adolescents with upper limb fractures (14 %) were vitamin D deficient, 34 cases were insufficient (34 %), i.e., 48 % can be considered to exhibit abnormal 25(OH)D levels. In the group of lower limb fractures, we noted that 14 teenagers (14 %) were vitamin D deficient and 42 subjects (42 %) were insufficient, hence, 56 % of this group exhibited abnormal 25(OH)D values (Table 1). The Z score based on vitamin D level is presented on Table 2.

Table 1: Characteristics of subjects and serum 25 hydroxyvitamin D [25(OH)D] levels

	Upper limb fractures (n = 100)	Healthy controls (n = 100)	Lower limb fractures (n = 100)
Age (years)	12.8 ± 1.4	12.2 ± 2.6	12.6 ± 1.8
Height (cm)	157.5 ± 12.6	158.7 ± 14.6	158.1 ± 12.7
Weight (kg)	47.8 ± 13	48.2 ± 14.2	50.4 ± 12.4
BMI (kg/m ²)	19.4 ± 2.6	19.2 ± 3.7	20.3 ± 2.3
Serum 25(OH)D ng/mL	31.5 (±7.8)	30.6 (±8.3)	29.2 (±6.8)

Table 2: Z score according to serum vitamin D level

	Vitamin D deficient (n = 35)	Vitamin D insufficient (n = 112)	Vitamin D sufficient (n = 153)
Serum 25(OH)D (ng/mL)	17.6 ± 1.6	26.2 ± 2.4	36.4 ± 6.4

Discussion

In this study, there was no significant differences in the baseline serum 25(OH)D concentrations between the three groups of patients, i.e., the healthy controls, the teenagers with lower limb fractures, and those with upper limb fractures. However, a high prevalence of vitamin D insufficiency was observed among teenagers in all three groups. 43 % of healthy controls presented a vitamin D insufficiency with 25(OH)D levels below 30 ng/mL. 48 % of teenagers with upper limb fractures and 56 % of those with lower limb fractures demonstrated vitamin D insufficiency with 25(OH)D levels below 30 ng/mL.

In one study, 59 % of African American children with fractures were vitamin D insufficient. In addition, the prevalence was higher than the baseline levels reported in comparable populations. In another study based on Swiss children, no significant differences in the baseline serum 25(OH)D concentrations was noted between the three groups of patients, i.e., the healthy controls, the teenagers with lower limb fractures, and those with upper limb fractures. On the other hand, several studies have suggested that the prevalence of low vitamin D levels among pediatric orthopedic patients was frequent. Saglam *et al.* [31], in their study, had higher prevalence of vitamin D insufficiency or deficiency in patients with impaction forearm fractures than healthy controls. McNally *et al.* [32]. Noted, in

their study, that 82 % of 730 Canadian children complaining of unexplained appendicular joint pain had "abnormally low" levels of 25(OH)D (<30 ng/mL) [32]. Davies *et al.* demonstrated equivalent results in the UK, with 40 % of children presenting with orthopedic conditions having insufficient vitamin D levels (<50 nmol/L) [33]. Similarly Szalay *et al.* [34] detected an incidence of vitamin D insufficiency (<30 ng/mL) of 63 % among orthopedic patients evaluated for aspecific musculoskeletal pain. Low vitamin D levels have been observed during winter and spring in 17–50 % of the non-immigrant children living in northern European countries [35]. In contrary, Conteras *et al.* [29] found no relationship between vitamin D deficiency and fracture risk in children. Because of high prevalence of vitamin D insufficiency in general pediatric population in Kashmir region where temperature is cold most of the year, we couldn't deduce statistically significant higher prevalence among teenagers with appendicular fractures.

Conclusion

The present study has shown that a substantial number of 10-15-year-old Kashmiri teenagers with or without limb fractures can be considered as vitamin D insufficient on the basis of their serum 25(OH)D concentration. In addition, no significant differences was noted in the serum 25(OH)D levels between

healthy controls and adolescents with limb fractures. Our results, thus, reinforce the concept that there are probably many confounders (race, genetics, diet, climate, etc.) in determining the real role of vitamin D status in bone accretion during growth.

Conflict of interest: None.

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