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Association of Vitamin D Level with Children Fractures: A Prospective Cohort Study

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Abstract: Fractures have increased prevalence among children which requires searching for intervening options. To evaluate the association of vitamin D with fractures in children. The study design was a prospective design. The study included 70 patients with diagnosed fracture by X-ray and 49 control subjects. Data were collected using a clinical data sheet and laboratory finding of vitamin D. Data were analyzed using SPSS Version 21. The mean age of study group was 6.57+4.66 years and that of control group was 6.88+5.47 years. Males were more frequent in both study and control groups 58.6 and 59.18%, respectively. The mean level of vitamin D in study group was 23.22+14.68 ng/mL and this was slightly higher than that of control group 22.52+12.23 ng/mL. According to anatomic site, fractures in upper limb 75.7% were more prevalent than that in lower limb 24.3%. The type of fracture was either complete 88.6% or green stick 11.4%. No significant association was obtained of vitamin D with fractures in children ($p>0.05$). Among patients who have fractures, a significant association between vitamin D level and each of age, anatomic location of structure and type of fracture. The present study showed, the lack of association between vitamin D level and fractures in children.

Key words: Children, vitamin D, fracture, type of fracture, anatomic, site

INTRODUCTION

An emerging trend has been witnessed in the middle of the 20th century, so that, the mortality of infants and children resulting from infections and nutritional disturbances has dramatically decreased in Europe. On the other hand he role of accidents in death rate and morbidity has become more important (Mayranpaa, 2012).

Several studies have indicated that fractures are prevalent among children accounting for 10-25% of all pediatric injuries (Sibert *et al*., 1981; Landin, 1983; Jones and Cooley, 2002; Mattila *et al*., 2004; Spady *et al*., 2007).

The term "vitamin D" was first used in 1922 when McCollum and colleagues reported the identification of a new lipid-soluble substance which they named vitamin D. This finding appeared to be of great importance as the new vitamin showed to be capable of preventing rickets, a bone disease which at that time had reach epidemic proportion (Hansen *et al*., 2001; Holick, 2006).

The identification of vitamin D led to intensive search for the active substrate of this vitamin in 1931. Askew and colleagues succeeded in isolating vitamin D2 from irradiated plant sterols, later in 1936, vitamin D3 was identified by Windaus and colleagues but it was not until the 1971 where (1,25 (OH) 2 D3) the metabolically active form of vitamin D3 was identified by Holick and colleagues (Holick, 2003; Kochupillai, 2008). Vitamin D regulates colonic proliferation, differentiation, apoptosis and angiogenesis and the colonic vitamin D system is regulated by several known natural factors, the most important once is nutritional calcium (Cross *et al*., 2009).

Cranney *et al*. (2007) conducted a study to review and analyze the literature about the association between vitamin D and bone fracture. The results showed a

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deficiency in studies about infants and recommended conducting additional high quality studies in infants, children, premenopausal women and diverse racial or ethnic groups. However, the evidence for an association was inconsistent for fractures in infants.

Contreras *et al.* (2014) conducted a study to evaluate the potential of healthy children who had fractures due to accidental trauma to be deficient of vitamin D compared to their counterparts without fractures. Findings of the study showed that the level of vitamin D in fracture group was 26.7 ng/mL and that of control group was 25.45 ng/mL. No statistical variations were obtained (p = 0.84).

Minkowitz *et al.* (2017) conducted a study to explore the possibility of existence of association between the level of vitamin D and life style of children with fractures and those without fractures. Results showed that both fracture and non-fracture patients and similar levels of vitamin D 27.5±8.9-27.4±9.1 ng/mL, respectively. No significant association was observed (p = 0.941).

Study objectives: The aim of this study was to evaluate the association of vitamin D level with fractures in children.

MATERIALS AND METHODS

- Study design: a single-center, prospective study design was conducted
- Study population: children from 0-16 years who admitted or visit OPD clinic at King Abdullah University Hospital with fracture confirmed by X-ray
- Study sample: study sample included 70 patients with diagnosed fracture and 49 control persons
- Study area: King Abdullah University Hospital, Jordan University of Science and Technology
- Study period: January 2017-March 2017
- Study tool: clinical data sheet with vitamin D level assessment
- Inclusion criteria: any child with fracture under the age of 18 years and his caregiver signed a consent form to carry out the study
- Exclusion criteria: participant not fulfilling the inclusion criteria

Data analysis: Data were collected in excel sheet to create raw data and then the data were exported into SPSS Version 21 for statistical analysis. Data were analyzed based on frequency and percentages for categorical variables such as gender, Means (M) and Standard Deviation (SD) for continuous variables such as age. The association between vitamin D level among study and control groups was computed based on independent t-test. Significance was considered at $p<0.05$.

RESULTS AND DISCUSSION

Demographic characteristics of participants: Table 1 and Fig. 1 and 2 shows that the mean age of study group was 6.57+4.66 years and that of control group was 6.88+5.47 years. Males were more frequent in both study and control groups 58.6 and 59.18%, respectively.

Clinical characteristics of study participants: Table 2 shows the mean level of vitamin D in study group was 23.22±14.68 ng/mL and this was slightly higher than that of control group 22.52±12.23 ng/mL (Fig. 3). According to anatomic site, fractures in upper limb 75.7% were more prevalent than that in lower limb 24.3% (Fig. 4). The type of fracture was either complete 88.6% or green stick 11.4% (Fig. 5).

Table 1: Demographic characteristics of participants

Variables	Description
Age-study group (M±SD) years	6.57±4.66
Age-control group (M±SD) years	6.88±5.47
Gender-study group (N, %)	
Males	41 (58.6)
Females	29 (41.4)
Gender-control group (N, %)	
Males	29 (59.18)
Females	20 (40.82)

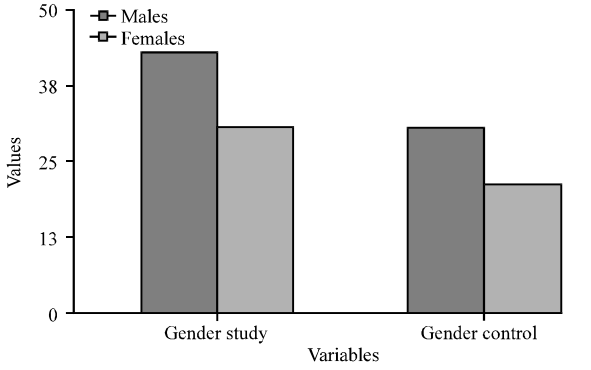

Fig. 1: The frequency of study participants by gender

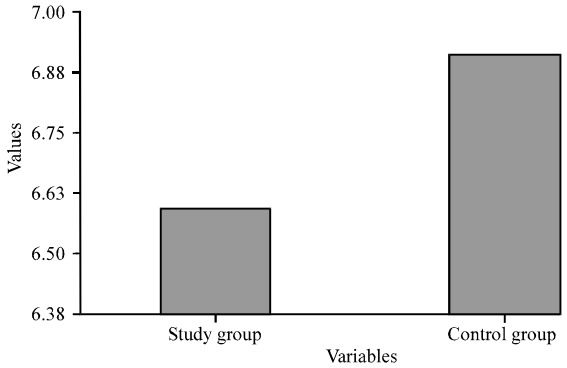

Fig. 2: The frequency of study participants by age

Table 2: Clinical characteristics of study participants

Variables	Description
Vitamin D-study group (MSD), ng/mL	23.22±14.68
Vitamin D-control group (M±SD), ng/mL	22.52±12.23
Fracture by anatomic region (N, %)	
Upper limb	53 (75.7)
Lower limb	17 (24.3)
Type of fracture (N, %)	
Complete	62 (88.6)
Green stick	8 (11.4)

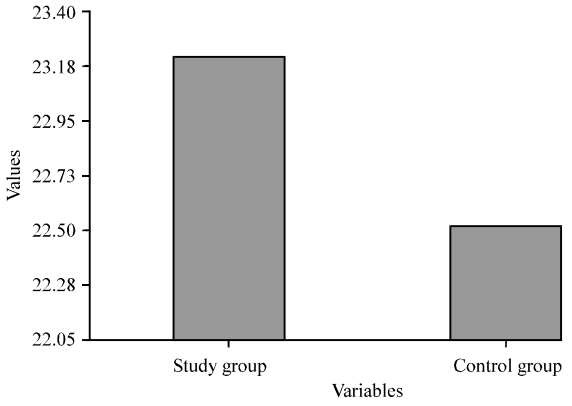

Fig. 3: Prevalence of vitamin D in study groups

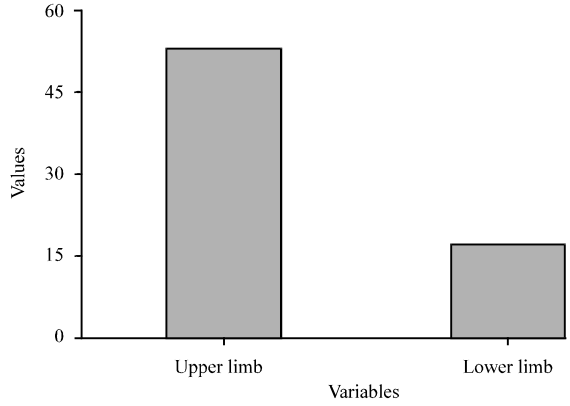

Fig. 4: Fracture by anatomic region

The association between vitamin D levels in study and control groups: Table 3 shows, no significant differences between the level of vitamin D in study group 23.22±14.26 ng/mL and control group 22.52±12.23 ng/mL p = 0.775.

The association between vitamin D and study variables (one way ANOVA): The level of vitamin D is subdivided into two main categories: ≤30 and >30 ng/mL. Table 4 shows, the level of vitamin D is associated significantly with age p = 0.006 and anatomic location of fracture p = 0.000 and type of fracture p = 0.000.

Table 3: The association between vitamin D levels in study and control groups (independent t-test)

Pairs	M	SD	p-value
Vitamin D-study group	23.22	14.26	0.775
Vitamin D-control group	22.52	12.23	-

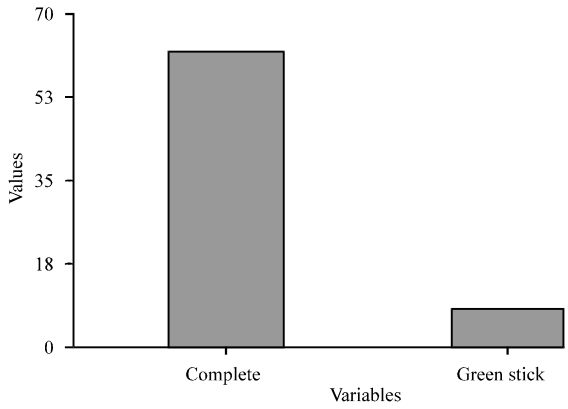

Fig. 5: Frequency of fractures according to their type

This study was conducted to investigate the association of vitamin D level with fractures in children. The data of this study showed that there was no association between vitamin D and fracture in children (p = 0.775). This finding is in line with other studies that reported no association between vitamin D and fracture (Contreras *et al*., 2014; Minkowitz *et al*., 2017).

The efforts in this study failed to prove this association, probably due to have similar levels of vitamin D in both groups. Although, the general trend in Jordan is to find population deficient in vitamin D as it is the general status in this study it seems that vitamin D deficiency may need to be less than in this study to impact fractures. According to the study by Cranney *et al*. (2007) there is a deficiency in studies about infants and recommended conducting additional high quality studies in infants, children, premenopausal women and diverse racial or ethnic groups. However, the evidence for an association was inconsistent for fractures in infants.

The findings of this study showed that among patients with fractures there was a strong association between vitamin D and each of age p = 0.006 anatomic location p = 0.000 and type of fracture p = 0.000. These findings may add new piece of information for literature because these findings are not well addressed in literature. It is plausible to claim a role of vitamin D in severity of fractures due to the effect of vitamin D in bone structures as reported in several studies (Cranney *et al*., 2007; Contreras *et al*., 2014; Minkowitz *et al*., 2017).

Table 4: The association between vitamin D and study variables (one way ANOVA)

Variables	Sum of squares	df	Mean square	F-values	Sig.
Age					
Between groups	1.851	1	1.851	8.112	0.006
Within groups	15.520	68	0.228		
Total	17.371	69			
Vitamin D-anatomic location					
Between groups	8785.506	1	8785.506	113.579	0.000
Within groups	5259.925	68	77.352		
Total	14045.431	69			
Vitamin D-type of fracture					
Between groups	8785.506	1	8785.506	113.579	0.000
Within groups	5259.925	68	77.352		
Total	14045.431	69			

CONCLUSION

The present study showed the lack of association between vitamin D level and fractures in children. Within patients who have fractures, a significant association between vitamin D level and each of age, anatomic location of structure and type of fracture.

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