

# ORIGINAL ARTICLE

## Is There Any Relationship between Vitamin D Deficiency and Gross Motor Development in 12-Month-Old Children?

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### Abstract

#### Objective

We aimed to assess the possible relationship between vitamin D deficiency and gross motor developmental milestones in Iranian children in Tehran City, Iran.

#### Materials & Methods

In this cross-sectional study, 186 healthy children of one-yr-old age referring to a children hospital in Tehran, Iran from May 2015 to April 2016, were enrolled. The gross motor developmental milestone of children and their serum vitamin D concentration were evaluated.

#### Results

Overall, 186 children, 92 males (49.5%) were studied. Twenty-four patients (12.9%) just were able to sit without support, and 40 patients (21.5%) to stand alone and to sit without support. Besides, 122 patients (65.6%) were able to walk with assistant or alone and to sit without support and stand alone. Vitamin D was sufficient in 148 children (79.6%), insufficient in 32 (17.2%) and deficient in 6 (3.2%). Sufficient vitamin D was significantly correlated with walking ability ( $P < 0.001$ , OR=3.9, 95%CI=1.9-8.4).

#### Conclusion

Considering the significant correlation between vitamin D deficiency and gross motor developmental milestones in this population of children, children referring to gross motor developmental delay need to be thoroughly evaluated for vitamin D deficiency.

**Keywords:** Vitamin D; Gross motor development; Children

## **Introduction**

Vitamin D is important for skeletal growth and cellular function due to its role in calcium homeostasis through regulating calcium absorption in bowel (1). Additional health benefits of vitamin D have been anticipated in children such as prevention of type 1 diabetes mellitus, asthma, cardiovascular disease, influenza and respiratory infections (2-5). In children, vitamin D has a role in motor development (6, 7).

Vitamin D deficiency is a common condition in children. Particularly those who have chronic disease, malnourished, have geographically limited sun exposure, as well as those with darker skin, and chronically using special medications(8, 9).

In case of vitamin D deficiency, bowel absorption of calcium and phosphorus is reduced and the parathyroid gland responds to low serum calcium levels by producing parathyroid hormone (PTH) to increase the serum calcium to an acceptable level. PTH increases calcium reabsorption in the kidneys and excretion of phosphorus, thus reducing the adverse complication of elevated calcium phosphate products (10, 12). Over weeks to months stunting, rickets and osteomalacia might appear (13, 14). Children's vitamin D insufficiency also may prevent children achieving their peak bone mass and genetically programmed height (13). The enhanced rate of bone growth in children implies how inadequate level of vitamin D in this period of life can damage this process (8).

Vitamin D status is important for motor development in children (6, 7); however, more researches are needed to evaluate the association of vitamin D status in pediatric patients with developmental status (15).

The prevalence of vitamin D deficiency is reported considerably higher in Middle-Eastern countries.

The incidence of Vitamin D deficiency among Iranian children is 85.6% (16, 17).

Even though there is high prevalence of Vitamin D deficiency among Iranian children; based on our knowledge the relation between Vitamin D levels and motor development in children has not ever been evaluated in Iran. Therefore, in this study, we aimed to assess the possible relationship between vitamin D deficiency and gross motor developmental milestones in one-year-old Iranian children in Tehran City.

## **Materials & Methods**

In this cross-sectional study, 186 twelve-month-old children referred to a university hospital in Tehran, Iran from May 2015 to April 2016, were enrolled. The study was approved by the Research Ethics Committee of Tehran University of Medical Sciences, Tehran, Iran. Informed parental consent was obtained prior to sampling.

The inclusion criteria included term delivery, twelve-month-old, without any history of asphyxia, neuromuscular disease, metabolic diseases, Down syndrome and any previous major disease.

The sampling was convenience. Demographic data such as gender were recorded. Gross motor development was assessed by a pediatrician.

Three distinct gross motor milestones were selected as follows: sitting without support; standing alone and walking with assistant or alone. These three milestones were selected considering that most of twelve-month-old children have the ability to perform them based on various existing developmental scale (18, 19). Moreover, they are universal and simple to test and evaluate. Therefore, administration and interpretation of the child's performance could be cleared (18, 19).

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**Vitamin D assessment:** Serum level of Vitamin D was measured by ELISA method (using Bioactiva Diagnostica kits). Then, children were divided into 3 groups based on serum level of Vitamin D:

- Deficient: 25(OH)D < 20 ng/ml
- Insufficient: 21 ng/ml < 25(OH)D < 29 ng/ml
- Sufficient: > 30 ng/ml (20).

### Data analysis

Statistical analyses were carried out using SPSS 18 (Chicago, IL, USA). The frequency of qualitative variables was reported. For evaluation of relationships between qualitative variables, Chi-squared test was used. In all tests,  $P$ -value < 0.05 was considered significant difference. Finally, to predict the effect of gender and vitamin D status on the gross motor developmental milestones in one-year-old children, multinomial logistic regression test was applied.

### Results

Overall, 186 children of one-yr-old age, including 92 boys (49.5%) and 94 girls (50.5%) were studied. Twenty-four patients (12.9%) just were able to sit

without support, 40 patients (21.5%) were able to stand alone, and to sit without support. Besides, 122 patients (65.6%) were able to walk with assistant or alone, in addition to sit without support and stand alone.

Vitamin D was sufficient in 148 children (79.6%), insufficient in 32 (17.2%) and deficient in 6 (3.2%). There was no significant relationship between gender and gross motor development ( $P=0.58$ ). There was a significant relation between Vitamin D status and motor development in our participants ( $P<0.001$ ). Of six children with Vitamin D deficiency, one case (16.7%) could walk and 1 case (16.7%) could stand alone. Four cases (66.7%) were able to sit without support (Table 1).

Table 2 shows the result of multinomial logistic regression test. Gender did not have a significant effect to predict the gross motor developmental milestones in one-year-old children. The probability of walking for a child who had sufficient Vitamin D was 35 times more than a child who had Vitamin D deficiency ( $P=0.002$ , OR=35.95, 95% CI=3.69-349.87).

**Table 1.** The relation between gender and serum levels of vitamin D with gross motor development

		Gross motor development			P-value
		Sitting without support (%)	Standing alone (%)	Walking with assistant or alone (%)	
Gender	Male	57 (46.7)	22 (55)	13 (54.2)	0.58
	Female	65 (53.3)	18 (45)	11 (45.8)	
Vitamin D status	Deficiency	1 (0.8)	1 (2.5)	4 (16.7)	<0.001
	Insufficiency	14 (11.5)	10 (25)	8 (33.3)	
	Sufficient	107 (87.7)	29 (72.5)	12 (50)	

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**Table 2.** The prediction value of gender and serum level of vitamin D to the gross motor development

Gross Motor Developmenta		B	OR	P-value	95% CI for OR
Walking with assistant or alone	Intercept	-1.83		0.17	
	Gender	0.29	1.34	0.53	0.52 – 3.45
	Vitamin D sufficient	3.58	35.95	0.002*	3.69 – 349.87
	Vitamin D insufficient	1.96	7.1	0.1	0.67 – 75.39
	Vitamin D deficit	0 <sup>b</sup>	.	.	.
Standing alone	Intercept	-1.34		0.32	
	Gender	-0.02	0.97	0.96	0.34 – 2.78
	Vitamin D sufficient	2.26	9.66	0.052	0.97 – 95.62
	Vitamin D insufficient	1.6	4.99	0.18	0.46 - 54
	Vitamin D deficit	0 <sup>b</sup>	.	.	.

a: The reference category is sitting without support

b: this parameter is set to zero because it is redundant.

B: Coefficient

OR: Odds ratio

CI: Confidence Interval

### Discussion

One common clinical symptom in Vitamin D-associated rickets is motor developmental delay in children (6, 7).

In the present study, 12.9% of children were able to sit without support, 21.5% were able to stand alone and 65.6% were able to walk. In case of serum levels of Vitamin D, only 6 participants had Vitamin D deficiency (3.2%). There was a significant relation between Vitamin D status and gross motor development in this population of children ( $P < 0.001$ ).

According to the results of Multinomial Logistic Regression analysis, the chance of walking ability in children with Vitamin D sufficient is up to 35 folds higher than children with Vitamin D deficiency ( $P = 0.002$ ).

A retrospective study on children suffering from hypocalcemia or rickets because of vitamin D

deficiency showed that Vitamin D deficiency could play a role in manifestations such as leg parenthesis, joint stretching, abnormal bones and motor developmental delay (21).

In another study in children with rickets, the clinical manifestations were motor developmental delay in 20 cases (33.3%), skeletal changes in clinical examination (66.66%) in 40 infants and radiologic signs of rickets in 51 cases (85%) were confirmed (22).

Overall, 24 under five years old children suffering from Vitamin D deficiency and motor developmental delay were the most important clinical signs among children with Vitamin D deficiency (23).

Totally, 42 infants older than 1 year were evaluated, who were not able to walk. About 60% of these children had nutritional rickets, and all of them showed normal radiologic and laboratory findings

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after 3 wk of treatment. Seventeen patients were able to walk 3 months after treatment (6). Moreover, walking delay was reported as one of severe Vitamin D deficiency complications (24). In England 17 children hospitalized because of secondary hypocalcemic convulsion due to Vitamin D deficiency were studied and showed delay in motor development especially walking as the most common complication (25). Vitamin D deficiency in children can be the cause of gross motor delay among them and both of them were consistent.

**In conclusion,** Vitamin D deficiency in children is associated with motor development delay. Children referring to physicians with motor developmental delay need to be checked for Vitamin D, in order to administer appropriate doses of Vitamin D and prevent further continuation of motor developmental delay.

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### Authors' Contributions

Reza Tavakolizadeh, Maryam Ardalani: Concept and design

Maryam Ardalani, Seyed Yousef Mojtahedi: Acquisition of data

Ghazal Shariatpanahi, Azadeh Sayarifard: Analysis and Interpretation of data

Reza Tavakolizadeh, Azadeh Sayarifard, Seyed Yousef Mojtahedi: Drafting and revising

Reza Tavakolizadeh, Ghazal Shariatpanahi: Final approval

All authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

### Conflict of interest

The authors declare that there is no conflict of interests.

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