



Serum Vitamin D Levels and Severity of Asthma in Children

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Authors' contributions

This work was carried out in collaboration between both authors. Author AS designed the study, wrote the protocol and interpreted the data and anchored the field study, gathered the initial data and performed preliminary data analysis. Author MA managed the literature searches and produced the initial draft. Both authors read and approved the final manuscript.

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ABSTRACT

Introduction: Asthma is a common chronic disease and it is a cause of attending the emergency department, hospitalization, and school absences in children. Several studies recorded in various countries report the increased prevalence of about 50% per decade for childhood asthma. Vitamin D is an essential vitamin which has effects on function of the immune system. There are Different and conflicting studies about the association between low concentration of vitamin D levels and severity of asthma in children.

The aim of this study was to assess the relationship between serum vitamin D status and childhood asthma.

Materials and Methods: In this analytical cross-sectional study, 134 children of 3-14 years old with asthma, who were hospitalized in 2014 in Madani Hospital in Khorramabad city, were investigated with regard to their age, gender, BMI, the use of inhaled corticosteroids, and serum levels of 25-Hydroxy Vitamin D. The variables and their possible association with vitamin D deficiency in patients were investigated, using the collected data from the questionnaires and laboratory exams.

Findings: Mean age of the hospitalized children was 6.76 ± 2.8 year. Mean serum vitamin D levels

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in children with asthma was, 58.8 ± 24.7 mg/dL, regardless of its severity. Among all of the children with moderate persistent asthma, 13 subjects (52%) have had vitamin D deficiency and in children with mild persistent asthma, this value was 17.1%. In addition, 1.5% of the children with intermittent asthma have had serum vitamin D deficiency. According to Fisher's exact test, the difference in the frequency distribution of serum vitamin D status in children with asthma based on the severity of asthma was significant statistically ($P_v < 0.0001$). In spite of lower serum vitamin D in obese and over-weighted children relative to the children with normal and low BMI, this difference was not statistically significant using one-way analysis of variance.

Conclusion: In higher severities of asthma, vitamin D deficiency is more evident. Therefore, sufficient amounts of vitamin D supplementation may be effective in reducing the severity of asthma in children.

Keywords: Asthma; children; vitamin D.

1. INTRODUCTION

Asthma is a chronic inflammatory condition of lung airways resulting in episodic airflow obstruction causing considerable morbidity in 2007, 9.6 million children (13.1%) had been diagnosed with asthma in their lifetimes. Of this group, 70% had asthma currently, and 3.8 million children (5.2%), nearly 60% of those with current asthma, had experienced at least one asthma attack in the prior year. Boys (14% vs 10% girls) and children in poor families are more likely to have asthma [1]. Asthma is one of the most common causes of hospitalization of children in the emergency room, hospital and school absenteeism, which is controlled through different treatments such as beta-agonists, inhaled corticosteroids and oral medications. Asthma in children imposes heavy costs on families and health center [2-4].

As a result of ultraviolet rays this vitamin is generated through a series of similar reactions with a material that exists under the derma. It is converted into 25-hydroxycholecalciferol and 1- and 25-hydroxycholecalciferolin the liver and in kidneys respectively [5,6]. Vitamin D is one of the basic vitamins, which has effects on epithelial cell, T and B lymphocytes, and by induction of regulatory T cells to produce interleukin (IL)-10. Vitamin D modulates inflammatory processes and could help to control asthma severity [7].

Vitamin D deficiency is related to many immune diseases, infections and cancers [8,9]. It plays an important role in lung development the use of which could be effective in the prevention and treatment of acute respiratory diseases [10]. In a series of studies it has been shown that taking enough vitamin D during pregnancy reduces the risk of respiratory infections and asthma in children [11,12].

A number of studies have suggested that low vitamin D levels are associated with increased risk of developing asthma [13-15] but other studies failed to confirm these findings [16,17].

2. MATERIALS AND METHODS

This study is a cross-sectional epidemic study, which is conducted on 134 children of 3 to 14 years old with asthma, who were hospitalized in Khorram Abad Children's Hospital in 2014. Convenience sampling was the employed sampling method. The sample acceptance criteria include: Asthma disease based on the physical examination, clinical trials and approved by pediatric allergist. Subjects presenting the other chronic respiratory diseases and a history of consumption of any supplements of vitamin D or drugs that modulate serum vitamin D levels were excluded. Written consent was received from all of the parents whose children have participated in this study.

A Performa was prepared, which included the background of the patients including age, gender, BMI, and use of inhaled corticosteroids. Serum 25-hydroxyvitamin D levels were measured using EIA method and stutfax-avernes (ids) kit made in England. Serum 25-hydroxyvitamin D levels of less than 25nmol/L and 25-74 nmol/L represent the deficiency and inadequacy respectively. By collecting the data obtained from the Performa and laboratory exam, the variables and their possible relation with vitamin D deficiency in patients was investigated. ANOVA or Kruskal-Weiss statistical methods were employed to compare the values of vitamin D according to the mentioned variables. In the case of converting vitamin D levels into a qualitative variable (vitamin deficiency-inadequacy of vitamin levels and normal vitamin levels) Chi-square test or Fisher's exact test were used.

3. FINDINGS

The mean age of hospitalized children with asthma was 6.76 ± 2.8 year. The youngest children were 2 and the oldest were 14 years old. 56% of the children were between 5-9 years old. 61.9% of them were boys. 88.8% of the patients have been city dwellers (Table 1).

BMI in 36.6% of the children was normal. 22 subjects had the BMI of higher than 30 (Table 2). The mean BMI of the patients was 22.5 ± 8.4 .

With regard to the type and severity of asthma in children under study, 68 (50.7%), 25 (18.7%), and 41 subjects (30.6%) suffered from intermittent, moderate persistent and mild persistent asthma.

Table 3 shows the frequency distribution of serum vitamin D levels in children with asthma

under study in which 31 (23.1%), 82 (61.2%) and 21 subjects (15.7%) have had normal vitamin D, inadequate vitamin D and vitamin D deficiency, respectively. The mean serum vitamin D levels in all children with asthma were 58.8 ± 24.7 mg/dL regardless of asthma severity.

Investigating serum vitamin D status according to the asthma severity has indicated that vitamin D deficiency was evident in 52%, 17.1%, and 1.5% of children with moderate persistent, mild persistent and intermittent asthma, respectively. Based on Fisher's exact test the difference between frequency distribution of serum vitamin D status in children with asthma is statistically significant according to the asthma severity ($PV < 0.0001$). Table 4 represents the mean and standard deviation of vitamin D values in different groups with asthma.

Table 1. Absolute, relative, and cumulative frequency distribution of characteristics of children with asthma

Characteristic	Absolute frequency (number)	Relative frequency (%)	Cumulative frequency (%)
Age (year):			
1-4	33	(24.6)	(24.6)
5-9	75	(56)	(80)
10-14	26	(19.4)	(100)
Gender:			
Male	83	(61.9)	(61.9)
Female	51	(38.1)	(100)
Place of habitation:			
City	119	(88.8)	(88.8)
Village	15	(11.2)	(100)

Table 2. Absolute, relative, and cumulative frequency distribution of BMI in children with asthma

BMI	Absolute frequency (number)	Relative frequency (%)	Cumulative frequency (%)
<18	45	(33.6)	(33.6)
18-24.9	49	(36.6)	(72.2)
25-29.9	18	(13.4)	(83.6)
≥ 30	22	(16.4)	(100)

Table 3. Absolute, relative, and cumulative frequency distribution of serum vitamin D status in children with asthma

Vitamin D status	Absolute frequency (number)	Relative frequency (%)	Cumulative frequency (%)
Normal	31	(23.1)	(23.1)
Inadequate	82	(61.2)	(84.3)
Deficiency	21	(15.7)	(100)

Table 4. A comparison of mean and standard deviation of serum vitamin D levels in children with asthma according the severity of asthma

Severity of asthma	Serum vitamin D values (mg/dl)	P-value
Moderate persistent	39.75±21.6	<0.0001
Mild persistent	50.067±18.42	
Intermittent	70.85±22.8	

* The type of statistical test: ANOVA

Investigating serum vitamin D status according to different age groups of children under study, the findings revealed that children with moderate persistent and mild persistent asthma, the highest vitamin D deficiency was observed in the age group of 10-14 years (50%, and 28.6% respectively).

In children with mild persistent asthma, only one case of vitamin D deficiency was observed that was related to the age group of 5-9 years old.

Despite the difference in frequency distribution of vitamin D deficiency in different age groups with different severities of asthma, none of these differences were significant statistically. In moderate persistent asthma, the mean serum vitamin D levels in girls was significantly lower than boys, which was significant statistically

according to the results of independent T-test; however, it was not significant in mild persistent and intermittent asthma.

Mean serum vitamin D in over-weighted and obese children was lower compared to slim and normal subjects with regard to BMI. However, this difference was not significant statistically according to ANOVA (Table 5).

In children with moderate persistent asthma and the history of regular use of inhaled corticosteroids, the mean vitamin D was lower than those without this history; however, this difference was not significant statistically (PV = 0.11). Nevertheless, in children with mild persistent asthma, the difference in the mean of serum vitamin D values was statistically significant (PV = 0.006), (Table 6).

Table 5. A comparison of mean and standard deviation of serum vitamin D levels in children with different severities of asthma by BMI

Severity of asthma	BMI	Serum vitamin D levels(mg/dl)	P-values
		Mean ± standard deviation	
Moderate persistent	<18	51.9±24.7	0.38
	18-24.9	36.8±21.3	
	25-29.9	38.2±20.7	
	≥30	24.2±10.2	
Mild persistent	<18	49.9±20.6	0.47
	18-24.9	54.9±19.7	
	25-29.9	53.3±13.9	
	≥30	42.3±13.8	
Intermittent	<18	78.1±24.6	0.052
	18-24.9	73.1±20.9	
	25-29.9	62.6±18.19	
	≥30	60.8±20.5	

Table 6. A comparison of mean and standard deviation of serum vitamin D levels in children with mild to moderate persistent asthma by the history of continuous use of inhaled corticosteroids

Severity of asthma	History of continuous use of inhaled corticosteroids	Serum vitamin D levels	P-values
		Mean ± standard deviation	
Moderate persistent	Yes	33.17±15.9	0.11
	No	48.12±25.6	
Mild persistent	Yes	41.07±13.28	0.006
	No	56.8±18.8	

4. DISCUSSION

In this study that involved 134 hospitalized children with asthma, most of the patients were boys who were city dwellers. 50.7%, 30.6%, and 18.7% of them suffered from intermittent, mild persistent, and moderate persistent asthma. The mean serum vitamin D level in all children under study was 58.8 ± 24.7 mg/dL.

52% of children with moderate persistent, 17.1% with mild persistent and 1.5% with intermittent asthma suffered from serum vitamin D deficiency. According to Fisher's exact test, the difference in frequency distribution of serum vitamin D status in children with asthma is significant with regard to the severity of asthma ($PV < 0.0001$). In the group with moderate persistent asthma, vitamin D deficiency was significantly more in girls compared to boys. Chinellato et al. measured serum vitamin D values in 77 children with asthma and it was reported that 53.3% of them suffered from serum vitamin D deficiency [18]; while in this study, 70.6% of the children suffered from this deficiency.

The study of Tolppanen et al. [17] showed, higher 25(OH) D concentrations are associated with increased risk of wheezing, asthma and flexural dermatitis in children and the result of their study was inconsistent with this study.

In a study conducted on 1014 children with asthma in the range of 5-12 years old, 65% had enough vitamin D, 25% had inadequate and 10% of the patients suffered from vitamin D deficiency, and deficiency more evident in older patients [19], which is consistent with our study.

The results of the study conducted in Turkey on 2-14 year old children with asthma revealed that there is an inverse correlation between serum vitamin D levels and asthma severity [20], which is consistent with the present study conducted on 3-14 year old children.

In the present study, mean vitamin D values were compared in different age groups of children with different severities of asthma. In intermittent and moderate persistent asthma, the lowest vitamin D value was observed in 10-14 year old group and this difference was statistically significant. In this study, there was no significant relationship between BMI and vitamin D deficiency. In a study by, Ann Chen, vitamin D deficiency in patients with asthma, who had

higher BMI values, was more evident which is not consistent with this study [21].

5. CONCLUSION

This study shows that in children with asthma, there is an inverse relationship between asthma severity and serum 25(OH) vitamin D levels and vitamin deficiency is more evident in higher severities of asthma.

6. SUGGESTION

It is suggested to conduct a periodic assessment of vitamin D in children with asthma to prescribe it in the case of deficiency in order to reduce the severity of asthma in these children. Since, in higher severities of asthma, vitamin D deficiency is more evident, supplements with sufficient amounts of vitamin D is given to these patients to compensate the deficiency and prevent the complications so that they can enjoy a better quality of life. We suggest that treatment with vitamin D supplement in children with asthma might reduce airway inflammation and severity of asthma.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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