Original article

Detection of Vitamin (D) deficiency in children and adolescents suffering from bronchial asthma in Suez Canal University Hospital, Ismailia

Background: *Recent data suggest that there is a worldwide epidemic of vitamin D deficiency and lack of vitamin D has been linked to increased incidence of asthma and increased severity of asthma in children. Therefore, the examination of relationship between vitamin D and bronchial asthma was important.* ***Objective:*** *To determine serum vitamin D level in children and adolescents suffering from bronchial asthma and to detect the relationship between vitamin D level and asthma severity symptoms.* ***Methods:*** *This case–control study was conducted on 40 asthmatic children and adolescents, their ages ranged from 2-18 years who were attending to pediatric department at Suez Canal University Hospital, and were previously diagnosed as bronchial asthma according to the National Asthma Education and Prevention Program (NAEPP) 2007. In addition, 40 age and sex matched healthy children served as a control group. All children were subjected to history taking, clinical examination, including; anthropometric measurements, and chest examination. Serum levels of 25-hydroxyvitamin D (25OHD)[25(OH) D], total IgE level, and peripheral blood eosinophil count were evaluated.* ***Results:*** *The mean age of studied asthmatic children was 5.14±2.87 years. Asthma was more reported in girls than boys (55% and 45% respectively). Asthma prevalence was higher in urban than rural areas. In our study, asthmatic patients had significantly lower vitamin D levels than controls. We found that vitamin D insufficiency in 35% of studied asthmatic children. There was a statistically significant negative correlation between vitamin D level and the severity of asthma ($p < 0.001$).* ***Conclusion:*** *Vitamin D deficiency is relatively frequent in asthmatic patients who were attending the pediatric department at Suez Canal University Hospital. There was a significant inverse relationship between vitamin D levels and the severity of asthma symptoms.*

Key Words: Children, adolescences, bronchial asthma, vitamin D.

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INTRODUCTION

Asthma prevalence has increased in recent decades. It is estimated to affect 300 million people worldwide, with an expected increase to 400 million worldwide by 2025. In a population of children and adolescents, bronchial asthma occurs with rate of 5-10%. As a chronic inflammatory disease of the airways, asthma causes 0.25 million deaths annually and substantial socioeconomic burden around the globe[1].

There is little doubt that the profound increase in asthma in the last few decades has been caused to a great extent by deprivation from sunlight exposure along with the increased use of sunscreen, which can inhibit up to 99% of vitamin D production by the skin[2].

Vitamin D deficiency remains a major health problem in many parts of the world, particularly Africa, the Middle East and India. Poor diet and limited sunshine exposure have been suggested as major contributors to vitamin D deficiency[3]. Epidemiological evidence suggests that there is a worldwide epidemic of vitamin D deficiency and lack of vitamin D has been linked to increased incidence of asthma and increased severity of asthma in children[4].

The relation between 25-hydroxyvitamin D levels (the major circulating form of vitamin D) and markers of allergy and asthma severity were shown in a cross-sectional study of 616 Costa Rican children between the ages of 6 and 14 years. In these children, lower vitamin D levels were associated with increased markers of allergy and asthma severity[4].

The objective of the present study was to measure the level of vitamin D in children and adolescents suffering from bronchial asthma in

order to determine the relationship between vitamin D level and the severity of bronchial asthma symptoms.

METHODS

The present study was a case-control study conducted in the Pediatric Department, Suez Canal University Hospital.

The asthmatic group included 40 patients aged 2 to <18 years, these children were previously diagnosed as bronchial asthma according to the National Asthma Education and Prevention Program (NAEPP) 2007[5]. They were recruited from the emergency room, the inpatient wards and the outpatient pediatric clinic at Suez Canal University Hospital.

The control group comprised 40 healthy children and adolescents who were matching with the patient group in age and gender. None of the controls had bronchial asthma, or other allergic disease.

Methods:

All patients were subjected to the following:

History taking: using the questionnaire adopted from International Study of Asthma and Allergies in Childhood (ISAAC), a unique worldwide epidemiological research program established in 1991 to investigate asthma, rhinitis and eczema in children (ISAAC Coordinating Committee et al., 2011)[6]. The questionnaire was translated into validated Arabic language using validation of Arabic wordings describing asthma symptoms by asthmatic Egyptian children.

The questionnaire stressed on age of onset, time interval between attacks, the last attack of bronchial asthma, acute severe exacerbation, status asthmaticus, history of hospitalization due to asthma, and history of any other atopic disease, Drug history of any continuous anti asthmatic medication, Socioeconomic history &Family history.

Medical examination: with emphasis upon the anthropometric measurements including (weight, height &BMI), vital signs as respiratory rate & complete chest examination.

Investigations: included measurement of serum 25-hydroxyvitamin D [25(OH) D] using ELISA technique. We divided the asthmatic group according to vitamin D level into insufficient (deficiency) (<30 ng/mL), or sufficient (normal) (>30 ng/mL) according to Holick (2007)[7].

In addition, the total serum IgE level was measured by Radioimmunoassay and the peripheral blood eosinophil count was evaluated by Coulter.

Statistical analysis:

Data was processed using IBM SPSS statistical package version 20. Quantitative data expressed as means ± SD while qualitative data expressed as numbers and percentages (%). Statistical significance between two continuous variables was determined using Student's t test; the Mann-Whitney test was used for non-parametric data. Chi –square test was performed to test for differences in proportions of categorical variables between two or more groups. Fishers exact test was used if >20% contained expected values <5. Spearman's rank correlation was performed for assessment of the relation between continuous and ordinal variables. A probability value (p-value) < 0.05 was considered statistically significant.

RESULTS

The mean age of children in the asthmatic group was 5.14 ± 2.87years, and the mean age in control group was 6.18± 2.77 years. Males were less than females in both studied groups. Of the asthmatic children, urban were higher than rural residences (65% and 35% respectively) while in the control group urban and rural residences were equal **(Table1).**

Table (2) shows that, 35% of asthmatic patients suffered from vitamin D deficiency (25(OH) D< 30 ng/mL) while in the control group vitamin D deficiency was present in 30% of them.

The mean level of 25(OH) D was significantly lower in asthmatic than control children (33.9 ± 12.1 vs. 51.4 ± 21.9, p=0.002). There was no significant difference in the mean of Hb level between asthmatic and control children (10.9 ± 1.2 vs. 10.8 ± 1.3), asthmatic children had higher Ig E level compared to control children (116.7 ± 137.3 vs.101.8 ± 99.3) with no significant difference (p=0.488) **(Table 3).**

There was statistically significant negative correlation between vitamin D level and severity of asthma (r=-0.77) (p<0.001). However there was no statically significant correlation between severity of asthma and BMI, Hb and IgE **(Table 4).** Mean 25(OH) D levels varied significantly among the four groups of asthma symptom severity. The highest mean level of 25(OH) D was in cases of intermittent asthma (41.1 ± 11.8) , it was 35.1 ± 6.4 in mild persistent asthma , 24.7 ± 3.8 in moderate persistent asthma and the lowest level of vitamin D was found in severe persistent (20.7±3.8) (p<0.001) **(Table 5).**

Table 1. Socio-demographic characteristics of the studied asthmatic and control children

		Control (n = 40)		Asthmatic (n = 40)			p-value
		Mean±SD	**Range**	**Mean±SD**		**Range**	
Age (years)		6.18±2.77	3 – 15	5.14±2.87		2 – 13	0.104
		No.	**%**	**No.**	**%**	**Total**	
Sex	Boys	16	40.0	18	45.0	34	0.651
	Girls	24	60.0	22	55.0	46	
Residence	Urban	20	50.0	26	65.0	46	0.175
	Rural	20	50.0	14	35.0	34	

Table 2. Distribution of Vitamin D in both groups

Vitamin D	Control (n = 40)		Asthmatic (n = 40)		Total	p-value
	No.	%	No.	%		
Deficient (10 – 29 ng/mL)	12	30.0	14	35.0	26	0.633
Normal (30 - 100 ng/mL)	28	70.0	26	65.0	54	

Table 3. Laboratory parameters of the studied asthmatic and control children

	Control (n = 40)		Asthmatic (n = 40)		p-value
	Mean ± SD	Range	Mean ± SD	Range	
Vitamin D level	51.4 ± 21.9	24 – 81	33.9 ± 12.1	15 – 74	0.002*
Ig E level	101.8 ± 99.3	16 – 272	116.7±137.3	11-652	0.488
Hb	10.8 ± 1.3	9.5 – 13.4	10.9 ± 1.2	8.3 –14.1	0.142

* Statistically significant at p<0.05; Mann-Whitney test

Table 4. Relationship between age , BMI, Hb, IgE and Vit D levels and severity of asthma (n = 40)

	Severity of asthma	
	Correlation coefficient "r"	p – value
Vitamin D level	-0.77	<0.001*
Age (years)	-0.25	0.122
BMI	0.16	0.313
Hb	-0.14	0.389
Ig E level	0.09	0.575

* Statistically significant at p<0.05; Spearman's rank correlation

Table 5. Distribution vitamin D levels according to severity of asthma in asthmatic participants (n=40)

Severity of asthma	N	Vitamin D Level Mean ± SD	p-value
Intermittent	20	41.1 ± 11.8	<0.001*
Mild persistent	6	35.1 ± 6.4	
Moderate persistent	9	24.7 ± 3.8	
Severe persistent	5	20.7 ± 3.8	

* Statistically significant at p<0.05; One-way ANOVA Test

DISCUSSION

Bronchial asthma is a major health problem especially among children. It has dramatically increased worldwide over the last few decades, in both developed and developing countries[8].

Vitamin D is a potent modulator of the immune system. Vitamin D deficiency may predispose to allergic phenotype and epidemiological evidences suggest that lack of vitamin D has been linked to increased incidence of asthma and increased severity of asthma in children[9].

This study was designed to measure the level of vitamin D in children and adolescents suffering from bronchial asthma and to determine relationship between vitamin D level and severity of bronchial asthma symptoms.

The present study showed that, the mean age of the studied asthmatic children was 5.14±2.87 years. Asthma was reported more common in girls than boys (55% and 45% respectively) in the current study. This was in accordance with a study done on 1,112 teenagers in Northern Sweden where, the prevalence of asthma was 6.8%, with a higher prevalence in girls (9.6%) than in boys (4.1%). Higher prevalence of asthma in girls, found in this study, may be understood because in adolescence, girls usually develop earlier than boys. It is, therefore, possible that the higher asthma prevalence in girls only reflects a greater tendency of hyperactivity in the dynamic events of adolescence. This may fade out when the growing period ceases[10].

Another study, showed a male: female ratio of about 1.5:1 for children younger than 15 years, with a female predominance after this age[11].

The present study showed that 65% of asthmatic children were from an urban area while 35% were from a rural area so, the asthma prevalence was higher in urban areas than rural ones. This high prevalence explained by increasing urbanization, increasing air pollution including smoking or new building methods resulting in a poor indoor environment. These results coincided with the results of Chakravarthy et al.,[12] they measure the prevalence of asthma in urban and rural children in Tamil Nadu and they found that, the prevalence of 'diagnosed' asthma was 5%. Twenty-two per cent of urban and 9% of rural children.

We found that vitamin D insufficiency exists in 35% of studied asthmatic children and 30% of control group had vitamin D insufficiency. Vitamin D not present naturally in most foods that humans eat. The primary sources of this vitamin are natural production in the skin secondary to sun exposure, and secondarily from fortified foods[13].

Despite its abundant sun shine in the Middle East, allowing vitamin D synthesis it was registered that it has one of the lowest levels of vitamin D and the highest rates of hypovitaminosis D worldwide. This major public health problem affects individuals across all life stages including pregnant women, neonates, infants, children and adolescents, adults, and the elderly[14].

Sunscreen use, increased time spent indoors, and clothing coverage) and intrinsic factors such as skin melanin content, decreased cutaneous production of vitamin D3, or increased coetaneous destruction of vitamin D3. All those factors are responsible for vitamin D deficiency[15].

In our study, asthmatic patients had significantly lowered vitamin D levels than controls. There have been numerous studies looking at vitamin D status in association with various lung diseases focusing on asthma, these studies have demonstrated a high prevalence of vitamin D deficiency in their participants[16]. This was in accordance with Shepl et al.,[17] they founded that vitamin D deficiency was highly prevalent in asthmatic patients, and there was a direct and a significant relationship between vitamin D levels and pulmonary function test outcomes in asthmatics patients. Vitamin D deficiency has been associated with lower lung function.

Other studies suggest that maternal intake of vitamin D during pregnancy was associated with a decreased risk of recurrence of wheezing in young children, others suggest that vitamin D supplementation may increase the risk of allergy[18]. There was a case-control study done in Qatar provides an epidemiological support for the association between vitamin D deficiency and asthma, 68.1% were deficient in vitamin D among the asthmatic children[3].

Freishtat et al.,[19] also reported that (86%), of inner-city African-American asthmatic children living in Washington were vitamin D deficient with only 19% of non-asthmatics having the deficiency. Low levels of serum vitamin D is associated with impaired pulmonary function, increased incidence of inflammatory and infectious diseases.

There was statistically significant negative correlation between vitamin D level and severity of asthma (p<0.001). These were in agreement with Brehm et al.,[2] who found that children with lower vitamin D levels were significantly more likely to have been hospitalized for asthma, tended to have airways with increased hyper reactivity and were likely to have used more inhaled corticosteroids, all signifying higher asthma severity. Vitamin D deficiency increases the risk of severe asthma

exacerbation and the need for emergency department evaluation or hospitalization. Moreover AlBanna et al.,[20] found that there was significant correlation between low vitamin D level and asthma severity.

The present study suggests that vitamin D deficiency is relatively frequent in asthmatic patients (35%) who were attending to pediatric department at Suez Canal University Hospital. There was a significant inverse relationship between vitamin D levels and severity of asthma symptoms. Measuring serum levels of vitamin D may be considered in patients with bronchial asthma especially un-controlled or severe asthmatic patients. Further studies are needed to define the correlation between vitamin D and asthma, to determine the role of vitamin D in the treatment of asthma.

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