

Original Research Article

The relationship between vitamin D level and severity and control of bronchial asthma among adult Sudanese patients

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ABSTRACT

Background: The aim of this study was to assess the relationship between vitamin D level and severity and control of bronchial asthma among adult Sudanese patients at Alshaab Teaching Hospital.

Methods: This prospective cross-sectional study, conducted at Alshaab Teaching Hospital, Khartoum Sudan in the period from June to August 2015. Eighty-six asthmatic patients participated in the study after taking their consent. Demographic data were collected using structured questionnaire, the clinical parameters of asthma severity and control were measured according to the criteria of Global Strategy for Asthma Management and Prevention 2014 of the Global Initiative for Asthma (GINA). Airway limitation was assessed using Peak Flow Meter. Three ml of blood was taken from each patient to measure vitamin D (25(OH)D) using enzyme-linked immunosorbent assay (ELISA) and data were analyzed using the statistical package for social science (SPSS) version 20.

Results: Normal serum 25(OH)D (30-50ng/ml) was found in only 2.3% of patients. The mean serum 25(OH)D level in patients with controlled asthma was 25.82 ± 17.27 ng/ml while in patients with uncontrolled asthma it was 16.48 ± 7.14 ng/ml. (P value = 0.005). The mean serum 25(OH)D level in patients with severe asthma was 16.15 ± 6.9 ng/ml (P value = 0.151).

Conclusions: There was a positive correlation between vitamin D level and bronchial asthma control and a negative correlation with bronchial asthma severity among the study group.

Keywords: Asthma control, Asthma severity, Bronchial asthma, Vitamin D deficiency

INTRODUCTION

Bronchial asthma is a heterogeneous disease, characterized by chronic airway inflammation. It is defined by the history of respiratory symptoms such as wheeze, shortness of breath, chest tightness and cough that vary over time and in intensity, together with variable expiratory airflow limitation.¹ It affects an estimated 300 million individuals worldwide, and there may be an additional 100 million persons with asthma by

2025. Annually, the World Health Organization (WHO) has estimated that 15 million disability-adjusted life-years (DALY) are lost and 250,000 asthma deaths are reported.²

Previous studies conducted in Sudan showed that the prevalence of asthma in adults was varied among regions.^{3,4} Evidence suggests a genetic predisposition for the development of asthma.^{5,6}

Signs include the use of accessory muscles of respiration and cyanosis.

In a mild exacerbation, the peak expiratory flow rate (PEFR) is >75% of the predicted best. Moderate exacerbation is defined as between 50% and 75% of the predicted best while severe is defined as 33-50% of the predicted best.

The diagnosis of asthma involves a thorough medical history, physical examination, and objective assessments of lung function (spirometry preferred) to confirm the diagnosis.^{5,7,8}

Spirometry is the preferred objective measure to assess for reversible airway obstruction (i.e., rapid improvement in lung function after inhalation of a rapid-acting bronchodilator) and to confirm a diagnosis of asthma. It is recommended for all patients over 6 years of age who are able to undergo lung function testing.^{5,7}

Spirometry measures the forced vital capacity (FVC, the maximum volume of air that can be exhaled) and the forced expiratory volume in 1 second (FEV1). The ratio of FEV1 to FVC provides a measure of airflow obstruction.

Peak expiratory flow (PEF) monitoring is an acceptable alternative when spirometry is not available and can also be useful for diagnosing occupational asthma and/or monitoring response to asthma treatments.

According to GINA for global strategy for asthma management and prevention 2014, assessment of asthma control is by assessment of symptoms of control and future risk of adverse outcomes, this is achieved by assessing symptoms of control over the last 4 weeks, identify any other risk factors for exacerbation, fixed airflow limitation or side effects and measurement of lung function at diagnosis or start treatment, 3-6 months after starting controller treatment, then periodically.

The patient is considered symptomatically controlled if in the past 4 weeks had no daytime asthma symptoms more than twice/week, no night waking due to asthma, relievers needed for symptom not more than twice/week and no activity limitation due to asthma.

If one or two of these criteria are present the patient is considered as partly controlled and if three or more of these is present the patient considered as uncontrolled. Also, there must be no exacerbations in the past 12 months, normal lung function (in practical terms FEV1 and/or PEF>80% predicted or best) and with minimal drug side effects.

Asthma severity is assessed according to GINA for the global strategy for asthma management and prevention 2014 retrospectively from the level of treatment required to control symptoms and exacerbation.⁹⁻¹¹ It can be

assessed once the patient has been on controller treatment for several months and, if appropriate, treatment step down has been attempted to find the patient's minimum effective level of treatment. Asthma severity is not static feature and may change over months or years.

Mild asthma is that which is well controlled with step 1 or step 2 treatment, while moderate asthma is asthma that is well controlled with step 3 treatment and the severe one is asthma that required step 4 or 5 treatment to prevent it from becoming uncontrolled, or asthma remains uncontrolled despite this treatment.

Vitamin D is a prohormone that the body produces when the skin is exposed to the sun and about 10% is derived from dietary sources.¹² Results from experimental and observational studies suggest that reduced maternal intake of vitamin D during pregnancy increases the risk of childhood asthma or wheezing and that vitamin D insufficiency increases asthma morbidity in children and adults.¹³

Vitamin D plays critical roles in supporting the immune system, which may help prevent acute asthma exacerbations, decreasing inflammation.¹⁴

Vitamin D has been shown to have a prominent role in pulmonary immunity. This is of particular interest in pediatric asthma as viral infections in infancy often precede the development of childhood asthma and acute exacerbations are frequently triggered by respiratory tract infections.^{15,16} There is no published data about the effect of vitamin D on asthma control and severity in Sudan.

The aim of this study was to assess the relationship between vitamin D level and severity and control of bronchial asthma among adult Sudanese patients.

METHODS

This prospective cross-sectional hospital-based study was conducted in the period from June to August 2015, at Alshaab Teaching Hospital which is a tertiary care hospital in Khartoum, Sudan.

Auhtors included 86 asthmatic patients, age 18 years or more who were seen at chest referred clinic and were diagnosed as a case of bronchial asthma who agreed to participate. We excluded patients aged >70 years, with a history of renal, liver or other lung diseases, on vitamin D (multivitamins), calcium and anticonvulsants drugs.

Data were collected using structured questionnaire which included demographic data, the clinical parameters of asthma severity and control measurement according to the criteria of Global Strategy for Asthma Management and Prevention 2014 of the Global Initiative for Asthma (GINA). A categorical scale was used to identify controlled, partially controlled or uncontrolled asthma, and to classify asthma severity to mild, moderate and

severe based on symptoms and asthma therapy as recommended. Airway limitation was assessed by Peak Flow Meter. (The best reading of three consecutive PEFR) after ensuring that the patients did not receive bronchodilators for at least the past 6 hours. Asthma exacerbations during the last year were divided into subgroups, no exacerbation, one, two and more than two per year.

Blood samples (3ml) for 25(OH)D measurement was taken from the patients then centrifuged and the serum was stored at -20C then quantified by ELISA. The intra-assay coefficient of variation was 3.87%. The detection limit of 25(OH)D ELISA kits was (0-120ng/ml). This investigation was done at Alrayan Laboratory which is a modern and advanced laboratory in Khartoum and it has divisions for diagnosis and research.

Interpretation criteria are provided by the Endocrine Society Clinical Practice Guideline, recently suggested a higher target level of normal of at least 30ng/ml (Table 1).¹⁷

Table 1: The Endocrine Society Clinical Practice Guideline regarding vitamin D levels interpretation.

Status	25-OH vitamin-D	
	ng/ml	nmol/L
Deficiency	<20	<50
Insufficiency	20-29	50-75
Sufficiency	30-100	75-250

The collected data were coded and entered into a computer and a master sheet was constructed to arrange the raw data using the statistical package for social science (SPSS) version 20 by which means and standard deviations (SD) were obtained and simple percentages were calculated. One -way ANOVA test was used to evaluate the differences in serum 25(OH)D level between subgroups. The P. value was considered statistically significant if <0.05.

RESULTS

In this study, we included 86 asthmatic patients with mean age of 40.93±16.31 SD years. More than two-thirds of the participants were females 68.9%. The mean duration of asthma was 10.73 years. The mean body mass index (BMI) was 24.77±(5.3)Kg/M², around two-thirds of the study group, had normal body mass index (n=52), while only one third were obese or overweight (n=29).

According to GINA classification of asthma control, the patients who had well-controlled asthma were 24.4% (n=21), their mean age was 40 years, 12 were males, all were on step one of asthma therapy and had normal BMI. The patients who had partially controlled asthma were 37.2% (n=32), their mean age was 37.46 years, 26 were females. The patients who had uncontrolled asthma were

38.4% (n=33), their mean age was 45.36 years, 24 were females.

Regarding bronchial asthma severity, mild asthma was found in 47.7% of patients (Table 2).

Table 2: Level of asthma severity.

Level of severity	Frequency	Percent
Mild	41	47.7
Moderate	35	40.7
Severe	10	11.6

Most of the participants had PEFR of <50% predicted (77.9%) (Figure1).

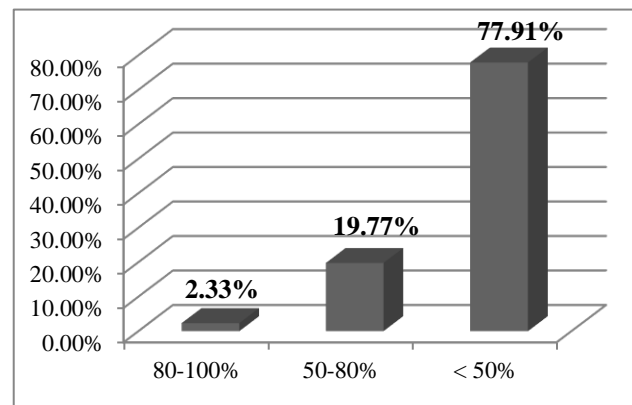


Figure 1: Distribution of asthmatic patients according to PEFR expressed as a percentage of predicted at Alshaab Teaching Hospital (June-August 2015) (n = 86).

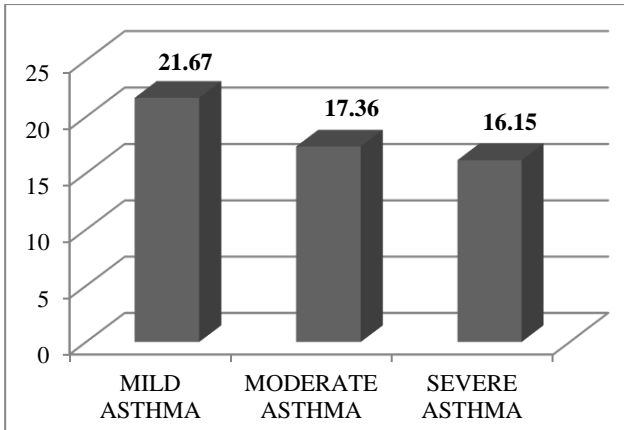
Normal serum 25(OH) D was found in only 2.3% while the rest of patients had deficient or insufficient serum 25(OH)D (Table 3).

Table 3: Distribution of asthmatic patients according to serum vitamin D level at Alshaab Teaching Hospital (June-August 2015).

Serum 25(OH)D level	Frequency	Percentage
Sufficient	2	2.3
Insufficient	43	50.0
Deficient	41	47.7
Total	86	100

The mean serum 25(OH) level in the controlled asthma group was 25.82±17.27ng/ml, while in patients who had partially controlled asthma it was 17.85±7.06ng/ml and in patients who had uncontrolled asthma was 16.48±7.14ng/ml (P value = 0.005).

The mean serum 25(OH)D level in patients who had severe asthma was 16.15±6.9ng/ml. The P value was 0.151 (Figure 2).

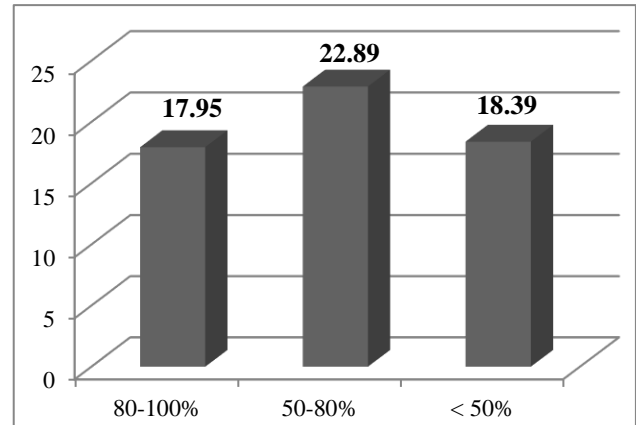


P value = 0.151

Figure 2: Means of serum vitamin D level (ng/ml) among asthmatic patients according to asthma severity at Alshaab Teaching Hospital (June-August 2015) (n = 86).

All patients with controlled asthma were deficient in vitamin D (Figure 3). The mean serum 25(OH)D in

patients who had no exacerbation was 23.64±4.7ng/ml and 17.97±7.29ng/ml in the patients who had more than two attacks per year. The P value was 0.026 (Table 4).



P value = 0.324

Figure 3: Means of serum vitamin D level (ng/ml) among asthmatic patients according to PEFR expressed as percentage of the predicted at Alshaab Teaching Hospital (June-August 2015) (n = 86).

Table 4: The relation between means of serum vitamin D level and frequency of asthma exacerbations during the last 12 months in the study population (n=86).

The frequency of asthma exacerbation	Frequency	Percentage	Mean [S.25 (OH)D]	SD	P value
No	26	30.2	23.64	4.7	0.026
One/year	19	22.1	17.37	7.13	
Two/year	16	18.6	15.06	6.94	
> Two/year	25	29.1	17.97	7.29	

DISCUSSION

Vitamin D deficiency is an unrecognized epidemic and a common health problem worldwide, associated with many diseases like bronchial asthma. In this study, we found that (47.7%) of the patients had vitamin D deficiency (serum 25(OH)D <20ng/ml). This is inconsistent with studies conducted by Li. et al, in China and Samarah S, et al in northern Jordan where they found much higher results (88.9% and 87% respectively).^{18,19} Vitamin D deficiency is known to be high in Asian population while Sudan is a sunny country which may explain the lower prevalence of vitamin D deficiency in our study group.

In this study, authors found that serum vitamin D levels had a statistically significant positive correlation to asthma control (P value = 0.005. This result was consistent with the outcome of the study conducted by Stephanie Korn et. al in Germany which showed that 25(OH)D deficiency was most pronounced in patients with uncontrolled asthma.²⁰ It was also consistent with

the study conducted by Samrah S, et al which showed that the severity of VDD correlated with poor asthma control, and a need for more medications to control asthma.¹⁹

The results of our study showed that vitamin D level has no role in asthma severity (P value = 0.151), in contrast to a previous study done in Costa Rica by Montero Arias et al.²¹ It is also in contrast to Stephanie Korn et al, study who found that 25(OH)D concentrations in adult asthmatics were low and vitamin D insufficiency or deficiency was significantly related to the severity of asthma.²⁰ Steroids use has been associated with low level of vitamin D, in our study only around half of the patients used corticosteroids, even those how used steroid they used low dose inhaled corticosteroids, this may explain the finding in our study.

Also, this study showed that there was no correlation between S. 25(OH)D and PEFR, in contrast, to study done in Dutch older population by Van-Schoor et al, which showed a strong relationship between serum 25 (OH) D and PEFR.²²

This study showed that vitamin D level correlated with the frequency of exacerbation. Similar to study done by Montero Arias et al.²¹ Also similar to the findings of a study done by Salas et al, which was conducted in 92 patients being treated for asthma at the University of New Mexico adult asthma clinic which demonstrated that vitamin D sufficiency was significantly associated with a decreased total number of asthma exacerbations and decreased emergency room visits.²³

CONCLUSION

The prevalence of vitamin D deficiency and insufficiency (<30 ng/ml) among our patients was 97.7%. Serum vitamin D level had a role in asthma control and frequency of asthma exacerbations but had no role in asthma severity among our patients.

Recommendations

Vitamin D should be measured in all asthmatic patients. Improve knowledge and awareness of asthmatic patients to sources of vitamin D and its relation to bronchial asthma.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee of Alshaab Teaching Hospital

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