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ORIGINAL ARTICLE

The Association Between Serum Vitamin D Levels and Level of Asthma Control Among Adult Asthmatics in Lagos

Lagos'taki Yetişkin Astım Hastalarında Serum D Vitamini Düzeyleri ile Astım Kontrol Düzeyi Arasındaki İlişki

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Abstract

Introduction: Asthma is of global public health concern due to its increasing prevalence, extensive health care costs, and impact on quality of life. Vitamin D has been suggested to play a role in asthma pathogenesis, severity, and control due to its immune-modulatory and anti-inflammatory effects. This study aims at determining serum Vitamin D status and its relationship with asthma control among adults with asthma attending the asthma clinic in Lagos University Teaching Hospital (LUTH).

Methods: This was a cross-sectional study. Participants were asthma patients attending the asthma clinic in Lagos University Teaching Hospital. Non-probability sampling involving consecutive sampling of all patients that met the inclusion criteria was done. Self-assessment of asthma control using Asthma Control Test (ACT) and GINA (Global Initiative for Asthma)-symptom control tools was documented. Spirometry, blood eosinophil count and serum Vitamin D levels were measured. A linear relationship between two numeric variables was assessed using spearman correlation. P value <0.05 was significant.

Results: The study was conducted on 90 patients, whose mean age was 48.74±15.5, and 75.6% were females while 24.4% were males. The frequency of Vitamin D status amongst the participants was deficient47 (52.2%), insufficient 9 (10.0%), and sufficient 34 (37.8%). There was no association between the Vitamin D status of patients and their level of asthma control.

Discussion and Conclusion: There was a statistically significant relationship between Vitamin D level and the assessed lung function indices (FEV1, FVC, and FEV1%) and no relationship was found between Vitamin D level and patient self-assessed asthma control as well as Vitamin D level and peripheral blood eosinophil count.

Keywords: Serum Vitamin D; Asthma control; Adult, Nigeria

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Asthma is a heterogeneous disease usually caused by chronic airway inflammation. It is defined by the history of respiratory symptoms such as wheezing, shortness of breath, chest tightness, and cough that vary over time and intensity, together with a variable expiratory airflow limitation.[1–3] Approximately 300 million people have asthma worldwide, and it is likely that by 2025 a further 100 million may be affected.[3] The global increase in asthma prevalence is due to an increase of asthma in low/middle-income countries which is driven by an increase in urbanization, atopic sensitization, and adoption of the Western lifestyle.[4–7]

In Nigeria, approximately 13 million are estimated to have asthma, which is likely among the highest in Africa making it a public health priority and a burden to the already fragile health system.[6,7]

The role of Vitamin D in asthma pathogenesis and asthma control is of considerable interest recently.[8–10] Some studies have evaluated the importance of serum vitamin D levels in the aetiopathogenesis of asthma, asthma severity and its control.[11,12] However, most of the findings have been inconclusive.[12–16] While some of these studies reported an improved asthma control from vitamin D supplementation others found no association.[11–17] There is limited evidence in our environment on the association between serum vitamin D and asthma control, Even the available studies were done in pediatrics population,[8,14,18,19] hence this study aims to find out the association of serum vitamin D and level of asthma control in adult asthmatic patients in Lagos.

Materials and Methods

The Study Place, Design and Sampling

This study was conducted at the Asthma clinic of the Medical Outpatient unit of The Lagos University Teaching Hospital (LUTH). Lagos is one of the largest economically important states of the country, with an estimated population as of 2015, 25 million.

The study was a cross-sectional analytical study. Non-probability convenience sampling method was used. The study was carried out with the patients diagnosed asthma between the date of 2022 and 2023. In the patients, vitamin D, eosinophil count and respiratory function tests were measured. Serum vitamin D level and asthma control using Asthma control test was assessed by the statistical analysis. The demographic characteristics, clinical situation and laboratory tests for the patients were recorded. The patients were classified as well controlled, not well controlled or partly controlled, very poorly controlled or uncontrolled according to the asthma control test and GINA asthma symptoms control

Inclusion Criteria

- Adults with spirometry-confirmed asthma who are aged 18 years to 65 years and,
- Have been on appropriate asthma treatment for more than 3 months
- Are stable and have no recent upper respiratory tract infection
- Further confirmation of asthmatic diagnosis was done using an inhaled bronchodilator to determine reversibility (patients with 12%- or 200-ml increase in FEV1 levels after inhaled bronchodilator was included as asthmatics).

Exclusion Criteria

- Patients with Chronic kidney disease, chronic liver disease, Patients on medications such as phenytoin, carbamazepine, Vitamin D-containing supplements.

Spirometry Technique

The procedure took place in the spirometry laboratory in LUTH and the equipment used, (Vitallograph spirometer) was calibrated daily before starting the procedure, using a 3L syringe to pump air to check the linearity as well as the center point of the volume measurement. All patients were positioned sitting upright on a chair with arms, their feet were placed flat on the floor and their legs were uncrossed and all tight-fitting clothing was loosened. The standard procedure for performing spirometry was followed as outlined in other studies.[3]

Measurement of Eosinophil Count

This was done in the virology laboratory in LUTH, two milliliters of blood were collected from all study participants into an ethylenediamine tetraacetic acid (EDTA) bottle and stored in a cooler via transport to the laboratory with an ice smudge. The eosinophils were counted using an automated cell counter with an automated differential. Eosinopenia1 was defined as less than 50 Eos/mm^3 and Eosinophilia is defined1 as count greater than 150 Eos /mm^3

Measurement of Serum Vitamin D

This was also done in the Virology laboratory in LUTH. Three milliliters of blood were collected from all the study participants into a lithium heparin bottle and stored in a

cooler via transport to the laboratory with ice smudge. The sample was centrifuged at 3500 revolations per minute, and plasma was separated into plain sample bottles, coded, and stored for bulk analysis at -80 degree Celsius when the sample size was completed. The analysis of serum 25-hydroxyvitamin D was done using High-Performance Liquid Chromatography.[18,19] Serum vitamin D levels were defined as Deficient: <12 ng/mL (<30 nmol/L), Insufficient: 12–30 ng/mL (30–77 nmol/L), Sufficient: >30 ng/mL (>75 nmol/L).[20]

Data Analysis

Data were entered, cleaned, and analyzed using IBM Statistical Package for Social Science (SPSS) version 29.0 (IBM SPSS Statistics 29.0.2.0, IBM Corp, Armonk, NY, USA, 2024). Categorical variables were presented using frequency and percentage while numerical data were presented using the mean and standard deviation. Association between Vitamin D status and asthma control using Asthma control test was assessed using chi-square. Mean comparisons were made using ANOVA to Compare the means of lung function parameters of the different categories of Vitamin D level. Spearman's rank correlation was used to assess the correlation between FEV 1 and vitamin D level. P value of <0.05 was considered significant.

Ethical Considerations

Ethical approval for the study was obtained from the Health Research Ethics Committee of the Lagos University Teaching Hospital (LUTH), on 14th December 2021, prior to the commencement of recruitment into the study- ADM/DSCST/HREC/APP/4871. Written informed consent was obtained from all prospective study participants, prior to recruitment into the study. The study was conducted in accordance with the Declaration of Helsinki.

Results

A total of 92 patients who consented and met the inclusion criteria were invited to participate in the study following the proposal's approval. One patient was excluded on account of having allergic bronchopulmonary aspergillosis and one patient was unable to perform spirometry correctly. The study included 90 cases. The mean age of patients was 48.74±15.5 with more females than males involved in the study, 68 (75.6%) and 22 (24.4%) respectively. Only about a fifth (21.1%) of our patients did not have any formal education. About a third also had a normal body mass index (Table 1).

Table 1. Socio-demographic characteristics of patients

Variable	Frequency (n=90)	Percentage
Age group (years)		
21–30	15	16.7
31–40	16	17.8
41–50	10	11.1
51–60	19	21.1
>60	30	33.3
Mean±SD	48.74±15.5	
Gender		
Male	22	24.4
Female	68	75.6
Marital status		
Single	20	22.2
Married	68	75.6
Divorced	2	2.2
Occupation		
Professional	42	46.7
Skilled non-professional	23	25.6
Unskilled/housewife	25	27.8
Level of education		
Non-formal	19	21.1
Primary	5	5.6
Secondary	15	16.7
Tertiary	51	56.7
BMI class		
Underweight	0	0.0
Normal	29	32.2
Overweight	30	33.3
Obese	31	34.5

SD: Standard deviation; BMI: Body Mass Index.

Table 2 shows that there was no association between vitamin D status and asthma control using the asthma control test tools and GINA asthma symptom control tools.

However, there were statistically significant differences in the means of lung function parameters (FEV1, FEV% and FVC) amongst the different categories of Vitamin D status as shown in Table 3 while in Table 4 there is a statistically significant association between Vitamin D status and lung function parameters. This finding was also corroborated in Figure 1, which also shows a significant correlation (Spearman correlation) between FEV1 and serum Vitamin D level. There was also no statistically significant association between serum vitamin D status and the grading of airflow obstruction Table 5.

Table 2. Association between Vitamin D status and asthma control using Asthma control test and the GINA- symptom control tool among participants

	Deficient (n=47)	Insufficient (n=9)	Sufficient (n=34)	χ^2	p
Asthma control test				2.689	0.611
Well controlled	13 (27.7)	3 (33.3)	13 (38.2)		
Not well controlled	12 (25.5)	3 (33.3)	11 (32.4)		
Very poorly controlled	22 (46.8)	3 (33.3)	10 (29.4)		
GINA asthma symptoms control				5.701	0.233
Well controlled	12 (25.6)	5 (55.6)	14 (41.2)		
Partly controlled	16 (34.0)	1 (11.1)	6 (17.6)		
Uncontrolled	19 (40.4)	3 (33.3)	14 (41.2)		

Chi square test; GINA: Global Initiative for Asthma.

Table 3. Comparison of the means of lung function parameters of the different categories of Vitamin D level

	Deficient (Mean±SD)	Insufficient (Mean±SD)	Sufficient (Mean±SD)	F-value	p
FEV1	1.41±0.7	1.57±0.9	1.70±0.7	5.136	0.033*
FEV%	57.33±20.6	66.66±23.9	79.52±22.89	4.945	0.015*
FVC	2.00±0.9	2.10±1.0	2.53±0.8	5.147	0.043*

F-value: Analysis of variance (ANOVA); FEV1: Forced Expiratory Volume in 1 second; FEV%: Percentage forced expiratory volume in 1 second; FVC: Forced vital capacity.

Table 4. The correlation between vitamin D status and lung function

	Spearman correlation (r)	p
FEV1	0.569	<0.001*
FEV%	0.512	<0.001*
FVC	0.495	<0.001*

FEV1: Forced Expiratory Volume in 1 second; FEV%: Percentage forced expiratory volume in 1 second; FVC: Forced vital capacity.

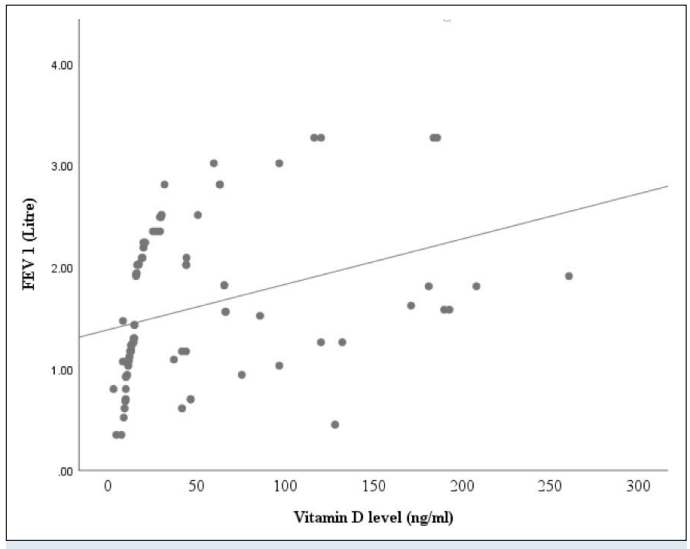

Figure 1. Correlation between FEV 1 and vitamin D level.

Spearman correlation (r)= 0.569, p<0.001*

Discussion

The findings of this study suggest that there may be a relationship between Vitamin D deficiency and asthma control as well as lung function indices among adult patients with asthma. This was evaluated by conducting a cross-sectional study among patients with asthma that was presented to the adult asthma clinic of our facility. Some studies have also suggested that there may or may not be a relationship between serum vitamin D and asthma control.[18–26]

Although the mean serum Vitamin D level among the asthma patients involved in this study seemed to be within the normal range. However, when compared with other studies such as that of Shahin et al.[24] and Niruban et al.,[25] where serum vitamin D level was reported to be sub-optimal. This difference with the findings in our study may be because most participants in our study reside in a tropical environment with adequate sunshine exposure unlike the cohorts of the study by Shahin et al.[24] In addition, differences in the methods of assay of serum Vitamin D, might also have accounted for the difference. An ELISA kit was used in that study, while high-performance liquid chromatogram method, the gold standard, was used in the present study and this could account for the discrepancy, due to their varied sensitivity and specificity to serum Vitamin D measurement. Similarly, when compared with other studies done in the tropics such as that of Omole et al.[14] who also obtained

Table 5. Association between Vitamin D status and grading of airflow obstruction using Z score among participants

	Deficient (n=47)	Insufficient (n=9)	Sufficient (n=34)	χ^2	p
Grading of airflow obstruction				4.383	0.821
Mild	22 (46.8)	3 (33.3)	14 (41.2)		
Moderate	12 (25.5)	3 (33.3)	9 (26.5)		
Severe	13 (27.7)	3 (33.3)	11 (32.3)		

high serum Vitamin D levels (with a mean of 47.2 ng/mL) in a study among asthmatic children in Ile-Ife, Nigeria.

Just as important, this study also revealed that there was no significant association between Vitamin D status asthma control. Similar findings were seen in a study done by Abubakar et al,[19] who in their study also reported no statistically significant association between serum vitamin D levels and asthma control among their participants. However, in as much as this study was also done in tropical environment and reported similar findings, it is important to note that the participants were paediatrics population who may not be able to give an adequate self-reported assessment of their asthma symptom control, unlike the present study conducted in adults.

In contrast, the study of Moamena et al.[12] and colleagues showed that there was a significant positive correlation between serum Vitamin D concentration and asthma control. They reported that asthmatics in their study with uncontrolled symptoms had lower serum vitamin D levels. The difference seen in this study may be partly explained by the high number of obese and overweight patients included in their study having uncontrolled asthma. This is because obesity has been shown to increase the risk for low Vitamin D.[25,26]

In addition, there is a statistically significant association between serum vitamin D levels and lung function parameters among our cohorts. This finding corroborates that of Liu and co-workers who in their meta-analysis also reported that serum vitamin D levels may be positively correlated with lung function in asthma patients. This meta-analysis further opines that this linear relationship exists irrespective of age of the patients studied.[2] However, we understand that this relationship between serum vitamin D levels and lung function parameters can be influenced by patient's socioeconomic status, age, body mass index, smoking, and level of physical activity. Therefore, to properly understand the relationship between FEV_1 and vitamin D, it's essential to control for these confounding variables using multivariable regression. Otherwise, the observed association might be spurious or overestimated, driven by these variables rather than a direct causal link.

This study investigated the relationship between serum vitamin D level in adult asthmatics in the tropics and lung function parameters. However, we were limited by it being a single center hospital-based study which may not be a true reflection of all the asthmatic patients in Lagos, Nigeria.

Discussion and Conclusion

The study showed that there is a positive relationship between Vitamin D level and lung function parameters. However, there was no significant relationship between serum vitamin D level and asthma control.

We therefore suggest a multi-centre study with a large number of patients to further access the possible relationship between serum vitamin D concentration, asthma control and lung function parameters in adult patients with asthma. This will establish or disprove if vitamin D supplementation would reduce the decline in lung function over time or improve the quality of asthma control with subsequent reduction of its burden in Nigeria.

Ethics Committee Approval: The Lagos University Teaching Hospital (LUTH) Ethics Committee granted approval for this study (date: 14.12.2021, number: ADM/DSCST/HREC/APP/4871).

Informed Consent: Written informed consent was obtained from participants.

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