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Assessing the Relationship between Vitamin D and Asthma Severity

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Abstract:

Background: Asthma is a chronic inflammatory disease with an immunological effect. This research aim was to estimate how vitamin D level affects asthma condition. **Patient and methods:** The current study involved 60 asthmatic patients, who came to the chest department, at Banha University Hospital from December 2022 to January 2024. Patients had full history taken and examination, calculating asthma control test, CBC with differential, Chest x-ray (P-A view), Pulmonary function tests, measuring Ig E and vitamin D. **Results:** findings were strong positive correlation between ACT, both age of patients and vit D level, a strong negative correlation between ACT and Ig E., No significant correlation between ACT and CRP, or eosinophils. From factors correlated with ACT, only vitamin D was the most factor associated with it. Cutoff value (vitamin D) to predict poorly controlled asthma is ≤36.65 ng / ml, sensitivity of 96%, and specificity of 80%. **Conclusion:** Vitamin D level could be used as a marker for predicting asthma severity.

Keywords: asthma, severity, vitamin D

Introduction

Respiratory problems such as wheezes, coughing, and SOB, which change in severity on time with fluctuating airflow restrictions, are indicative of asthma, a chronic inflammation of the airways [(1)].

Three hundred million people over the world are asthmatic [(2)]. It is generally recognized that vitamin D, which is easily measured by Serum vitamin D levels, can change bone metabolism and control calcium and phosphorus homeostasis. Sunlight influence vitamin D in human race [(3)]. Some chronic conditions, including rheumatoid arthritis, DM, asthma, and inflammatory bowel disease are associated with vitamin D insufficiency [(4)].

Vitamin D's immunological function helped to explain the coexistence. Macrophages, B, T lymphocytes, and structural cells in the airways are among immune cells that are affected by vitamin D when it attaches to the vitamin D receptor (VDR) [(5)]. According to one research, lower vitamin D level was linked to a higher prevalence of asthma. [(6, 7)]

Subjects - Method acting:

Retrospective study, which was performed at respiratory department, Banha University Hospital, during time December 2022 to January 2024. 60 asthmatic Patients were diagnosed according to (GINA). FEV1 / FVC less than 70% is a mark of airflow obstruction and a 12% increase in FEV1 after 200 micro-grams inhaled salbutamol is a measure of full reversibility (diagnostic of asthma).

Exclusion criteria: (1) any affection of bone metabolism. (2) Cancer, gastrointestinal disorders, liver insufficiency, and DM, (3) diet intake has vitamin D or calcium.

All patients undergo the following: 1. Written consent 2. History taking and clinical examination. 3-Calculating asthma control test 4. CBC with differential 4. CXR 5. PFT 6- Measuring Ig E by ELISA 7. Measuring 25 vitamin D3 by (ELISA).

Asthma control test was calculated as follows: The ACT includes five questions that the patient asked to recall how his asthma symptoms have affected him over the last 4 weeks. The questions relate to: how often your symptoms kept you from doing regular activities, how often you were short of breath, how often symptoms disrupted your sleep, how often you used your rescue medication, how well you think your asthma is controlled. Each question carries a score of 1–5. Your total score will be somewhere on a scale of 5–25.

Ethical committee approval number: RC 16-8-2024

Statistical analysis:

SPSS, version 28 (SPSS Inc., Chicago, IL, USA) was used to analyze the data. The absolute frequencies and percentages of categorical variables were used to characterize them. Alamogordo Smirnoff test was employed to confirm assumptions for use in parametric testing. The degree and direction of the correlation between two variables were evaluated using the Spearman rank correlation coefficient. Quantifying related independent factors for dependent components using Linear regression analysis. To find independent risk factors linked to specific health issues, binary logistic regression was employed. The best cutoff of a certain quantitative parameter in the diagnosis of specific medical conditions was proved using the ROC curve. The cutoff for statistical significance was $P < 0.05$. High signification at $p \leq 0.001$. [(31)]

Results:

This work included 60 patients with asthma. Males represented 55%. Age range 14 - 68 years, median 37. Median CRP, IgE, and eosinophils were 12 mg/dl, 97.5 IU/ml, and 0.23.

($10^9/mm^3$). Vitamin D levels ranged from 4 to 77 ng/ml, a median 19.15 ng/ml. Twenty-nine patients (48.3%) had levels

≥20 ng/ml (normal levels). ACT ranged from 7 to 25. Ten patients had ACT >19 which can be categorized as well-controlled asthma patients (16.7%) (table 1). found a high significance correlation (ACT, age of patients and vitamin D). found a high significance negative correlation (ACT and Ig E). No significant correlation between ACT and CRP, or eosinophils (table 2). Among factors significantly correlated with ACT, only vitamin D was significantly independently associated with it (unstandardized β=0.18, $p < 0.001$) (table 3). Uni-variate analysis, Male gender, increasing CRP, Ig E, and eosinophils non-significantly increase the risk of poor asthma control by 1.27, 1.03, 1.01, and 7.64 folds respectively while in multivariate analysis, Male, increasing age, CRP, Ig E, eosinophils non-significantly increase risk of poor asthma control by 3.36,1.02, 1.04, 1.01 and 9.47 folds respectively. Vitamin D <20 ng/ml significantly independently increases risk by 13.5 folds in uni-variate analysis which increased to 22.87 folds in multivariate analysis (table 4). The best cutoff value to vitamin D in predicting poorly controlled asthma was ≤ 36.65 ng/ml with the area under curve 0.898, sensitivity 96%, specificity 80%, positive predictive value 96%, negative predictive value 80%, and overall accuracy 93.3% ($p < 0.001$) (table 5).

Table (1) Data about patients studied:

	Number=60	%
Gender		
Female	27	45%
Male	33	55%
	Median (IQR)	Range
Age (year)	37(28 – 55.75)	14 – 68
CRP (mg/dl)	12(6.9 – 26)	0.1 – 200
IgE (IU/ml)	97.5(42 – 232.79)	0.25 – 814
Eosinophils (109/mm3)	0.23(0.13 – 0.5)	0 – 0.9
Vitamin D (ng/ml)	19.15(12 – 29.75)	4 – 77
Normal	29	48.3%
Abnormally low	31	51.7%
ACT [mean ± SD]	16.62 ± 3.62	7 – 25
Well-controlled	10	16.7%
Poor controlled	50	83.3%

Table (2) Correlation between ACT and the studied parameters:

	r	p
Age (year)	0.372	0.003*
CRP (mg/dl)	-0.219	0.093
IgE (IU/ml)	-0.352	0.006*
Eosinophils (109/mm3)	-0.189	0.148
Vitamin D (ng/ml)	0.785	<0.001**

Table (3) linear regression analysis of factors associated with ACT:

	Unstandardized Coefficients		Standardized Coefficients	t	p	95% Confidence Interval	
	β	Std. Error	Beta			Lower	Upper
(Constant)	12.289	0.477		25.741	<0.001**	11.334	13.245
Vitamin D (ng/ml)	0.180	0.016	0.821	10.971	<0.001**	0.147	0.213

Table (4) Uni and multivariate analysis of factors of poor asthma control:

	COR (95% CI)	p	AOR (95% CI)	p
Sex				
Female	1 (reference)	0.728	1 (reference)	0.222
Male	1.27(0.33 – 4.96)		3.36(0.48 – 23.53)	
Age (year)	0.99(0.94 – 1.03)	0.488	1.02(0.96 – 1.09)	0.501
CRP (mg/dl)	1.03(0.98 – 1.08)	0.233	1.04(0.98 – 1.09)	0.183
IgE (IU/ml)	1.01(0.996 – 1.02)	0.091	1.01(0.995 – 1.03)	0.169
Eosinophils (10^9/mm3)	7.64(0.25 – 233.91)	0.244	9.47(0.15 – 613.95)	0.291
Vitamin D (ng/ml)	1 (reference)	0.017*	1 (reference)	0.028*
≥20 ng/ml	13.5(1.59 – 114.98)		22.87(1.39 – 375.68)	
<20 ng/ml				

Table (5) Performance of S. vit. D in the diagnosis of poorly controlled asthma:

Cutoff	AUC	Sensitivity	Specificity	PPV	NPV	Accuracy	p
≤36.65	0.898	96%	80%	96%	80%	93.3%	<0.001**

Discussion:

Numerous nations around the world have reported vitamin D deficiency [12], which also correlates with other epidemiological trends of worsening asthma incidence, such as an increase in asthma and allergies in Westernized nations and a rise in sun-avoidance practices, such as the widespread use of sunscreen [13]. Research s found that high-dose vitamin D intake during pregnancy lowers offspring's chance of developing asthma in the early years [14,15].

Because of its strong immunological effects, vitamin D is related to a number of inflammatory conditions like asthma [16]. Low vit. D in asthmatic individuals was linked to worse overall outcomes, including increased inflammation, more exacerbation s, and poorer lung function [17].

Study found a high significance correlation between ACT and both age of patients and vitamin D. a strong negative correlation between ACT and Ig E. Vit. D was the most significant parameter independently associated with ACT. Vitamin D <20 ng/ml increases risk of poor asthma control by 13.5 folds in uni-variate analysis which increased to 22.87 folds in multivariate analysis. The best cutoff value of vitamin D in poor asthma prediction was ≤36.65 ng/ml with the area under curve 0.898, sensitivity 96%, specificity 80%, positive predictive value 96%, negative predictive value 80%, and overall accuracy 93.3% (p <0.001).

Low vitamin D levels had been linked in a number of studies to steroid-resistant asthma [21], poor asthma outcomes [20], and exacerbation s [18, 19]. In one study, having enough vitamin D was linked to fewer ER visits as well as a reduction in the frequency and intensity of asthma flare-ups [22]. However, some investigations found no correlation between asthma severity and vitamin D [23] or asthma control indicators [24].

Low vita D's impact on innate immunity and elevated risk of respiratory virus infections may account for the correlation between it and asthma flare-ups and inadequate management [25]. Antimicrobial [26] and anti-inflammatory peptides, including antiviral components [27], are produced in greater quantities when vitamin D is present. It is known that active vita D increases hydrocortisone absorption and inhibits airway hyper-reactivity [28].

In the current work, among factors significantly correlated with ACT, only vitamin D was the most significantly independent one associated with it. Cutoff

value of vita. D in prediction of poorly controlled asthma is ≤ 36.65 ng/ml with the area under curve 0.898, sensitivity 96%, specificity 80%, positive predictive value 96%, negative predictive value 80%, and overall accuracy 93.3% (p <0.001).

Patients with score 19 of ACT, with 48.1% of their asthma under control and 22% at higher risk of exacerbation in future, according to Montasir et al., [29]. 31.18.mol/L was the median 25(OH) D deficit (34% insufficiency and 66% deficiency). Vitamin D and ACT showed a strong positive connection (r = 0.91, p = 0.000). Vitamin D deficiency was more common (94.4%), and the 25 (OH) D level was lower (p = 0.000) among asthmatics who experienced a future exacerbation.

Vit D deficiency was more common in asthmatic patients than in control subjects [19, 20]. According to multiple surveys, the prevalence of asthma increases with every 10 ng/ml drop in vitamin D levels. In contrast to findings seen in children, a small number of studies showed no correlation between vitamin D levels and adult asthma or its severity markers [23].

In another study found that a vitamin D deficiency can be considered independent prognostic factor for uncontrolled asthma as a vitamin D level ≤ 24, 5 ng/ml (Adjusted OR 8, 32, 95% CI 2, 9 - 23, 72, p<0.001) was linked to uncontrolled asthma. [30]

Conclusion:

Vitamin D concentration could be used as a marker for predicting level of asthma severity. Patients with poorly controlled asthma should be screened for vitamin D and treated appropriately if any deficiency is found.

Conflict of interest:

None of the contributors declared any conflict of interest.

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