Case Study

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Level of Vitamin D and its effect on the Lung Function among Paediatric with Bronchial Asthma: A Case–Control Study

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ABSTRACT

Background: Bronchial asthma consider as one of chronic inflammatory illness among children, categorized by airflow restriction and bronchial hyper-responsiveness. A new studies that D deficiency may effects on immunomodulatory, in turn provoke asthma among patients who suffer from it.

Objective: To evaluate serum vitamin D levels among children with asthma compared to healthy controls. In addition to assess an association of serum 25-hydroxyvitamin D levels and severity of asthma, pulmonary function, and disease control.

Method: case–control study included 100 children aged 5–13 years, at Babylon hospital for maternity and paediatric, Iraq, from July 2024 to January 2025. Fifty children diagnosed with bronchial asthma were compared with 50 age and sex matched healthy controls. Serum 25-hydroxyvitamin D measured by ELISA and categorized into deficiency groups. Asthma severity was assessed clinically, and pulmonary function was evaluated using spirometry (FEV1 and FEV1/FVC).

Results: D level expressively lesser among asthmatic child when compared with controls. Severe D deficiency (≤5 ng/mL) detected in 10% of asthmatic children and none of the controls, while deficiency (≤15 ng/mL) was present in 50% of cases compared to 10% of controls ($p<0.001$). A noteworthy converse association found between D levels and severity of asthma, with the lowest levels observed in severe asthma ($p<0.001$). Moreover, asthmatic children with D insufficiency (≤15 ng/mL) had significantly reduced pulmonary function, with mean FEV1 of 60.8±3.2 compared to 80.5±2.5 in those with higher vitamin D levels and 88.2±7.2 in controls ($p<0.001$).

Conclusion: deficiency in vitamin D meaningfully linked with the bronchial asthma and its severity among children and correlates with impaired pulmonary function.

Introduction

Bronchial asthma is a prevalent prolonged inflammatory condition affecting the respiratory system among children. Triggered by specific stimuli, causing periods of wheezing, difficulty of breathing, rib cage tightness, and coughing [1]. An exact cause of asthma still somewhat understood; though, many factors have been involved [2-5].

Evaluation of Asthma in Children

Asthma diagnosis based on recognising recurring periods of airflow restriction which is reversible [6-8]. Vitamin D plays a significant role in immune regulation, influencing cellular proliferation and differentiation [9, 10]. Beyond its classical functions, it is also involved in processes such as cellular maturation, insulin secretion, and blood pressure regulation, and is considered an important modulator of immune

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responses with potential implications in allergic diseases [11–15].

Objectives of Study

To appraise the difference in vitamin D levels between asthmatic children and healthy controls children. In addition to assess the association between D level status and asthma among the paediatric. Moreover to assess the relationship between 25-hydroxyvitamin D the primary circulating form of vitamin D—and the clinical presentation, functional severity, and degree of asthma control among asthmatic children.

Method

A total of 100 children their age from 5-13 years, participated in current case-control study design at Babylon hospital for maternity and paediatric, Iraq, from July 2024 to January 2025. Children were categorized in two groups, the 1st group included 50 patients with asthma, the 2nd group is the control group which included 50 healthy children. We choose age and sex matched children.

History, physical examination and work up

Medical history taken from parents regarding any respiratory manifestations, frequency, duration, aggravated factors, presence of other health conditions. Asthma diagnosed by occurrence of airflow obstruction (shortness of breathing, chest tightness, and wheezy chest) that is reactive to broncho-dilators and\or steroids. Severity of asthma, SABA practice for rapid relief, capability to involve in usual activities, asthma was classify into three groups.

Blood sampling and laboratory analysis

Band applied in the proper place and 3 ml of blood withdrawn, put it in a tube, then the tube placed in centrifuge for 3 minutes. After separation of serum it kept at -200C. 25 hydroxy cholecalciferol ranks assessed by ELISA kit and level expressed in ng/ml. Study depend on vitamin D levels according to standard parameter [17]

Statistical analysis

Current study utilized of Microsoft excel, as well as SPSS version 25. Both descriptive and inferential statistical analysis recruited to meet study objectives.

Results

A 100 children evaluated in current case control study, 50 children suffer from asthma and 50 healthy consider control. For asthmatic children 30 (60%) males and 20 (40%) females. A corresponding number of the same age groups and sex were selected as a control group.

Table 1: Demographic Characteristics for both patients and controls.

Variable	Controls (n=50)	Cases (n=50)	Total (n=100)
Age (years), mean ± SD	7.5 ± 2.1	8 ± 1.3	
Sex			
Male, n (%)	31 (62%)	30 (60%)	61 (61%)
Female, n (%)	19 (38%)	20 (40%)	39 (39%)

Also the study show the mean serum D3 level were lower in severe asthmatic children (<5 ng/ml) in comparison to mild (>15-20 ng/ml) and moderate (<=15 ng/ml) asthmatic and a significant difference in the level of D3 between mild, moderate and severe asthma (p<0.001)

Table 2: Correlation of serum D3 level and asthma severity

Severity of Asthma	Number of Patients (n)	D Level (ng/mL)	P value
Mild	20	>15–20	
Moderate	25	≤15	<0.001
Severe	5	≤5	

Table 3. Distribution of Vitamin D Status Among Cases and Controls

D level	Controls (n=50) n (%)	Cases (n=50) n (%)	P value
Severe Insufficiency (≤5 ng/mL)	0 (0%)	5 (10%)	
Deficiency (≤15 ng/mL)	5 (10%)	25 (50%)	<0.001
Insufficiency (>15–<20 ng/mL)	45 (90%)	20 (40%)	

Table 4. Pulmonary Function Parameters According to Vitamin D Levels

Parameter	Asthmatics ≤15 ng/mL (n=30)	Asthmatics >15 ng/mL (n=20)	Controls (n=50)	P value
FEV1 (% predicted) mean ± SD	60.8 ± 3.2	80.5 ± 2.5	88.2 ± 7.2	<0.001
FEV1/FVC (%) mean ± SD	54.3 ± 3.0	76.6 ± 4.4	82.2 ± 8.2	<0.001

Discussion

In the present case–control study, a total of 100 children were evaluated, equally divided between asthmatic patients and healthy controls. The sex distribution showed a male predominance in both groups, with 60% males among cases and 62% among controls. This result go along with Almqvist et al. [18] who revealed that asthma more common in male than females. Likewise, Jang and Shin [19] confirmed a higher rate of asthma among males rather than females.

Concerning D level and its effect on the severity of asthma, present study verified reverse relationship of D3 and severity of asthma. This outcome agree with Brehm et al. [20], who indicated that the low levels of D significantly correlated with severity of asthma.

The level of D of cases and controls in present study further reinforce this relationship. Severe insufficiency observed among asthmatic patients and its absent in control group, whereas insufficiency existent in half of patients compared to only less than quarter of controls. While, majority of control had D deficiency range, compared to only less than half of asthmatic children. Current result are supported by Bener et al. [21] who revealed meaningfully lower D levels of asthmatics compared to control group.

Likewise, Somashekar et al. [22] found that participants with bronchial asthma had meaningfully lower D, higher rates of deficiency compared to non-asthmatic children.

Furthermore, the present study demonstrated a strong relationship between D and pulmonary function. Asthmatic participants with serum 25-hydroxyvitamin D levels ≤15 ng/mL had markedly reduced lung function, with mean FEV1 of 60.8±3.2 compared to 80.5±2.5 in those with higher vitamin D levels and 88.2±7.2 in controls ($p<0.001$). Similarly, the FEV1/FVC ratio was significantly lower in vitamin D-deficient asthmatic children (54.3±3) compared to those with higher levels (76.6±4.4) and controls (82.2±8.2). These findings indicate that vitamin D deficiency is associated not only with the presence and severity of asthma but also with impaired pulmonary function.

These results are in agreement with Bai and Dai [23], who reported that serum 25-hydroxyvitamin D3 were positively correlated with pulmonary function.

Similarly, Somashekar et al. [24] observed that lower vitamin D levels were associated with poorer lung function indices in asthmatic children. The underlying mechanism may involve the importance of D in maintaining airway structural integrity, reducing airway remodeling, and modulating inflammatory responses.

Conclusion

current study results support the assumption that D3 play a vital role in the severity of asthma especially among children. The consistent relationship between low levels of vitamin D, amplified the severity asthma, and compromised lung function among asthmatic patients

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