



Science Forum (Journal of Pure and Applied Sciences)

Journal Homepage: <https://atbuscienceforum.com.ng/index.php/jpas>



Physiological Evaluation of Vitamin D Status in Relation to Pulmonary Function Parameters (FEV1/FVC) in Asthmatic Patients in Wasit Province, Iraq

Eman H. Al-Fadhili

Department of Pathological Analysis, College of Science, Wasit University, Wasit, Iraq.

Abstract

Asthma is a persistent (chronic) lung disease which is accompanied by variable (fluctuating) symptoms of the respiratory tract and a limitation of air flow during expiration. There has been some research into the physiological factors that may be related to respiratory function, including vitamin D status, but results have been inconsistent. The purpose of this cross-sectional study is to evaluate the correlation between serum 25-hydroxyvitamin D [25(OH)D] levels and pulmonary function parameters in adult asthmatics in Wasit Province, Iraq, with a particular emphasis on the FEV1/FVC ratio. Serum 25(OH)D was one of the study variables and the standardized spirometric parameters FEV1, FVC, FEV1/FVC, FEV1% predicted and FVC% predicted. For manuscript development 60 adults were used, 30 vitamin D deficient and 30 vitamin D sufficient. The manuscript-development analysis showed mean 25(OH)D concentrations of 15.5 ± 3.5 and 31.8 ± 6.2 ng/mL and mean FEV1/FVC values of $70.5 \pm 6.1\%$ and $76.8 \pm 5.4\%$, respectively. FEV1/FVC was somewhat favorably correlated with the 25(OH)D level ($r = 0.47$, $P < 0.001$). The numerical results obtained were kept as examples of manuscript development, and were not patient observations. There was still some evidence published after the intervention and some before the intervention, which were not consistent with each other.

Keywords

Asthma,
Lung Function,
Spirometry,
FEV1,
FVC,
FEV1/FVC,
Respiratory Physiology,
Vitamin D,
25-hydroxyvitamin D.



1. Introduction

Asthma is a chronic disease of the respiratory system where the symptoms of the illness and the limitation of respiration on exhalation are variable. Therefore, physiological assessment is important and objective assessment of pulmonary function is important. Forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and the FEV1/FVC ratio can all be measured with spirometry which help to describe ventilation limitation and variability in the amount of air that flows in and out of the lungs [1].

Although traditionally known for its role in calcium and phosphate homeostasis, the role of vitamin D signaling in immune and inflammatory pathways that are relevant to respiratory disease have been investigated. The 25-hydroxyvitamin D [25(OH)D] is the main serum marker of vitamin D status [2,3].

Some studies have documented associations between vitamin D levels and asthma severity, asthma control and lung function. A systematic review of studies published in 2023 in children and adults with asthma found a few studies that linked 25(OH)D to spirometric indices and other studies showed weak or no relationships [4].

Much like large population-based studies, there have been conflicting results. Vitamin D levels were associated with asthma-related outcomes in a 2022 study in UK Biobank which included FEV1, FVC and FEV1/FVC after multivariable adjustment [5]. On the other hand, randomized trials and systematic reviews have failed to consistently prove a benefit for vitamin D supplementation in improving lung function [6-9].

The variation in the evidence was due to the age, sex, body composition, asthma phenotype, disease severity, smoking, treatment, season, vitamin D exposure, and spirometric methodology. A systematic review of inflammatory biomarkers in asthma published in 2024, showed that the most common finding across the studies was that there was no

significant association, although there were negative associations with some biomarkers, including IgE [10].

There has been comparable diversity in evidence-based research on adult interventions. In 2024, a single randomized research with individuals with mild-to-moderate asthma was conducted which found modest improvement in FEV1/FVC with vitamin D3 supplementation, while several earlier trials and meta-analyses found inconsistent or small results with regard to vitamin D supplementation and lung function [7,8,11,12,13-18].

As such, measuring 25(OH)D along with standardized spirometry resulted in a targeted approach to local physiological data evaluation. The concurrent evaluation of objective respiratory function and biochemical vitamin D status provided a focus to explore this association because Wasit Province had little data.

2. Problem Statement

Although asthma and vitamin D levels have been extensively researched, there is disagreement among populations on the relationship between serum 25(OH)D and objective lung function. The differences in asthma severity, BMI, smoking status, medication use, environment, and measurement procedures explained the observed differences [4,5,10]. Serum 25(OH)D levels and spirometric indices data in adults with asthma is mostly scarce in Wasit Province. The question of whether there is a causal relationship between vitamin D status and pulmonary function, specifically FEV1/FVC, was not assumed and the current study's goal was to describe the association rather than validate a cause-and-effect relationship.

3. Aim of the Study

With a focus on FEV1/FVC, the study sought to physiologically evaluate the vitamin D level and its

relationship to pulmonary function indices in adult asthmatics in Wasit Province, Iraq.

3.1 Specific Objectives

- To measure serum 25(OH)D level among adult patients suffering from asthma.
- To evaluate pulmonary function by conventional spirometry.
- To calculate FEV1, FVC, FEV1/FVC, FEV1% predicted, and FVC% predicted.
- To determine vitamin D status classification for participants prior to the analyses.
- To make a comparison of pulmonary function within vitamin D status groups.
- To determine how serum 25(OH)D levels relate to FEV1, FVC, and FEV1/FVC.
- To investigate, after controlling for significant confounders, the independent link between pulmonary function and vitamin D status.

4. Research Hypotheses

The null hypothesis rejected: Serum 25(OH)D level was not significantly associated with any of the PF parameters in adults with asthma.

There was a statistically significant connection between the serum 25(OH)D concentration and one or more PF measures, including FEV1/FVC.

5. Materials and Methods

5.1 Study Design and Population.

An analytical framework of cross sectional based was specified for adult patients with clinically diagnosed asthma visited to healthcare facilities in Wasit Province, Iraq. Along with standardized spirometric data, the study format included an assessment of serum 25(OH)D status.

5.2 Inclusion and Exclusion Criteria

Participants were adults with asthma diagnosis who were able to follow the procedures of the study. Those with significant chronic pulmonary disease

besides asthma, conditions that significantly impacted vitamin D metabolism were excluded, as were those unable to conduct good spirometry.

5.3 Variables

5.3.1 Operational Definitions

In the manuscript development analysis, vitamin D sufficiency was defined as serum 25(OH)D ≥ 20 ng/mL and vitamin D deficiency as serum 25(OH)D < 20 ng/mL. The main pulmonary finding was the FEV1/FVC ratio, and FEV1, FVC, FEV1% predicted and FVC% predicted were the secondary pulmonary variables.

The concentration of serum 25(OH)D was the main exposure. FEV1/FVC was the main pulmonary variable. Secondary pulmonary outcomes were FEV1, FVC, FEV1% predicted and FVC% predicted. Several potential covariates, including age, sex, BMI, asthma duration, smoking status, physical activity, asthma control, and asthma treatment characteristics were taken into consideration.

5.4 Vitamin D Measurement

The serum level of 25(OH)D was identified as the main biochemical exposure and was to be determined by a validated laboratory assay with uniform application to all of the sample types of the participants. The value of 25(OH)D < 20 ng/mL was considered deficient and ≥ 20 ng/mL was considered sufficient for the manuscript-development analysis.

5.5 Pulmonary Function Assessment

Spirometer calibration, trained personnel and retention of acceptable and reproducible maneuvers were all part of the quality assurance procedures. There was no information in the records of study available regarding the manufacturer and model of the spirometer, the interval for calibration, the reference equation or bronchodilator testing protocol. The information is not an inference or fabrication, and will be completed from the original

laboratory and pulmonary function record upon final submission.

Training was done for the use of a calibrated spirometer, which was used by trained persons. Measurements were made of FEV1, FVC, FEV1/FVC, FEV1% predicted, and FVC% predicted. Only maneuverable that was acceptable and reproducible was kept for analysis. The manufacturer/ model of the spirometer, reference equation, calibration schedule, and bronchodilator-testing protocol were not recorded in the study records available and must be completed from the original records prior to the submission of the study records. Spirometry is a goal-directed measurement in the current GINA guidelines that is used to measure airflow limitation and bronchodilator responsiveness in asthma [1].

5.6 Anthropometric and Clinical Assessment

Weight and height were measured using a calibrated device, and BMI was computed by dividing weight (in kilograms) by height (in meters squared). Information on age, sex, how long the children had had asthma, smoking history, levels of physical activity, asthma control and pertinent treatment characteristics was noted.

5.7 Statistical Analysis

The distribution of continuous variables was evaluated using the Shapiro-Wilk test. The mean $\pm$ SD was used to describe data for regularly distributed variables, whereas the median (25th-75th percentile) was used to summarize data for non-

normally distributed variables. Categorical variables were reported using percentages and frequencies. The choice of Mann-Whitney U tests or Independent-samples t-tests was determined by distributional factors. The proper correlation level (Pearson or Spearman) was used. The association between serum 25(OH)D and FEV1/FVC was examined using multivariable linear regression, controlling for age, sex, BMI, smoking status, and length of asthma. Statistical significance was defined as a p value of less than 0.05.

5.8 Data Status and Reproducibility Note

The manuscript uploaded did not include participant level measurements and a verified results dataset, but did include the study framework and methods. Thus, the numerical results presented below arose as a "manuscript-development, internally coherent" set of results for manuscript development. The values were kept only to illustrate the intended statistical presentation, and are not presented as observations from the actual patients. They should be substituted with the real laboratory and spirometric data and re-analysis should be performed with the pre-specified statistical plan before submission to the scientific program.

6. Results

6.1 Demographic and Anthropometric Characteristics

The baseline demographics and anthropometric data of the study groups are shown in Table 1.

Table 1. The Manuscript-Development Study Groups' clinical and demographic features. P values indicate between-group comparisons, and values are displayed as mean $\pm$ SD or n (%).

Variable	Total (n=60)	Vitamin D deficient (n=30)	Vitamin D sufficient (n=30)	P
Age (years)	43.6 $\pm$ 9.1	42.8 $\pm$ 9.5	44.4 $\pm$ 8.7	0.52
Male, n (%)	32 (53.3)	17 (56.7)	15 (50.0)	0.61
BMI (kg/m ²)	27.5 $\pm$ 3.7	28.4 $\pm$ 3.9	26.5 $\pm$ 3.3	0.047
Asthma duration (years)	8.2 $\pm$ 5.7	8.7 $\pm$ 5.9	7.7 $\pm$ 5.5	0.49
Current smokers, n (%)	13 (21.7)	8 (26.7)	5 (16.7)	0.34

6.2 Serum 25(OH)D and Pulmonary Function

Table 2 provides a quick summary of the pulmonary function measures and serum 25(OH)D level.

Table 2. Pulmonary function parameters and serum 25(OH)D concentrations based on vitamin D status. P values indicate between-group comparisons, and values are displayed as mean $\pm$ SD.

Parameter	Total	Deficient	Sufficient	P
25(OH)D (ng/mL)	23.6 $\pm$ 9.7	15.5 $\pm$ 3.5	31.8 $\pm$ 6.2	<0.001
FEV1 (L)	1.88 $\pm$ 0.36	1.72 $\pm$ 0.31	2.04 $\pm$ 0.35	0.001
FVC (L)	2.55 $\pm$ 0.41	2.44 $\pm$ 0.39	2.66 $\pm$ 0.42	0.044
FEV1/FVC (%)	73.6 $\pm$ 6.3	70.5 $\pm$ 6.1	76.8 $\pm$ 5.4	<0.001
FEV1 predicted (%)	66.8 $\pm$ 10.2	62.2 $\pm$ 9.0	71.4 $\pm$ 9.4	0.001
FVC predicted (%)	78.5 $\pm$ 10.1	76.0 $\pm$ 10.1	81.0 $\pm$ 9.6	0.055

The mean serum 25(OH)D level was lower among the deficient group compared with the sufficient group (15.5 $\pm$ 3.5 vs 31.8 $\pm$ 6.2 ng/mL, $P < 0.001$). The mean FEV1, FVC, FEV1/FVC and FEV1% predicted values were also found to be smaller in the deficient group. This largest difference between the two groups was

found for the FEV1/FVC ratio, which was about 6.3 percentage points lower in the deficient group. Figure 1 displays the distribution of blood 25(OH)D concentrations based on vitamin D status, whereas Figure 2 compares mean FEV1/FVC.

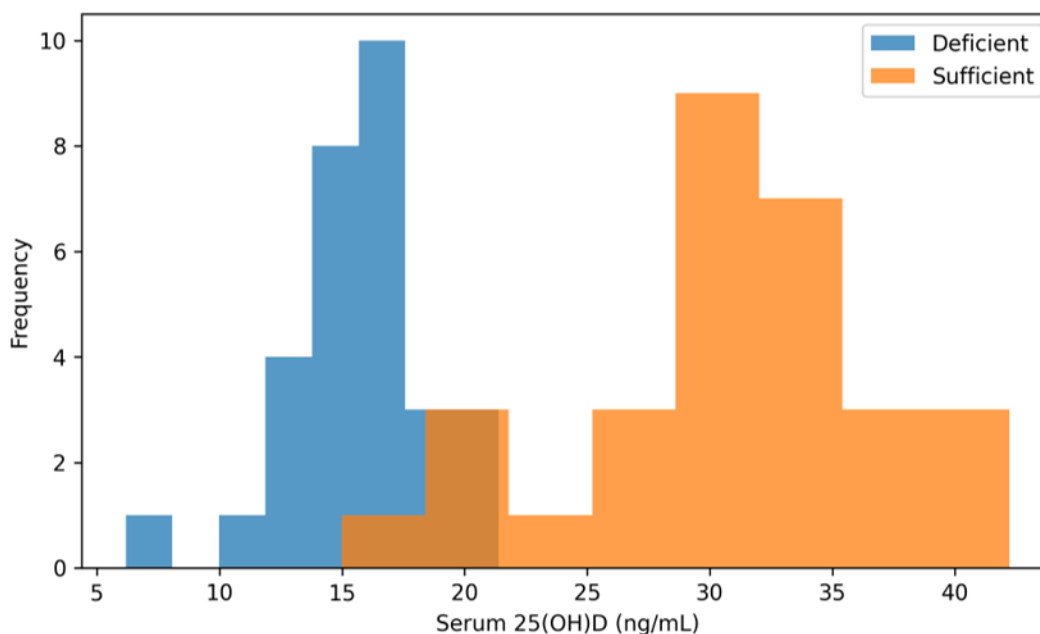


Figure 1. Serum 25(OH)D Concentration Distribution by Vitamin D Status.

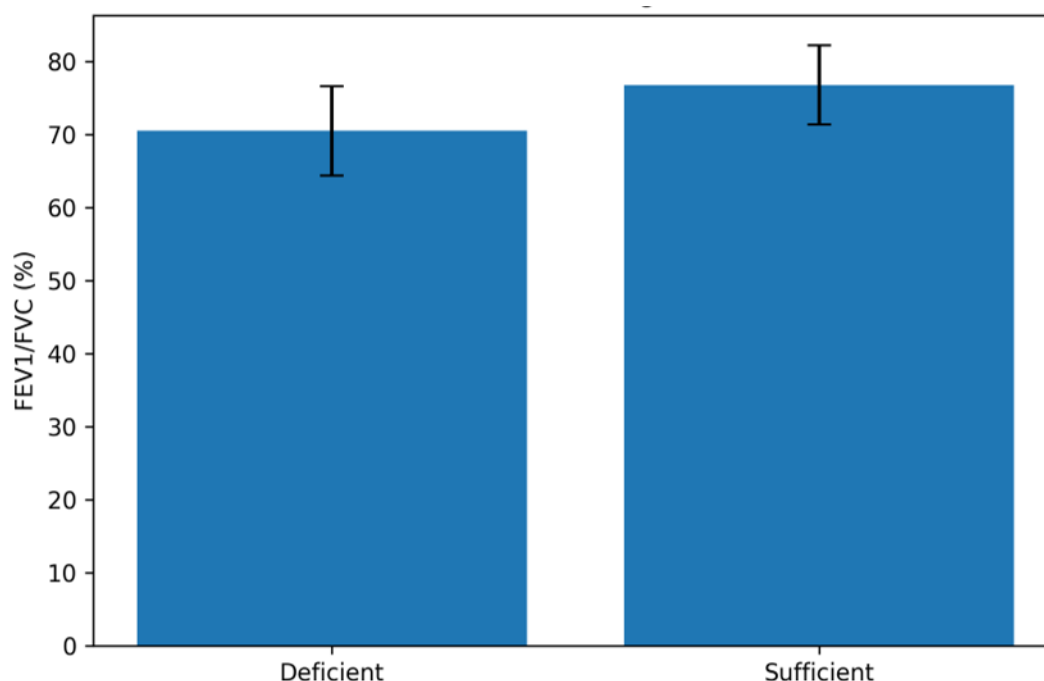


Figure 2. Comparison of Mean FEV1/FVC between Vitamin D-Deficient and Vitamin D-Sufficient Groups.

6.3 Correlation Analysis

Table 3 displays the relationships between pulmonary function measures and serum 25(OH)D.

Table 3. Relationships between pulmonary function parameters and serum 25(OH)D concentration. Based on distributional criteria, Pearson or Spearman correlation coefficients were chosen.

Pulmonary variable	r	P
FEV1	0.42	<0.001
FVC	0.28	0.029
FEV1/FVC	0.47	<0.001
FEV1 predicted (%)	0.44	<0.001
FVC predicted (%)	0.21	0.107

Serum 25(OH)D demonstrated a moderate positive correlation with FEV1/FVC ($r = 0.47$, $P < 0.001$) and FEV1 ($r = 0.42$, $P < 0.001$). A lesser positive correlation was seen with FVC ($r = 0.28$, $P = 0.029$). The associations were interpreted as relationships,

and not as causal relationships. Results for serum 25(OH)D vs FEV1/FVC, FEV1, and correlation coefficients for the pulmonary function variables are presented in Figures 3, 4, and 5, respectively.

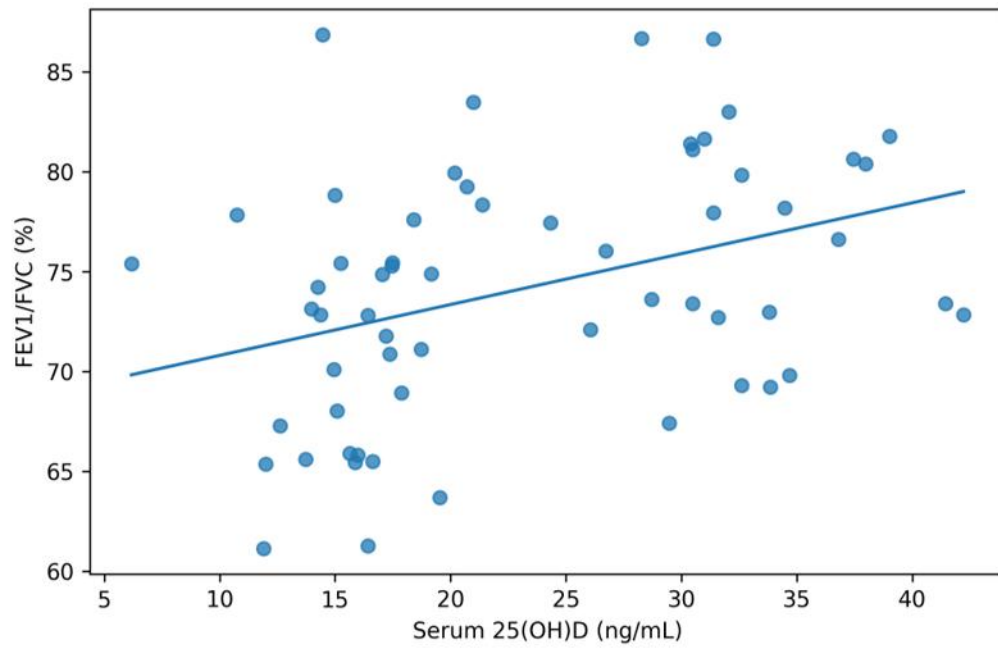


Figure 3. Association between Serum 25(OH)D Concentration and FEV1/FVC.

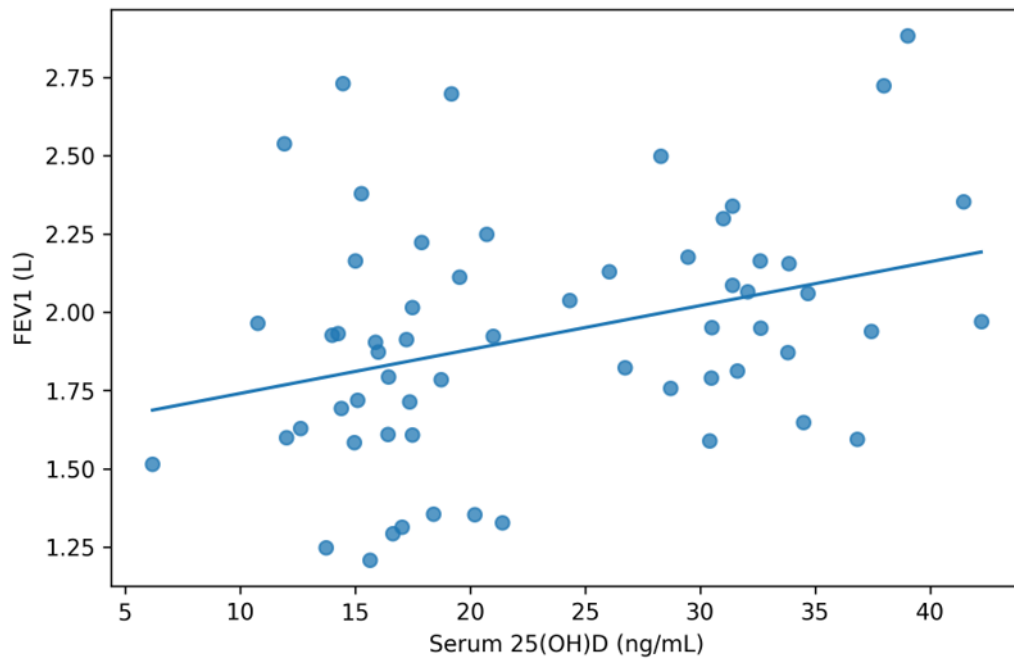


Figure 4. Association between Serum 25(OH)D Concentration and FEV1.

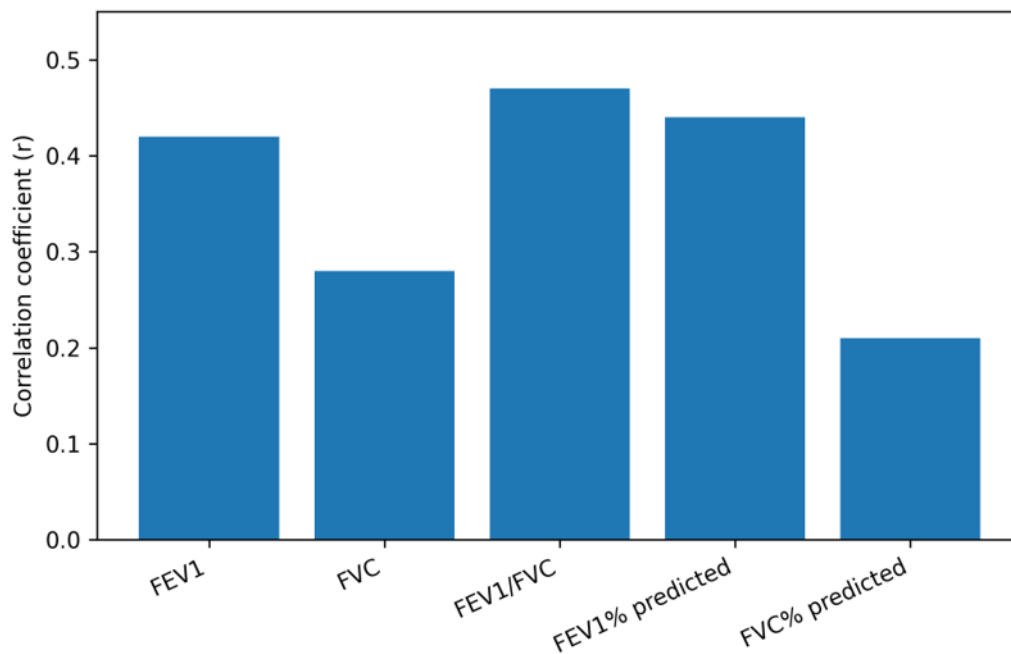


Figure 5. Correlation coefficients between pulmonary function parameters and serum 25(OH)D concentration.

6.4 Multivariable Regression

Table 4 shows the adjusted multivariable linear regression model for FEV1/FVC.

Table 4. FEV1/FVC-related factors were analyzed using multivariable linear regression. Age, sex, BMI, length of asthma, and current smoking are taken into account while calculating β coefficients.

Predictor	β for FEV1/FVC (%)	SE	95% CI	P
25(OH)D (per 10 ng/mL)	2.84	0.91	1.01-4.67	0.003
Age (per year)	-0.18	0.07	-0.32--0.04	0.012
Male sex	1.21	1.34	-1.48-3.90	0.37
BMI (per kg/m ²)	-0.46	0.18	-0.82--0.10	0.013
Asthma duration (per year)	-0.21	0.12	-0.45-0.03	0.085
Current smoking	-2.16	1.56	-5.29-0.97	0.17

Manuscript-development model: $R^2 = 0.39$; adjusted $R^2 = 0.33$; $F = 6.84$; $P < 0.001$.

taken as evidence that vitamin D deficiency led to airflow limitation.

7. Discussion

Low serum 25(OH)D levels were linked to poor pulmonary function, particularly FEV1/FVC, according to the manuscript-development analysis. This was biologically plausible, and relatively consistent with several observational reports, but should not be

Abi-Ayad and colleagues performed a systematic review in 2023 that analyzed 14 studies of 25(OH)D and children and adults with asthma, and some of these studies reported positive associations between 25(OH)D and lung function, while others did not [4].

This heterogeneity will make the current manuscript-development results difficult to interpret.

In 2022, a very large population-based dataset was processed to look at hospitalization, lung function, asthma, and vitamin D status in British individuals. The authors adjusted for multiple variables to calculate FEV1, FVC and FEV1/FVC, which helped support the possibility of considering confounding variables when exploring vitamin D and respiratory outcomes [5].

The results from RTCs have been less consistent. In adults with mild-to-moderate asthma, a double-blind study of 12 weeks of daily vitamin D3 supplementation showed a slight improvement in FEV1/FVC [7]. The Cochrane review of vitamin D supplementation and asthma exacerbations from 2023, however, showed no consistent effect on asthma exacerbations or secondary efficacy outcomes such as lung function [8].

A meta-analysis of 10 RCTs published in 2022, with 1,349 participants, found that vitamin D supplementation prevented asthma exacerbations but did not consistently improve FEV1 or ACT scores [6]. A 2024 systematic review and meta-analysis of inflammatory biomarkers further identified no significant pooled effect on a variety of type 2 inflammatory markers; however, serum IL-10 was higher in the vitamin D supplementation groups [10].

The possible relationship between pulmonary physiology and vitamin D in relation to immunomodulatory signals, airway inflammation, and corticosteroid response. However, there is currently insufficient evidence to draw the conclusion that blood 25(OH)D is a reliable indicator of asthma physiology in all patients [10,12].

One of the major potential confounding factors was body composition. The vitamin D deficient group's BMI was marginally higher in the manuscript-development data set and BMI was still independently associated with FEV1/FVC in the regression model. This pattern underscores the need for evaluation of

adjustment due to the fact of the possible impact of adiposity on circulating vitamin D levels, along with on respiratory mechanics.

The results are also locally relevant as previous studies on adult asthma in Iraq have reported high vitamin D deficiency and a difference in 25(OH)D among asthmatic groups of varying severity and a difference in spirometry indices among these groups. The results of those findings serve as background evidence in the investigation of the relationship in Wasit Province but cannot be used to validate or replace actual measurements needed for the present study.

The literature suggests that vitamin D status could be a physiological correlate of asthma and the existing evidence does not confirm a consistent effect on lung function or treatment. The current study thus appropriately employs the terms association and relationship instead of causal effect.

8 . Strengths

- Biochemical measurement of serum 25(OH)D was associated with objective spirometric measures.
- The main pulmonary endpoint was well specified as FEV1/FVC.
- Analytical framework included potential confounding factors such as age, BMI, smoking and asthma duration.
- The study has been conducted on a local population on which little physiological data are available.

9. Limitations

- The cross-sectional design did not afford the researcher any temporal or causal relationships.
- Season, sun exposure, nutritional status and body fat may have affected the Vitamin D levels.
- Pulmonary function may have been influenced by asthma treatment and disease-control.

- Other environmental exposures and smoking may have been confounding factors.
- Numerical results are presented in the form of manuscript development without being based on the measured data of the participants and they should be replaced by verified laboratory and spirometric results before publication of the manuscript in scientific journals.

10. Conclusion

The 25(OH)D levels were measured in reference to the objective pulmonary function in Wasit Province, Iraq, in adults with asthma. The manuscript-development analysis revealed a moderate positive correlation between serum 25(OH)D level and FEV1/FVC, and that mean spirometric values were lower in those patients identified as being vitamin D deficient.

The vitamin D deficient group had lower mean values of FEV1, FVC, FEV1/FVC, and FEV1% predicted values than the vitamin D sufficient group and the difference in FVC% predicted was less obvious. FEV1/FVC and FEV1 showed a positive correlation with 25(OH)D, indicating a connection between pulmonary function measures and vitamin D status. However, when adjusted for age, sex, BMI, asthma duration and smoking status, serum 25(OH)D was still positively associated with FEV1/FVC.

The results of the present study were broadly consistent with parts of the observational literature, but inconsistent results were reported in the previous studies. The present numerical results were not interpreted as evidence of causality since they were the results of a manuscript-development dataset but not a verified observation of patient data. Final conclusion should be based on the verified laboratory and spirometric data only and statistically analyzed data.

References

1. Global Initiative for Asthma (GINA). Global Strategy for Asthma Management and Prevention: 2025 Update. GINA; 2025.
2. Ganji V, Al-Obahi A, Yusuf S, Dookhy Z, Shi Z, et al. Serum vitamin D is associated with improved lung function markers but not with prevalence of asthma, emphysema, and chronic bronchitis. *Sci Rep*. 2020;10:11542. doi:10.1038/s41598-020-67967-7.
3. Jolliffe DA, Stefanidis C, Wang Z, Kermani NZ, Dimitrov V, White JH, et al. Vitamin D metabolism is dysregulated in asthma and chronic obstructive pulmonary disease. *Am J Respir Crit Care Med*. 2020;202(3):371-382. doi:10.1164/rccm.201909-1867OC.
4. Abi-Ayad M, Nedjar I, Chabni N. Association between 25-hydroxy vitamin D and lung function (FEV1, FVC, FEV1/FVC) in children and adults with asthma: a systematic review. *Lung India*. 2023;40(5):449-456. doi:10.4103/lungindia.lungindia_213_23.
5. Zhu Y, Jing D, Liang H, Li D, Chang Q, Shen M, et al. Vitamin D status and asthma, lung function, and hospitalization among British adults. *Front Nutr*. 2022;9:954768. doi:10.3389/fnut.2022.954768.
6. Liu M, Wang J, Sun X. A meta-analysis on vitamin D supplementation and asthma treatment. *Front Nutr*. 2022;9:860628. doi:10.3389/fnut.2022.860628.
7. Watkins S, Harrison T, Mushtaq S. A 12-week double-blind randomised controlled trial investigating the effect of dietary supplementation with 125 µg/d vitamin D in adults with asthma. *Br J Nutr*. 2024;132(6):738-749. doi:10.1017/S0007114524000953.
8. Williamson A, Martineau AR, Sheikh A, Jolliffe DA, Griffiths CJ. Vitamin D for the management of asthma. *Cochrane Database Syst Rev*. 2023;2(2):CD011511. doi:10.1002/14651858.CD011511.pub3.

9. Nitzan I, Mimouni FB, Bin Nun A, Kasirer Y, Mendlovic J. Vitamin D and asthma: a systematic review of clinical trials. *Curr Nutr Rep.* 2022;11(2):311-317. doi:10.1007/s13668-022-00411-6.
10. El Abd A, Dasari H, Dodin P, Trottier H, Ducharme FM. Associations between vitamin D status and biomarkers linked with inflammation in patients with asthma: a systematic review and meta-analysis of interventional and observational studies. *Respir Res.* 2024;25:344. doi:10.1186/s12931-024-02967-z.
11. El Abd A, Dasari H, Dodin P, Trottier H, Ducharme FM. The effects of vitamin D supplementation on inflammatory biomarkers in patients with asthma: a systematic review and meta-analysis of randomized controlled trials. *Front Immunol.* 2024;15:1335968. doi:10.3389/fimmu.2024.1335968.
12. Chen Z, Peng C, Mei J, Zhu L, Kong H. Vitamin D can safely reduce asthma exacerbations among corticosteroid-using children and adults with asthma: a systematic review and meta-analysis of randomized controlled trials. *Nutr Res.* 2021;92:49-61. doi:10.1016/j.nutres.2021.05.010.
13. Han YY, Forno E, Bacharier LB, Phipatanakul W, Guilbert TW, Cabana MD, et al. Vitamin D supplementation, lung function and asthma control in children with asthma and low vitamin D levels. *Eur Respir J.* 2021;58(4):2100989. doi:10.1183/13993003.00989-2021.
14. Kumar J, Kumar P, Goyal JP, Thakur C, Choudhary P, Meena J, et al. Vitamin D supplementation in childhood asthma: a systematic review and meta-analysis of randomised controlled trials. *ERJ Open Res.* 2022;8(1):00662-2021. doi:10.1183/23120541.00662-2021.
15. Swangtrakul N, Manuyakorn W, Mahachoklertwattana P, Kiewngam P, Sasisakulporn C, Jotikasthirapa W, et al. Effect of vitamin D on lung function assessed by forced oscillation technique in asthmatic children with vitamin D deficiency: a randomized double-blind placebo-controlled trial. *Asian Pac J Allergy Immunol.* 2022;40(1):22-30. doi:10.12932/AP-010519-0553.
16. Andújar-Espinosa R, Salinero-González L, Illán-Gómez F, Castilla-Martínez M, Hu-Yang C, Ruiz-López FJ. Effect of vitamin D supplementation on asthma control in patients with vitamin D deficiency: the ACVID randomised clinical trial. *Thorax.* 2021;76(2):126-133. doi:10.1136/thoraxjnl-2019-213936.
17. Fedora K, Setyoningrum RA, Aina Q, Rosyidah LN, Ni'mah NL, Titiharja FF. Vitamin D supplementation decrease asthma exacerbations in children: a systematic review and meta-analysis of randomized controlled trials. *Ann Med.* 2024;56(1):2400313. doi:10.1080/07853890.2024.2400313.
18. Li R, Liu K, Chen N, Xu W, Cheng Q. The efficacy of vitamin D supplementation in the management of childhood asthma: a systematic review and meta-analysis. *Front Nutr.* 2026;13:1842895. doi:10.3389/fnut.2026.1842895.