Association Between Serum Vitamin D Levels and Anxiety and Depression among Adults with Allergic Rhinitis

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Introduction

Anxiety or depression often accompanies allergic rhinitis (AR), and vitamin D (VD) may act as a mediator in this relationship.

Objectives

To investigate whether serum VD levels are associated with the presence of anxiety or depression among adults with AR, and to explore potential interactions with other clinical or immunological factors that may influence this relationship.

Methods

Ethics
- Approval was obtained from the Ethics and Research Committee of the Hospital Civil de Guadalajara "Fray Antonio Alcalde."
- Written informed consent was obtained

Study Design
- Cross-sectional study.

Setting
- Nuevo Hospital Civil de Guadalajara.

Sample Size
A total of 147 patients were included.

Sampling Method
Non-probabilistic consecutive case sampling.

Selection Criteria
Inclusion Criteria
- AR patients; aged ≥ 18 years

Exclusion Criteria
- Death of a loved one during the previous 6 months, use of systemic steroids during the previous month; previous psychiatric disorders; use of antidepressants, antiretrovirals, antifungals, antiepileptics, diuretics, or VD supplements; use of antiresorptive bone remodeling therapy; suffering from any of the following diseases: asthma, diabetes, arterial hypertension, rheumatoid arthritis, urticaria, renal insufficiency, liver failure, or parathyroid gland diseases; pregnant or lactating women

Recruitment Period
January 2023 and November 2024

Measurement Instrument
Beck Anxiety Inventory (BAI)
Beck Depression Inventory-II (BDI-II)

Definitions
Anxiety: BAI ≥ 14 points.
Depression: BDI-II ≥ 14 points.
Total serum IgE
- < 100 UI/mL or ≥ 100 UI/mL

Vitamin D
- Sufficient: ≥ 30 ng/dL; Insufficient 20 - < 30 ng/dL; Deficient: < 20 ng/dL.

Analysis
- Descriptive statistics.
- Multivariate and interaction statistical analyses.
- Data were analyzed using SPSS Statistics software.

Results

A total of 147 patients were included, with a mean age of 34.2 years. Of these, 75.5% were women, 77.6% had persistent AR, and 63.3% had moderate-severe AR, **Table 1. A total of 82 out of 147 patients (55.8%) presented with anxiety, and 67 out of 147 (45.6%) with depression**.

Table 1. Clinical Characteristics of the study population.

	Total n = 147
Age, years, mean ± SD	34.2 ± 14.4
Sex, female, n (%)	111 (75.5)
Current alcohol consumption, n (%)	62 (42.2)
Current tobacco use, n (%)	21 (14.3)
Exercise, n (%)	34 (23.1)
BMI, (kg/m^2), mean ± SD	26.8 ± 5.28
Allergic rhinitis, n (%)	
Persistent	114 (77.6)
Moderate to severe	93 (63.3)
Duration of allergic rhinitis, years, median (P_{25} - P_{75})	7 (3 - 15)
Eosinophils, cells/mm^3, median (P_{25} - P_{75})	239 (130 – 414)
IgE, UI/mL, median (P_{25} - P_{75})	108 (49 – 264)
Vitamin D, n (%)	
Sufficient	**43 (29.3)**
Insufficient	**62 (42.2)**
Deficient	**42 (28.6)**
BAI, median (P_{25} - P_{75})	15 (8 – 22)
BDI-II, median (P_{25} - P_{75})	13 (13 – 19)

Table 2 shows a multiplicative interaction between anxiety and both VD insufficiency with IgE ≥ 100 IU/mL (OR 16.39, p = 0.004), as well as VD deficiency with IgE ≥ 100 IU/mL (OR 21.92, p = 0.005).

Table 2. Multivariate analysis of the interaction between VD and total serum IgE concentration on the risk of **anxiety** (dependent variable) in patients with AR.

	OR	95% CI	p
All patients, n = 147			
Interaction between VD and total IgE			
Sufficient VD*IgE < 100 UI/ml	1		
Insufficient VD*IgE ≥ 100 UI/ml	**16.39**	**2.39 to 112.54**	**0.004**
Deficient VD*IgE ≥ 100 UI/ml	**21.92**	**2.58 to 186.42**	**0.005**
Sex (female)	2.91	1.08 to 7.86	0.035
Depression	6.50	2.85 to 14.83	< 0.001

Notably, neither patients with total IgE concentrations below 100 IU/mL nor those with levels equal to or above this threshold showed a significant association with depression, Table 3.

Table 3. Multivariate analysis of the interaction between VD and total serum IgE concentration on the risk of **depression** (dependent variable) in patients with AR.

	OR	95% CI	p
All patients, n = 147 (Anxiety was excluded from the model)			
Interaction between VD and total IgE			
Sufficient VD*IgE < 100 UI/ml	1		
Insufficient VD*IgE ≥ 100 UI/ml	**2.9**	**0.55 to 15.59**	**0.207**
Deficient VD*IgE ≥ 100 UI/ml	**1.79**	**0.29 to 11.16**	**0.535**
Education level (bachelor's degree or higher)	0.41	0.18 to 0.95	0.037

Conclusions

Our findings suggest that individuals with AR may be at increased risk of anxiety—but not depression—when presenting with low VD levels and elevated serum IgE. Future studies should further investigate the potential mechanistic pathways linking VD deficiency and immune dysregulation to anxiety symptoms in AR patients.

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