

Allergic Rhinitis Is Associated With Loss of Energy and Concentration Difficulty: A Cross-sectional Study

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Abstract

Objective: To assess whether loss of energy and concentration difficulty are related to allergic rhinitis.

Design: A cross-sectional study.

Setting: Secondary care allergy outpatients.

Participants: A total of 100 patients with allergic rhinitis and 96 healthy subjects.

Main Outcome Measure: Loss of energy and concentration difficulty were assessed through a survey using the Beck Depression Inventory-II (BDI-II).

Results: The average BDI-II score was higher in the allergic rhinitis population than in the healthy controls (12.8 points vs 1.8 points, $P < .0001$), and the frequencies of loss of energy (69.0% vs 32.3%) and concentration difficulty (65.0% vs 34.4%) were higher in patients with allergic rhinitis ($P < .0001$). The prevalence of depression was 0% in the control group and 38% in the case group ($P < .0001$). Allergic rhinitis and depression were independently associated with loss of energy, odds ratio (OR) = 2.55, $P = .005$, and OR = 9.61, $P = .001$, respectively, and concentration difficulty (OR = 2.04, $P = .033$; OR = 6.19, $P = .001$, respectively).

Conclusions: This study is one of the first studies in Latin America to report an independent association of allergic rhinitis with loss of energy and concentration difficulty.

Keywords

allergic rhinitis, depression, cross-sectional study, prevalence, risk factors, adult

Introduction

From the public health perspective, allergic rhinitis is a major problem worldwide. Its prevalence in adults ranges from 7% in Latin America to 9% in the Asia-Pacific region and up to 14% in the United States.¹ In our country, allergic rhinitis has been estimated to affect 7% to 15% of young adults in the general population.^{2,3} Since no effective methods are currently available to prevent allergic rhinitis either in children or adults, its prevalence has increased in recent years.^{4,5}

Allergic rhinitis is often accompanied by various health problems, including asthma, atopic dermatitis, or allergic conjunctivitis. Although sleep disorders, productivity loss, attention deficits, and learning difficulties are observed in allergic rhinitis cases,⁶ they have received little attention.

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Loss of energy and concentration difficulty are both important components of emotional disruption and depression. The attention deficit concept, although seemingly routine, may have different implications for each individual. This concept is considered multidimensional and includes 3 important elements: concentration, selective attention, and divided attention.⁷ Energy has been defined as the “ability of each individual to perform physical and mental activity.”⁸ Loss of energy is interchangeable with fatigue and is described as subjective sensations of tiredness, exhaustion and loss of both physical and mental energy.⁹

As previously described, allergic rhinitis is not only a nasal problem but also causes a wide spectrum of symptoms, some of which involve cognitive and emotional problems related to decreases in productivity and quality of life. Thus, allergic rhinitis has become an important health problem.¹⁰ The purpose of this study was to assess whether loss of energy and concentration difficulty are related to allergic rhinitis.

Methods

Ethical Considerations

All subjects included in the study provided informed consent. Subjects with depressive symptoms (a Beck Depression Inventory-II [BDI-II] score higher than 13 points) underwent a psychological evaluation. This research was approved by the Ethics and Research Committee of Hospital Civil de Guadalajara “Dr. Juan I. Menchaca.”

Study Design

The cross-sectional study was performed in a secondary care hospital and included 2 groups of adult subjects ≥ 18 years old living in the metropolitan area of Guadalajara, Jalisco, Mexico. The first group included patients with allergic rhinitis with aqueous rhinorrhea, nasal obstruction, nasal itching, and sneezing induced after aeroallergen exposure¹¹ who were consecutively selected from patients receiving care in the Allergy Service in a teaching hospital for the first time. All of the patients were sensitized to at least 1 aeroallergen. Following the recommendations of Allergic Rhinitis and its Impact on Asthma (ARIA), allergic rhinitis was classified as intermittent or persistent and mild or moderate-severe.¹² The second group included consecutively recruited presumably healthy patients without allergic rhinitis who were accepted as blood donors. The ratio of subjects between the groups was 1:1.

In both groups, we excluded subjects with a clinical history of asthma, diabetes mellitus, arterial hypertension, rheumatoid arthritis, hives, renal insufficiency,

neoplasia, systemic steroid usage in the previous month, or a family death 6 months prior to the survey and pregnant or breastfeeding women. Alcohol or tobacco consumption was also noted.

Variables

Physical activity. Subjects were considered active when they affirmatively answered the question *Do you practice any physical activity such as walking, running, swimming, gymnastics, or ball games for at least 20 minutes?*

Depression, loss of energy, and concentration difficulty. A global score higher than 13 in a version of the BDI-II validated in Spanish was used to identify patients with depression. Loss of energy was also assessed using the BDI-II through a Likert scale with the following options and codes: (0) *I have as much energy as always*; (1) *I have less energy than usual*; (2) *I do not have enough energy for many activities*; and (3) *I do not have enough energy for anything*. Answering positively to options 1 to 3 was considered affirmative for loss of energy. Concentration difficulty was also identified with the same inventory but with the following options and codes: (0) *I can concentrate as well as always*; (1) *I cannot concentrate as well as usual*; (2) *I have difficulty keeping my mind on a single item for a long time*; and (3) *I cannot concentrate on anything*. Concentration difficulty was identified when patients answered options 1 to 3 positively.

Skin prick test technique. A battery of 40 aeroallergens was applied to each patient to identify allergic sensitization; the panel included several regional pollens, fungal spores, and indoor allergens, and its analysis was performed following international recommendations.¹³

Statistical Analysis

For the data analysis, IBM SPSS for Windows version 20.0 was used (IBM Co., Armonk, NY, USA). Continuous variables were compared with Student's *t* tests or Mann-Whitney *U* tests according to their distributions. Categorical variables were compared with χ^2 tests or Fisher's exact tests. To identify associated factors, 2 binary logistic regression models were designed, including one for loss of energy (dependent variable) and another for concentration difficulty (dependent variable). In both cases, the independent covariates were allergic rhinitis, depression, sex, alcohol consumption, physical activity, and overweight-obesity. The strengths of the associations among the variables identified from these models were assessed with odds ratios (ORs) and 95% confidence intervals (CIs). A *P* value $\leq .05$ was considered statistically significant.

Results

One hundred subjects with allergic rhinitis and 96 presumably healthy subjects were included; 4 patients in the latter group were excluded due to incomplete data. Both groups had a similar average age (31.5 years vs 32.1 years, $P = .65$; Table 1). Alcohol consumption and physical activity were reported more frequently among males in the presumably healthy group than among those in the allergic rhinitis group ($P < .05$). Weight, however, was significantly higher in the healthy subjects, and the body mass index did not differ between the groups. However, when classifying groups according to nutritional status, a relevant difference was found.

The BDI-II score was significantly higher in the allergic rhinitis group than that the presumably healthy group (12.8 points vs 1.8 points, $P < .0001$; Table 1).

Loss of energy (69.0% vs 32.3%) and concentration difficulty (65.0% vs 34.4%) were more frequent in the patients with allergic rhinitis ($P < .0001$). In contrast, the proportion of patients with depression was 0% in the presumably healthy group and 38% in the allergic rhinitis group ($P < .0001$; Table 1).

Table 2 shows an analysis of the patients with allergic rhinitis. For this analysis, the patients were divided according to the severity of their symptoms. Although the risks of energy loss and concentration difficulty were higher in patients with persistent and moderate-severe allergic rhinitis, no statistically significant differences were found.

Multivariate analysis revealed allergic rhinitis and depression as factors associated with loss of energy (OR = 2.55, $P = .005$; OR = 9.61, $P = .001$, respectively; Table 3) and concentration difficulty (OR = 2.04, $P = .033$; OR = 6.19, $P = .001$, respectively; Table 4).

Table 1. Characteristics of Study Groups.

	Allergic Rhinitis		<i>P</i>
	Yes <i>n</i> = 100	No <i>n</i> = 96	
Age, years mean $\pm$ SD	31.5 $\pm$ 10.7	32.1 $\pm$ 9.7	.650
Sex, <i>n</i> (%)			
Male	34 (34.0)	59 (61.5)	<.0001
Current smoking, <i>n</i> (%)	10 (10.0)	14 (14.6)	.328
Alcoholic beverage consumption, <i>n</i> (%)	29 (29.0)	49 (51.0)	.002
Physical activity, <i>n</i> (%)	58 (58.0)	71 (74.0)	.019
Weight, kg, mean $\pm$ SD	69.1 $\pm$ 15.2	76.1 $\pm$ 12.0	<.0001
BMI, kg/m ² , mean $\pm$ SD	26.1 $\pm$ 5.5	26.9 $\pm$ 3.7	.204
BMI, <i>n</i> (%)			.011
Normal weight	50 (50.0)	30 (31.3)	
Overweight	28 (28.0)	46 (47.9)	
Obesity	22 (22.0)	20 (20.8)	
BDI-II, score, mean $\pm$ SD	12.8 $\pm$ 8.6	1.8 $\pm$ 0.4	<.0001
Loss of energy, <i>n</i> (%)	69 (69.0)	31 (32.3)	<.0001
Concentration difficulty, <i>n</i> (%)	65 (65.0)	33 (34.4)	<.0001
Depression, <i>n</i> (%)	38 (38.0)	0 (0)	<.0001

Abbreviations: BDI-II, Beck Depression Inventory-II; BMI, body mass index; SD, standard deviation.

P value was obtained using χ^2 test, Fisher's exact test, or Student's *t* test as necessary.

Table 2. Subgroup Analysis: Energy Loss or Concentration Difficulty According to the Severity of Allergic Rhinitis.

	Loss of Energy					Concentration Difficulty				
	Yes <i>n</i> = 48	No <i>n</i> = 21	OR	95% CI	<i>P</i>	Yes <i>n</i> = 43	No <i>n</i> = 26	OR	95% CI	<i>P</i>
Allergic rhinitis										
Persistent	41 (85.4)	15 (71.4)	2.3	0.7–8.1	.19	36 (83.7)	20 (76.9)	1.5	0.5–5.2	.54
Intermittent	7 (14.6)	6 (28.6)	1			7 (16.3)	6 (23.1)	1		
Allergic rhinitis										
Moderate-severe	41 (85.4)	16 (76.2)	1.8	0.5–6.6	.49	36 (83.7)	21 (80.8)	1.2	0.3–4.3	.75
Mild	7 (14.6)	5 (23.8)	1			7 (16.3)	5 (19.2)	1		

Abbreviations: CI, confidence interval; OR, odds ratio.

Discussion

Summary of the Main Findings

This study reveals the following important findings. First, the extranasal manifestations of loss of

energy and concentration difficulty are 2 common occurrences in patients with allergic rhinitis. Moreover, the study shows that both elements together with depression are associated with allergic rhinitis.

Table 3. Factors Associated With Loss of Energy.

	Unadjusted Model			Adjusted Model		
	OR	95% CI	P	OR	95% CI	P
Allergic rhinitis						
No	1			1		
Yes	2.32	1.15–4.69	.019	2.55	1.32–4.92	.005
Depression						
No	1			1		
Yes	9.26	2.55–33.59	.001	9.61	2.67–34.58	.001
Sex						
Female	1					
Male	0.72	0.37–1.43	.351	–	–	.258
Alcoholic beverages consumption						
No	1					
Yes	0.84	0.43–1.67	.856	–	–	.415
Physical activity						
No	1					
Yes	0.86	0.44–1.68	.653	–	–	.565
Overweight or obesity						
No	1					
Yes	1.16	0.60–2.24	.669	–	–	.721

Abbreviations: 95% CI, 95% confidence interval; OR, odds ratios were obtained using binary logistic regression.

Table 4. Factors Associated With Concentration Difficulty.

	Unadjusted Model			Adjusted Model		
	OR	95% CI	P	OR	95% CI	P
Allergic rhinitis						
No	1			1		
Yes	1.73	0.86–3.48	.123	2.04	1.06–3.91	.033
Depression						
No	1			1		
Yes	6.13	2.08–18.01	.001	6.19	2.13–17.94	.001
Sex						
Female	1					
Male	0.58	0.30–1.12	.107	–	–	.085
Alcoholic beverages consumption						
No	1					
Yes	1.04	0.53–2.04	.911	–	–	.666
Physical activity						
No	1					
Yes	0.93	0.48–1.81	.840	–	–	.791
Overweight or obesity						
No	1					
Yes	0.82	0.43–1.55	.817	–	–	.468

Abbreviations: 95% CI, 95% confidence interval; OR, odds ratios were obtained using binary logistic regression.

The Frequency of Symptoms of Depression in Patients With Allergic Rhinitis

In this report, concentration difficulty affected almost two-thirds of the patients with allergic rhinitis, which is similar to observations in previous studies demonstrating that performance in attention-requiring tasks decreased in patients with allergic rhinitis.^{14,15} Moreover, control of allergic rhinitis symptoms was related to better performance.¹⁴ Nevertheless, to the best of our knowledge, a few studies have reported the prevalence of concentration difficulty as a symptom of allergic rhinitis; therefore, this study provides valuable information in this regard.

Our study showed that three-quarters of the patients with allergic rhinitis experienced loss of energy. Similarly, fatigue was present as one of the most frequent symptoms identified in this group of patients.¹⁰ Another study revealed that patients with allergic rhinitis had higher scores for sleep and fatigue in the Rhinosinusitis Disability Index than those among healthy subjects.¹⁶ In addition, patients with seasonal allergic rhinitis sensitized to ambrosia had a higher degree of fatigue during pollen season.¹⁷ Nevertheless, cognitive changes are not limited to the period when nasal symptoms are present. Such changes are also found during other periods to a lesser extent. Thus, allergic rhinitis can possibly introduce persistent changes in patients.

Possible Explanations

Studies evaluating the correlation between depression and rhinitis are scarce. In our population, depression affected close to 40% of the patients, and one-third of patients with chronic rhinosinusitis were found to be affected by depression.¹⁸ Previous studies have demonstrated that the depression risk in preadolescents with allergic rhinitis is higher than that in patients without allergic rhinitis,¹⁹ and allergic rhinitis in teenagers leads to a higher risk of depressive disorders in adulthood.²⁰ Recently, a systematic review revealed that patients with allergic rhinitis had a higher risk of depression than did nonallergic patients.²¹ Similar to fatigue, the severity of depressive symptoms was related to disease activity and was even more drastic during pollination season in patients with seasonal allergic rhinitis.²² The association between allergic rhinitis and depression is important to consider as depression may contribute to cognitive function damage in patients with allergic rhinitis.

The impact of allergic rhinitis on cognitive function is considered to be the result of several processes. For example, patients with allergic rhinitis frequently have sleep disorders.²³ Sleep deficiency has previously been

shown to negatively impact cognitive functions such as attention, especially long-term attention.²⁴ Among the proposed mechanisms affecting sleep quality, nasal congestion is notable. Increased resistance to air flux in the nasal airway leads to a higher risk of sleep respiratory disorders such as apnea or snoring.²⁵ Interestingly, a study found that patients with allergic rhinitis had lower reaction speeds than did healthy controls in attention tests during pollen season. Furthermore, patients with allergic rhinitis achieved greater cognitive control recruitment when symptomatic, which may represent a compensatory mechanism for the cognitive changes induced by rhinitis according to the authors. These disturbances were independent of sleep and the severity of the disease. However, a positive association between IgE levels and reaction speed was observed in the tests used, which supports the idea that inflammatory processes underlie cognitive deficits in these patients.²⁶ Usually, allergic rhinitis occurs due to inflammatory factors²⁷ that are not only responsible for the nasal manifestations of the disease but also seem to affect systemic levels of inflammation. For example, histamine is involved in wakefulness maintenance,²⁸ whereas interleukins IL-1 β , IL-4, and IL-10 are correlated with increased sleep latency during rapid eye movement (REM) sleep and decreased latency at the beginning of sleep and at the end of REM sleep.²⁹ Cerebral structures such as the hippocampus may be involved. An allergic rhinitis murine model showed that the expression of inflammatory markers in the hippocampus was increased compared to that in a healthy group, supporting the above speculation.³⁰ However, another assay demonstrated no differences in synaptic marker expression between affected and healthy mice, suggesting the absence of structural changes.³¹ Nevertheless, further studies are required to identify all involved factors and their importance in the cognitive changes observed in patients with allergic rhinitis. In addition, these new studies can show whether the association of allergic rhinitis with energy loss and concentration difficulty found in our results is also evident in developed countries with different social determinants and qualities of life.

Possible Biases and Confounding Factors

One of the main biases when using questionnaires is memory bias. Therefore, the patients in both groups (with and without allergic rhinitis) were asked to answer the BDI-II according to how they had felt in the last 4 weeks. On the other hand, the exclusion criteria prevented the introduction of possible confounding factors, which was reinforced in the multivariate analysis.

Limitations

This study has limitations related to the cross-sectional design and other methodological weaknesses that should be mentioned. The prevalence of concentration difficulty and loss of energy may vary depending on the instrument used for measurement. Other limitations include the lack of evaluation of the quality of the participants' sleep, and the season of the year was not considered. In addition, the effects of medications on the control of allergic rhinitis symptoms on energy loss and on concentration difficulty were not evaluated.

Conclusions

In conclusion, this study is one of the first studies showing an independent association of allergic rhinitis with loss of energy and concentration difficulty.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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