ASTHMA ALLERGY IMMUNOLOGY
ASTIM ALLERJİ İMMÜNOLOJİ

doi: 10.21911/aai.2025.888
Asthma Allergy Immunol 2025;23:292-300

RESEARCH ARTICLE

Received: 24.06.2025 • Accepted: 27.07.2025
Online Published: 19.11.2025

Are There any Factors Affecting Pulmonary Function Tests in Patients with Chronic Rhinitis?

Iclal HOCANLI[1], Sadan SOYYIGIT[2]

[1] Clinic of Immunology and Allergy Diseases, Ankara Bilkent City Hospital, Ankara, Türkiye
[2] Clinic of Immunology and Allergy Diseases, Ankara Yıldırım Beyazıt University and Ankara Bilkent City Hospital, Ankara, Türkiye

Corresponding Author: Iclal Hocanli ✉ iclalhocanli2163@gmail.com

This study was presented as an oral presentation at the National Lung Health Congress (Ulusal Akciğer Sağlığı Kongresi - UASK) held on April 9-12, 2025.

ABSTRACT

Objective: Chronic rhinitis (CR) is one of the most common conditions globally. CR, nasal polyp (NP), and asthma share similar histopathological features, including marked eosinophil, mast cell, and CD4+ T cell infiltration in both the upper and lower airways. The aim of this study is to investigate the Pulmonary Function Tests (PFTs) results of patients with a diagnosis of rhinitis and to identify the factors influencing these results.

Materials and Methods: As a cross-sectional study, 1500 patients with CR who presented to a single Immunology and Allergy Diseases outpatient clinic between July 2023 and December 2024 were screened. Demographic and clinical data, skin prick tests and serum specific Immunoglobulin E (IgE) results, PFTs, and laboratory findings were retrospectively analysed.

Results: A total of 130 patients met the inclusion criteria. Of these, 59.2% were female (n=77) and 40.8% male (n=53). Patients in the AR group were significantly younger than those in the NAR group. In addition, compared to the NAR group, the lymphocyte and eosinophil counts as well as the total IgE levels were found to be significantly higher in the AR group. NPs were significantly more common in the NAR group. In eosinophilic patients, both Forced Expiratory Volume in one second (FEV1) % and Maximal Expiratory Flow (MEF25-75) % values were significantly lower than in non-eosinophilic patients. Similarly, patients with NPs had significantly lower Forced Expiratory Volume in one second / Forced Vital Capacity (FEV1/FVC) % and MEF25-75% values compared to those without NPs. No significant correlation was found between allergen sensitisation and PFTs parameters. However, a moderate negative correlation was observed between eosinophilia and both MEF 25-75% and FEV1%. Additionally, a weak negative correlation was found between the presence of NPs and both MEF 25-75% and FEV1/FVC%.

Conclusion: In patients with CR, elevated peripheral blood eosinophil counts and the presence of NPs may be important predisposing factors for lower airway obstruction.

Keywords: Rhinitis, eosinophilia, nasal polyp, Pulmonary Function Tests (PFTs)

INTRODUCTION

Chronic rhinitis (CR) is one of the most common diseases worldwide, characterised by symptoms such as runny nose, sneezing, congestion, cough, and nasal itching. Etiologically, it is classified into two different types: allergic and non-allergic rhinitis**.** Depending on geographic location and age, inhalant allergens can cause allergic rhinitis (AR). Non-allergic rhinitis (NAR) can develop due to various mechanisms, including gustatory and vasomotor factors, irritants, medications, and systemic diseases (1)**.**

Many patients with CR develop increased airway sensitivity to odors and volatile substances**,** making rhinitis a risk factor for asthma (2,3). In a study conducted by Eriksson et al., the prevalence of asthma in patients with AR was

ORCID Iclal Hocanli / 0000-0003-3283-9639, Sadan Soyyigit / 0000-0003-3270-5884

found to be 20% (4). Pulmonary Function Tests (PFTs) are the most commonly used test and provide strong supporting evidence in the diagnosis of asthma. In particular, pre- and post-bronchodilator Forced Expiratory Volume in one second (FEV1) and Forced Expiratory Volume in one second/ Forced Vital Capacity (FEV1/FVC) measurements are the most important parameters indicating improvements in respiratory function (5).

Nasal polyps (NPs) are soft, well-defined masses commonly found in the upper and middle nasal passages of adults. Although they are often treated surgically, the recurrence rate is high. In patients with chronic rhinitis, nasal polyps are more likely to develop in areas of edematous mucosa that are in mutual contact (6). The coexistence of allergic AR and NPs is common and significantly impairs patients' quality of life, affecting their work, education, and daily functioning (7,8). AR, NP and asthma share similar histopathological characteristics, as both conditions involve intense eosinophil, mast cell, and CD4+ T cell infiltration in the upper and lower airways. Eosinophils are key cytotoxic effector cells involved in allergic and autoimmune diseases (9).

In patients diagnosed with CR, both the upper and lower respiratory tracts are affected due to internal and external factors, either simultaneously or chronically. The aim of this study is to investigate the PFT results of patients with a diagnosis of CR and to identify the factors influencing these results.

MATERIALS and METHOD

Patient Selection

As a cross-sectional study, 1500 patients with CR who presented at a single Immunology and Allergy Diseases outpatient clinic between July 2023 and December 2024 were screened. Demographic and clinic data, comorbidity, skin prick tests and serum specific Immunoglobulin E (IgE) results, PFTs, laboratory tests and ear, nose and throat (ENT) examination notes and/or paranasal computed tomography (PNCT) data of these patients were retrospectively examined. Of the patients screened, 1300 were excluded due to the absence of PFTs results and laboratory data, 10 were under the age of 18, and 60 had comorbidities such as asthma, bronchiectasis, chronic obstructive pulmonary disease (COPD), or cystic fibrosis. As a result, a total of 130 patients over the age of 18 years, whose skin prick tests and allergen serum specific IgE levels, laboratory data, and PFTs were available, and without respiratory tract disease were included in the study (Figure 1). Approval was obtained from the Ankara Bilkent City Hospital local ethics committee in accordance with the principles of the Declaration of Helsinki (Approval number: E1-23-4517).

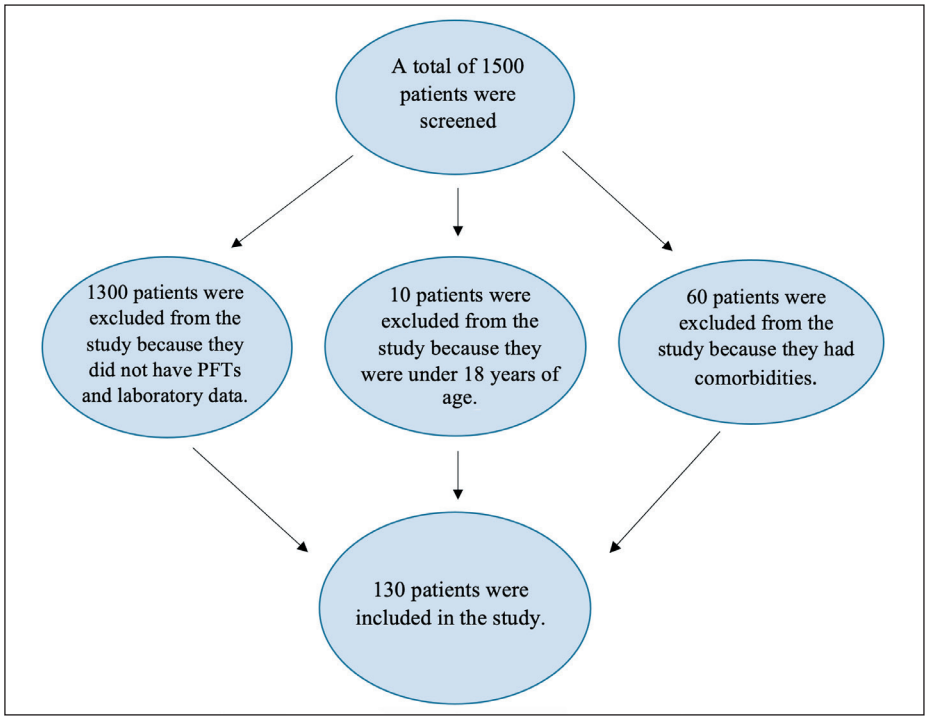

Figure 1: Patient selection flow chart

Laboratory Data

Biochemical (glucose, renal function tests, liver function tests, etc.), haemogram, total IgE, serum specific IgE and skin prick tests results of the patients were obtained from the hospital registration system. The PFTs measurement was performed and evaluated at our hospital using the COSMED microQuark Spirometer (Italy). The same device was used for all patients throughout the study period. The best PFT curves and results of the values obtained as a result of 3 trials with 95% consistency were also obtained from the imaging records. The most important parameters related to airway resistance in PFTs are FEV1, Forced Vital Capacity (FVC), FEV1/FVC, and Maximal Expiratory Flow (MEF) 25-75. FEV1 represents the volume of air forcefully exhaled in the first second of expiration, while FVC refers to the total volume of air exhaled during a rapid and forced expiration, and MEF25-75 indicates the maximum airflow during the middle portion of expiration, specifically between the 25th and 75th percentiles of the forced expiratory maneuver (10).

Grouping of Patients

In the skin prick tests applied to a symptomatic patient, an erythematous induration ≥3 mm larger than the negative control on the skin with at least one allergen or a serum specific IgE level >0.35 kU/L was accepted as allergy. Patients were divided into two groups, allergic rhinitis (AR) and non-allergic rhinitis (NAR), based on the results of the skin prick tests / serum specific IgE. Demographic, laboratory data and symptoms of the patients were compared between the AR and NAR groups. In the complete blood count measurement, a peripheral blood absolute eosinophil count of ≥450 cells/μL was considered eosinophilia (11). Patients with a peripheral blood absolute eosinophil count of ≥450 cells/μL were classified as eosinophilic, while those with a count of <450 cells/μL were classified as non-eosinophilic. Patients were divided into two groups as with and without NPs based on ENT examination notes and/or PNCT findings. Patients who had at least one cat, dog or budgie at home were categorised as pet owners and non-pet owners. Since the mean age of patients was under 40 in the AR group and over 40 in the NAR group, the patients were divided into two different groups: those under and over the age of 40. PFT data were compared between groups according to the presence or absence of allergies, pet ownership, eosinophilia, NPs, and age. Additionally, the correlation of eosinophilia, NPs, and allergen sensitivity with PFT parameters was determined.

Statistical Analysis

Data analysis was performed using the SPSS 25.0 for Windows software package (SPSS Inc., Chicago, IL, USA). The Kolmogorov-Smirnov Test was used to assess whether continuous data were normally distributed. Normally distributed data were expressed as Mean ± SD, and non-normally distributed data were expressed as Median (25-75 IQR). Normally distributed data were compared using Student's t Test, and non-normally distributed data were compared using the Mann-Whitney U Test. Chi-square or Fisher's exact test was used as appropriate to compare categorical variables. The correlation between eosinophilia, nasal polyps, and age with allergy status and PFTs parameters was assessed using Spearman and Pearson correlation analyses. Values below 0.05 were considered significant for all p-values.

RESULTS

A total of 130 patients were included in the study. 59.2% of them were female (n=77) and 40.8% were male (n=53). The demographic and laboratory data of the patients between the AR and NAR groups are compared in Table I. The patients in the AR group were significantly younger. In addition, compared to the NAR group, the lymphocyte and eosinophil counts as well as the total IgE levels were found to be significantly higher in the AR group (r=0.001, r=0.011, r<0.001). Body mass index (BMI) was significantly lower in patients with AR, while there was no significant difference between the two groups in terms of smoking status (r=0.017, r=0.580, respectively). A total of 62 patients owned pets. 33.1% of these patients had a cat, 2.3% had a dog, and 8.5% had a budgie. However, no significant difference was found between the two groups in terms of pets. NPs were found to be statistically higher in NAR patients (p=0.038).

Eighteen of the patients included in the study had various comorbidities. Hypertension (HT) was both the most common comorbidity and was found to be significantly higher in the NAR group (p=0.023). Regarding other comorbidities, no significant differences were found between the AR and NAR groups. (Table II).

Although classic rhinitis symptoms (rhinorrhea, nasal congestion, sneezing, etc.) were seen more intensely in the AR group, there was no statistically significant difference between the AR and NAR groups (Table III).

Table I: Comparison of demographic and laboratory data between AR and NAR groups

	AR (n=88)	NAR (n=42)	p
Age (year)	31.5 ± 12.3	44.5 ± 14.6	**< 0.001**
Gender (female/male)	55/33	22/20	0.272
BMI (m^2/kg)	25.4±5.2	27.8±5.1	**0.017**
Glucose, mg/dL	86.4 ± 21.3	89.5 ± 12.6	0.327
Urea, mg/dL	25.1 ± 6.9	29.5 ± 8.4	**0.011**
Creatinine, mg/dL	0.8 ± 0.6	0.7 ± 0.1	0.634
AST, U/L	17.5 ± 8.6	16.8 ± 6.2	0.633
ALT, U/L	25.8 ± 17.5	24.3 ± 9.4	0.578
WBC, $x10^9$/L	8.0 ± 1.9	7.3 ± 2.0	0.090
Neutrophil, $x10^9$/L	4.5 ± 1.5	4.5 ± 1.6	0.908
Lymphocyte, $x10^9$/L	2.3 ± 0.6	1.9 ± 0.6	**0.001**
Eosinophil, $x10^9$/L	0.38 ± 0.33	0.25 ± 0.21	**0.011**
Basophil, $x10^9$/L	0.05 (0.03-0.07)	0.04 (0.03-0.07)	0.278
ESR, mm/hour	11.6 ± 7.4	13.2 ± 11.4	0.571
CRP, mg/L	1.9 (0.5-5.8)	2.3 (0.5-6.8)	0.908
Hb, g/dL	14.0 ± 1.4	13.6 ± 2.3	0.399
Vitamin D, ng/L	19.1 ± 8.9	20.3 ± 10.0	0.666
Total IgE, IU/ml	195.0 (63.1-717.0)	55.6 (15.4-130.9)	**<0.001**
Smoking, n (%)	25 (28.4)	10 (23.8)	0.580
Pet, n (%)	47 (53.4)	15 (35.7)	0.059
Nasal polyp, n (%)	4 (4.5)	7 (16.7)	**0.038**

AR: Allergic rhinitis, **NAR:** Non allergic rhinitis, **BMI:** Body mass index, **AST:** Aspartate aminotransferase, **ALT:** Alanine aminotransferase, **WBC:** White blood cell, **ESR:** Erythrocyte sedimentation rate, **CRP:** C-reactive protein, **Hb:** Hemoglobin.

Table II: Comparision of comorbidities between AR and NAR groups

	AR (n=88)	NAR (n=42)	P
HT, n (%)	2 (2.3)	5 (11.9)	***0.023***
DM, n (%)	0 (0.0)	1 (2.4)	0.146
HThy, n (%)	2 (2.3)	0 (0.0)	0.325
RD, n (%)	0 (0.0)	1 (2.4)	0.146
HT+DM, n (%)	0 (0.0)	1 (2.4)	0.146
AD, n (%)	2 (2.3)	0 (0.0)	0.325
GER, n (%)	1 (1.1)	0 (0.0)	0.488
SD, n (%)	1 (1.1)	0 (0.0)	0.488
ND, n (%)	0 (0.0)	1 (2.4)	0.146
NeoD, n (%)	0 (0.0)	1 (2.4)	0.146

AR: Allergic rhinitis, **NAR:** Non allergic rhinitis, **HT:** Hypertension, **HThy:** Hypothyroidism, **DM:** Diabetes mellitus, **RD:** Rheumatologic disease, **AD:** Atopic dermatitis, **GER:** Gastroesophageal reflux, **SD:** Sleep disorders, **ND:** Neurological disorders, **NeoD:** Neoplastic disorders.

Table III: Comparison of rhinitis symptoms according to Allergen sensitivity

	AR (n=88)	NAR (n=42)	P
Rhinorrhea, n (%)	67 (76.1)	26 (61.9)	0.093
Congestion, n (%)	64 (72.7)	27 (64.3)	0.326
Sneeze, n (%)	58 (65.9)	28 (66.7)	0.932
Itching, n (%)	57 (64.8)	20 (47.6)	0.063
Postnasal drip, n (%)	52 (59.1)	30 (71.4)	0.173
Cough, n (%)	46 (52.3)	24 (57.1)	0.602
Dyspnea, n (%)	44 (50.0)	13 (31.0)	0.410

AR: Allergic rhinitis, **NAR:** Non allergic rhinitis.

Table IV: Comparison of PFT data between Pet Ownership and Allergen Sensitivity

	AR (n=88)	NAR (n=42)	P1	Pet ownership (n=62)	Non-pet ownership (n=68)	P2
FEV1, L	3.3±1.0	3.0±0.8	0.166	3.1 ± 0.8	3.3±1.1	0.266
FEV1, %	94.5±18.8	97.7±22.1	0.483	94.3±17.4	96.0±21.9	0.667
FVC, L	3.7(3.0-5.0)	3.7(2.9-4.5)	0.349	3.6(3.0-4.2)	3.8(2.9-5.1)	0.474
FEV1/FVC, %	84.5 ± 11.6	83.3±8.0	0.524	83.3±12.4	84.7±8.5	0.457
MEF 25-75, %	85.2 ± 27.1	80.6±35.2	0.450	80.8±27.4	85.7±31.9	0.351

AR: Allergic rhinitis, **NAR:** Non allergic rhinitis, **FEV1:** Forced Expiratory Volume in one second, **FVC:** Forced Vital Capacity, **FEV1/FVC:** Forced Expiratory Volume in one second / Forced Vital Capacity, **MEF 25-75:** Maximal Expiratory Flow, 25th and 75th percentile
p1; comparison value of spirometric parameters between AR and NAR groups
p2; comparison value of spirometric parameters between Pet and Non-pet groups

PFT data were compared among the pet ownership, allergen sensitivity, NPs, age, and eosinophilia groups. While there was no significant difference between allergen sensitivity and the pet ownership groups, FEV1% (p=0.002) and MEF 25-75% (p=0.001) values in eosinophilic patients were found to be significantly lower com-

Table V: Comparison of PFT data between Eosinophilia and NPs groups

	Eosinophilic (n=32)	Non-eosinophilic (n=88)	P1	NPs (n=11)	Non-NPs (n=119)	P2
FEV1, L	3.1±1.0	3.2±0.9	0.625	3.2±1.1	3.2±0.9	0.943
FEV1,%	85.7±18.0	99.4±19.9	**0.002**	90.7±32.9	96.0±18.1	0.419
FVC, L	3.5(2.9-4.2)	3.7(2.9-4.5)	0.869	4.4(2.7-5.1)	3.7(3.0-4.7)	0.544
FEV1/FVC, %	82.3±9.8	84.5±10.7	0.298	77.9±12.1	84.7±10.2	**0.041**
MEF25-75	72.0±21.9	89.4±28.9	**0.001**	68.2±37.6	86.2±26.6	**0.041**

NPs: Nasal polyps, **FEV1:** Forced Expiratory Volume in one second, **FVC:** Forced Vital Capacity, **FEV1/FVC:** Forced Expiratory Volume in one second / Forced Vital Capacity, **MEF 25-75:** Maximal Expiratory Flow 25th and 75th percentile.
p1; comparison value of spirometric parameters between Eosinophilic and Non-eosinophilic groups
p2; comparison value of spirometric parameters between NPs and Non-NPs groups

Table VI: Comparison of PFT data between age groups

	Patient group under 40 years of age (n=83)	Patient group over 40 years of age (n=47)	P
FEV1, L	3.5±0.9	2.8±0.8	**≤0.001**
FEV1,%	94.5±17.2	97.2±23.8	0.555
FVC, L	3.8 (3.2-5.1)	3.1(2.6-4.2)	**0.001**
FEV1/FVC, %	84±9.0	81±12.6	0.087
MEF25-75, %	84.8±26.6	84.5±30.6	0.952

FEV1: Forced Expiratory Volume in one second, **FVC:** Forced Vital Capacity, **FEV1/FVC:** Forced Expiratory Volume in one second / Forced Vital Capacity, **MEF 25-75:** Maximal Expiratory Flow 25th and 75th percentile

pared to non-eosinophilic patients and in the group with NPs, FEV1/FVC% (r=0.041) and MEF 25-75% (r=0.041) rates were statistically lower than in the group without NPs (Table V). In addition, while FEV1 (p<0.001) and FVC (p=0.001) values were significantly higher in the patients under 40 years of the age than in those over 40 years of the age, no significant difference was found between the two groups regarding the FEV1/FVC%, FEV1%, and MEF 25-75% values (Table VI).

Table VII presents the results of the Pearson and Spearman correlation analyses between allergen sensitivity, eosinophilia, NPs, and PFT parameters. No significant correlation was found between allergen sensitisation and PFT parameters. However, a moderate negative correlation was observed between eosinophilia and both MEF 25-75% (r = -0.300, p = 0.002) and FEV1% (r = -0.312, p = 0.002). Additionally, a weak negative correlation was found between the presence of NPs and both MEF 25-75% (r = -0.180, p = 0.041) and FEV1/FVC% (r = -0.181, p = 0.041).

Table VII: Correlation of eosinophilia, NPs, and allergy sensitivity with PFTs parameters using Pearson and Spearman analyses

	NPs	Eosinophilia	Allergy Sensitivity
FEV1/FVC %			
Pearson r	-0.181*	-0.093	0.116
p	**0.041**	0.316	130
n	118	118	0.189
MEF 25-75 %			
Pearson r	-0.180*	-0.300**	0.028
p	**0.041**	**0.002**	0.756
n	118	118	130
FVC %			
Spearman r	0.054	-0.015	0.083
p	0.546	0.870	0.351
n	118	118	130
FEV1 %			
Pearson r	-0.006	-0.312**	-0.075
p	0.943	**0.002**	0.454
n	118	118	130

NPs: Nasal polyps, **PFTs:** Pulmonary Function Tests, **FEV1/FVC:** Forced Expiratory Volume in one second / Forced Vital Capacity, **MEF 25-75:** Maximal Expiratory Flow 25th and 75th percentile, **FVC:** Forced Vital Capacity FEV1: Forced Expiratory Volume in one second. ** Correlation is significant at p<0.05, ** Correlation is significant at p<0.01*

DISCUSSION

This study investigated the factors influencing PFTs parameters in patients with CR. The main finding was that NPs and eosinophilia were associated with decreased MEF 25-75%, FEV_1%, and FEV_1/FVC% values, whereas allergen sensitisation had no significant impact on PFTs parameters.

CR is a highly prevalent condition worldwide, characterised by nasal mucosal inflammation due to allergic or non-allergic causes. AR**,** in particular, is more commonly observed, although its prevalence varies across countries. Studies have shown that the prevalence of AR in adults ranges from 10% to 30% in the United States, 11.8% to 36.4% in Turkey, and approximately 20% in Canada (12-14). In the meta-analysis study conducted by Pinart et al.**,** a female dominance was observed in both adolescent and adult AR patients (15). However, two separate studies conducted in Korea and Nigeria reported a limited male predominance among AR patients. (16,17). Studies conducted in Asia and Singapore have found that the likelihood of AR occurring is higher, particularly among individuals aged 20-45 (18,19). In our study, similar to the literature data, female sex ratio was found to be higher in both AR and NAR groups, and especially the AR group consisted of significantly younger patients.

The upper and lower airways share similar anatomical structures (20). The epithelial tissue forms a continuous structure between cells, serving as a crucial barrier that protects the body from environmental stress and physical damage. These epithelial cells not only function as a physical barrier but also produce antimicrobial cytokines and peptides, playing significant roles in immune response, inflammation, repair, and remodeling processes. While epithelial cells can rapidly repair themselves in acute inflammation, chronic inflammatory processes lead to permanent structural changes such as goblet cell metaplasia, basement membrane thickening, submucosal extracellular matrix deposition, smooth muscle hypertrophy, subepithelial angiogenesis, and myofibroblast hyperplasia. These processes develop due to exposure to triggers such as respiratory allergens, various chemicals, cigarette smoke, air pollution, temperature changes, cold air, and pathogens. These epithelial barrier defects have been demonstrated in affected organs in diseases such as asthma and allergic rhinitis. This evidence highlights the close anatomical and histopathological relationship between the upper and lower airways (21,22). As our study was retrospective, data on several important predisposing factors affecting the upper and lower airways—such as chemical exposure, air pollution, climate change, and cold weather—were not available. However, 27% of the patients were smokers, and 67.7% showed allergen sensitisation. According to the literature, both smoking and allergen sensitisation may play important roles in the pathogenesis of rhinitis.

The relationship between AR and asthma constitutes the "united airways concept" and is highlighted in the Allergic Rhinitis and Its Impact on Asthma guidelines (ARIA) (23). The prevalence of asthma in patients with rhinitis ranges between 10-40%. In a study conducted by William et al., asthma was observed in 21.3% of patients with AR, whereas Lombardi et al. reported a prevalence of 31.8% (24,25). Additionally, a 23-year follow-up study conducted by Settipane et al., which included 1,836 university students, found that AR and positive allergy skin tests were significant risk factors for the development of new-onset asthma. Individuals with these risk factors had an approximately threefold higher likelihood of developing asthma compared to negative controls (26). In patients diagnosed with AR, when asthma is suspected, the most important and commonly used test to confirm and support the diagnosis is the PFTs. In asthma, FVC is generally close to normal, whereas FEV1 is reduced. A decreased FEV1/FVC ratio is a characteristic feature of asthmatic patients. MEF 25-75 primarily provides information about small airway function and is typically the first parameter to decrease before FEV1 in obstructive conditions (27). A study conducted in Spain reported significant impairments in FEV1 and FVC parameters in children diagnosed with allergic rhinitis (AR) without a history of asthma. It was emphasized that this condition was related to the severity and frequency of rhinitis, but not associated with atopy (28). In a study conducted by Bavbek et al., among non-asthmatic AR patients with a positive methacholine bronchoprovocation test, a significant decrease in FEV1/FVC and FEF 25-75 values was observed (29). Ciprandi et al. performed spirometry on 1,967 AR patients and found that 17.8% had impaired FEF 25-75 values (30). In brief, these studies have found a negative correlation between the severity and duration of rhinitis symptoms and PFTs parameters in patients with allergic rhinitis. In our study, when the PFTs data of 130 patients diagnosed with non-asthmatic rhinitis were compared between the allergic and non-allergic rhinitis groups, no statistically significant difference was found in FEV1, FEV1/FVC, and MEF 25-75 parameters. One of the possible reasons why such a relationship was not observed in our study could be the lack of a significant difference in rhinitis symptoms between the AR and NAR groups. In addition, lack of sufficient data including symptom duration and severity might cause this result.

Eosinophils are proinflammatory leukocytes that play a role in many important processes such as defense, repair, homeostasis and regeneration. In AR patients, allergen exposure can lead to various clinical manifestations, including increased eosinophil counts in the nasal mucosa, lower respiratory tract, and peripheral blood, as well as other systemic inflammatory pathologies. In the lower airways, eosinophils release toxic proteins such as eosinophil cationic protein (ECP), major basic protein (MBP), and eosinophil peroxidase (EPO) leading to epithelial damage. An increase in peripheral blood eosinophil count leads to damage in both upper and lower airway epithelium, resulting in a reduction in ciliary function, increased release of mast cell mediators, and ultimately causing bronchial hyperreactivity and bronchoconstriction (31-33). In the study conducted by Chawes, it was stated that there was a relationship between blood and nasal eosinophilia and nasal airway obstruction in rhinitis patients without asthma diagnosis (34). In a different study, it was emphasized that patients with eosinophilic chronic rhinosinusitis had more peripheral airway obstruction compared to patients with non-eosinophilic chronic rhinosinusitis and that eosinophilic chronic rhinosinusitis is a pathology that requires caution in terms of lung diseases (35). In our study, eosinophilia was present in 26.1% of the patients. Patient's peripheral blood eosinophil counts in the AR patient group were found to be statistically higher compared to the NAR patient group. Additionally, in the eosinophilic patient group, FEV1% and MEF 25-75% ratios were significantly lower compared to the non-eosinophilic patient group. Based on these findings, which are supported by the literature, we may consider that the presence of peripheral blood eosinophilia in patients with CR indicates early small airway obstruction.

NP is one of the most common comorbidities in CR. Both diseases are chronic nasal inflammatory diseases that develop as a result of pathogenic chronic stimuli and have similar pathogenesis such as disruption of the nasal epithelial barrier and physical barrier, and increased Th2 cell differentiation (7,36). In addition, many studies have shown IgE-mediated type 2 inflammatory response and release of cytokines such as IL4, IL5, IL 13 in the lower airway epithelium of patients with chronic rhinosinusitis with NP (CRSwNP) (37). In the study conducted by Gu et al., patients with CRSwNP were found to have a higher rate of abnormal pulmonary function, and it was concluded that the risk of developing lower respiratory tract diseases was increased in these patients (38). In our study, we found that FEV1/FVC% and MEF 25-75% values were significantly lower in CR patients with NPs, and there was also a weak negative correlation between the presence of NPs and both FEV1/FVC and MEF 25-75 values. This finding suggests that the presence of NPs in patients with CR may be a risk factor for small airway obstruction. Furthermore, in another study it has been shown that 67% of patients with CRSwNP have asthma and highlighted that in many of the patients, asthma remains undiagnosed (39). Considering together, our finding indicates the importance of the measurement of PFT in CR patients with NPs.

Our study had certain strength and limitations. To the best of our knowledge, this is the first study in the literature to simultaneously evaluate multiple factors in relation to PFT parameters in patients with CR. First of the limitations, since it was a single-center study, the number of cases included was limited. Secondly, because of the retrospective nature of the study, some missing clinical data such as environmental exposure, symptom duration and severity were present.

CONCLUSION

CR is a significant pathological condition characterised by inflammatory reactions in both the upper and lower airways. In CR patients, especially those with accompanying peripheral blood eosinophilia and NPs, spirometry should be performed. These patients should be carefully evaluated for lower airway obstruction and closely monitored.

Acknowledgments

None.

Conflict of Interest

There are no conflicts of interest.

Funding

There is no funding support in this study.

Author Contributions

Concept: **Iclal Hocanli, Sadan Soyyigit,** Design: **Iclal Hocanli,** Data collection or processing: **Iclal Hocanli,** Analysis or Interpretation: **Iclal Hocanli,** Literature search: **Iclal Hocanli, Sadan Soyyigit,** Writing: **Iclal Hocanli,** Approval: **Iclal Hocanli, Sadan Soyyigit.**

REFERENCES

1. Şimşek Y, Yılmaz, O, Yuksel H. Allerjik Rinit. Asthma Allergy Immunology 2018;16:59-69.
2. Druce HM, Wright RH, Kossoff D, Kaliner MA. Cholinergic nasal hyperreactivity in atopic subjects. J Allergy Clin Immunol 1985;76:445-52.
3. Sarin S, Undem B, Sanico A, Togias A. The role of the nervous system in rhinitis. J Allergy Clin Immunol 2006;118:999-1016.
4. Eriksson J, Bjerg A, Lötvall J, Wennergren G, Rönmark E, Torén K, et al. Rhinitis phenotypes correlate with different symptom presentation and risk factor patterns of asthma. Respir Med 2011;105:1611-21.
5. Global Initiative for Asthma. 2024 GINA Main Report. Global strategy for asthma management and prevention. Accessed on Jul 12, 2024. Available from: https:// ginasthma.org/2024-report.
6. Tosun F, Gerek M, Şener O, Durmuş C, Özkaptan Y. Nonallerjik Kronik Rinitlerde Capsaicin Tedavisi. KBB. ve Baş Boyun Cerrahisi Dergisi 1999;7:157- 61.
7. Georgy MS, Peters AT. Chapter 7: Nasal polyps. Allergy Asthma Proc 2012;33:22-3.
8. Bachert C, Bhattacharyya N, Desrosiers M, Khan AH. Burden of Disease in Chronic Rhinosinusitis with Nasal Polyps. J Asthma Allergy 2021;14:127-134.
9. Radonjic-Hosli S, Simon HU. Eosinophils. Chem Immunol Allergy 2014;100:193-204.
10. Glady CA, Aaron SD, Lunau M, Clinch J, Dales RE. A spirometry-based algorithm to direct lung function testing in the pulmonary function laboratory. Chest 2003;123:1939-46.
11. Kovalszki A, Weller PF. Eosinophilia. Prim Care 2016;43:607-17.
12. McCrory DC, Williams JW, Dolor RJ, Gray RN, Kolimaga JT, Reed S, et al. Management of allergic rhinitis in the working-age population. Evid Rep Technol Assess (Summ) 2003;67:1-4.
13. Keith PK, Desrosiers M, Laister T, Schellenberg RR, Waserman S. The burden of allergic rhinitis (AR) in Canada: perspectives of physicians and patients. Allergy Asthma Clin Immunol 2012;8:7.
14. Civelek E, Yavuz ST, Boz AB, Orhan F, Yuksel H, Uner A, et al. Epidemiology and burden of rhinitis and rhinoconjunctivitis in 9- to 11-year-old children. Am J Rhinol Allergy 2010;24:364-70.
15. Pinart M, Keller T, Reich A, Fröhlich M, Cabieses B, Hohmann C, et al. Sex-Related Allergic Rhinitis Prevalence Switch from Childhood to Adulthood: A Systematic Review and Meta-Analysis. Int Arch Allergy Immunol 2017;172(4):224-35.
16. Song WJ, Kim MY, Jo EJ, Kim MH, Kim TH, Kim SH, et al. Rhinitis in a community elderly population: relationships with age, atopy, and asthma. Ann Allergy Asthma Immunol 2013;111: 347-51.
17. Desalu OO, Salami AK, Iseh KR, Oluboyo PO. Prevalence of self reported allergic rhinitis and its relationship with asthma among adult Nigerians. J Investig Allergol Clin Immunol 2009;19:474-80.
18. Ng TP, Tan WC. Epidemiology of allergic rhinitis and its associated risk factors in Singapore. Int J Epidemiol 1994;23:553-8.
19. Chong SN, Chew FT. Epidemiology of allergic rhinitis and associated risk factors in Asia. World Allergy Organ J 2018;11:17.
20. Cingi C, Muluk NB, Cobanoglu B, Çatli T, Dikici O. Nasobronchial interaction. World J Clin Cases 2015;3(6):499-503.
21. Demoly P, Simony-Lafontaine J, Chanez P, Pujol JL, Lequeux N, Michel FB, et al. Cell proliferation in the bronchial mucosa of asthmatics and chronic bronchitics. Am J Respir Crit Care Med 1994;150:214-7.
22. Jeffery PK, Wardlaw AJ, Nelson FC, Collins JV, Kay AB. Bronchial biopsies in asthma. An ultrastructural, quantitative study and correlation with hyperreactivity. Am Rev Respir Dis 1989;140(6):1745-53.
23. Bousquet J, van CP, Khaltaev N. Allergic rhinitis and its impact on asthma. J Allergy Clin Immunol 2001;108:147-334.
24. Greisner WA 3rd, Settipane RJ, Settipane GA. Co-existence of asthma and allergic rhinitis: a 23-year follow-up study of college students. Allergy Asthma Proc 1998;19:185-8.
25. Lombardi C, Passalacqua G, Gargioni S, Senna G, Ciprandi G, Scordamaglia A, et al. The natural history of respiratory allergy: a follow-up study of 99 patients up to 10 years. Respir Med 2001;95:9-12.
26. Settipane RJ, Hagy GW, Settipane GA. Long-term risk factors for developing asthma and allergic rhinitis: a 23-year follow-up study of college students. Allergy Proc 1994;15:21-5.
27. Heijkenskjöld Rentzhog C, Janson C, Berglund L, Borres MP, Nordvall L, et al. Overall and peripheral lung function assessment by spirometry and forced oscillation technique in relation to asthma diagnosis and control. Clin Exp Allergy 2017;47:1546-54.
28. Saranz RJ, Agresta MF, Lozano NA, Alegre G, Sasia LV, Ianiero L, et al. Relación entre grado clínico de rinitis y función pulmonar en niños y adolescentes sin asma. [Relationship between rhinitis severity and lung function in children and adolescents without asthma]. Rev Fac Cien Med Univ Nac Cordoba 2019;76:164-9.
29. Bavbek S, Saryal S, Karabiyikoglu G, Misirligil Z. Pulmonary function parameters in patients with allergic rhinitis. J Investig Allergol Clin Immunol 2003;13:252-8.
30. Ciprandi G, Signori A, Tosca MA, Cirillo I. Bronchodilation test in patients with allergic rhinitis. Allergy 2011;66:694-8.
31. Gleich GJ, Adolphson CR. The eosinophilic leukocyte: structure and function. Adv Immunol 1986;39:177-253.
32. Hogg JC. The pathology of asthma. APMIS 1997;105(10):735-45.
33. Flavahan NA, Slifman NR, Gleich GJ, Vanhoutte PM. Human eosinophil major basic protein causes hyperreactivity of respiratory smooth muscle. Role of the epithelium. Am Rev Respir Dis 1988;138:685-8.
34. Chawes BL. Upper and lower airway pathology in young children with allergic- and non-allergic rhinitis. Dan Med Bull 2011;58:B4278

35. Uraguchi K, Kariya S, Makihara S, Okano M, Haruna T, Oka A, et al. Pulmonary function in patients with eosinophilic chronic rhinosinusitis. Auris Nasus Larynx 2018;45:476-81.
36. Rahimi RA, Nepal K, Cetinbas M, Sadreyev RI, Luster AD. Distinct functions of tissue-resident and circulating memory Th2 cells in allergic airway disease. J Exp Med 2020;217:e20190865.
37. Tomassen P, Vandeplas G, Van Zele T, Cardell LO, Arebro J, Olze H, et al. Inflammatory endotypes of chronic rhinosinusitis based on cluster analysis of biomarkers. J Allergy Clin Immunol 2016;137:1449-56.
38. Gu X, Ye P, Chen FY, Chen YL, Yang Y, Zhang LQ, et al. Clinical significance of pulmonary function test in patients with chronic rhinosinusitis with nasal polyps. Zhonghua Er Bi Yan Hou Tou Jing Wai Ke Za Zhi 2013;48:244-7.
39. Langdon C, Mullol J. Nasal polyps in patients with asthma: prevalence, impact and management challenges. J Asthma Allergy 2016;9:45-53.