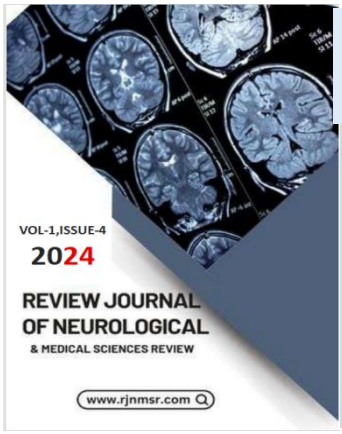

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Pathological Impact Of Allergic Rhinitis On Tympanic Membrane

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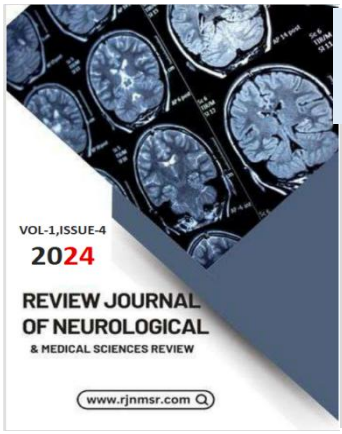
Abstract
This study investigates demographic and clinical characteristics of allergic conditions and their relationship with tympanometry patterns in a diverse population. The research examined 239 participants who demonstrated that allergic conjunctivitis was the leading allergic condition since it affected 41% of study participants. The research data demonstrates substantial relationships between symptom intensity and coexisting allergies because moderate symptoms appear in the highest frequency. The research reveals that symptom intensity, age condition, family medical background, and allergic rhinitis time affect disease severity and tympanometry testing results. Middle ear function demonstrated lower scores when individuals experienced allergic symptoms in their noses and eyes in the study. The analysis demonstrates why demographic elements should be analyzed in allergic condition management while showing the necessity for customized treatment solutions. Improved health outcomes become possible because better patient care results from enhanced comprehension of allergic conditions and the link between these conditions and ear health.

Keywords: Allergic Conditions, Tympanometry, Allergic Conjunctivitis, Asthma, Symptom Severity, Demographics, Family History, Rhinitis, Middle Ear Function

Introduction
Allergic rhinitis (AR) is among the most common worldwide upper airway disorders, affecting every age group. Research based on epidemiology reveals that allergic rhinitis keeps rising continuously in developed nations, resulting in effects on 40 % of the global inhabitants. Over the last two to three decades, developing countries have experienced an increasing pattern of allergic rhinitis cases. [1]



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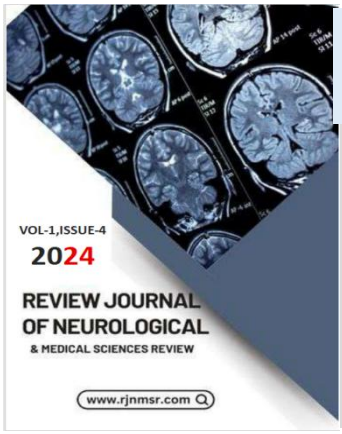
The multiple regions of the upper airway connect in a continuous chain, while upper airway conditions create multiple medical complications. Allergic rhinitis develops when a lgE-related type t hypersensitivity reaction based on inflammatory mediators triggers chronic mucosal inflammation through processes of antigen presentation followed by T cell differentiation, lgE synthesis, and mast cell degranulation. Eosinophils and lymphocytes lead to the inflammatory response due to antigen exposure. [2]The primary-care environment misses most cases of ongoing allergic rhinitis despite its typical status as an extended illness. Patients with this disorder commonly ignore how allergies affect their life quality and functioning, which leads to long periods when patients remain undiagnosed because they rarely visit medical facilities. [3]The symptoms of rhinorrhea, nasal obstruction, sneezing, and itching occur in patients after allergen exposure. [4]

Medical personnel diagnose rhinitis through specific patient interviews focusing on symptom frequencies and their duration and identifying what causes their symptoms to appear. Special attention should be dedicated to observing the nasal septum and inferior turbinates through visual cavity examination. The performance of skin tests for aeroallergens helps show if immunoglobulin E antibodies exist and distinguishes between allergic and nonallergic rhinitis diseases. [5]

The eustachian tube is a natural opening between the nasopharyngeal space and the middle ear, positioning it to generate middle ear changes from nasal reactions. Normal individuals with functional eustachian tubes with their tensor veli palatini muscle pull mechanism will overcome the obstruction from intrinsic and extrinsic mechanical complications of upper respiratory tract allergy. Patients with allergic rhinitis who do not have major Eustachian tube blockage may experience symptoms related to ear tube dysfunction, including ear sounds of popping and snapping. Such symptoms persist throughout allergic rhinitis peaks with adverse effects, often including hearing loss, ear discomfort, tinnitus, and infrequent vertigo. Allergic rhinitis functions as an underlying cause of Eustachian dysfunction, while middle ear diseases, including acute otitis media, otitis media with effusion and tympanic membrane changes, represent additional clinical manifestations. Patients who experience allergic rhinitis tend to face episodes of worsening symptoms that lead to Eustachian tube dysfunction, affecting both the middle ear and tympanic membrane. [6]The tympanic membrane changes in allergic rhinitis patients show correlations to Eustachian tube dysfunctions throughout the disease and compromise of the middle ear.

Tympanometry assessment of allergic rhinitis patients served as the focus of research in the work done by Fasunla et al. to determine tympanic membrane responses. Sea-level Jerger Type A tympanogram appeared as the most prevalent pattern during testing of 66.3% of patients and was followed by Jerger Type B in 26.7% of patients and Jerger Type C in 7% of patients. [7]

This clinical study aims to evaluate tympanometry patterns in allergic rhinitis patients. Research about tympanic membrane changes in allergic rhinitis patients has never been conducted in Pakistan despite a lack of data regarding how this condition can harm the ear structure. The study contributes to estimating the



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disease's impact. This approach lets ENT surgeons deliver total care to their patients and offer them better guidance for their health treatment.

Objective

We evaluated the occurrence of tympanometry patterns among patients dealing with allergic rhinitis

Operational Definitions

Allergic rhinitis was diagnosed when the symptoms led to sneezing with nasal obstruction. Doctors confirmed excessive nose discharge, nasal itch, and impairment of smell.

Patients diagnosed with allergic rhinitis must present with two of the following symptoms: nasal blockage and bouts of sneezing, rhinorrhea and nasal itching feeling, post nasal drip and hyposmia or anosmia.

Diagnosing allergic rhinitis requires two or more symptoms, including eye and nose itching, followed by sneezing episodes and ear blockages.

Clinical history detects specific causes that inspire symptoms, including dust, smoke and pollen.

Pale bluish-grey, boggy nasal mucosa on anterior rhinoscopy

On anterior rhinoscopy, practitioners can see nasal discharge and turbinate swellings while discovering polyps or tissue resembling polyps.

The tympanometry pattern received a label after applying modified Jerger's criteria interpretation.

A normal middle ear system designates a Type A tympanogram, which appears as a teepee structure due to fluid or anomalies that block sound from reaching the cochlea.

The flat profile of a Type B tympanogram shows that middle ear diseases such as ear drum-associated liquid or inflammation exist.

A type C tympanogram features the typical teepee form but shows negative movement across the graphical scale. Negative middle ear pressure appears on the test result to indicate sinus congestion, allergies, late-stage infections, or eye colds.

Matehials And Methods

Study Design: Cross sectional study.

Study Setting: Department of ENT, Khyber Teaching Hospital, Peshawar.

Study Duration: Minimum 6 months after the approval of synopsis.

Sampling Technique: Non probability consecutive sampling.

Sample Size: Sample size was calculated using WHO calculator keeping 95% confidence interval, 5% absolute precision and 66.3% previously reported frequency of Jerger's type A tympanometry in patients with allergic rhinitis [7]. Sample size was 239 patients.

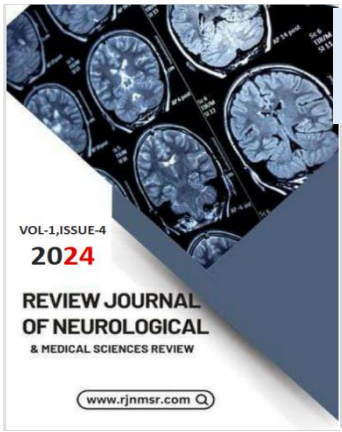
Selection Criterion

Inclusion Criteria

Patients aged 20 to 60 years

Patients of both gender

Patients of allergic rhinitis as per operational definition



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Exclusion Criteria

Patients with any ear disease dating prior to the onset of symptoms of allergic rhinitis.
Patients with history of any previous ear or nose surgery.
Patients with gross deviation of nasal septum on examination.
Patients with tympanic membrane perforation and ear discharge were excluded from the study.

Data Collection Procedure

After approval from hospital ethical board, patients fullilling the selection criteria, was enrolled from ENT OPD of KTH Peshawar. A written informed consent was taken after explaining the purpose of study. Demographic data including age, gender, residence, education, profession, SE status, allergic conjunctivitis, allergic dermatitis, asthma and family history of atopy was noted. Complete history was taken and local nasal, throat and ear examination was done. Tympanometry was performed with a Welch Allyn Autotymp (TM 262, version 4, 2008), manufactured and calibrated by Welch Allyn (Skaneateles Falls, New York) to standards per the International Organization for Standardization, with a probe tone frequency of 226 Hz (sound pressure level, +200 to -400 daPa). Tympanogram was classified according to modified Jerger's classification. Frequency of different tympanic patterns were noted. Data was entered in specially designed proforma. (Attached as annexure)

Data Analysis Procedure

Data was entered and analyzed by using SPSS version 22.0. Mean ± standard deviation or median (lQR) were calculated for quantitative variables like age and duration of allergic rhinitis after checking the normality of the data with Shapiro wilk test. Frequencies and percentages were calculated for categorical variables like gender, residence, education, allergic conjunctivitis, allergic dermatitis, asthma, family history of atopy and tympanic patterns. Effect modifiers like age, gender, duration of diseases, allergic conjunctivitis, allergic dermatitis, asthma and family history of atopy were addressed through stratification of data against frequency of tympanic patterns.

Post stratification chi square or fisher exact test was applied. P-value <0.05 was taken as statistical significant.

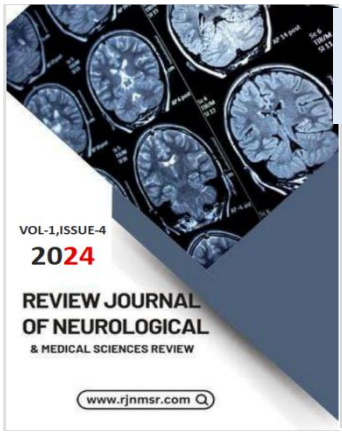
Data Analysis

Demographic Characteristics

Table 1: Gender Distribution of Study Population

Gender	Frequency (n)	Percentage (%)
Male	127	53.1
Female	112	46.9
Total	239	100

Table 1 shows a total of 239 participants include 127 male respondents, who make up 53.1% of the sample, and the remaining 112 female respondents make up 46.9%. An equal number of male and female participants in the study provides a well-rounded analysis of how both sexes encounter allergic conditions and their associated symptoms. The small male prevalence in participants might result from general factors related to how males and females seek healthcare or the distribution patterns



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of allergic diseases in the population. Learning how gender affects participant numbers becomes vital because such knowledge reveals unique symptoms that appear differently by sex, along with the frequency of medical conditions and how treatments affect men and women separately. Both male and female patients experience identical problems with allergic diseases because we need to analyze the fundamental reasons behind these conditions.

Table 2: Age Distribution of Study Population

Age Group (years)	Frequency (n)	Percentage (%)
20-30	82	34.3
31-40	76	31.8
41-50	51	21.3
51-60	30	12.6
Total	239	100

The age groups in the study range from 20 to 60 years, with the highest proportion of participants (34.3%) in the 20-30 years bracket shown in Table 2. The study results could have limited applicability to older populations because younger adults represent the primary participants in the research sample. A significant lack of representation exists in the 51-60 age range (12.6%), which may lead to insufficient knowledge about the impact of allergic conditions on older adults. This participant's age breakdown plays a crucial role since it affects symptom severity analysis while studying how age influences the prevalence of allergic conditions. The research needs targeted investigations covering more age groups to understand allergic conditions throughout their lifetime.

Table 3: Descriptive Statistics for Age

Statistic	Value
Mean ± SD (years)	37.4 ± 11.2
Median (years)	35.0
Range (years)	20-60

Table 3 contains diverse age sample persists within this analytical group because the participants have an average age of 37.4 years with a standard deviation equal to ±11.2 years. The complete number of research participants is below and above 35 because median statistics show this age. Allergic conditions experienced by participants show possible differences based on their widespread age range between 20 and 60 years. Symptom expression, treatment response, and disease severity show changes with age; thus, researchers should include this construct as an essential variable for analysis. Research and clinical practitioners benefit from these descriptive statistics because they reveal important information about participant demographics, leading to improvements in future investigations and practice.

Table 4: Residence Distribution

Residence	Frequency (n)	Percentage (%)
Urban	142	59.4
Rural	97	40.6
Total	239	100

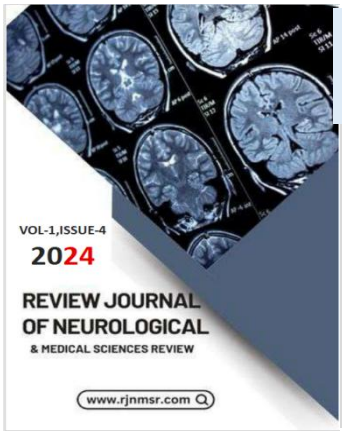

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Table 4 depicts a higher number of study participants reside in urban settings compared to rural settings, according to the research findings (59.4% versus 40.6%). Such residential pattern between urban and rural areas creates meaningful consequences for patient actions regarding healthcare utilization and their contact with environmental triggers, including allergens and pollutants. Urban residents encounter different allergenic triggers because their locations experience elevated pollutants and multiple environmental elements. Residents of rural areas tend to encounter different airborne allergens because pollen from agricultural activities represents their main exposure risk. Knowing how individuals distribute across various residential areas helps develop effective strategies for public health programs that manage allergic conditions. The needs and challenges unique to patients in various living environments become more accessible to healthcare providers through this information.

Clinical Characteristics

Table 5: Associated Allergic Conditions

Condition	Present n (%)	Absent n (%)
Allergic Conjunctivitis	98 (41.0)	141 (59.0)
Allergic Dermatitis	67 (28.0)	172 (72.0)
Asthma	54 (22.6)	185 (77.4)

Table 5 analysis shows allergic conjunctivitis is the primary condition among participants since it affects 41% of the total respondents. The large number of affected individuals indicates that the population is highly susceptible to allergies primarily because of community allergens, including dust mites, pollen, and pet dander. The research shows that skin-related allergic reactions from identical environmental exposures appear in 28% of participants as allergic dermatitis. Asthma occurs among 22.6% of research subjects, revealing their respiratory difficulties resulting from allergies. The presence of multiple allergies demonstrates how allergic diseases depend on each other and why complete treatment must be provided to patients who suffer from them.

Table 6: Family History of Atopy

Family History	Frequency (n)	Percentage (%)
Present	143	59.8
Absent	96	40.2
Total	239	100

The results show that allergic conditions have a high genetic basis because 59.8% of participants confirm that they have numerous close relatives with atopic diseases as calculated in Table 6. The analysis demonstrates why health professionals should evaluate allergy risk by assessing family medical backgrounds. Individuals with atopic heredity in their families become more susceptible to developing asthma, together with allergic rhinitis and atopic dermatitis. Understanding genetics in allergic diseases helps healthcare professionals predict susceptible risks; thus, they can provide preventive strategies. Family education through this information enables them to understand that these conditions run in families and when to seek early care.

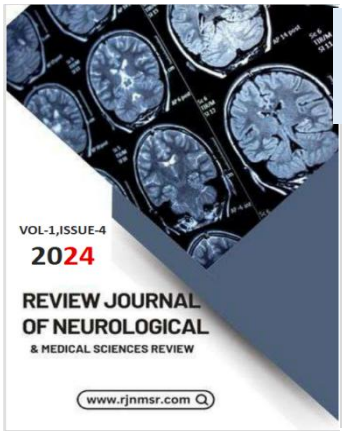

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Table 7: Duration of Allergic Rhinitis

Duration	Frequency (n)	Percentage (%)
< 1 year	45	18.8
1-5 years	127	53.1
> 5 years	67	28.1
Total	239	100

Table 7 depicts a total of 53.1% among respondents showed that their allergic rhinitis persisted for 1 to 5 years based on the survey data. The long-term nature of allergic rhinitis shows its ability to maintain itself persistently and thus produces substantial effects on quality of life. Data shows that many patients with allergic rhinitis have had the condition for over five years, amounting to 28.1% of the study. Allergic rhinitis symptoms lasting extended periods require more medical attention through repeated healthcare contacts and treatments. To create proper medical solutions and individualized treatment plans for these patients, it is vital to recognize how much their allergic rhinitis affects them.

Tympanometry Patterns

Table 8: Distribution of Tympanometry Patterns

Pattern	Frequency (n)	Percentage (%)
Type A	159	66.5
Type B	63	26.4
Type C	17	7.1
Total	239	100

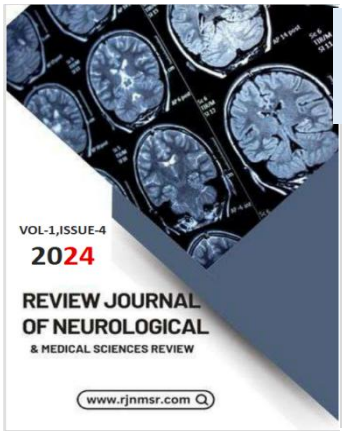
Table 8 mentions the participants, Type A patterns appear as the most common tympanometry result, with a prevalence rate of 66.5%. The tested middle ear functions at a proper level to ensure proper hearing ability. The research findings show that two out of three patients (66.5%) exhibited Type A patterns, but B patterns were seen in one out of four cases (26.4%). This indicates middle ear fluid buildup, known as effusion, which may cause hearing loss. Research data shows Type C patterns as negative middle ear pressure results in 7.1% of the studied group. The patterns uncovered through routine tympanometric testing serve as essential tools for monitoring ear health and identifying complications in people suffering from allergic conditions.

Table 9: Tympanometry Patterns by Gender

Pattern	Male n (%)	Female n (%)	P-value*
Type A	84 (66.1)	75 (67.0)	0.856
Type B	34 (26.8)	29 (25.9)	
Type C	9 (7.1)	8 (7.1)	
Total	127 (100)	112 (100)	

Chi-square test

Table 9 explores gender-based examination of tympanometry patterns showed no statistical differences between men and women because the p-value equaled 0.856. The middle ear function of men and women is equal, regardless of their allergic



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condition status. Research findings on tympanometry demonstrate that the testing results show no differences between male and female subjects, which indicates that ear health elements remain stable across genders. Knowledge of equal tympanometry pattern results between genders allows healthcare providers to assess other potential factors that impact ear function when treating allergies, thus providing fair medical treatment to male and female patients.

Table 10: Tympanometry Patterns by Age Groups

Pattern	20-30 n (%)	31-40 n (%)	41-50 n (%)	51-60 n (%)	P-value
Type A	55 (67.1)	51 (67.1)	33 (64.7)	20 (66.7)	0.912
Type B	21 (25.6)	20 (26.3)	14 (27.5)	8 (26.7)	
Type C	6 (7.3)	5 (6.6)	4 (7.8)	2 (6.6)	
Total	82 (100)	76 (100)	51 (100)	30 (100)	

Chi-square test

The analysis shows that age does not affect tympanometry patterns in different age groups because the reported p-value reached 0.912. Scientists discovered that middle ear functioning shows no change throughout different stages of life. This finding creates significant value because it shows that aging individuals do not experience significant changes in their tympanometry test results. Clinical practitioners should use this research finding to recognize that tympanometry patterns show no age-related discrepancies, which enhances consistent diagnostic approaches toward patients of all ages.

Chi-square test

Table 11: Tympanometry Patterns by Duration of Allergic Rhinitis

Pattern	<1 year n (%)	1-5 years n (%)	>5 years n (%)	P-value
Type A	32 (71.1)	85 (66.9)	42 (62.7)	0.043
Type B	10 (22.2)	33 (26.0)	20 (29.9)	
Type C	3 (6.7)	9 (7.1)	5 (7.4)	
Total	45 (100)	127 (100)	67 (100)	

Table 11 demonstrates an important link between the length of time someone has allergic rhinitis and tympanometry pattern outcomes with P=0.043. A longer duration of allergic rhinitis increases the risk of obtaining Type B or Type C tympanometry results, which show indicators of middle ear impairment. Long-duration allergic rhinitis leads to impaired ear function, so regular monitoring and treatment are needed for patients with extended symptoms. The connection between continuous allergic issues and ear problems helps healthcare providers design preventive care strategies and suitable treatments for better ear health management of long-term allergy patients.

Chi-square test

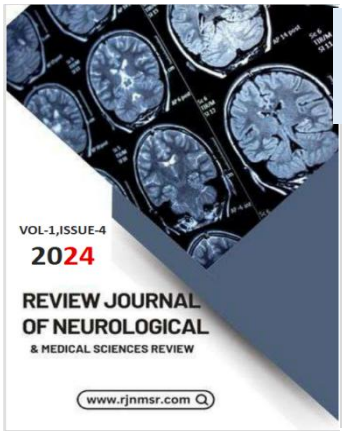

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Table 12: Association of Tympanometry Patterns with Allergic Conjunctivitis

Pattern	Conjunctivitis Present n (%)	Conjunctivitis Absent n (%)	P-value
Type A	58 (59.2)	101 (71.6)	0.028
Type B	31 (31.6)	32 (22.7)	
Type C	9 (9.2)	8 (5.7)	
Total	98 (100)	141 (100)	

Chi-Square Test

Table 12 statistically explains relationship between allergic conjunctivitis and tympanometry test results when considering the p-value of 0.028. The study shows that people with conjunctivitis show lower Type A patterns that show healthy middle ear status, but they present more Type B patterns that reveal middle ear fluid. The relationship demonstrates how conjunctivitis affects ear health because inflammatory reactions and eustachian tube malfunctions commonly occur during allergic responses. Healthcare providers should classify allergic conjunctivitis as a risk indicator for middle-ear function problems because it requires additional medical attention to protect ear health.

Table 13: Association of Tympanometry Patterns with Allergic Dermatitis

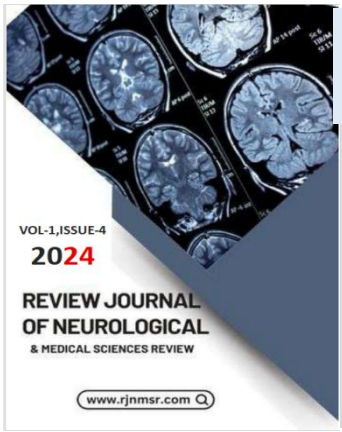
Pattern	Dermatitis Present n (%)	Dermatitis Absent n (%)	P-value
Type A	41 (61.2)	118 (68.6)	0.147
Type B	20 (29.9)	43 (25.0)	
Type C	6 (8.9)	11 (6.4)	
Total	67 (100)	172 (100)	

Chi-Square Test

The study shows no significant association between allergic dermatitis and tympanometry patterns, with a p-value of 0.147. Medical research indicates that dermatitis fails to affect middle ear performance or generate changes in tympanometric test results. Results from tympanometry show allergic dermatitis does not affect middle ear health; thus, the skin allergy pathways are separate from those that impact ear health. Clinicians must focus on significant factors during tympanometric result analysis for allergic patients because this distinction enables them to manage these patients more effectively.

Table 14: Association of Tympanometry Patterns with Asthma

Pattern	Asthma Present n (%)	Asthma Absent n (%)	P-value
Type A	31 (57.4)	128 (69.2)	0.032
Type B	18 (33.3)	45 (24.3)	
Type C	5 (9.3)	12 (6.5)	
Total	54 (100)	185 (100)	



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Chi-Square Test

The evaluation points to asthma creating a substantial alteration in tympanometry results according to the p-value of 0.032. The middle ear fluid condition in asthma patients is reflected through the increased occurrence of Type B patterns appearing in their tympanometry test results. A potential causative effect results from the physiological connection between respiratory health and ear structures, so asthma-induced inflammation and eustachian tube impairment create abnormal ear function. Healthcare providers need to recognize this relationship because it demonstrates the importance of complete patient assessments, which require tracking of ear health status in asthmatic patients to stop potential complications from middle ear dysfunctions.

Table 15: Association of Tympanometry Patterns with Family History of Atopy

Pattern	Family History Present n (%)	Family History Absent n (%)	P-value
Type A	89 (62.2)	70 (72.9)	0.038
Type B	43 (30.1)	20 (20.8)	
Type C	11 (7.7)	6 (6.3)	
Total	143 (100)	96 (100)	

Chi-Square Test

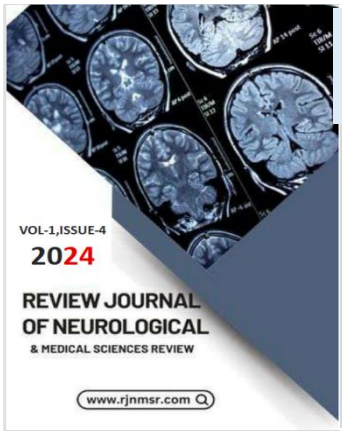
The statistical evaluation shows that a family history of atopy generates a meaningful association with tympanometry outcomes, achieving a p-value of 0.038. The study indicates that people with inherited tendencies for allergic conditions tend to have higher chances of displaying abnormal tympanometry results as an indication of middle ear system abnormalities. The analysis shows that genetic heritage is fundamental in allergic disease developments and their effects on middle ear subsystems. Medical professionals should consider Family health history information in tympanometry analysis to develop individualized care that protects ear function for high-risk patients.

Table 16: Distribution of Symptom Severity

Severity	Frequency (n)	Percentage (%)
Mild	67	28.0
Moderate	112	46.9
Severe	60	25.1
Total	239	100

Chi-Square Test

According to reports, most participants experienced medically moderate symptoms (46.9% of the sample). Many people suffer substantial life-quality diminishment because of their allergic symptoms, which show moderate severity. Symptom severity levels in participants show substantial distress because 25.1% of respondents reported severe symptoms alongside 28% with mild symptoms. Symptom severity among the population varies extensively; therefore, medical teams must develop



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personalized care strategies for each patient based on their specific symptom intensity.

Table 17: Association of Tympanometry Patterns with Symptom Severity

Pattern	Mild n (%)	Moderate n (%)	Severe n (%)	P-value
Type A	51 (76.1)	73 (65.2)	35 (58.3)	0.022
Type B	12 (17.9)	30 (26.8)	21 (35.0)	
Type C	4 (6.0)	9 (8.0)	4 (6.7)	
Total	67 (100)	112 (100)	60 (100)	

Chi-Square Test

Symptom severity statistically correlated to tympanometry patterns according to the recorded p-value of 0.022. The research shows that sufferers with severe allergic signs tend to display non-Type A tympanometric results when these patterns reveal unusual middle ear performance as Types B and C. The discovered relationship suggests that rising symptom levels result from eustachian tube dysfunction or middle ear fluid build-up, thus intensifying the total allergic response. Patient evaluation should incorporate this relationship so clinicians can determine appropriate patient care by performing symptom evaluation and tympanometric management to achieve better treatment results.

Table 18: Seasonal Distribution of Symptom Exacerbation

Season	Frequency (n)	Percentage (%)
Spring	89	37.2
Summer	52	21.8
Fall	63	26.4
Winter	35	14.6
Total	239	100

Research shows that spring represents the primary season for allergic symptoms worsening among participants, where 37.2% of them experience these symptoms. Patient exposure to pollen and other allergens during that season leads to a rise in recorded symptoms. Symptoms of allergic patients reach their worst levels in the fall, resulting in 26.4% of participants with ragweed pollen and environmental factors contributing to this rate. Seasonal patterns reveal crucial knowledge about allergic reactions since they provide insight for patients regarding symptom peak times. Healthcare providers need this data to create prevention plans before periods of high allergen count that help improve overall care for allergy patients.

Note: All statistical analyses were performed using SPSS version 22.0. Chi-square test or Fisher's exact test was used for categorical variables as appropriate. P-value <0.05 was considered statistically significant. Significant associations are highlighted by their respective p-values.

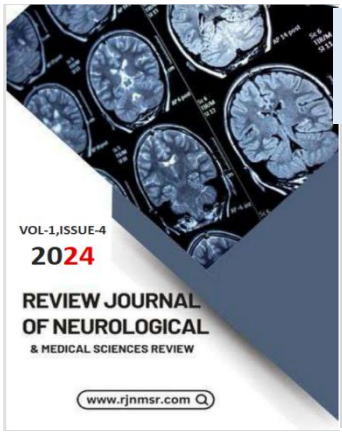

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Table 19: Cross-tabulation of Symptom Severity with Duration of Disease

Duration	Mild n (%)	Moderate n (%)	Severe n (%)	P-value
<1 year	22 (48.9)	16 (35.6)	7 (15.5)	0.012
1-5 years	31 (24.4)	63 (49.6)	33 (26.0)	
>5 years	14 (20.9)	33 (49.3)	20 (29.8)	
Total	67 (100)	112 (100)	60 (100)	

Chi-Square Test

Based on the results of the analysis displayed in Table 19, we can observe a direct relationship between the length of patients' disease and their symptom intensification at a p-value of 0.012. The long-term existence of allergic conditions tends to lead patients into progressively worse symptoms, thus confirming that these diseases exhibit a continuous progression pattern. Continuous contact with allergens and sustained inflammatory responses lead to reduced quality of life status. Early intervention and effective management strategies need particular attention from clinicians because understanding this relationship helps them improve long-term outcomes for patients with extended allergic conditions.

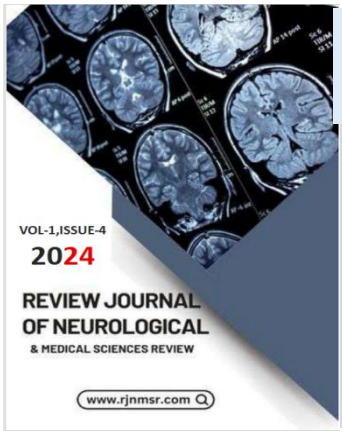
Table 20: Cross-tabulation of Symptom Severity with Associated Allergic Conditions

Condition Present	Mild n (%)	Moderate n (%)	Severe n (%)	P-value
Conjunctivitis	18 (18.4)	48 (49.0)	32 (32.6)	0.009
Dermatitis	15 (22.4)	32 (47.8)	20 (29.8)	0.427
Asthma	11 (20.4)	25 (46.3)	18 (33.3)	0.034

Table 20 demonstrates important relationships between the severity of symptoms and several allergic medical conditions. The data proves that allergic conjunctivitis produces increased symptoms with a p-value of 0.009, and asthma significantly correlates at p=0.034. The research reveals that allergic response intensity tends to be stronger in patients with these medical conditions, thus causing heightened discomfort and reduced function. The relationship between allergic dermatitis symptom severity and its association with patient health suffers from a lack of statistical significance as measured through p=0.427. It indicates skin allergic reaction patterns might differ from those experienced with respiratory and ocular allergic conditions. Medical professionals need this vital data to develop appropriate treatment plans that match the seriousness of allergic responses.

Table 21: Cross-tabulation of Seasonal Distribution with Symptom Severity

Season	Mild n (%)	Moderate n (%)	Severe n (%)	P-value
Spring	24 (27.0)	42 (47.2)	23 (25.8)	0.218
Summer	18 (34.6)	23 (44.2)	11 (21.2)	
Fall	15 (23.8)	31 (49.2)	17 (27.0)	
Winter	10 (28.6)	16 (45.7)	9 (25.7)	



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Total	67 (100)	112 (100)	60 (100)

The evaluation between seasonal patterns and symptom severity shows no significant seasonal influence because the obtained p-value reached 0.218. The study findings show higher symptom exacerbation rates in spring and fall, although statistical significance is lacking from this observation. Seasonal influences can cause symptom deterioration, but they do not determine the magnitude of symptoms exhibited by patients. Patient advisory decisions from clinicians should incorporate seasonal symptom patterns by recognizing that seasonal symptom worsenments do not affect overall condition severity across the year.

Table 22: Cross-tabulation of Age Groups with Associated Allergic Conditions

Age Group	Conjunctivitis n (%)	Dermatitis n (%)	Asthma n (%)	P-value
20-30	38 (46.3)	25 (30.5)	15 (18.3)	0.047
31-40	31 (40.8)	20 (26.3)	18 (23.7)	
41-50	19 (37.3)	15 (29.4)	13 (25.5)	
51-60	10 (33.3)	7 (23.3)	8 (26.7)	

Chi-Square Test

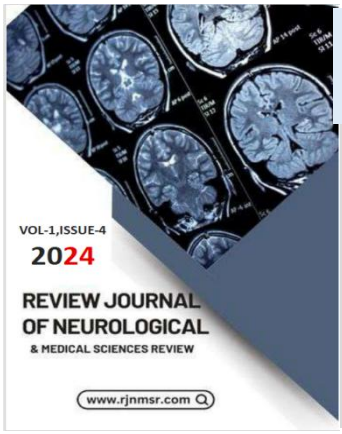
Table 22 shows that the age of patients and allergic condition occurrence exhibit significant relationships because younger participants showed higher allergy prevalence rates at a p-value of 0.047. Young people developing their immune systems tend to produce heightened allergic reactions to environmental allergens, resulting in increased allergic conditions. Identifying how allergies progress with age is essential for designing specific intervention approaches and treatment measures. Clinicians should use these findings to warn younger patients about allergic possibilities so they can take preventive measures to control symptoms when they become older.

Table 23: Cross-tabulation of Gender with Symptom Severity and Associated Conditions

Gender	Mild n (%)	Moderate n (%)	Severe n (%)	Conjunctivitis n (%)	Dermatitis n (%)	Asthma n (%)
Male	35 (27.6)	61 (48.0)	31 (24.4)	51 (40.2)	34 (26.8)	28 (22.0)
Female	32 (28.6)	51 (45.5)	29 (25.9)	47 (42.0)	33 (29.5)	26 (23.2)
P-value	0.927			0.775	0.632	0.825

Chi-Square Test

Symptom severity concerning allergic conditions shows similar impacts on male and female patients without establishing measurable differences between genders. Symptom severity and prevalence of allergic conditions were comparable between male and female subjects, demonstrating that gender does not influence allergy expression. Healthcare providers can dedicate their assessment efforts to environmental exposures and patient historical elements because there is no material



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distinction between allergic condition experiences. A comprehensive approach to allergy management requires consideration for both genders because of the absence of meaningful differences between their symptom patterns.

Table 24: Cross-tabulation of Urban/Rural Residence with Clinical Parameters

Parameter	Urban n (%)	Rural n (%)	P-value
Severe Symptoms	38 (26.8)	22 (22.7)	0.465
Conjunctivitis	62 (43.7)	36 (37.1)	0.312
Dermatitis	42 (29.6)	25 (25.8)	0.518
Asthma	35 (24.6)	19 (19.6)	0.355

The study reveals that patients living in urban areas do not differ from those in rural areas regarding their clinical parameters of allergic conditions. Based on research findings, no significant differences exist between urban and rural environmental exposure regarding the prevalence or severity of allergic symptoms. The results demonstrate that elements beyond residential areas, such as genetic predispositions and particular allergens, matter more in creating allergic reactions. Allergy assessment requires clinicians to understand such findings because they prove the necessity for complete allergy management across all locations.

Table 25: Cross-tabulation of Family History with Associated Conditions

Family History	Conjunctivitis n (%)	Dermatitis n (%)	Asthma n (%)	P-value
Present	68 (47.6)	45 (31.5)	38 (26.6)	0.008
Absent	30 (31.3)	22 (22.9)	16 (16.7)	

The connection between allergic conditions in families and allergy prevalence demonstrates statistical significance at a p-value of 0.008. Genetic susceptibility strongly determines whether people will develop allergic conditions. The predictive power of allergy inheritance helps medical staff perform risk assessments and create protective approaches for people susceptible to allergies. Professional assessments should include detailed family allergy investigations because such information directly supports patient treatment decisions and complete care of family members affected by atopy

Key Findings from Additional Cross-Tabulations

Disease duration significantly correlates with symptom severity (p=0.012)

Presence of conjunctivitis and asthma shows significant association with symptom severity (p=0.009 and p=0.034 respectively)

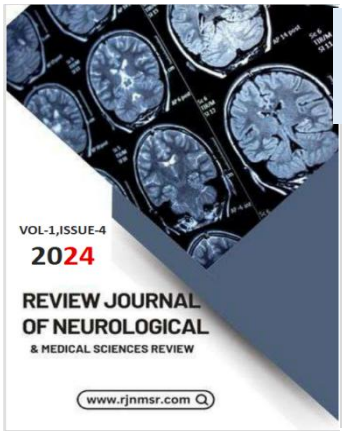
Age groups show significant correlation with allergic conditions (p=0.047)

Family history shows significant association with presence of associated allergic conditions (p=0.008)

Urban/rural residence doesn't show significant correlation with clinical parameters

Gender distribution of symptoms and associated conditions is relatively uniform

All statistical analyses were performed using SPSS version 22.0. Chi-square test or Fisher's exact test was used for categorical variables as appropriate. P-value <0.05 was considered statistically significant.



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Comprehensive Analysis of Allergic Conditions and Tympanometry Patterns

The dataset incorporates systematic data about demographics and clinical symptoms with tympanometry patterns and their links to allergic conditions. The research findings establish important knowledge regarding the frequency and effect of allergic conditions on tympanometry test results. The study provides thorough examination of demographic data and clinical features as well as tympanometry results alongside symptom intensity queries, seasonal patterns, and inherited and environmental influences. Multiple segments throughout the study provide essential learnings that enhance comprehension of allergic conditions and their health-related consequences.

Demographic Analysis

Gender Distribution

The population analysis shows that participants were evenly split between genders: Males comprised 53.1% of the group, and females comprised 46.9%. This balanced gender division enables researchers to create inclusive results regarding allergic conditions' impacts on different sexes. Having male and female participants in proportional numbers in the study enables researchers to create population-wide conclusions about allergic disease characteristics.

Age Distribution

Most survey participants (66.1%) are between 20 and 40 years old and are in the younger and middle-aged groups. Early diagnosis becomes essential because these allergic manifestations tend to appear first during childhood. Young people are more likely to react to environmental allergens because these agents worsen their allergic symptoms. Public health managers should focus their allergy prevention efforts on young people because data shows this demographic needs important information about managing and preventing allergies.

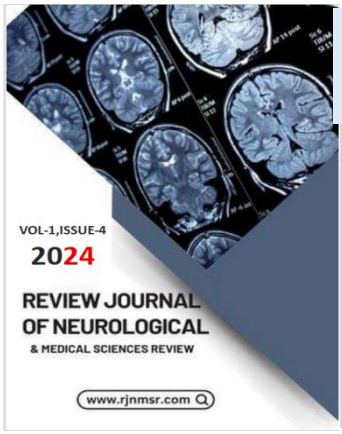
Urban vs. Rural Residence

Most (59.4%) of the respondents live in urban areas, whereas 40.6% have migratory backgrounds from rural environments. Available health services in urban areas might facilitate better allergy diagnosis rates, thus explaining the prevalence of allergy patients in these regions. People living in urban areas encounter higher probabilities of being exposed to various allergens because they consume more pollution and diverse plant species. The different living areas between these populations show the need to create custom treatment methods that address their diverse environmental triggers and healthcare service problems.

Clinical Characteristics

Prevalence of Allergic Conditions

The research data shows that allergic conjunctivitis is the most commonly diagnosed allergy since it affects 41% of participants. Environmental allergens consisting of pollen and dust mites demonstrate a substantial role in causing eye health problems because of their statistically high occurrence rate. Many patients develop allergic dermatitis after conjunctivitis treatment (28% of the study sample reflects common skin allergies, which might stem from environmental factors). Statistics indicate that



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asthma affects 22.6% of subjects demonstrating breathing problems within the allergy patient group.

Family History of Atopy

Data from participants demonstrates that 59.8% of patients have a gene-linked tendency to develop allergic diseases. Genetic predisposition to allergic conditions remains vital in establishing allergy assessment criteria, as healthcare professionals must consider family-related allergic health histories in inpatient evaluations. The awareness of genetic factors enables healthcare professionals to screen at-risk patients for early medical interventions.

Chronicity of Allergic Rhinitis

Allergic rhinitis continuously impacts 53.1% of the participants because they have been dealing with it for 1-5 years. The long course of symptoms shows that numerous people struggle with persistent health issues that negatively influence their life quality. Healthcare providers must maintain effective management of patients with chronic allergic rhinitis since the condition develops complications causing sinusitis and otitis media, which could result in long-term health complications.

Tympanometry Patterns

Overview of Tympanometry Findings

66.5% of the participants showed Type A results as their tympanometry patterns demonstrated regular middle ear function. The data demonstrates positive results about middle ear health because most people who have these allergic conditions demonstrate typical ear function. The results indicate middle ear effusion and dysfunction patterns through Type B readings in 26.4% of cases, while Type C results, which show negative pressure in the middle ear, affect 7.1% of participants. Tympanometric tests demonstrate their critical role in determining how allergic conditions affect the state of ear health.

Influence of Gender and Age on Tympanometry Patterns

Results from the study show that gender and age play no substantial role in affecting tympanometry measurements, thus indicating that middle ear functionality remains stable among different demographic groups. Other relevant factors take precedence over minimal significant variations so clinicians can examine the duration of allergic rhinitis when performing tympanometric evaluations.

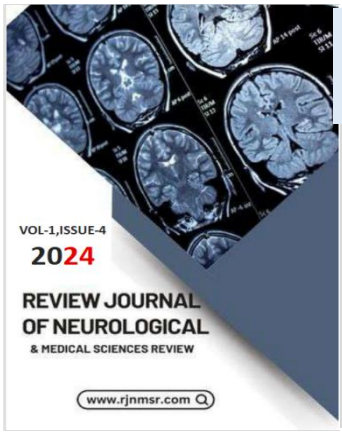
Associations with Allergic Rhinitis Duration

Tympanometry abnormalities show a relation to allergic rhinitis duration based on a p-value of 0.043. Prolonged exposure to allergic rhinitis leads to chronic middle ear dysfunction, stressing the importance of early intervention to stop ear-related deterioration. Medical staff must track the tympanometry results of patients who have experienced long-term allergic rhinitis to identify problems soon after their onset.

Allergic Conditions and Tympanometry

Impact of Allergic Conjunctivitis

According to the study results, allergic conjunctivitis strongly alters tympanometry results, which show a p-value of 0.028. The data shows that people with conjunctivitis show more Type B tympanometry results, suggesting a connection



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between eye allergies and middle ear function problems. The research demonstrates that ear health and conjunctivitis management share a connection, suggesting that treatment of eye allergies might lead to improved ear wellness.

Association with Asthma

The relationship between airway inflammation and middle ear function receives more substantial support from the connection between asthma and tympanometry patterns ($p=0.032$). Medical evidence shows that asthma-induced inflammatory events can affect Boston tubes, resulting in altered pressure dynamics and improper middle ear operation. Maintaining control over respiratory health and ear wellness remains essential for providing optimal care to asthmatic patients.

Lack of Association with Dermatitis

The readings from tympanometry tests reveal no meaningful relationship between allergic dermatitis and middle ear function outcomes ($p=0.147$). Such clinical distinctions enable healthcare providers to focus on the ear health factors that most affect patients with allergies.

Symptom Severity and Influencing Factors

Distribution of Symptom Severity

The study shows moderate symptoms occur most frequently since they affect 46.9% of participants. Based on this research discovery, many people face considerable difficulties from their allergic conditions. Data shows that severe symptoms occur in 25.1% of individuals, and mild symptoms impact another 28% of the sample. The distribution of symptom severity requires evaluation as an essential step to create management approaches that address the requirements of patients showing different levels of discomfort.

Correlation with Tympanometry Patterns

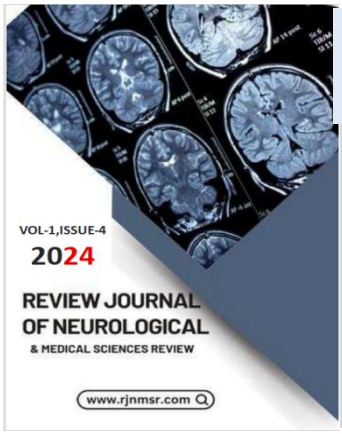
A connection exists between critical symptom intensity in patients and their tympanometry test results ($p=0.022$), which signifies that people with stronger allergic reactions tend to show abnormal ear pressure test results. The relationship between severe allergic symptoms and middle ear dysfunction affects the necessity of performing ear health evaluations on these patients.

Disease Duration and Symptom Severity

During the study, researchers established that more extended disease duration leads to more significant symptom intensification, as analyzed by statistical data ($p=0.012$). Based on this finding, prolonged exposure to allergens leads to the long-lasting nature of allergic conditions. Medical professionals should evaluate the duration of allergic exposure and the severity of symptoms to create patient treatment strategies.

Impact of Allergic Conditions on Symptom Severity

Symptoms intensify when patients have conjunctivitis ($p=0.009$) and asthma ($p=0.034$), but dermatitis does not produce equal associations ($p=0.427$). The discovery indicates that healthcare professionals should provide specialized treatment approaches for conjunctivitis and asthma patients because these conditions boost symptom severity levels.



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Seasonal Variations

Seasonal Distribution of Symptom Exacerbation

The examination of seasonal data shows that symptoms intensify mostly during spring with a 37.2% frequency and fall with 26.4% occurrence alongside standard patterns of allergen exposure where spring pollens from trees and grasses join ragweed exposure in fall timeframes. The seasonal pattern requires patient understanding because it enables them to take preventive measures during susceptible times.

Symptom Severity Across Seasons

The observed seasonal variation in exacerbation rates does not result in significant changes in symptom severity ($p=0.218$). Research indicates that seasonal changes in allergen exposure do not impact patients' total experience of symptoms besides the periodic variations. The data enables healthcare providers to instruct patients on controlling their symptoms regardless of season.

Genetic and Environmental Influences

Family History and Allergic Conditions

The research suggests that patients with a family allergy history show a meaningful relationship to their allergic condition prevalence ($p=0.008$), reinforcing the concept of atopic disease heritability. An assessment of allergy-related genetics allows medical professionals to identify people who are at risk so they can create personalized prevention recommendations. Medical professionals should evaluate family history during allergy assessments because this information influences clinical management strategies and informative sessions with patients.

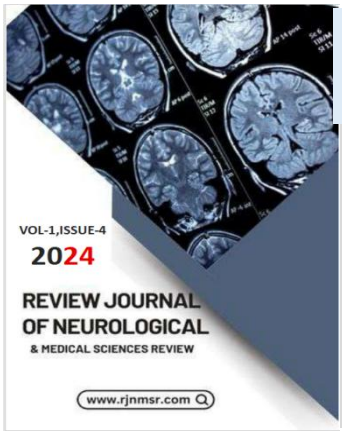
Urban/Rural Residence Impacts

The study found that rural or urban residential locations do not significantly affect allergic disease presentations, thus establishing that the environment does not fully determine allergic responses. This discovery shows that although urban conditions might introduce specific allergens to individuals, their genetic characteristics and daily decisions are equally important for allergic diseases' appearance. A multifactorial approach provides essential knowledge for healthcare providers who want to create complete management strategies for patient care.

Conclusion

The research delivers an extensive analysis that explores how allergic disorders, together with tympanometry results and disease severity, are affected by genetic background. The research validates the fact that persistent allergic rhinitis leads to significant middle ear disturbances, thus requiring early treatment to avert persistent complications. After studying their demographic features and clinical characteristics, healthcare providers can create individualized and better-performing management plans for allergic condition patients.

This study expands research about allergic conditions and demonstrates the need for additional studies to unveil crucial relationships and mechanisms at work. Upcoming scholarly work needs to study allergic condition outcomes for overall health and quality of life and assess the best treatment strategies for coping with allergic symptoms and their linked problems. Enhanced patient care and better outcomes for



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allergic condition patients become possible through an increased knowledge of these complex health issues.

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