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Determination of Risk Factors for Allergic and Non-Allergic Rhinitis

Alerjik ve Non-Alerjik Rinit Risk Faktörlerinin Belirlenmesi

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Abstract: Allergic rhinitis (AR) and non-allergic rhinitis (NAR) are common respiratory conditions affecting pediatric populations. This study aimed to investigate the risk factors and clinical characteristics of AR and NAR in children. A retrospective study was conducted at Goztepe Professor Suleyman Yalcin City Hospital's Pediatric Allergy and Immunology outpatient clinic. Between August 2023 and August 2024, 327 patients under 18 were diagnosed with AR or NAR. Data were collected through computerized questionnaires completed by parents. Patients were classified into AR and NAR groups based on skin prick tests and specific IgE results. Statistical analysis was performed using SPSS version 26.0. Of the 327 patients, 31.5% were diagnosed with NAR and 68.5% with AR. No significant differences were found in age of diagnosis, gender distribution, or symptom onset age between groups. AR patients had more siblings and house residents (p=0.047, p=0.05, respectively). C-section births and indoor smoking were more prevalent in the AR group (p=0.018, p=0.031, respectively). Breastfeeding for over one year was more common in NAR patients (p=0.011). AR patients more frequently experienced symptom exacerbation during school time (p=0.029). Logistic regression analysis revealed that playing outside and paracetamol use before age 1 increased NAR risk (p=0.008, p=0.044, respectively), while eczema and recurrent wheezing after age 1 increased AR risk (p=0.025, p=0.018, respectively). This study identifies distinct risk factors and clinical characteristics for AR and NAR in pediatric patients, providing valuable insights for differential diagnosis and management strategies in clinical practice.
Keywords: Allergic rhinitis, non-allergic rhinitis, risk factors of rhinitis

Özet: Alerjik rinit (AR) ve non-alerjik rinit (NAR), çocukluk çağının en sık görülen kronik solunum yolu hastalıklarındandır. Bu çalışma, çocuklarda AR ve NAR'ın risk faktörlerini ve klinik özelliklerini araştırmayı amaçladı. Göztepe Profesör Süleyman Yalçın Şehir Hastanesi Çocuk Alerji ve İmmünoloji polikliniğinde, retrospektif olarak, Ağustos 2023 ile Ağustos 2024 arasında başvuran 18 yaş altı hastalar analiz edildi ve 327 hastanın rinit tanısı aldığı belirlendi. Veriler, ebeveynler tarafından elde edilen bilgilerle anket aracılığıyla toplandı. Hastalar, deri prik testleri ve spesifik IgE sonuçlarına göre AR ve NAR gruplarına ayrıldı. İstatistiksel analiz, SPSS versiyon 26.0 kullanılarak gerçekleştirildi. 327 hastanın %31,5'i NAR ve %68,5'i AR tanısı aldı. Gruplar arasında tanı yaşı, cinsiyet dağılımı veya semptom başlangıç yaşı açısından anlamlı fark bulunmadı. AR hastalarının daha fazla kardeşi ve evde yaşayan bireyi olduğu saptandı (p=0,047, p=0,05, sırasıyla). AR grubunda sezaryen doğum ve ev içi sigara içimi daha yaygın bulundu (p=0,018, p=0,031, sırasıyla). NAR hastalarında bir yıldan uzun süre emzirme daha yaygındı (p=0,011). AR hastaları okul zamanında daha sık semptom alevlenmesi yaşamıştı (p=0,029). Lojistik regresyon analizi, dışarıda oynamanın ve 1 yaşından önce parasetamol kullanımının NAR riskini artırdığını (p=0,008, p=0,044, sırasıyla), egzema ve 1 yaşından sonra tekrarlayan hırıltılı solunumun ise AR riskini artırdığını gösterdi (p=0,025, p=0,018, sırasıyla). Bu çalışma, pediatrik hastalarda AR ve NAR için farklı risk faktörlerini ve klinik özellikleri tanımladı ve klinik uygulamada ayırıcı tanı ve yönetim stratejileri için değerli bilgiler sundu.
Anahtar Kelimeler: Alerjik rinit, non-alerjik rinit, rinit risk faktörleri

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1. Introduction

Rhinitis represents a significant health concern affecting approximately 10-40% of the pediatric population globally, exerting considerable influence on children's quality of life, sleep patterns, and academic performance (1). This condition imposes a substantial socioeconomic burden through increased healthcare utilization, treatment costs, and loss of school days (2). Rhinitis can be categorized into two primary types: allergic rhinitis (AR) and non-allergic rhinitis (NAR), distinguished by the presence or absence of relevant aeroallergen sensitization. AR is characterized by symptoms such as rhinorrhea, nasal congestion, sneezing, and elevated levels of allergen-specific IgE or a positive skin prick test (SPT). Conversely, NAR is a less well-defined condition, which some studies suggest may be less severe than AR in specific populations (3). NAR encompasses several subtypes, including vasomotor rhinitis and non-allergic rhinitis with eosinophilia syndrome (4). Notably, various non-allergic conditions can mimic AR symptoms, including infections, hormonal imbalances, physical and chemical agents, anatomical anomalies, and certain medications. Unlike AR, there is no specific laboratory test to confirm NAR, making it primarily a diagnosis of exclusion. An immune-mediated response to environmental allergens such as pollen, dust mites, animal dander, and mold characterizes AR. In contrast, NAR is triggered by non-immunological factors like viral infections, environmental irritants, and sometimes hormonal changes, all contributing to inflammation in the nasal mucosa (2, 5). Together, these conditions are a significant cause of pediatric morbidity worldwide, and both conditions are associated with an increased risk of developing comorbid conditions such as asthma and otitis media (6, 7).

The development of AR in children has been linked to various genetic and environmental risk factors. Environmental elements, particularly airborne pollutants, and allergens, are well-documented in their influence on AR. Exposure to traffic-related air pollution, tobacco smoke, and indoor allergens (e.g., dust mites) has significantly correlated with increased AR prevalence and severity in children (8). Additionally, lifestyle changes and dietary factors have gained attention, with recent studies exploring their role in immune modulation and subsequent AR development. Urbanization, for example, has led to a concentration of these environmental pollutants and allergens, directly correlating with higher AR incidences in pediatric populations in urban settings (8, 9).

Genetic factors also play a crucial role in determining susceptibility to AR. A positive family history of atopy, including asthma or eczema, significantly increases a child's likelihood of developing AR (10). Epigenetic studies have also indicated that prenatal and early childhood exposures to pollutants may alter gene expression, particularly those associated with immune responses, which may predispose children to AR (11). Furthermore, climate change has exacerbated pollen levels and altered seasonal patterns, contributing to longer and more intense allergen exposure periods, especially in temperate regions. This environmental shift has been associated with increased rates of AR in children, as evidenced by studies linking pollen seasons and high allergen counts with AR incidence (12).

While sharing some symptomatic characteristics with AR, NAR operates through distinct mechanisms and involves different risk factors. Viral infections, especially those affecting the respiratory tract, are primary triggers of NAR episodes in children. Additionally, exposure to irritants such as chlorine, strong odors, and air pollution can aggravate NAR symptoms, though these factors do not involve IgE-mediated responses, as seen in AR (13). Studies indicate that children with underlying respiratory conditions, such as chronic rhinosinusitis or structural abnormalities like a deviated septum, may be at a higher risk for NAR, as these conditions may create a predisposition for nasal inflammation independent of allergenic sensitization (14).

Given the overlapping symptoms yet differing etiologies of AR and NAR, precise diagnosis is essential to ensure appropriate treatment strategies. AR is typically managed through allergen avoidance, pharmacotherapy (e.g., antihistamines, intranasal corticosteroids), and in some cases, immunotherapy (2, 10). For NAR, symptom relief is generally achieved through decongestants or saline sprays. However, care must be taken to avoid prolonged use of nasal decongestants due to the risk of rebound congestion (13, 14). Furthermore, addressing environmental exposures—both indoors and outdoors—forms a crucial component of both AR and NAR management strategies, underscoring the importance of preventive measures for these prevalent conditions (8).

In conclusion, AR and NAR present significant health challenges for children, driven by a complex interplay of genetic, environmental, and lifestyle factors. Future research should continue to explore these associations, especially as environmental factors evolve with urbanization and climate change, potentially exacerbating the incidence and severity of pediatric rhinitis (12). Comprehensive management and preventive strategies tailored to these risk factors are essential for improving the quality of life in affected pediatric populations.

2. Material and Methods

This study was conducted at the Goztepe Professor Suleyman Yalcin City Hospital Pediatric Allergy and Immunology outpatient clinic, following approval from the Institutional Review Board (IRB) under protocol number 2023/0548. The study adhered to the principles outlined in the Helsinki Declaration, and informed consent was obtained from all participants.

Pediatric patients under 18 years of age, diagnosed with AR or NAR, who visited the clinic between August 1, 2023, and August 1, 2024, were identified through patient records. Researchers completed a computerized questionnaire-based interview of the participant's parents, including data on living conditions, detailed characteristics of symptoms, associated medical conditions, medication use, specific exposures, emergency department visits, and various socioeconomic parameters. According to the allergy skin prick test and specific IgE results, the patients were classified into AR and NAR. 327 patients; among the whole study population, 31.5% had NAR, and 68.5% were diagnosed with AR. AR was defined as a history of rhinitis symptoms concomitant with a positive SPT and specific IgE. NAR was defined by the same set of symptoms but with a negative SPT. Patients with infectious rhinitis diagnosis or anatomical anomalies were excluded from the study.

Statistical evaluation was performed using the Statistical Package for the Social Sciences (SPSS) version 26.0. The normal distribution of continuous variables was inspected through visual and analytical tests. Categorical variables were represented as frequencies (n) and percentages (%), with differential analyses conducted using the chi-square or Fisher's exact test where appropriate. Bonferroni correction was wielded to find the groups with more than two groups. Continuous variables adhering to a normal distribution were expressed via the mean ± standard deviation (SD), and comparative analyses between distinct groups were explored via Student’s t-test. For data non-normal distribution, median values [interquartile range (IQR)] were presented, and the Mann-Whitney U test was used to search for comparative analysis between groups. To investigate the risk factors of NAR and AR, a set of predictor variables, namely age of diagnosis, gender, and other factors, were found to be different between groups due to univariate analysis, and multivariable binary logistic regression models were employed. The outcomes were stated as odds ratios (ORs) with 95% Confidence Intervals (CIs). The Hosmer–Lemeshow goodness-of-fit test evaluated the appropriateness of model fit. All P-values reported were based on bi-directional hypotheses and were evaluated against a predetermined significance threshold of 5%.

3. Results

Our study included 327 patients; among the whole study population, 31.5% of them had NAR, and 68.5% were diagnosed with AR. 17% of AR patients had pollen allergies, 4.9% had mold allergies, 57.6% had house dust-mite allergies, 17% had cat allergies, 11.2% had dog allergies, and 2.7% had cockroach allergies. No statistical differences were found regarding the age of diagnosis and gender distribution between the two groups ($p>0.05$). Median symptom age was 48.0 [96.0] months in NAR and 53.50 [56.0] months in the AR group, and the difference was not significant ($p=0.77$). There was no difference between the two groups according to current ages (64.0 [86.0] months vs 80.0 [72.0] months, respectively, and $p=0.36$). The mother’s ages of the patients were also similar in AR and NAR groups (30.0±5.6 vs 30.1±5.1 years, and $p=0.88$). The number of siblings and house residents was significantly higher in the AR group than in the NAR group ($p=0.047$, $p=0.05$, respectively). The number of older siblings and siblings who were at school age were also similar in both groups (for NAR:0.0 [1.0] and AR:0.0 [1.0], $p=0.26$ and for NAR:1.0 [1.0] and for AR:1.0 [1.0], and $p=0.16$, respectively). No differences were observed between NAR and AR groups regarding birth weight, birth time, birthplace, and the season of birth ($p>0.05$ for all). The birth rate with C/S was significantly higher in the AR group than in the NAR group (74.1% and 61.2%, $p=0.018$). The ratio of smoking indoors was 58.0% in the AR group, whereas 44.7% in the NAR group, the difference being significant ($p=0.031$). Breastfeeding for more than one year was significantly higher in the NAR group than the AR

group (70.9 vs. 54.9%, respectively, and p=0.011). When the parents' family history was inquired, there was no difference in AR, asthma, atopic eczema, food allergy, allergy to dust/pollen, cat/dog allergy, drug allergy, or nasal polyp of the mother. However, the nasal polyp history of the father was significantly higher in the AR group than in the NAR group (15.6% vs 3.9% and p=0.002). Playing outdoors was more common in the NAR group than in the AR group, and the difference was statistically significant (p=0.015). The detailed results are summarized in Table 1.

Table 1. Baseline characteristics of the non-allergic and allergic rhinitis groups

	Non-allergic rhinitis (n=103)	**Allergic rhinitis (n=224)**	**p**
Girl Boy	44 (42.7) 59 (57.3)	102 (45.5) 122 (54.5)	0.63
Age of diagnosis (month)	84.8 ±56.5	85.5±48.4	0.91
Number of residents in the home	4.0 [1.0]	4.0 [2.0]	***0.005***
Siblings	1.0 [2.0]	2.0 [3.0]	***0.047***
Complementary feeding	2.0 [4.0]	2.0 [4.0]	0.48
Age of preschool (years)	3.0 [0.0]	3.0 [0.0]	0.12
Age at start of vitamin D use (months)	1.0 [1.0]	1.0 [2.0]	0.25
Regular use of Vit D	71 (69.6)	172 (77.1)	0.15
Exposure to cigarette smoke during pregnancy	27 (26.2)	47 (21.0)	0.29
Indoor smoking	46 (44.7)	130 (58.0)	***0.031***
Intubation	7 (6.8)	14 (6.3)	0.85
Having a Pet at Birth	9 (8.7)	11 (4.9)	0.18
Prepartum depression	1 (1.0)	11 (4.9)	0.11
Smoking during pregnancy	10 (9.7)	16 (7.1)	0.43
Use of antibiotics in the first week of birth	3 (2.9)	15 (6.7)	0.20
Use of antibiotics in the first month of birth	10 (9.7)	23 (10.3)	0.88
Breastfeeding None <6 months 6-12 months > 1 year*	 - 16 (15.5) 14 (13.6) 73 (70.9)	 7 (3.1) 36 (16.1) 58 (25.9) 123 (54.9)	***0.011***
Playing outdoor less than once/week more than twice/week	 32 (31.1) 71 (68.9)	 101 (45.3) 122 (54.7)	***0.015***

The variables were presented as number (%), mean ± SD, or median [IQR]
**The group in which the difference was aroused according to Bonferroni correction.*

Table 2 shows the patients' symptoms. The symptoms of admission, severity, and the symptoms' beginning were similar in the NAR and AR groups. However, the increment of the symptoms during school time was more common in the AR group than the NAR group (68.8% vs 56.3%, p=0.029). There were no differences in conjunctivitis symptoms between the two groups (p>0.05 for all), as well as sinusitis and asthma symptoms (p>0.05).

Table 2. The features of the symptoms of the patients with non-allergic and allergic rhinitis

Symptoms	**Non-allergic rhinitis (n=103)**	**Allergic rhinitis (n=224)**	**p**
Rhinorrhea	77 (74.8)	156 (69.6)	0.34
Nasal Itching	62 (60.2)	136 (60.7)	0.93
Sneezing	56 (54.4)	122 (54.5)	0.99
Snoring	20 (19.4)	60 (26.8)	0.15
Postnasal Discharge	46 (44.7)	115 (51.3)	0.26
Anosmia	5 (4.9)	7 (3.1)	0.43
Open mouth sleeping	44 (42.7)	77 (34.4)	0.15
The severity of the symptoms	7.0 [2.0]	6.0 [1.0]	0.34
Persistent Intermittent	68 (67.3) 33 (32.7)	167 (75.6) 54 (24.4)	0.12
Severity Mild Moderate/Severe	 44 (42.7) 59 (57.3)	 118 (57.9) 105 (47.1)	 0.087
Beginning of preschool/school	31 (30.1)	88 (39.3)	0.11
Increment in school	58 (56.3)	154 (68.8)	***0.029***
Symptoms of Conjunctivitis			
Tearing/Discharge	39 (37.9)	71 (31.7)	0.27
Itching	29 (28.2)	54 (24.1)	0.44
Redness	36 (35.0)	59 (26.3)	0.11
Congestion	8 (7.8)	14 (6.3)	0.61
Symptoms of Sinusitis			
Rhinorrhea/Postnasal Discharge	41 (39.8)	67 (30.0)	0.082
Throat cleaning	7 (6.8)	16 (7.1)	0.91
Hyposmia/anosmia	1 (1.0)	4 (1.8)	1.0
Headache	11 (10.7)	33 (14.7)	0.32
Tonsillectomy	5 (4.9)	20 (8.9)	0.20
Recovery of symptoms post-tonsillectomy	3 (2.9)	16 (7.1)	0.20
Recurrent Symptoms	1 (1.0)	2 (0.9)	1.0
Ventilation tube	-	7 (68.5)	-
Nasal polyps	1 (1.0)	2 (0.9)	1.0
Obstructive sleep apnea syndrome	-	5 (2.2)	-
Asthma	8 (7.8)	20 (8.9)	0.73
Symptoms of Asthma			
Cough	10 (9.7)	16 (7.1)	0.43
Dyspnea	7 (6.8)	9 (4.0)	0.28
Wheezing	9 (8.7)	16 (7.1)	0.62

The variables were presented as number (%), mean ± SD, or median [IQR]

Risk factors for NAR and AR are shown in Table 3 according to exposure age (<1 year and >1 year). In those below 1 year of age, paracetamol use was significantly more common in the NAR group than in the AR group (94.1% vs 86.1%, p=0.035). Furthermore, traffic/factory smoke exposure was significantly higher in the AR group than in the NAR group (p=0.013) in patients aged 1 year and younger. On the other hand, it was seen that at age 1 year older, eczema was more common in the AR group than the NAR group (p=0.024). Patients with AR more commonly had wheezing more than three times per week compared to patients with NAR (27.2% vs 15.5% and p=0.021).

Table 3. Risk factors for non-allergic and allergic rhinitis according to age

	Non-allergic rhinitis (n=103)	**Allergic rhinitis (n=224)**	**p**
< 1 year of age			
Antibiotics usage 0 1 2	 32 (31.1) 59 (57.3) 12 (11.7)	 98 (43.9) 107 (48.0) 18 (8.1)	0.078
Paracetamol usage	96 (94.1)	192 (86.1)	***0.035***
Ibuprofen usage	75 (75.0)	152 (81.3)	0.21
Cat at home	2 (1.9)	4 (1.8)	1.0
Dog at home	3 (2.9)	6 (2.7)	1.0
Eczema	3 (2.9)	19 (8.5)	0.093
Food allergy	2 (1.9)	8 (3.6)	0.73
Recurrent Wheezing	15 (14.6)	30 (13.4)	0.86
Middle ear infection	8 (7.8)	16 (7.2)	0.86
Living at Home with Wood-Coal Heating	10 (9.7)	14 (6.3)	0.26
Exposure to Traffic /Factory smoke	9 (8.7)	44 (19.6)	***0.013***
Living in a rural area	4 (3.9)	6 (2.7)	0.51
Exposure to cigarette smoke	40 (38.8)	96 (42.9)	0.49
Formula, 6 months	32 (31.1)	70 (31.4)	0.95
Formula	17 (16.5)	47 (21.0)	0.34
Hospitalization due to LRTI	12 (11.7)	25 (11.2)	0.90
>1 year of age			
Antibiotics usage	102 (99.0)	220 (98.2)	0.58
Paracetamol usage	102 (99.0)	224 (100.0)	-
Ibuprofen usage	99 (96.1)	211 (94.2)	0.47
Cat at home	9 (8.7)	29 (12.9)	0.27
Dog at home	9 (8.7)	21 (9.4)	0.85
Eczema	4 (3.9)	27 (12.1)	***0.024***
Food allergy	2 (1.9)	8 (3.6)	0.73
Wheezing	16 (15.5)	61 (27.2)	***0.021***
Middle ear infection	30 (29.1)	56 (25.0)	0.43
Living at Home with Wood-Coal Heating	8 (7.8)	11 (4.9)	0.30
Exposure to Traffic /Factory smoke	14 (13.6)	28 (12.6)	0.80
Living in a rural area	3 (2.9)	5 (2.2)	0.71
Exposure to cigarette smoke	40 (38.8)	111 (49.6)	0.071
Hospitalization due to LRTI	9 (8.7)	25 (11.2)	0.51

The risk factors for AR and NAR were investigated by binary logistic regression analysis (backward method). After adjustment for age, gender, and other variables found in univariate analysis, playing outside with friends and using paracetamol for under 1 year increased the risk of NAR. Furthermore, eczema and frequent wheezing after 1 year of age increased the risk of AR. The detailed results are seen in Table 4.

Table 4. Multivariable logistic regression analysis of the possible risk factors NAR and AR

	Odds Ratio	**95 % Confidence Interval**	**p**
Non-allergic Rhinitis			
Playing outdoors less than once/a week	2.04	1.20-3.45	0.008
Use of paracetamol before 1 year old	2.63	1.02-6.67	0.044
Allergic Rhinitis			
Eczema after 1 year	3.55	1.17-10.76	0.025
Wheezing after 1 year	2.15	1.14-4.05	0.018

Variables were adjusted for age of diagnosis, sex, increment of the symptoms in school, playing outdoors, use of paracetamol before 1 year old, eczema after 1 year old, wheezing after 1 year old, and exposure to traffic or factory smoke before 1 year old of age.

4. Discussion and Conclusion

This study reveals several underlying patterns and associations that warrant careful consideration, particularly in the pediatric population, by comprehensively analyzing risk factors for allergic rhinitis AR and NAR. The investigation encompassed 327 patients, with 31.5% diagnosed with NAR and 68.5% with AR, providing robust data for analysis aligning with current epidemiological patterns (2, 5). A striking finding was the significant correlation between indoor smoking exposure and AR; AR patients demonstrated significantly higher indoor smoking exposure compared to the NAR group. Additionally, our results indicated that traffic and factory smoke exposure was significantly associated with AR development in children under one year of age.

Our study demonstrates a significant association between paternal history of nasal polyps and AR. Furthermore, our analysis indicated that breastfeeding duration beyond one year had significant protective effects against AR development. Multivariate analysis identified several critical, independent risk factors: limited outdoor activity increased the risk of NAR, while eczema and recurrent wheezing after one year of age increased the risk of AR. Early life exposures proved particularly important in our findings, with paracetamol use being more common in the NAR group before one year of age. We observed that traffic and factory smoke exposure in the first year of life had a stronger association with AR development. School attendance emerged as a significant factor in our study, with AR patients showing more pronounced symptom exacerbation during school periods. Notably, we found that the number of siblings and house residents was significantly higher in the AR group compared to the NAR group.

The environmental exposure analysis in the study revealed convincing correlations, with traffic and factory smoke exposure in the first year of life being more strongly associated with the development of AR compared to the NAR group (19.6% vs. 8.7%). Parmes et al. (7) showed that traffic-related air pollution and factory smoke exposure significantly affect the development of AR in children under one year of age. Recent epidemiological studies have shown that the prevalence of AR varies significantly by geographic region and level of urbanization. Wu et al. (8) showed that urban environmental factors are becoming increasingly important, with studies showing that higher concentrations of environmental pollutants are directly associated with the increased incidence of AR in metropolitan areas. Environmental pollutants play an increasingly important role in the exacerbation of symptoms. The effects of climate change have become increasingly important, and studies show changing pollen patterns and extended exposure times. This environmental change has contributed to the changing AR and NAR presentation patterns in pediatric populations (13, 14).

The study revealed an interesting connection between paternal nasal polyp history and AR, with a 15.6% prevalence in AR patients compared to 3.9% in NAR patients. This finding underscores the potential genetic component in AR development. Studies have demonstrated that children with a family history of atopy have a significantly higher risk of developing AR (11). Recent epigenetic studies have further illuminated how immune mediators and genetic and environmental factors influence AR development, particularly in immune response modulation (15, 16).

This study's association between early-life paracetamol exposure and NAR aligns with emerging evidence suggesting early medication use may influence immune system development. This finding corroborates research by Beasley et al. (17), who reported a link between paracetamol use in infancy and increased risk of asthma symptoms in childhood. The higher prevalence of paracetamol use in the NAR group before age one than in the allergic rhinitis group warrants further investigation into the potential mechanisms underlying this association. While our results do not establish causality, they underscore the importance of considering early-life exposures in the etiology of NAR. Future longitudinal studies are needed to elucidate the long-term effects of early paracetamol use on respiratory health and to inform evidence-based guidelines for infant medication use.

This analysis yielded compelling evidence regarding the protective effects of extended breastfeeding. This protective effect was markedly more prevalent in the NAR group, with 70.9% of NAR patients having been breastfed for over a year, compared to only 54.9% in the AR group. This finding aligns with and further substantiates the research conducted by Kanchanapoomi et al. (5), who previously reported on the potential immunological benefits of

prolonged breastfeeding in reducing the risk of allergic conditions.

Furthermore, our study revealed that school attendance emerged as a significant factor in the manifestation and exacerbation of rhinitis symptoms, particularly for AR patients. We observed a distinct pattern where AR patients exhibited more pronounced symptom exacerbation during school periods compared to non-school periods. This observation is consistent with the findings reported by Goniotakis et al. (2), who documented similar trends in their research. The exacerbation of symptoms during school hours could be attributed to various factors, including exposure to allergens in the school environment, stress associated with academic activities, or changes in daily routines. This finding underscores the importance of considering the educational environment in managing AR in pediatric patients. It suggests the need for targeted interventions to mitigate symptom exacerbation during school hours.

The multivariable analysis conducted in our study unveiled several critical and independent risk factors for both NAR and AR in the pediatric population. A key finding was the association between limited outdoor activity and an increased risk of NAR. This relationship suggests that reduced exposure to outdoor environments may play a role in developing NAR symptoms. The mechanism behind this association could be linked to decreased exposure to diverse environmental stimuli or reduced physical activity, which may influence the development and function of the nasal mucosa. Conversely, our analysis revealed that the presence of eczema and recurrent wheezing after one year of age were significant risk factors for the development of AR. The association between eczema and AR is particularly noteworthy, as it aligns with the 'atopic march' concept. This finding corroborates the observations made by Yum et al. (14), who documented complex interrelationships between various allergic conditions. The link between eczema and AR suggests a shared underlying immunological dysfunction that may predispose individuals to multiple allergic manifestations. These findings are consistent with comprehensive reviews of pediatric rhinitis risk factors (8, 9, 18, 19). Such alignment with existing literature lends credibility to our results and underscores their relevance within the broader context of pediatric rhinitis research.

Treatment implications suggest the need for differentiated approaches to AR and NAR management. The distinct risk profiles identified for each condition necessitate tailored therapeutic strategies, particularly considering the role of environmental modifications (20). Future interventions should focus on modifiable risk factors, especially in urban settings with high pollution exposure. The significant association between indoor smoking and AR emphasizes the importance of smoke-free environments and regular ventilation of indoor spaces in prevention strategies.

The study's strengths lie in its comprehensive assessment of risk factors across different age groups and environmental contexts. However, future research should focus on longitudinal outcomes and intervention effectiveness to better inform clinical practice and public health policies. Our study has limitations, including geographical limitations and lack of time frame assessments.

Our findings contribute significantly to understanding risk factors for both AR and NAR in pediatric populations. These provide valuable insights for developing targeted preventive strategies for both AR and NAR in pediatric populations. The results emphasize the importance of early intervention, environmental modification, personalized treatment approaches, and regular follow-up protocols based on specific risk profiles. Continued research is essential, particularly regarding the long-term impacts of early-life exposures and the effectiveness of preventive strategies in different environmental contexts.

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