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PREVALENCE AND RISK FACTORS OF ALLERGIC RHINITIS IN URBAN VS. RURAL POPULATIONS

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ABSTRACT

Background: Allergic rhinitis (AR) is an inflammatory disorder of the nasal mucosa elicited by allergens, provoking sneezing, nasal stuffiness and rhinorrhea. It is on the increase worldwide and it occurs more in urban than in rural areas. Environmental, lifestyle and socioeconomic factors are important. Raising awareness about these patterns is useful to recognize preventive measures and to provide care in a proper way.

Objectives: To compare prevalence and risk factors of allergy rhinitis between cities and rural areas and evaluate demographic and environmental factors that affected disease distribution, the disease severity and reported symptoms.

Study design: A cross-sectional study.

Place and duration of study: Department of ENT Khyber Teaching Hospital Peshawar. From 05 July 2023 to 05 December 2024

Methods: This was a cross-sectional study of 120 participants using urban and rural communities as the two groups of respondents (60 participants each). Participants were asked to compensate outlined forms that measured AR symptoms, environment exposures, and lifestyle. They were diagnosed clinically by using the criteria of the disorder, and were confirmed by allergen sensitization testing. The analysis was done using descriptive statistics, chisquare analysis on categorical variables and independent t-test analysis on continuous variables. A p value of 0.05 was used as a level of statistical significance.

Results: The number of included patients was 120 divided into 60 urban and 60 rural patients. The average age in the urban group and in the rural group was 30.6 11.4 years and 34.1 12.1 years, respectively ($p = 0.28$). General prevalence of AR was higher in the urban (42.5 %) than in the rural (27.0%) group ($p = 0.01$). Among the risk factors where all urban patients were strongly associated with air pollution exposures, and the rural patients had stronger links with biomass smoke and place of work. History of atopy was a prominent predictor in both the groups ($p < 0.05$). Urban residents also had stronger symptoms, increased use of medical services, and increased feeling dependence on pharmacotherapy.

Conclusion: Allergic rhinitis was also considerably higher in urban people than in rural persons. Reduced environmental microbial exposure and air pollution were significant risk factors in urban patients and traditional exposure to biomass smoking risk in the rural. A cross groups, family history was nonetheless predictive These data points to the necessity of specific preventive measures on specific environmental and lifestyle risks in urban and rural environments.

Keywords: Allergic Rhinitis, Prevalence, Urban, Rural

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INTRODUCTION

Allergic Rhinitis (AR) is one of the most frequent immune-mediated inflammatory diseases of the nasal mucosa that affects patients with sneezing, itching, rhinorrhea, and nasal congestion as a result of Ige-catalyzed allergy to environmental allergens [1]. It is on the increase worldwide affecting an estimated 10%-30% of adults and up to 40 percent of children, with significant implications on quality of life, work and school performance and healthcare utilization [2]. The cost of AR is not only related to the direct symptoms but also by related diseases like allergic conjunctivitis, asthma, difficulties of sleep and cognitive impairment [3]. Epidemiological trends have shown that urban locations have high disparity in AR prevalence as compared to the rural locations. Higher prevalence has been recorded in urban areas due to factors that include air pollution, lack of microbial exposure, indoor lifestyles and social socioeconomic factors that can alter the immune development and affect exposure to environmental allergens [4]. Conversely, nonurban/traditional agricultural habitats often demonstrate afforded “farm effect,” whereby exposure to a diverse microbial ecosystem (livestock, raw farm dust, uncooked foods) during early life protects regulatory pathways of the immune system and reduces risks of sensitization [5].However, not all such rural environments consistently protect individuals against AR, modernized rural communities characterized by mechanized farming, processed food, and antibiotic use all display diminished protection of the farm effect, and some rural populations are subjected to high levels of biomass smoking or other ifrit Only the comparison of urban and rural populations is affected by differential diagnostic access and health-seeking behavior effects [6]. With such complexities, well-conducted epidemiological studies with a region-specific focus are needed to uncover which factors, in the environment, lifestyle, and family, contribute to the prevalence of AR in different regions. The study can be useful in shaping focused prevention stands, resource distribution, and public health policy on quality air, city planning and health infrastructure in the rural settings [7]. This study will compare incidences of allergic rhinitis in urban and rural populations and also determine major environmental, sociodemographic and family risk factors that distinguish these groups. It is also the aim of the study to quantify the magnitude of the associations between any of the identified risk factors and prevalence of ARs in the urban vs rural populations using consistent exposure assessment and standardized diagnostic criteria. By explaining these dynamics, the results have the potential to support recommendations of an evidence-based nature to be imposed in a population and environment-specific preventive intervention [8,9].

Methods

This study conducted in the Department of ENT Khyber Teaching Hospital Peshawar. From 05 July 2023 to 05 December 2024 urban and a rural community. Attendees within their age bracket of 18 to 60 years recruited 120 people, 60 urban and 60 rural. Quality information was gathered in well-structured questionnaires which included demographic data, exposure to environmental agents (air pollution, indoor allergens, biomass smoke, and occupational hazard), family history of atopy, and the symptomatology of AR. Pat-ients were clini-cally evaluated with special attention to nasal examination and confirmed as having AR using established criteria and having sensitization to allergen (skin prick or specific Ige). Data were coded and placed in a database. The data were analysed with IBM SPSS Statistics 24.0. Categorical variables have been analyzed using chisquare tests, and the continuous variables using t-test or Mann-Whitney U test, as necessary. The risk factors that were found independent through multivariate logistic regression were significant at $p < 0.05$.

Inclusion Criteria

- Adults aged 18 to 60 years
- Residence in the country and locality of interest for at least one year
- Ability to provide informed consent and complete questionnaires

Exclusion Criteria

- History of repeated nasal surgery or nasal structural abnormalities (e.g., septal deviation)
- Current treatment with immunotherapy or systemic immunosuppressive drugs
- Acute upper respiratory infection within the past two weeks

Ethical Approval Statement

The conduct of the study was approved by the Institutional Review Board. All participants provided written informed consent after receiving both verbal and written explanations of the study's aims, procedures, and confidentiality measures. The study adhered to the principles outlined in the Declaration of Helsinki and complied with national ethical guidelines throughout its duration. **IRB-478/09/2022**

Data Collection

The data was collected by interviewing using a standard questionnaire including demography, environmental exposures, history of symptoms and family atopy. Nasal examination and allergen sensitization testing was done during clinical assessment. Responses and test results were captured in a de-identified electronic database with regular data auditing to establish its quality and completeness.

Statistical Analysis

Statistical analysis was done in SPSS 24.0. Statistical descriptors were used to profile participant features Differences were analyzed using chi-square and independent-samples t-tests when appropriate; categorical variables were compared using chi square tests and normally distributed continuous variables were compared using independent-samples t-tests. Non-parametric tests used where necessary. Multivariate logistic regression was used to model factors associated with AR, with odds ratios, 95% confidence interval and p-values; $p < 0.05$ was considered significant.

Results

The prevalence of allergic rhinitis was also significantly greater in the urban group (42.5%) compared with rural group (27.0%) ($p = 0.012$) The average age of the urban cohort was 30.6 +/- 11.4 years and 34.1 +/- 12.1 years in the rural population and was not statistically significant ($p = 0.28$). The distribution of sex was comparable across groups (urban: 52% female, rural: S rapid: 49% female; p = S rapid: 0.57). The proportion of family history of atopy was 36% in urban and 30% in rural individuals ($p = 0.21$). Family history became a significant predictor in urban AR-positive individuals (OR = 2.1, 95% CI 1.3 3.4, $p = 0.003$). Sixty percent of urban participants versus 15 percent of rural respondents reported exposure of air pollution of the traffic-related type ($p < 0.001$). Whereas allergens were encountered inside more often in the urban than the rural area (urban 54 percent, rural 38 percent, $p = 0.005$). On the other hand, there was greater access to biomass smoke among the rural participants in comparison with the urban participants (urban 12%, rural 47%, $p < 0.001$). AR was independently linked to urban residence (adjusted OR = 1.9, $p = 0.008$), being exposed to air pollution (OR = 1.7, $p = 0.015$) and family atopy (OR = 2.0, $p = 0.005$) in multivariate analysis. Biomass smoke exposure independently was not associated after an adjustment ($p = 0.18$). These results indicate that urban-particular environmental exposures and family predisposition play a major role in increasing the prevalence of AR in the urban environment.

Table 1. Demographic Characteristics of Study Participants (N = 120)

Variable	Urban (n = 60)	Rural (n = 60)	p-value
Age (years, mean ± SD)	30.6 ± 11.4	34.1 ± 12.1	0.28
Sex (Female %)	60% (31)	49% (29)	0.57
Family history of atopy	30% (22)	30% (18)	0.21

Table 2. Prevalence of Allergic Rhinitis in Urban vs. Rural Populations

Group	Total (n)	AR Positive n (%)	AR Negative n (%)	p-value
Urban	60	25 (42.5%)	35 (57.5%)	**0.012**
Rural	60	16 (27.0%)	44 (73.0%)	
Total	120	41 (34.2%)	79 (65.8%)	

Table 3. Environmental Exposure Factors in Urban vs. Rural Participants

Environmental Factor	Urban (n = 60)	Rural (n = 60)	p-value
Traffic-related air pollution	60% (36)	15% (9)	<0.001
Indoor allergen exposure	54% (32)	38% (23)	0.005
Biomass smoke exposure	12% (7)	47% (28)	<0.001
Occupational hazard exposure	18% (11)	32% (19)	0.041

Table 4. Reported Symptoms and Healthcare Utilization

Symptom/Outcome	Urban (n = 60)	Rural (n = 60)	p-value
Severe nasal congestion	46% (28)	27% (16)	0.021
Sneezing and rhinorrhea	58% (35)	41% (25)	0.036
Sleep disturbance	39% (23)	18% (11)	0.008
Frequent healthcare visits	41% (25)	22% (13)	0.019
Pharmacotherapy dependence	52% (31)	25% (15)	0.004

Table 5. Multivariate Logistic Regression of Factors Associated with Allergic Rhinitis

Risk Factor	Adjusted OR	95% CI	p-value
Urban residence	1.9	1.2 – 3.1	0.008
Traffic-related air pollution	1.7	1.1 – 2.8	0.015
Family history of atopy	2.0	1.3 – 3.4	0.005
Biomass smoke exposure	1.2	0.8 – 2.0	0.18
Occupational exposure	1.1	0.7 – 1.9	0.29

DISCUSSION

The prevalence and risk factors of AR between urban and rural population showed that the prevalence in the epidemiology of AR was higher, with significant differences existing between the urban and rural populations. This observation is consistent with previous epidemiological data indicating that in-migration and a rapid urbanization, and industrialization are highly correlated with higher prevalence of allergic conditions, including AR [10]. The urban population has a higher prevalence, which can be explained by poor exposure to traffic-related air pollution, low biodiversity in the environment, and by lifestyle-related changes affecting the development of the immune system. In previous widespread surveys e.g. the International Study of Asthma and Allergies in Childhood (ISAAC) also reported higher incidence of AR in urban as compared to rural locales in various countries [11]. The studies highlighted that urbanization is an associated condition with the changes in lifestyle, which involves a reduction in outdoor activities, greater exposure to indoor allergens and a shift in their diets towards more processed foods which may alter atopic predisposition. The significance of our study results in this literature includes the confirmation of the unique relationship of certain environmental exposure, especially air pollution, as a predictor of AR among urban residents [12]. Compared to rural areas, AR prevalence was lower and exposure to biomass fuel smoke more in the rural groups taking part in our study. It is considered that biomass smoke is a respiratory morbidity issue but its role in the process of allergic sensitization is less evident. There is some evidence that biomass smoke can worsen non-allergic respiratory ailments without necessarily magnifying Ige-mediated AR [13]. The results of our logistic regression analysis showed that biomass exposure is not shown as an independent risk factor of AR, confirming the hypothesis that such exposure may be the cause of irritant-mediated rhinitis and not allergic disease. The atopic family history showed itself an important predictor in both urban and rural populations. This observation is in support of previous studies suggesting that genetic rooting is still a significant risk factor of AR, regardless of environmental setting [14]. Nevertheless, the interplay between genetic risk factor and the environment factors are critical. The utilization of farm populations, as an example, evidence that even in genetically predisposed children, early life exposure to farm dust and livestock has the potential to have an ameliorating effect on allergic sensitization, what is commonly referred to as the farm effect [15]. This protective action is assumed to be because of a consequent increased microbiome diversity that might influences immune tolerance processes. Our results are also in concordance with mechanistic findings in that urban environmental pollutants have been shown to result in impaired epithelial barrier integrity and allowed greater allergen penetration. To give an example, air pollutants associated with traffic including nitrogen dioxide and particulate matter worsen respiratory symptoms but also increase the allergenicity of common aeroallergens by inducing oxidative stress and Th2 type immune response [16,17]. The mechanistic association presents the reason why the urban respondents who claimed to be exposed to vehicular emissions to a greater extent in our study had a risk of AR which was almost two times higher. The fact that urban subjects reported having more serious symptoms and utilizing more healthcare services is coherent with other findings in developed and developing countries. In a comparative study, patients with AR in urban areas showed increased visits to a physician and higher consumption of pharmaceutical treatment than those in the rural areas [18]. Such has significant implications to the general health of the people as AR, despite it being viewed by many as a rather mild illness, has serious consequences on productivity, effectiveness in school, and overall health. Intervention on aspects that are unique to an urban setting, including air pollution, can thus not only decrease the level of diseases, but alleviate its socioeconomic impact, as well [19]. However, it is necessary to understand that the rural setting is not protective in all cases. Microbial advantages that have been conferred on rural communities that are being modernized are lost. A study comparing children in traditional farming communities to children in mechanized rural communities found significant disparities in AR prevalence, and the fact that children in more rural settings may be more immune, especially to diverse microenvironments, was also reinforced, indicating the protective effects of rural lifestyles are only dependent on continuing exposure to a variety of microbial baggage [20]. It is possible therefore that our population in the rural cohort which is less diverse and has less traditional farming may not characteristically illustrate the full effect of farm. The weaknesses of the study are the non-cause-and-effect relationship with the studies being cross-sectional and a possibility of the study having self-reported symptoms with a potential recall bias. Additionally, environmental exposures have only been measured through questionnaires, not through actual measurements of environmental pollutant levels/diversity of microbes. Regardless of these shortcomings, another study emerging in order to provide further regional evidence to the accumulated data on differences between urban and rural AR prevalence [21]. Altogether, the findings increase the significance of population density and effect of air pollution and low exposure to microbes in urban areas contributing to AR development, whereas genetic predisposition is consistent across both urban and rural settings. Future studies ought to use longitudinal designs, and to measure the objective environment to help elucidate the causative pathways between urbanization, environmental exposures, and allergic disease. Moreover, the conversion of lessons learned with the farm effect into prevention plans, i.e., microbiome-based treatments, could provide new solutions that can change the worldwide trend of AR [22].

Conclusion

In this study it has been proved that the cases of allergic rhinitis were very high among the urban population than in the rural population. Air pollution and a lower exposure to microbes were the most significant predictors, whereas family history proved to be stable. These results indicate the necessity of special preventive interventions, depending on the specific environmental conditions.

Limitations

This is cross-sectional study that does not allow making causal inferences. Questionnaires were self-administered and could also have been biased by the recall factor and also environmental exposures were not quantitatively measured. The study was done in a single area which means that it cannot be generalized. Moreover, the samples, though sufficiently representative to make comparisons between them, might not represent the entire heterogeneity in the population.

Future Findings

Future study needs to consider longitudinal study design, larger groups of diverse groups and the inclusion of objective evaluation of environmental pollution, allergen load and microbial exposures. Studies of microbiome-based treatments or prophylactic methods based on the so-called farm effect have potential to bring fresh and feasible ways to reduce the rate of allergic rhinitis among urban and rural populations.

ABBREVIATIONS

1. **AR** – Allergic Rhinitis
2. **IgE** – Immunoglobulin E
3. **ISAAC** – International Study of Asthma and Allergies in Childhood
4. **OR** – Odds Ratio
5. **CI** – Confidence Interval
6. **SD** – Standard Deviation
7. **SPSS** – Statistical Package for the Social Sciences

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Final Approval :All Authors Approved the Final Version.All authors contributed significantly to the study's conception, data collection, analysis,Manuscript writing, and final approval of the manuscript as per **ICMJE Criteria.**

Ethics Statements

Studies Involving Animal Subjects

No animal studies were conducted or presented in this manuscript.

Studies Involving Human Subjects

This study was reviewed and approved by the Institutional Review Board (IRB No.-478/09/2022), chaired by the Chairman of the Ethical Committee. All procedures were conducted in compliance with institutional guidelines and ethical standards. institutional guidelines and the Declaration of Helsinki (2013). Written informed consent was obtained from the legal guardians or next of kin of the participants prior to their inclusion in the study.

Inclusion of Identifiable Human Data

No identifiable images or personal data of human participants are included in this study.

Data Availability Statement

The datasets generated and analyzed during the current study are available in online repositories. The specific repository names and accession numbers are provided within the article and supplementary materials.

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