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Original Article

Development and clinical applicability of a questionnaire for screening allergic rhinitis in children: a retrospective study

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SUMMARY

Introduction. Allergic rhinitis (AR) is a common chronic condition in children and often overdiagnosed, leading to unnecessary and costly testing.

Materials and Methods. This retrospective study reviewed data from 111 children aged 3–17 years, assessed for AR during routine outpatient visits. A standardized questionnaire was administered as part of clinical practice, and diagnoses were confirmed through allergy testing.

Results. Family history of atopy was a strong risk factor for AR (OR=2.43), while symptoms like mucopurulent rhinorrhea, wet cough, snoring, and sleep apnea were inversely associated. A cut-off based on ≥2 negative responses to inversely correlated items helped identify low-risk patients.

Discussion. This tool, developed from clinical and anamnesis data collected during the diagnostic process, showed high sensitivity (92.86%) and negative predictive value (80%), supporting its use in primary care to screen for AR and avoid unnecessary testing.

Conclusions. This simple, non-invasive questionnaire is a promising screening method to improve AR diagnosis and reduce healthcare burden, especially in resource-limited settings.

KEY WORDS: Allergic rhinitis, Screening tool, Pediatric allergy

INTRODUCTION

Allergic rhinitis (AR) is defined as a symptomatic disorder of the nose caused by an IgE-mediated inflammation following contact of the nasal mucosa with an allergen[1]. AR is among the most common diseases worldwide from childhood to adulthood[2]. Its prevalence has significantly increased since the 1990s [1,3]. Globally, the prevalence of AR in pediatric age is estimated to range between 2% and 24% [4]. The onset generally occurs in childhood, after the fifth year of age, reaching a peak incidence between 8 and 12 years, with no gender distinction [5]. The symptom intensity is higher at the age of 20 to 40 years, gradually decreasing with aging [6].

AR, therefore, affects individuals during the most productive years of their lives, both in terms of learning and later professional activities. For this reason, AR is the most frequent IgE-mediated disease leading to outpatient specialist visits [7], with a significant impact on healthcare costs. In particular, it has been demonstrated that these symptoms negatively affect children's social life, school performance, and, most importantly, the quality of life of both the child and the family [7,8]. Moreover, a significant number of patients mistakenly believe they suffer from AR. This belief leads them to book allergy consultations for themselves and their children, both in public and private healthcare facilities, undergoing tests such as the Skin Prick Test (SPT) or specific IgE dosage, which are often associated with a high rate of false positives[9]. Furthermore, the prevalence of self-reported AR among adults worldwide is

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estimated to range from 1% to over 40% [1,10], whereas the confirmed prevalence in the same population varies between 17% and 28.5% [1]. This represents an overestimation of approximately 40% of AR cases. Since, at present, the only way to distinguish AR from non-allergic rhinitis is through SPT/specific IgE tests based on a thorough medical history collected during the consultation, and considering that these diagnostic tests are expensive and/or often unavailable in primary care settings, developing a screening tool to differentiate between atopic and non-atopic individuals would provide significant resource savings. Data from a large pediatric cohort study suggest that around 5 to 10 specific questions during medical history collection could accurately predict non-allergic rhinitis [11]. There is a need for simple, validated tools to support early identification and reduce unnecessary specialist referrals.

This study aimed at evaluating the predictive accuracy of a simple, cost-effective, and non-invasive survey in order to screen AR and perennial non-allergic rhinitis (PNAR). By distinguishing between these two conditions, this approach could help minimize unnecessary diagnostic tests and reduce healthcare costs.

MATERIALS AND METHODS

This retrospective observational study was conducted on a pediatric population aged 3 to 17 years, assessed between September 2023 and October 2024. A total of 111 patients were retrospectively enrolled at our Pediatric Pulmonology and Allergology Clinic, part of the outpatient unit of the Pediatric Department at Giovanni XXIII Pediatric Hospital in Bari.

Clinical data, including responses to a structured anamnesis survey administered during routine visits, were retrospectively anonymized and analyzed. Patients were divided into two groups:

- Suspected AR: this group included 61 children and adolescents attending their first visit due to persistent symptoms — such as rhinorrhea, frequent sneezing, nasal obstruction, itching, and ocular disturbances — lasting at least 12 months. To confirm or rule out AR, all underwent SPTs, and some also received serum-specific IgE testing;
- Confirmed AR: this group comprised 50 patients with a previously established diagnosis, attending follow-up visits to monitor symptom progression and treatment response.

In both groups (Tab. I), the diagnosis of AR was established when suggestive nasal symptoms were associated with allergic sensitization, documented by SPT and/or serum-specific IgE testing, consistent with the reported symptom pattern and seasonality. Nearly all patients (n = 105) underwent SPT to common inhalant allergens, including olive, cypress, grass, birch, dust mites, molds, pet dander, and ragweed mix. The remaining six patients were tested using the ImmunoCAP assay. Additionally, 35 patients underwent otolaryngology evaluation with nasal endoscopy.

Data recorded during outpatient visits were organized into a standardized dataset (Tab. II) and analysed retrospectively. Statistical analyses were performed to compare patients with and without AR and to assess the predictive performance of the screening survey. Continuous variables were reported as means ± standard deviation (M ± SD), while categorical variables were expressed as frequencies and percentages. Group comparisons were performed using the Wilcoxon rank-sum test for continuous variables and the Chi-square test for categorical variables; Fisher's exact test was used when expected frequencies were low.

To evaluate the diagnostic performance of the survey, we calculated sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for each item. Logistic regression analysis was employed to assess associations between AR and individual survey responses, with results expressed as odds ratios (ORs) and 95% confidence intervals (CIs). All tests were two-tailed, and a p-value < 0.05 was considered statistically significant. Analyses were performed using StataCorp software (version 18) (Tab. III).

Lastly, to enhance the survey's ability to discriminate between AR and PNAR, a categorical variable was introduced based on the number of negative ("No") responses to items inversely associated with AR. A cut-off of two negative responses was applied: patients with two or more "No" responses were classified as high risk for AR, while those with fewer were considered low risk.

RESULTS

Several anamnesis-based items were significantly associated with AR and were used to develop a structured questionnaire intended to assist in the clinical characterization and differentiation of patients with and without the condition. Several anamnesis-based items were significantly associated with AR using logistic regression analysis and were used to develop a structured questionnaire to support clinical differentiation.

1. Family History of Atopy:
   Patients with a first-degree family history of atopy were significantly more likely to be diagnosed with AR, with an odds ratio (OR) of 2.43 (p = 0.03, 1.10 to 5.37 95%, C.I.). This finding suggests that a positive family history increases the risk of AR by approximately 2.4 times compared to those without such a history.
2. Recurrent Otitis:
   An inverse association was observed for recurrent otitis (OR = 0.24, p = 0.01, 1.10 to 5.37 ,95% C.I.), indicating a 76% lower probability of AR in patients with this condition.
3. Mucopurulent Rhinorrhea:
   This symptom showed a strong inverse association with AR (OR = 0.08, p < 0.001, 0.03 to 0.23, 95% C.I.), corresponding to a 92% reduction in the likelihood of an AR diagnosis.
4. Wet Cough:
   The presence of a wet cough was inversely correlated with AR (OR = 0.17, p < 0.001, 0.07 to 0.41 95%, C.I.), suggesting an 83% lower probability of the condition in affected individuals.
5. Snoring:
   Snoring was associated with a reduced risk of AR (OR = 0.44,

TABLE I. Cohort Characteristics and Allergic Rhinitis.

Parameter	Total Cohort	No (n = 41)	Yes (n = 70)	p-value
Age (years)	8.78 ± 3.68	6.15 ± 2.79	10.33 ± 3.24	<0.0001
Gender (M) (%)	62 (55.86)	21 (51.22)	41 (58.57)	0.45
Ethnicity (%)				
Caucasian	108 (97.30)	41 (100.00)	67 (95.71)	
African	1 (0.90)	0 (0.00)	1 (1.43)	
Indian	1 (0.90)	0 (0.00)	1 (1.43)	
Latin American	1 (0.90)	0 (0.00)	1 (1.43)	
School Start (years)	2.70 ± 0.65	2.61 ± 0.70	2.76 ± 0.62	0.47
Delivery (%)				
Cesarian Section	32 (28.83)	10 (24.39)	22 (31.43)	0.43
Vaginal Delivery	79 (71.17)	31 (75.61)	48 (68.57)	
Gestational Age (%)				0.76
Preterm	13 (11.71)	4 (9.76)	9 (12.86)	
Term	98 (88.29)	37 (90.24)	61 (87.14)	
Body Weight (g)	3141.88 ± 461.10	3190.00 ± 480.17	3113.70 ± 450.67	0.14
Breastfeeding (Yes) (%)	58 (52.25)	22 (53.66)	36 (51.43)	0.82

Descriptive statistics of the study population. Values are expressed as mean ± standard deviation or percentage, with p-values indicating statistical significance between AR and non-AR groups.

TABLE II. Clinical Data Collected by the Standardized Survey.

Demographic and Personal Data	Age, Gender, Ethnicity, Type of Schooling
Physiological History	Birth Type, Feeding Method, Gestational Age
Past Medical History	History of associated conditions: sinusitis, food allergies, asthma, dermatitis, recurrent otitis
Recent Medical History	Symptoms leading to AR suspicion: Rhinorrhea, Sneezing, Nasal itching, Oral tingling, Tearing, Ocular itching, Eye redness, Eyelid swelling, Dry cough, Wet cough, Respiratory difficulty, Wheezing, Headache, Snoring, Postnasal drip sensation, Nocturnal Apnea, Otalgia, Epistaxis
Seasonality of Symptoms	Presence of a seasonal pattern: occurrence of symptoms during specific months of the year
Allergy Test Results	Skin Prick Test (SPT) results; if SPT was not performed, results of specific IgE tests

Data collected through a standardized clinical questionnaire. Categories include demographic, physiological, past and recent medical history, symptom seasonality, and allergy test results.

p = 0.04, 0.19 154 to 0,98, 95% C.I.), representing a 56% lower likelihood of diagnosis.

6. Sleep Apnea:
   Sleep apnea also emerged as a significant inverse factor (OR = 0.06, p < 0.001, 0.02 to 0.23, 95% C.I.), corresponding to a 94% reduction in the likelihood of AR.

In summary, a first-degree family history of atopy represents a significant risk factor for AR, while recurrent otitis, mucopurulent rhinorrhea, wet cough, snoring, and sleep apnoea are inversely correlated with the condition. These findings supported the selection of the corresponding items for inclusion in a structured questionnaire designed to aid in the clinical assessment of suspected AR cases.

Analysis of the questionnaire's diagnostic performance showed a sensitivity of 92.86%, indicating that most affected individuals were correctly identified (7.14% false negatives). However, specificity was limited (51.22%), resulting in a notable proportion of false positives and a potential risk of overdiagnosis. The positive predictive value (PPV) was 76.47%, meaning that approximately three-quarters of positive results corresponded to confirmed cases, while the negative

TABLE III. Risk Factors and Odds Ratios.

Parameter	OR	SE (OR)	p-value	95% CI
Family history of atopy (1st degree)	2.43	0.98	0.03	1.10-5.37
Recurrent otitis	0.24	0.14	0.01	0.07-0.76
Mucopurulent rhinorrhea	0.08	0.04	< 0.0001	0.03-0.23
Productive cough	0.17	0.08	< 0.001	0.07-0.41
Snoring	0.44	0.18	0.04	0.19-0.98
Sleep apnea	0.06	0.02	< 0.001	0.02-0.23
Frequent otalgia	0.2	0.09	0.02	0.06-0.47
ENT	0.13	0.06	< 0.001	0.05-0.32
Pronounced symptoms	0.02	0.01	< 0.001	0.01-0.08
Temperature changes	0.32	0.13	0.006	0.14-0.72
Humidity	0.39	0.16	0.002	0.18-0.88
Oral steroids	0.16	0.06	0.004	0.05-0.56
Nasal decongestant sprays	0.16	0.07	< 0.001	0.07-0.38

OR, Odds Ratio; SE, Standard Error; CI, Confidence Interval.
Associations between clinical/environmental variables and allergic rhinitis. Values <1 indicate inverse association.

predictive value (NPV) was 80%, providing reasonable confidence in negative findings.

Overall, the questionnaire demonstrated strong potential for excluding AR due to its high sensitivity and acceptable NPV. Nevertheless, its limited specificity underscores the need for confirmatory diagnostic testing in positive cases.

To further improve discrimination, a composite variable based on the number of "No" responses to protective items was created, and a cut-off of ≥ 2 was empirically chosen to stratify patients by risk.

Based on these findings, a simple risk stratification approach was developed, grouping patients into two categories with potential clinical relevance, as further discussed in the following section.

DISCUSSION

Our study demonstrates that the questionnaire can stratify patients according to their risk of AR using a two-tier evaluation approach. First, the questionnaire assesses the presence of a family history of atopy (a well-established risk factor for AR). Second, it examines responses to several items representing factors inversely correlated with AR (such as recurrent otitis, mucopurulent rhinorrhea, and similar clinical features).

Patients who answer "yes" to having a family history of atopy and "no" to at least two of these inversely correlated factors are classified as high risk. This combination suggests that not only is there an inherent predisposition to allergic conditions, but the absence of certain protective or alternative clinical features further increases the likelihood of AR. Conversely, patients who report a negative family history but provide affirmative responses to one or more of the inversely correlated items are considered low risk, as these features are more characteristic of non-allergic conditions.

This stratification supports targeted referrals: high-risk patients can be directed toward further diagnostic evaluations (e.g. allergy testing), while low-risk patients may be managed more conservatively. Such an approach is particularly useful in primary care settings, where access to specialist diagnostics may be limited.

However, this study has limitations. Its retrospective, single-center design and relatively small sample size may introduce selection bias and limit the generalizability of the findings. The questionnaire's specificity (51.22%) results in a relatively high false-positive rate, underscoring the need for refinement and prospective validation in larger populations. This underscores the need for further refinement to improve its capacity to exclude non-atopic individuals. On the other hand, the high sensitivity (94.29%) confirms the tool's ability to effectively identify patients at risk of AR, potentially reducing the need for invasive and costly procedures.

The questionnaire's simplicity, rapid administration, and non-invasive nature make it especially suitable for routine clinical use, including by non-specialist personnel in resource-limited settings.

Our findings align with previous research. In particular, Hammersley et al. [12] developed a similar screening tool for adults, reporting sensitivity and negative predictive values comparable to ours. This supports the potential of questionnaire-based screening as a viable alternative to conventional diagnostic tests such as SPTs and serum-specific IgE measurements. Future research should focus on improving specificity and validating the tool in larger, diverse populations. Clinically,

adopting this screening tool could enhance diagnostic efficiency, optimize patient management, and reduce healthcare costs by minimizing unnecessary testing.

CONCLUSION

This study suggests that a simple, cost-effective, and non-invasive questionnaire, developed from anamnesis-based items, may represent a promising tool to support preliminary AR assessment, especially in low-resource settings where access to diagnostic testing may be limited. It is particularly helpful in identifying non-atopic individuals and reducing reliance on invasive, costly tests. The tool's high sensitivity (92.86%) and negative predictive value (84.00%) support its use in ruling out AR, despite limited specificity (51.22%). A cut-off based on two negative responses to inversely associated items improves patient stratification. While these findings are encouraging, further research is needed to confirm the tool's utility and reproducibility. This approach may enhance diagnostic efficiency and resource use in settings with limited access to specialist care. Further studies should validate the tool in broader populations and assess its clinical and economic value.

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Ethical consideration

This retrospective study used anonymized data collected during routine clinical practice.

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Conflicts of interest statement

The authors declare that they have no competing interests.

Authors' contributions

Conceptualization: F.C.; Methodology: F.C., C.S., C.M.; Writing - Original Draft Preparation: C.S., C.M., F.C.; Writing - Review and Editing: C.S., C.M., F.C. All authors made substantial revisions to the manuscript and approved the final version.

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