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Prevalence of Asthma and Allergic Diseases in Giresun, Turkey: Two-Stage Epidemiological Study

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ABSTRACT

Objective: This study aimed to determine the prevalence of asthma and allergic diseases in the province of Giresun and to evaluate their associations with demographic, geographic, and environmental factors using a two-stage population-based epidemiological design.

Materials and Methods: Conducted between March and November 2025, the study employed a two-stage cross-sectional survey based on the European Community Respiratory Health Survey (ECRHS). In Stage 1, 1,322 adults aged 20-44 years completed the ECRHS Stage 1 questionnaire to assess respiratory and allergic symptoms. In Stage 2, a random subsample of 131 participants completed the main ECRHS questionnaire to estimate prevalence. Narrow-definition allergy was defined as the presence of specific allergen-related respiratory or nasal symptoms, whereas broad-definition allergy included any self-reported allergic symptoms irrespective of particular triggers. Asthma and allergy definitions were based on standardized ECRHS criteria. Logistic regression analyses were performed to identify independent predictors of current asthma and allergic disease. Bias was minimized through random sampling, validated instruments, and standardized procedures.

Results: The prevalence of current asthma was 14.5% (95% CI: 8.6-20.4). Narrow-definition allergy was present in 57.3% of participants, and broad-definition allergy in 72.5%. Early childhood respiratory infections, shared-room exposure before age 5, and occupational respiratory symptoms were significantly associated with current asthma in univariate analyses. In multivariable models, pollen-triggered respiratory symptoms remained the only independent predictor of current asthma (OR = 10.22, p = 0.009). For narrow-definition allergy, animal-induced and pollen-induced atopic symptoms were significant predictors. Traditional demographic and lifestyle factors, including age, sex, smoking status, and family history, were not independently associated with asthma or allergy after multivariable adjustment.

Conclusion: Asthma/allergic diseases are highly prevalent in Giresun and appear to be predominantly associated with environmental allergen exposures rather than traditional demographic risk factors. The strong influence of pollen- and animal-related atopic symptoms underscores the role of regional ecological characteristics in shaping respiratory health and highlights the need for environmentally targeted public health strategies in similar settings.

Keywords: Asthma, prevalence, allergic Diseases, ECRHS, European Community Respiratory Health Survey

INTRODUCTION

Asthma is a chronic inflammatory disease of the airways affecting approximately 300 million people worldwide (1). Its prevalence shows marked geographic variation, ranging from 1% to 18%, with higher rates reported in Western Europe and Africa and the lowest in Southeast Asia (1-3). Beyond international differences, substantial variability has also been observed within regions of the same country (4,5). To enable the comparable assessment of these epidemiological differences, the European Community Respiratory Health Survey (ECRHS) questionnaire has been widely adopted as a reference tool in population-based studies (6,7).

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The prevalence of asthma in Turkey has been reported to be between 4.4% and 9.8%, with notable differences across age groups and geographic regions (8-10). Previous studies conducted in various Turkish cities have reported asthma prevalence rates ranging from 1.2% to 8.7% in both children and adults (4,5,11,12). Notably, several studies have suggested a higher prevalence of asthma in rural areas and in the Black Sea region compared with other parts of the country (13,14). Such variability has been attributed to differences in study methodology, population characteristics, and regional environmental conditions.

Asthma and allergic diseases are known to be influenced by a broad range of factors, including family history of disease, occupational exposures, childhood infections, smoking/secondhand smoke exposure, contact with pets, and indoor air quality (1,6). A family history of asthma or allergy has been reported to increase disease risk by up to sevenfold (15). At the same time, exposure to indoor dampness, mold, and tobacco smoke has been associated with a 1.5-4-fold increase in asthma and allergic disease prevalence (16-19). In addition, global trends such as environmental pollution, climate change, increased pollen load, and lifestyle-related factors are thought to contribute to the rising burden of asthma and allergic diseases worldwide (1,20,21).

The Black Sea Region of Turkey is characterized by high humidity and rainfall, environmental conditions that promote indoor dampness, mold growth, and increased house dust mite density, all of which may enhance allergic sensitization. Studies from this region have shown that individuals with allergic rhinitis frequently exhibit sensitization to house dust mites and mold spores (22). Moreover, humid and forested areas have been reported to have higher airborne fungal spore concentrations and greater plant and pollen diversity (23,24). Despite these distinctive ecological features and previous regional data, no population-based study has specifically evaluated the prevalence of asthma and allergic diseases, and their associated factors, in Giresun province using a standardized two-stage ECRHS approach.

Therefore, the present study aimed to determine the prevalence of asthma and allergic diseases in Giresun province and to evaluate their associations with geographic, demographic, and environmental factors using a two-stage population-based epidemiological design.

MATERIALS and METHODS

This study was conducted between March and November 2025 and was designed as a two-stage, population-based, cross-sectional epidemiological survey. The total study duration was 9 months, comprising a 3-month first stage and a 6-month second stage. The methodological framework and questionnaire structure were based on the recommendations of the European Community Respiratory Health Survey (ECRHS) (6). The study was approved by the Scientific Research Ethics Committee and conducted in accordance with the Declaration of Helsinki (decision number 19.02.2025/07). All participants who met the inclusion criteria provided written informed consent before enrollment.

The inclusion criteria were being aged 20-44 years, having sufficient cognitive capacity to understand and respond to the questionnaire, and providing written informed consent. Exclusion criteria included cognitive impairment that limited the ability to complete the questionnaire (e.g., delirium, dementia), acute or decompensated medical conditions that could interfere with survey participation (e.g., acute respiratory failure, uncontrolled cardiovascular disease), and pregnancy.

Design and Population

For the Giresun study population, which has a central district population of 143,890, it was planned to include 1,500 individuals (750 women and 750 men) in the first stage. This sample size was determined to ensure adequate representativeness and precision and to allow a 1:10 sampling ratio between the first- and second-stage surveys. Based on this planning, the margin of error was calculated to be 2.52% at a 95% confidence level, assuming a response rate of 50%.

The required sample size was calculated using a finite population correction formula based on a 95% confidence level (Z=1.96), an assumed prevalence of 50%, and a margin of error of 2.5%. The general formula used was:

$$n = \frac{N \cdot Z^2 \cdot r(1-r)}{(N-1)E^2 + Z^2 \cdot r(1-r)}.$$

In stage 1, in order to ensure the representativeness of the target population, participants aged 20-44 years residing in the central district of Giresun province were reached through family health centers (FHCs). Ten FHCs

were included, and 150 participants (75 women and 75 men) were randomly selected from each center, yielding the planned first-stage sample. The ECRHS Stage 1 questionnaire was translated into Turkish and administered to the participants to assess their symptom burden.

For Stage 2, a random subsample of approximately 10% of the first-stage population was selected, yielding 150 individuals (75 women and 75 men). This 1:10 sampling ratio was chosen in accordance with established ECRHS-based two-stage population studies and to balance logistical feasibility with sufficient statistical precision for prevalence estimation (11). The second-stage sample size was calculated to provide a 90% confidence level with a 5% margin of error. To minimize selection bias, participants were randomly selected using a sequence generated by Randomizer.org and contacted by telephone. In stage 2, participants completed the main ECRHS questionnaire, which includes detailed items on asthma and allergic disease diagnoses. In both stages, questionnaires were self-administered under the supervision of trained study staff.

Definitions of Outcomes

- Asthma (Current Asthma): Participants reporting physician-diagnosed asthma, an asthma attack within the past 12 months, or current use of asthma medication (inhalers, nebulizers, or tablets).
- Narrow Definition of Allergy: Participants reporting hay fever (allergic rhinitis) or eczema/atopic dermatitis.
- Broad Definition of Allergy: Participants reporting any allergic condition, including hay fever, eczema/atopic dermatitis, animal allergy, pollen allergy, insect allergy, or food allergy.

Primary, Secondary Outcomes, and Potential Biases

Primary outcomes: Current asthma prevalence, defined according to ECRHS criteria. Prevalence of narrow-definition and broad-definition allergic diseases in the second-stage random subsample.

Secondary outcomes: Associations between asthma/allergic disease and demographic factors (age, sex, smoking status, family history), environmental exposures (indoor humidity, mold, pets, heating/ventilation characteristics, occupational exposures), and early-life respiratory infections. Independent predictors of asthma and allergic diseases were identified using multivariable logistic regression models.

Bias control: Several strategies were implemented to minimize bias. Selection bias was reduced through random sampling within each family health center and random selection for the second stage using Randomizer.org. Information bias was minimized through the use of a validated instrument (ECRHS) and standardized administration procedures. Non-response bias was addressed by inflating the first-stage sample size based on an anticipated 50% response rate and by making repeated contact attempts during the second stage. Misclassification bias was limited by applying standardized, guideline-consistent definitions of asthma and allergic diseases. Potential confounding was addressed by collecting relevant demographic and environmental variables and incorporating them into multivariable models.

Statistical Analysis

Statistical analyses of sociodemographic variables and questionnaire-based outcomes were conducted using SPSS Statistics version 22.0 (IBM Corp., Armonk, NY, USA). Normality was assessed using the Kolmogorov-Smirnov test. Between-group comparisons were conducted using Student's t-test or the Mann-Whitney U test, as appropriate, while within-group comparisons were conducted using the paired t-test or the Wilcoxon test for within-group comparisons.

Multivariable logistic regression analyses were used to examine associations between asthma or allergic diseases and potential predictors. Participants with missing data were excluded from the studies using listwise deletion. A two-tailed p-value of <0.05 was considered statistically significant.

Prevalence estimates for asthma and allergic diseases were calculated from the second-stage random subsample ($n = 131$) drawn from the initial screening population ($n = 1322$). Because this subsample was randomly selected, crude prevalence estimates were considered unbiased estimators of population prevalence. Ninety-five percent confidence intervals (95% CI) were calculated using exact binomial (Clopper-Pearson) methods. Reporting followed STROBE guidelines (25).

RESULTS

A total of 1,322 participants were included in Stage 1, yielding a response rate of 88.1%. In Stage 2, 131 individuals were enrolled from the first-stage sample, corresponding to a response rate of 87.1%. Table I summarizes the demographic characteristics and the distribution of asthma- and allergy-related symptoms among the 1322 participants included in Stage 1. Wheezing in the past 12 months was reported by 24.9% of participants, and 14.0% reported shortness of breath accompanying wheezing. Chest tightness (13.7%), nocturnal dyspnea (6.5%), and nocturnal cough (21.2%) were also frequently reported. Allergic symptoms were common in the sample: 40.1% reported nasal or ocular symptoms, and 25.8% reported itchy dermatitis or eczema. A family history of allergic disease was present in 44.9% of participants. Sex-based comparisons revealed significant differences for several respiratory and allergic symptoms (see Table I).

Prevalence estimates derived from the second-stage random subsample (n = 131) are presented in Table II. The prevalence of current asthma was 14.5% (95% CI: 8.6-20.4). Narrow-definition allergic disease was observed in 57.3% of participants (95% CI: 48.8-65.7), while broad-definition allergic disease was present in 72.5% (95% CI: 64.9-80.2). Allergic diseases were more prevalent among females. Current or former smokers showed higher crude prevalence estimates for asthma; however, this association did not persist in multivariable analysis.

Environmental, familial, and early-life factors significantly associated with asthma and allergic outcomes in univariate analyses are summarized in Table III.

Table I: Demographic characteristics and distribution of asthma- and allergy-related symptoms among participants in the first-stage screening (n = 1322)

		Mean ± SD/ n (%)
Age, years		33.87 ± 9.31
Gender	**Female**	693 (52.5)
	Male	629 (47.5)

	Female Yes, n (%)	Male Yes, n (%)	Total Yes, n (%)
1. Wheezing in the past 12 months (Q1)	183 (26.4)	146 (23.2)	329 (24.9)
1.1. Dyspnea accompanying wheeze (Q1.1)	117 (16.8)	68 (10.8)	185 (14.0)
1.2. Wheeze without cold (Q1.2)	76 (10.9)	93 (14.8)	169 (12.8)
2. Nocturnal chest tightness (Q2)	105 (15.1)	76 (12.1)	181 (13.7)
3. Nocturnal dyspnea (Q3)	53 (7.6)	33 (5.2)	86 (6.5)
4. Nocturnal cough (Q4)	170 (24.5)	110 (17.5)	280 (21.2)
5. Asthma attack in past 12 months (Q5)	33 (4.7)	21 (3.3)	54 (4.1)
6. Lifetime asthma attack (Q6)	91 (12.6)	58 (9.2)	149 (11.3)
7. Current asthma treatment (Q7)	68 (9.8)	31 (4.9)	99 (7.5)
8. Allergic rhinitis symptoms (Q8)	323 (46.6)	207 (32.9)	530 (40.1)
9. Eczema or itchy dermatitis (Q9)	209 (30.1)	132 (21.0)	341 (25.8)
10.Family history of allergic disease (Q10)	357 (51.5)	237 (37.7)	594 (44.9)
Current asthma	Question 1, 1.1, 1.2, 2, 3, 4, 5, 7		
Cumulative asthma	Question 6		
Asthma-like symptoms	Question 1, 1.1, 1.2, 2, 3, 4		
Non-infectious rhinitis	Question 8		
Itching dermatitis and/or eczema	Question 9		
Family histories of atopy	Question 10		

*Chi-square test was applied for comparisons between sexes.
*Abbreviated item descriptions are shown; full question wording is provided in the ECRHS questionnaire.

Table II: Prevalence of asthma and allergic diseases in the study population (n = 131)

	Current asthma prevalence (n=19; 14.5%) (95% CI: 8.6-20.4)	Narrow allergy prevalence (n=75; 57.3%) (95% CI: 48.8-65.7)	Broad allergy prevalence (n=95; 72.5%) (95% CI: 64.9-80.2)
Female	12 (15)	52 (65)	63 (78.8)
Male	7 (13.7)	23 (45.1)	32 (62.7)
Current or former smoker	13 (68.4)	35 (46.7)	44 (46.3)
Family history of asthma (+)	5 (26.3)	19 (25.3)	22 (23.2)
Family history of allergic diseases (+)	9 (47.4)	39 (52.0)	46 (48.4)

Values are presented as n (% within each subgroup).

Table III: Significant bivariate associations between selected risk factors and asthma and allergic outcomes in the second-stage sample (n=131)

A. Current Asthma				
Risk factors	**Category**	**Asthma absent, n (%)**	**Asthma present, n (%)**	**p-value**
Father with asthma	No	96 (88.1)	13 (11.9)	0.032
	Yes	13 (81.3)	3 (18.8)	
	Unknown	3 (50.0)	3 (50.0)	
Shared a bedroom with older siblings before age 5	No	52 (92.9)	4 (7.1)	0.004
	Yes	58 (82.9)	12 (17.1)	
	Unknown	2 (40.0)	3 (60.0)	
Severe respiratory infection before age 5	No	89 (91.8)	8 (8.2)	0.001
	Yes	7 (58.3)	5 (41.7)	
	Unknown	16 (72.7)	6 (27.3)	
Chest tightness/wheezing at work	No	109 (91.6)	10 (8.4)	<0.001
	Yes	3 (25.0)	9 (75.0)	
Occupational exposure to dust, fumes, or gases	No	111 (86.7)	17 (13.3)	0.009
	Yes	1 (33.3)	2 (66.7)	
B. Allergic Outcomes (Narrow Allergy)				
Risk factors	**Category**	**Narrow allergy absent, n (%)**	**Narrow allergy present, n (%)**	**p-value**
Father with asthma	No	42 (53.8)	36 (46.2)	0.001
	Yes	8 (20.0)	32 (80.0)	
	Unknown	6 (46.2)	7 (53.8)	
Father with eczema, skin allergy, rhinitis, or hay fever	No	45 (50.0)	45 (50.0)	0.032
	Yes	6 (22.2)	21 (77.8)	
	Unknown	5 (35.7)	9 (64.3)	
C. Allergic Outcomes (Broad allergy)				
Risk factors	**Category**	**Narrow allergy absent, n (%)**	**Narrow allergy present, n (%)**	**p-value**
Mother with eczema, skin allergy, rhinitis, or hay fever	No	29 (37.2)	49 (62.8)	<0.001
	Yes	4 (10.0)	36 (90.0)	
	Unknown	3 (100.0)	0 (0.0)	
Father with eczema, skin allergy, rhinitis, or hay fever	No	32 (35.6)	58 (64.4)	0.004
	Yes	1 (3.7)	26 (96.3)	
	Unknown	3 (21.4)	11 (78.6)	

*Chi-Square Fisher's Exact

* "Unknown" responses were retained in analyses but interpreted with caution due to small cell sizes

Early childhood respiratory infections, shared-room exposure before the age of five, and occupational respiratory symptoms were significantly associated with current asthma. Parental allergic diseases were significantly associated with both narrow-definition and broad-definition allergic outcomes. Only statistically significant associations ($p < 0.05$) are presented to improve readability.

Environmental and allergenic exposures significantly associated with current asthma are shown in Supplementary Table SI. Significant correlates included animal-triggered and pollen-triggered respiratory symptoms. Supplementary Table SII presents factors associated with narrow-definition allergic disease, with significant associations observed for animal-triggered and pollen-triggered atopic symptoms. Supplementary Table SIII summarizes factors associated with broad-definition allergic disease, all of which were strongly related to allergen-triggered symptoms.

Results of the multivariable logistic regression analysis for current asthma are presented in Table IV. After adjustment for age, sex, family history of asthma and allergy, smoking status, narrow-definition allergic disease, childhood infection history, and environmental exposures, pollen-triggered respiratory symptoms emerged as the only independent predictor of current asthma (OR = 10.22, p = 0.009). Animal-triggered respiratory symptoms showed a borderline association with current asthma (OR = 0.22, p = 0.086). Other variables, including age, sex, family history, smoking status, and early childhood respiratory infection, were not independently associated with current asthma. The model explained 41.2% of the variance (Nagelkerke $R^2 = 0.412$) and correctly classified 89.3% of participants.

Table V presents the multivariable logistic regression model for narrow-definition allergic disease. Animal-triggered atopic symptoms were independently associated with increased odds of narrow-definition allergic disease (OR = 0.25, 95% CI: 0.08-0.79, p = 0.021). Pollen-triggered atopic symptoms were also independently associated with narrow-definition allergic disease (OR = 0.21, 95% CI: 0.08-0.53, p = 0.002). Other variables, including age, sex, dampness or mold exposure, smoking status, and allowing pets into the bedroom, were not independently associated with narrow-definition allergic disease. Family history of allergy showed a borderline association (OR = 0.40, 95% CI: 0.16-1.01, p = 0.052).

DISCUSSION

The large-scale symptom screening conducted in the first stage of this study (n = 1,322) revealed a substantial burden of wheeze and allergic symptoms in the community. In the second-stage diagnostic subsample (n = 131), the estimated population prevalence of current asthma was 14.5%, while the prevalence of allergic disease ranged from 57% to 72% depending on the definition used. The symptom frequencies observed in the first stage were consistent with those reported in ECRHS studies, including wheezing (20-30%), nocturnal cough, dyspnea, and chest tightness (6-20%), as well as with previous studies conducted in Türkiye (18-28%) (4,7,11,26). The wheezing prevalence of 24.9% observed in the present study, along

Table IV: Multivariable logistic regression analysis for predictors of current asthma

Predictor	B	SE	Wald	p-value	OR (Exp(B))	95% CI for OR
Sex (female)	-0.031	0.692	0.002	0.964	0.97	0.25 - 3.68
Age (years)	-0.001	0.033	0.002	0.967	0.99	0.93 - 1.06
Family history of asthma	-0.356	0.753	0.223	0.637	0.70	0.16 - 3.09
Family history of allergy	1.116	0.866	1.659	0.198	3.05	0.55 - 16.8
Narrow allergic disease	0.472	0.826	0.326	0.568	1.60	0.32 - 7.91
Animal-triggered respiratory symptoms	-1.527	0.890	2.942	0.086	0.22	0.04 - 1.23
Childhood severe respiratory infection	0.540	0.375	2.071	0.150	1.72	0.81 - 3.66
Ever smoker (≥1 year)	-0.547	0.732	0.560	0.454	0.58	0.14 - 2.37
Passive smoking (last 12 months)	-0.212	0.805	0.070	0.792	0.81	0.17 - 3.96
Pollen-triggered respiratory symptoms	**2.325**	**0.893**	**6.776**	**0.009**	**10.22**	**1.75 - 59.8**
Constant	-2.006	1.524	1.732	0.188	—	—

*OR < 1 indicates lower odds relative to the reference category.

Table V: Multivariable logistic regression analysis of factors associated with narrow-definition allergic disease (n = 131)

Predictor	B	SE	Wald	p-value	OR (Exp(B))	95% CI for OR
Sex (female)	0.359	0.454	0.626	0.429	1.43	0.59-3.47
Age	0.006	0.021	0.087	0.768	1.01	0.96-1.05
Family history of allergy	-0.908	0.467	3.786	**0.052**	0.40	0.16-1.01
Dampness/mold exposure	-0.390	0.445	0.767	0.381	0.68	0.28-1.63
Ever smoker	0.389	0.481	0.653	0.419	1.48	0.57-3.84
Animal-induced atopic symptoms	**-1.407**	0.611	**5.297**	**0.021**	**0.25**	**0.08-0.79**
Pollen-induced atopic symptoms	**-1.564**	0.494	**10.036**	**0.002**	**0.21**	**0.08-0.53**
Pet enters the bedroom	-0.921	0.620	2.203	0.138	0.40	0.12-1.39
Constant	3.133	1.110	7.970	0.005	22.94	—

*OR < 1 indicates lower odds relative to the reference category.

with its higher frequency among women, is in line with the existing literature. Similarly, the high prevalence of nocturnal respiratory symptoms further indicates that airway-related complaints are common in the general population. The proportion of participants reporting an asthma attack in the previous 12 months (4.1%) was comparable to global adult estimates of 3% to 7% (3,27,28). In contrast, the relatively high prevalence of lifetime asthma symptoms reported in the literature may be related to regional characteristics of the Black Sea area, where allergic burden is known to be higher, as well as to the high prevalence of rhinitis observed in this study (40.1%). It should also be noted that respiratory symptoms do not exclusively reflect asthma or allergic disease, as viral infections, smoking, and obesity may contribute to similar clinical presentations. The proportion of participants reporting regular asthma treatment use was relatively low (7.5%), consistent with previous reports from the general adult population in Turkey (5-10%), suggesting that regular treatment uptake remains limited despite frequent symptom reporting. The prevalence of allergic rhinitis symptoms in the present study (40.1%) exceeded those reported in ECRHS studies (20-30%) and previous Turkish data (25-35%) (7,26,29). This finding may be partly explained by the inclusion of lifetime symptom reporting and the use of a broad allergy definition. Seasonal factors may also have contributed, as data collection occurred predominantly during spring, summer, and autumn, when pollen exposure is highest in the Black Sea region. Similarly, the prevalence of eczema and pruritic dermatitis (25.8%) was higher than that reported in European studies (10-20%) and other Turkish cohorts (8-18%) (30,31). The inclusion of non-atopic pruritic conditions within the questionnaire framework may have contributed to this finding. The high prevalence of family history of allergic disease (44.9%) further supports the notion of an increased atopic burden in the region, potentially driven by shared environmental exposures.

The prevalence estimates obtained in the second stage of the study were higher than those previously reported in adult populations, with current asthma and allergic disease prevalences of 14.5%, 57.3%, and 72.5%, respectively. These findings are compatible with recent reports indicating increasing asthma prevalence in the Black Sea region, including studies demonstrating physician-diagnosed asthma rates of 10.5% among children and elevated asthma prevalence among occupationally exposed groups such as hairdressers (14,32). As most adult prevalence studies in Turkey were conducted more than a decade ago, current data reflecting recent environmental and lifestyle changes remain limited. In this context, the present findings provide updated regional evidence on the prevalence of adult asthma and allergic diseases. In addition to population-level prevalence data, studies based on the Turkish Adult Asthma Registry (TAAR) have provided valuable insights into adult asthma phenotypes and clinical characteristics in Turkey. TAAR data demonstrate a predominance of allergic and eosinophilic asthma phenotypes and highlight regional variations in disease severity and control among adults with asthma (e.g., prevalence of the allergic-eosinophilic phenotype) in a multicenter clinical registry. These findings support the relevance of atopic and environmental factors observed in our population-based results and reinforce the importance of integrating registry-based clinical evidence with epidemiological surveys (33,34).

In multivariable analyses, pollen-triggered respiratory symptoms emerged as the only independent predictor of current asthma, highlighting the predominance of atopic asthma phenotypes in this region. Similarly, in the narrow-definition allergy model, pollen- and animal-triggered symptoms were independently associated with allergic disease, while family history showed a borderline association. These findings suggest that environmental exposures, particularly pollen and animal contact, may play a central role in shaping patterns of allergic disease in the Black Sea region. Previous studies have likewise emphasized the influence of humidity, mold, pollen exposure, animal contact, and lifestyle-related environmental changes on the development of asthma and allergic diseases, supporting the consistency of the present results with existing literature.

A high prevalence of a family history of allergy was observed in both study stages, suggesting a combined effect of genetic susceptibility and shared environmental conditions. Early-life factors, including severe childhood respiratory infections and shared-room exposure, were associated with asthma, underscoring the potential contribution of early environmental exposures to later respiratory morbidity. In adulthood, the presence of work-related wheezing and associations with dust, smoke, and gas exposure further suggest that ongoing environmental exposures may exacerbate respiratory symptoms.

The strengths of this study include its two-stage population-based design, the use of standardized ECRHS questionnaires, a large screening sample, high response rates, and random selection of the second-stage subsample, all of which support the reliability of the prevalence estimates. Nevertheless, several limitations should be acknowledged. The relatively small sample size in the second stage and the absence of objective clinical assessments such as spirometry, serum IgE, or eosinophil measurements limit diagnostic precision. Additionally, individuals who participated in the second stage may have had a higher symptom burden, potentially inflating prevalence estimates. Although standardized ECRHS instruments were used, self-reported data are inherently subject to misclassification. Finally, restricting the study population to individuals aged 20-44 years may limit generalizability to other age groups; however, this approach reduces confounding from age-related comorbidities and facilitates more straightforward interpretation of asthma and allergy patterns.

CONCLUSION

The higher-than-expected prevalence of asthma and allergic symptoms in the region highlights the significant impact of environmental sensitivities, particularly pollen exposure. These findings underscore the importance of developing early diagnosis and regular monitoring practices among the local population. Given that current environmental conditions—including air pollution, climate change, and lifestyle transformations—are changing rapidly, it is necessary to continue conducting region-specific prevalence studies.

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Conflict of Interest

The authors have no conflicts of interest to declare.

Author Contributions

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Supplementary Table S1 presents environmental and allergenic exposures that were significantly associated with current asthma in the second-stage sample (n = 131).

Table SI: Significant environmental and allergenic factors associated with asthma (n = 131)

Risk factor	Category	No asthma n (%)	Asthma n (%)	p-value
Animal-triggered cough	No	104 (90.4)	11 (9.6)	**0.038**
	Yes	8 (50.0)	8 (50.0)	
Animal-triggered wheeze	No	106 (91.4)	10 (8.6)	**<0.001**
	Yes	6 (40.0)	9 (60.0)	
Animal-triggered chest tightness	No	110 (89.4)	13 (10.6)	**<0.001**
	Yes	2 (25.0)	9 (75.0)	
Animal-triggered dyspnea	No	108 (90.8)	11 (9.2)	**<0.001**
	Yes	4 (33.3)	8 (67.7)	
Pollen-triggered cough	No	103 (93.6)	7 (6.4)	**<0.001**
	Yes	9 (42.9)	12 (57.1)	
Pollen-triggered wheeze	No	107 (90.7)	11 (9.3)	**0.007**
	Yes	5 (38.5)	8 (61.5)	
Pollen-triggered chest tightness	No	110 (91.7)	10 (8.3)	**<0.001**
	Yes	2 (18.2)	9 (81.8)	
Pollen-triggered dyspnea	No	108 (92.3)	9 (7.7)	**<0.001**
	Yes	4 (26.8)	10 (71.4)	
Work-related chest tightness or wheeze	No	109 (91.6)	10 (8.4)	**<0.001**
	Yes	3 (25.0)	9 (75.0)	
Occupational exposure to dust, smoke, or gas	No	111 (86.7)	17 (13.3)	**0.009**
	Yes	1 (33.3)	2 (66.7)	

*Chi-square or Fisher's exact test, as appropriate.

Supplementary Table S2 presents environmental and allergenic factors that were significantly associated with narrow-definition allergic disease in the second-stage sample (n = 131).

Table SII: Significant environmental and allergenic factors associated with allergic disease (Narrow definition)

Risk factor	Category	No allergy n (%)	Allergy n (%)	p-value
Animal-triggered cough	No	53 (46.1)	62 (53.9)	**0.033**
	Yes	3 (18.8)	13 (81.3)	
Animal-triggered wheeze	No	54 (46.6)	62 (53.4)	**0.014**
	Yes	2 (13.3)	13 (86.7)	
Animal-triggered nasal symptoms	No	51 (55.4)	41 (44.6)	**<0.001**
	Yes	5 (12.8)	34 (87.2)	
Animal-triggered eye symptoms	No	55 (51.9)	51 (48.1)	**<0.001**
	Yes	1 (4.0)	24 (96.0)	
Pollen-triggered cough	No	52 (47.3)	58 (52.7)	**0.017**
	Yes	4 (19.0)	17 (81.0)	
Pollen-triggered wheeze	No	55 (46.6)	63 (53.4)	**0.007**
	Yes	1 (7.7)	12 (92.3)	
Pollen-triggered nasal symptoms	No	47 (63.5)	27 (36.5)	**<0.001**
	Yes	9 (15.8)	48 (84.2)	
Pollen-triggered eye symptoms	No	51 (56.6)	39 (43.4)	**<0.001**
	Yes	5 (12.2)	36 (87.8)	
Pet entering the bedroom	No	50 (49.0)	52 (51.0)	**0.007**
	Yes	6 (20.7)	23 (79.3)	

*Chi-square or Fisher's exact test, as appropriate.

Supplementary Table S3 presents factors that were significantly associated with broad-definition allergic disease in the second-stage sample (n = 131).

Table SIII: Significant factors associated with broad allergy (Expanded definition)

Risk factor	Category	No broad allergy n (%)	Broad allergy n (%)	p-value
Animal-triggered cough	No	36 (31.3)	79 (68.7)	**0.009**
	Yes	0 (0.0)	16 (100.0)	
Animal-triggered wheeze	No	36 (31.3)	79 (68.7)	**0.011**
	Yes	0 (0.0)	16 (100.0)	
Animal-triggered dyspnea	No	36 (30.3)	83 (69.7)	**0.036**
	Yes	0 (0.0)	12 (100.0)	
Animal-triggered nasal symptoms	No	36 (39.1)	56 (60.9)	**<0.001**
	Yes	0 (0.0)	39 (100.0)	
Animal-triggered eye symptoms	No	36 (34.0)	70 (66.0)	**0.001**
	Yes	0 (0.0)	25 (100.0)	
Pollen-triggered cough	No	36 (32.7)	74 (67.3)	**0.001**
	Yes	0 (0.0)	21 (100.0)	
Pollen-triggered wheeze	No	36 (30.5)	82 (69.5)	**0.019**
	Yes	0 (0.0)	13 (100.0)	
Pollen-triggered dyspnea	No	36 (30.8)	81 (69.2)	**0.011**
	Yes	0 (0.0)	14 (100.0)	
Pollen-triggered nasal symptoms	No	36 (48.6)	38 (51.4)	<0.001
	Yes	0 (0.0)	57 (100)	

*Chi-square or Fisher's exact test, as appropriate.
*Cells with 100% prevalence reflect small subgroup sizes and should be interpreted with caution.