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Evaluation of Extrinsic Asthma Severity Using Clinical Indicators, Environmental Exposures, and Lung Function Measures in Pakistan

Article History:

Name of Author:
Dr. Zoha Rehman[1], Dr. Muhammad Huzaifa[2], Hamna Nasir[3], Dr. Aneeqa Ahmad Ali[4], Dr. Sabeela Zubair[5], Dr. Fatima Noor[6], Ansharah Mudassar[7], Hamna Khalid[8] , Pramisha Adhikari[9]

Affiliation: *[1]H.O. at P.O.F Hospital, Wah Cantt, Pakistan*
zohar7150@gmail.com *ORCID: 0009-0001-3317-5662*
[2]H.O. at P.O.F Hospital, Wah Cantt, Pakistan
mh728767@gmail.com *ORCID: 0009-0008-5084-7839*
[3]MBBS Student at Wah Medical College, Wah Cantt, Pakistan
hamnanasir445@gmail.com *ORCID:0009-0000-2957-1358*
[4]H.O. at P.O.F Hospital, Wah Cantt, Pakistan
aneeqaahmad2003@gmail.com *ORCID:0009-0003-1019-3555*
[5]H.O. at P.O.F Hospital, Wah Cantt, Pakistan
zubairsabeela@gmail.com *ORCID:0009-0000-5721-3216*
[6]H.O. at P.O.F Hospital, Wah Cantt, Pakistan
fatimanoore.021@gmail.com *ORCID:0009-0002-5537-7668*
[7]MBBS Student at Wah Medical College, Wah Cantt, Pakistan
ansharah184@gmail.com *ORCID: 0009-0002-1717-0113*
[8]MBBS Student at Wah Medical College, Wah Cantt, Pakistan
hamnakhalid2412@gmail.com *ORCID:0009-0005-5414-1356*
[9]Bachelors in Public Health(BPH) from Purbanchal University, Nepal
pramishaadhikari087@gmail.com *ORCID number:0009-0005-5058-9372*

Corresponding Author:
Hamna Khalid

Abstract:
***Introduction**:* Asthma is a persistent inflammatory airway disease with variable severity depending on the clinical, environmental, and genetic factors. Limited healthcare access and poor air quality in low- and middle-income countries (LMICs) serve to contribute to poor asthma control. Nonetheless, there is a paucity of integrated evidence between symptoms, spirometry and the environmental exposures in relationship to extrinsic asthma among adults in Pakistan. *Objectives*: To determine the association of clinical characteristics, lung function, and environmental factors with asthma severity with extrinsic asthma in Pakistan. *Materials and Methods*: The retrospective cross-sectional study was carried out at Pulmonology outpatient between January and June, 2025 at a tertiary care hospital in Pakistan. A convenience sampling method was used to enroll 580 patients with extrinsic asthma. Validated questionnaires were used to collect the data on demographics, symptoms, lifestyle, and environmental exposures (GAN, GINA 2024-2025, IPAQ, WHO STEPS). Spirometry was done as per ATS/ERS 2019. GINA was used to categorize the severity of asthma. Associations were analyzed using chi-square tests, and multivariable multinomial logistic regression was performed to identify independent predictors of asthma severity. A p-value <0.05 was considered statistically significant *Results*: Participants were distributed across age groups as follows: 5–18 years (20.3%), 19–40 years (33.4%), 41–60 years (29.8%), and >60 years (16.4%). Among the participants, 58.6% having partially controlled and 17.9% uncontrolled asthma. Increasing asthma severity was associated with worsening respiratory symptoms and reduced lung function ($p < 0.001$). Multivariable analysis identified high pollution exposure (aOR = 29.75, 95% CI: 13.91–63.63, $p < 0.001$), pollen exposure (aOR = 1.62, 95% CI: 1.25–2.12, $p < 0.001$), family history of asthma (aOR = 34.58, 95% CI: 16.33–73.22, $p < 0.001$), and smoking status (aOR = 0.68, 95% CI: 0.52–0.89, $p < 0.001$) as significant independent predictors of asthma severity. *Conclusion*: Symptom burden, lung function, and exposure to the environment factors particularly air pollution that strongly associate with asthma severity in this LMIC population. There is a need to address the issue of environmental pollution and the clinical management of asthma based on guidelines to enhance asthma outcomes.

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INTRODUCTION

Asthma is a persistent inflammatory disorder of the airways which is marked by unstable respiratory signs including wheezing, dyspnea, chest tightness, and cough and intermittent expiratory airflow limitation.[1] The most prevalent phenotype is extrinsic (allergic) asthma, which is activated by IgE-mediated hypersensitivity to the environmental allergens such as dust mites, pollens, molds and animal dander. The pathophysiology is associated with T helper 2 (Th2) activation, eosinophilia, mast cell activation, mucous secretion, and bronchial hyperresponsiveness, and they are frequently accompanied by atopic manifestations, eczema and allergic rhinitis.[2] These immunological and structural airway changes contribute to variable symptom severity and airway obstruction, underscoring the need for detailed assessment of both clinical and biological characteristics.[1,2]

The World Health Organization estimates that 262 million people are affected by asthma and more than 455,000 die of it in 2019.[3] The number of burdened people is disproportionate in low- and middle-income countries (LMICs), where the provision of diagnostic care, guideline-based care, and environmental protection is still sparse.[4] South Asia bears a substantial burden of this disease, Pakistan has an estimated prevalence of asthma of about 4.3%, India has nearly 35 million cases of the disease with a high rate of underdiagnosis and Afghanistan has a high prevalence of symptoms in regional surveys with limited national data.[5] Such statistics point to the widespread and growing respiratory health challenges in the region, especially in rapidly urbanizing environments with high pollution levels.[6]
Specifically, Global Initiative on Asthma (GINA) suggests that asthma diagnosis is based on presence of a compatible clinical history and objective evidence of varying airflow limitation, which is usually indicated by spirometry.[7] The important measurements are the forced expiratory volume in one second (FEV_1) forced vital capacity (FVC) and the ratio of FEV_1/FVC which in turn shows that there is an obstruction of airflow. GINA also emphasizes on symptom control and exacerbation risk evaluation, as well as, response to treatment as another measure of the asthma. Lungs function tests thus, has remained a fundamental component in assessing the disease severity, the progression, and finding people with persistent and severe obstruction, who might need more intensive management.[7,8]

The ultimate determinants of asthma severity are environmental exposures which are very critical especially in LMICs. Exacerbations, symptom persistence, and lung function decline have been linked strongly with outdoor air pollution, industry emissions and vehicle exhausts. Airway inflammation is further exacerbated by indoor exposures like tobacco smoke, the use of biomass fuels, household dust and workplace irritants.[9] Physical inactivity, unhealthy eating patterns, and a score approaching high allergen burden have lifestyle factors that are synergistically coupled with biological susceptibility, and aggravated as an outcome.[10,11] The most significant external factors contributing to these hazards in Pakistan and surrounding nations are the rapid urbanization, poor air quality, and little regulation of health to the populace, making environmental assessment essential for understanding asthma patterns in local populations.[12]

Although the burden of asthma is known in South Asia, more recent literature indicates that there are still gaps in the field of asthma and particularly in terms of extrinsic asthma phenotype, thorough environmental evaluation, and the combination of the lung functions with clinical characteristics. No previous research in Pakistan, to the best of our knowledge, has concomitantly combined spirometrically verified airflow limitations alongside indices of environmental exposure with lifestyle factors to measure extrinsic asthma severity wholesome.[13] These gaps are filled in this retrospective cohort study that assessed extrinsic asthma severity through clinical features, environmental exposures, and lung features across a Pakistani population, which has been shown to confirm the possibility that enhances diagnosis, specific interventions, and context-specific public health interventions in LMIC settings. This study is among the first in Pakistan to integrate clinical indicators, spirometric lung function, and quantified environmental exposures into a unified model for evaluating extrinsic asthma severity.

METHODS

Study Design and Setting

This retrospective cross-sectional study was conducted between Jan 2025 to June 2025 at Pulmonology Outpatient Department of POF Hospital, Wah Cantt, a tertiary-care hospital with a mixed urban and peri-urban community. Ethical approval was given by the Institutional Review Board of POF Hospital (ERC/IRB no. 0946).

Sampling Technique and Participant Flow

A convenience sampling technique was used. All consecutive patients aged 5–80 years presenting to the OPD during the study period were screened (n=680). A total of 100 individuals were excluded due to intrinsic asthma (n=50), acute respiratory infection (n=12), COPD (n=30), or incomplete evaluations (n=8). The remaining 580 patients who met inclusion criteria were enrolled and represented the final analytical sample. Included participants were all diagnosed with extrinsic (allergic) asthma according to symptoms, atopy and objective evidence of variable airflow limitation. Of them, 136 (23.4%), 340 (58.6%), and 104 (17.9) of them were classified as well controlled, partially controlled, and uncontrolled as defined by GINA 2024-2025 as shown in figure 1

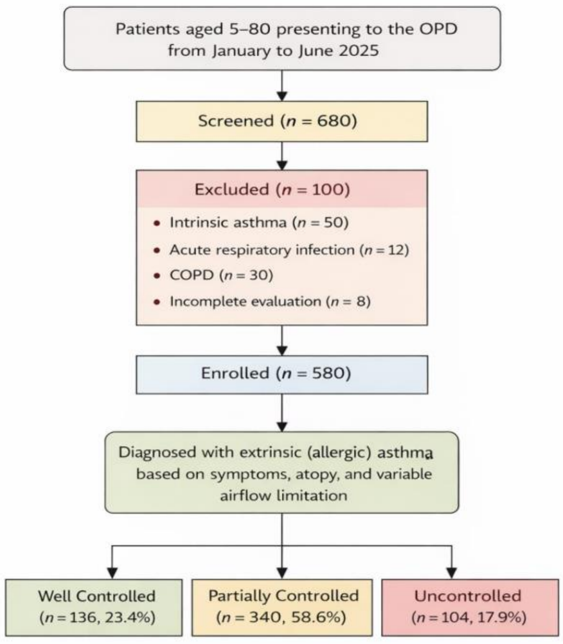

Figure 1. Participant screening, exclusions, an final classification of asthma severity

Study Population

Inclusion criteria were:

- Age ≥5 years
- Diagnosis of extrinsic asthma
- Complete demographic, allergy, exposure, lifestyle, and spirometric data
- Acceptable spirometry per ATS/ERS 2019 standards

Exclusion criteria included intrinsic (non-allergic) asthma, COPD, bronchiectasis, interstitial lung disease, acute respiratory infection or incomplete assessments

Data Collection Procedures

Data were collected using a structured, interviewer-administered questionnaire integrating validated components from:

- Global Asthma Network (GAN) Adult Questionnaire (allergen exposures, atopy history, environmental triggers, symptom provocation)[14]
- GINA 2024–2025 symptom and control assessment framework (symptom burden, nocturnal symptoms, activity limitation, reliever use)[1]
- International Physical Activity Questionnaire – Short Form (IPAQ-SF) (weekly physical activity levels)[16]
- WHO STEPwise NCD Surveillance (STEPS) modules (demographics, smoking, diet, BMI)[17]

The questionnaire underwent forward translation, cultural adaptation, and back-translation into Urdu. A pilot test among 30 individuals demonstrated good reliability (Cronbach α = 0.72–0.88).

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Variables collected included

- Allergen/Atopy: dust exposure, pollen seasons, pets, mold, dampness, eczema, allergic rhinitis, childhood allergy, and family atopy
- Environmental exposures: household and ambient pollution using the validated GAN 0–10 visual analogue scale, passive smoke exposure
- Lifestyle factors: smoking, BMI (WHO cutoffs), diet quality, sleep patterns, physical activity (IPAQ scoring)
- Symptom data: wheezing, dyspnea, cough, nocturnal awakenings, chest tightness, and exercise-induced bronchoconstriction

Anthropometric measurements (height, weight) followed WHO STEPS protocols

Clinical Assessment and Diagnostic Criteria
Asthma diagnosis followed GINA 2024–2025 criteria requiring both typical symptoms[8,14,15] and objective variability in airflow limitation demonstrated by any of the following:

- ≥12% and ≥200 mL improvement in FEV_1 after bronchodilator
- % diurnal peak expiratory flow variability
- Positive bronchial challenge test

Extrinsic (allergic) asthma was defined by atopy (eczema, allergic rhinitis, childhood allergy, or family history of allergy) and symptom exacerbation following exposure to allergens such as dust, pollen, pets, or mold

Asthma Severity Classification
Asthma severity[8,14] was categorized according to GINA 2024–2025 control-based criteria:

- Well Controlled
- Partially Controlled
- Uncontrolled

Classification was based on symptom frequency, nighttime symptoms, activity limitation, reliever use, and spirometric airflow obstruction.

Spirometry Procedures and Quality Assurance
Spirometry was performed using a portable ultrasonic spirometer following ATS/ERS 2019 technical standards. At least three acceptable maneuvers were recorded with reproducibility ≤150 mL. Daily calibration was performed using a 3-L syringe. Flow–volume loops were inspected for errors, and 10% of curves underwent blinded pulmonologist review. FEV_1/FVC ratios were categorized as

- Normal: ≥80%
- Mild obstruction: 70–79%
- Moderate obstruction: 60–69%
- Severe obstruction: <60%

Operational Definitions

- Extrinsic asthma: Allergic asthma with atopy or allergen-triggered symptoms
- Atopy: History of eczema, allergic rhinitis/hay fever, or physician-diagnosed childhood allergy
- High allergen exposure: Frequent symptom-provoking exposure to dust, pollen, pets, or mold
- High pollution exposure: Score ≥7 on the GAN visual analogue scale^4
- Obesity: BMI ≥30 kg/m² (WHO)
- Smoking exposure: Active smoking or ≥30 minutes/day secondhand exposure
- Adequate physical activity: ≥150 minutes/week
- The body mass index (BMI) was determined as the ratio of weight (kg) to height (m ^{2}). In the case of participants with an age of 18 years and above, BMI categories were established based on the adult cut-off values of the World Health Organization (WHO) as underweight (<18.5 kg/m^2), normal weight (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2) and obese (30.0-29.9 kg/m^2). Among children with ages ranging between 5 and 17 years, age-based and sex-specific percentile curves of their BMI were used and underweight was defined as BMI-for-age <5th percentile, normal weight as 5th–85th percentile, overweight as 85th–95th percentile, and obesity as ≥95th percentile.[34]

Statistical Analysis

The statistical analysis was done through SPSS version 28.0 (IBM Corp) and R version 4.3. The continuous variables were determined to be normal and summarized as a result of means and standard deviations. Categorical variables were used in the form of frequencies and percentages. The chi-square tests were used to determine the association between asthma severity categories with clinical, environmental and lifestyle variables. All the analyses assumed to have a p value <0.05 to be statistically significant. BMI was measured as a categorical variable and also as a continuous variable. Chi-square test was used to determine the association between BMI categories and asthma severity whereas Spearman correlation was used to determine the relationship between continuous values of BMI and asthma severity. Multivariable multinomial logistic regression analysis was performed to identify independent predictors of asthma severity while adjusting for potential confounding variables. Adjusted odds ratios (aORs) with 95% confidence intervals (CIs) were calculated, and a p-value <0.05 was considered statistically significant

Ethical Considerations

Ethical approval was given by the Institutional Review Board of POF Hospital (ERC/IRB no. 0946). Anonymity of all personal identifiers was taken seriously to ensure that the privacy of participants was breached, and data were kept in a secure place under limited access. The research was carried out in compliance with ideals of ethics embedded in the Declaration of Helsinki, and protocols of research with the use of human subjects.

RESULTS

Table 1 presents an overview of baseline features of 580 adults with extrinsic asthma, demonstrating representation across all age groups 5–18 years 118 (20.3%), 19–40 years 194 (33.4%), 41–60 years 173 (29.8%), and >60 years 95 (16.4%) with an almost equal distribution in terms of males and females. The participants generally had high-school education, who showed moderate to high physical activity, had a high-exposure to dust, pollen, and pollution along with frequent atopy (eczema, allergies, GERD). The lung function patterns were normal in 192 (33.1%) however mild-severe obstruction was observed with a majority of the patients having patterns that were partially-controlled, well-controlled and uncontrolled asthma

Table 1. Baseline Characteristics of Study Participants (N = 580)

Variable Group	Characteristic	Category / Value	n (%)
Demographics	Age	5–18 years	118 (20.3%)
		19–40 years	194 (33.4%)
		41–60 years	173 (29.8%)
		>60 years	95 (16.4%)
	Gender	Male	302 (52.1%)
		Female	278 (47.9%)
	Education Level	Uneducated	105 (18.1%)
		High School	229 (39.5%)
		Bachelors	191 (32.9%)
		Higher Education	55 (9.5%)
Lifestyle Factors	BMI Category	Underweight	345 (59.5%)
		Normal	117 (20.2%)
		Overweight	63 (10.9%)
		Obese	55 (9.5%)
	Smoking Status	Yes	81 (14.0%)
		No	499 (86.0%)
	Physical Activity	Low	152 (26.2%)
		Moderate	185 (31.9%)
		High	243 (41.9%)
	Diet Quality	Poor	169 (29.1%)
		Moderate	166 (28.6%)
		Good	245 (42.2%)
	Sleep Quality	Poor	97 (16.7%)
		Moderate	180 (31.0%)
		Good	303 (52.2%)
Environmental Factors	Dust Exposure	None	129 (22.2%)
		Occasional	188 (32.4%)
		Frequent	263 (45.3%)
	Pollen Exposure	None	130 (22.4%)
		Occasional/ Seasonal	190 (32.8%)
		Frequent	260 (44.8%)
	Pollution Exposure	Occasional	231 (39.8%)
		Frequent	349 (60.2%)
	Pet Allergy	No	481 (82.9%)
		Yes	99 (17.1%)
Comorbidities / Clinical History	Family History of Asthma	Yes	283 (48.8%)
		No	297 (51.2%)
	History of Allergies	No	362 (62.4%)
		Yes	218 (37.6%)
	Eczema	Yes	455 (78.4%)
		No	125 (21.6%)
	Hay Fever	No	436 (75.2%)
		Yes	144 (24.8%)
	Gastroesophageal Reflux (GERD)	No	473 (81.6%)
		Yes	107 (18.4%)

Lung Function Measures	FVC (L)	Mean ± SD	3.68 ± 1.29
	FEV_1 (L)	Mean ± SD	2.55 ± 0.87
	FEV1/ FVC (%)	>80% (Normal)	192 (33.1%)
		70-79% (Mild)	145 (25%)
		60-69%(Moderate)	133 (22.9%)
		<60% (Severe)	110 (19%)
Asthma Severity Classification	Asthma Severity	Well Controlled	136 (23.4%)
		Partially Controlled	340 (58.6%)
		Uncontrolled	104 (17.9%)

Note: BMI, Body Mass Index; GERD, Gastroesophageal Reflux Disease; FEV_1, Forced Expiratory Volume in one second; FVC, Forced Vital Capacity; SD, Standard Deviation

Table 2 indicates that the respiratory symptoms are clearly increasing as asthma control worsens. Symptoms of wheezing, dyspnea, chest tightness, cough, nocturnal symptoms, and symptoms that occurred upon exercise was significantly more common in partially controlled and uncontrolled patients than those who had well-controlled cases. Lung function decreased between the severity categories and normal FEV1/FVC values were more prevalent in the well-controlled asthma. Severe airflow obstruction on the contrary was mostly evident in patients with asthma that was not controlled.

Table 2: Clinical Characteristics And Lung Function Tests Across Asthma Severity Levels (N = 580)

Clinical Characteristic	Category	Well Controlled (n=136)	Partially Controlled (n=340)	Uncontrolled (n=104)
Wheezing	Yes	42 (30.9%)	208 (61.2%)	94 (90.4%)
	No	94 (69.1%)	132 (38.8%)	10 (9.6%)
Shortness of Breath	Yes	32 (23.5%)	180 (52.9%)	85 (81.7%)
	No	104 (76.5%)	160 (47.1%)	19 (18.3%)
Chest Tightness	Yes	28 (20.6%)	177 (52.1%)	85 (81.7%)
	No	108 (79.4%)	163 (47.9%)	19 (18.3%)
Coughing	Yes	36 (26.5%)	195 (57.4%)	86 (82.7%)
	No	100 (73.5%)	145 (42.6%)	18 (17.3%)
Night-Time Symptoms	Yes	43 (31.6%)	213 (62.6%)	87 (83.7%)
	No	93 (68.4%)	127 (37.4%)	17 (16.3%)
Exercise-Induced Symptoms	Yes	43 (31.6%)	218 (64.1%)	88 (84.6%)
	No	93 (68.4%)	122 (35.9%)	16 (15.4%)
FEV1/FVC Ratio	Normal (>80%)	56 (41.2%)	132 (38.8%)	4 (3.8%)
	Mild (70–79%)	47 (34.6%)	98 (28.8%)	0 (0%)
	Moderate (60–69%)	28 (20.6%)	105 (30.9%)	0 (0%)
	Severe (<60%)	5 (3.7%)	5 (1.5%)	100 (96.2%)

Note: FEV_1, Forced Expiratory Volume in one second; FVC, Forced Vital Capacity.

Table 3 indicates that the most of the demographic, lifestyle, and environmental variables, such as smoking ($p<0.001$), pollution exposure ($p<0.001$), pollen exposure ($p<0.001$), and family history of asthma ($p<0.001$) are statistically significant. However, there is no statistically significant association of asthma severity with age ($p=0.842$), gender ($p= 0.535$), BMI ($p=0.567$), diet quality ($p=0.211$), physical activity ($p= 0.182$), eczema ($p=0.621$), hay fever ($p=0.889$) and (GERD $p=0.866$). The air pollution exposure is also a strong gradient of controlled and uncontrolled asthma and family history of asthma who had significant associations with the severity ($p < 0.001$). The BMI categories were evaluated across asthma severity groups but no statistically significant relationship was found ($p = 0.567$). Moreover, Spearman correlation analysis indicated no significant correlation between continuous BMI values and the severity of asthma ($\rho = 0.040$, $p = 0.335$).

Table 3: Association of Demographic, Clinical Comorbidities, Lifestyle and Environmental Factors With Asthma Severity (N = 580)

Variable Group	Variable	Variable Category	Well Controlled (n=136)	Partially Controlled (n=340)	Uncontrolled (n=104)	p-value
Demographic Factors	Age	5–18 years	28 (20.6%)	72 (21.2%)	18 (17.3%)	0.842
		19–40 years	44 (32.4%)	116 (34.1%)	34 (32.7%)	
		41–60 years	40 (29.4%)	102 (30.0%)	31 (29.8%)	
		>60 years	24 (17.6%)	50 (14.7%)	21 (20.2%)	
	Gender	Male	72 (52.9%)	181 (53.2%)	49 (47.1%)	0.535
		Female	64 (47.51%)	159 (46.8%)	55 (52.9%)	
Lifestyle Factors	BMI	Underweight	87 (64.0%)	197 (57.9%)	61 (58.7%)	0.567
		Normal	28 (20.6%)	67 (19.7%)	22 (21.2%)	
		Overweight	10 (7.4%)	39 (11.5%)	14 (13.5%)	
		Obese	11 (8.1%)	37 (10.9%)	7 (6.7%)	
	Smoking	Yes	22 (16.2%)	45 (13.2%)	14 (13.5%)	<0.001
		No	114 (83.8%)	295 (86.8%)	90 (86.5%)	
	Sleep Quality	Poor	18 (13.2%)	63 (18.5%)	16 (15.4%)	0.330
		Moderate	37 (27.2%)	109 (32.1%)	34 (32.7%)	
		Good	81 (59.6%)	168 (49.4%)	54 (51.9%)	
	Diet Quality	Poor	38 (27.9%)	95 (27.9%)	36 (34.6%)	0.211
		Moderate	40 (29.4%)	106 (31.2%)	20 (19.2%)	
		Good	58 (42.6%)	139 (40.9%)	48 (46.2%)	
	Physical Activity	Low	32 (23.5%)	91 (26.8%)	29 (27.9%)	0.182
		Moderate	50 (36.8%)	96 (28.2%)	39 (37.5%)	
		High	54 (39.7%)	153 (45.0%)	36 (34.6%)	
Environmental Factors	Pollution Exposure	Low Exposure	93 (68.4%)	122 (35.9%)	16 (15.4%)	<0.001
		High Exposure	43 (31.6%)	218 (64.1%)	88 (84.6%)	
	Pollen Exposure	None	26 (19.1%)	78 (22.9%)	26 (25.0%)	<0.001
		Seasonal	57 (41.9%)	102 (30.0%)	31 (29.8%)	
		Frequent	53 (39.0%)	160 (47.1%)	47 (45.2%)	
	Dust Exposure	None	33 (24.3%)	72 (21.2%)	24 (23.1%)	<0.001
		Occasional	46 (33.8%)	111 (32.6%)	31 (29.8%)	
		Frequent	57 (41.9%)	157 (46.2%)	49 (47.1%)	
	Pet Allergy	No	110 (80.9%)	284 (83.5%)	87 (83.7%)	<0.001
		Yes	26 (19.1%)	56 (16.5%)	17 (16.3%)	
Comorbidities / Clinical History	Family History of Asthma	Yes	104 (76.5%)	160 (47.1%)	19 (18.3%)	<0.001
		No	32 (23.5%)	180 (52.9%)	85 (81.7%)	
	Eczema	Yes	103 (75.7%)	268 (78.8%)	84 (80.8%)	0.621
		No	33 (24.3%)	72 (21.2%)	20 (19.2%)	
	History of Allergies	No	82 (60.3%)	217 (63.8%)	63 (60.6%)	<0.001
		Yes	54 (39.7%)	123 (36.2%)	41 (39.4%)	
	Hay Fever	No	101 (74.3%)	255 (75.0%)	80 (76.9%)	0.889
		Yes	35 (25.7%)	85 (25.0%)	24 (23.1%)	
	GERD	No	113 (83.1%)	276 (81.2%)	84 (80.8%)	0.866
		Yes	23 (16.9%)	64 (18.8%)	20 (19.2%)	

Note: BMI, Body Mass Index; GERD, Gastroesophageal Reflux Disease.

Multivariable multinomial logistic regression analysis was used to identify factors related to asthma severity in table 4. Moderate physical activity was significantly associated to a reduced chance of severe asthma (aOR = 0.50, 95% CI: 0.28–0.91, $p = 0.022$), but moderate diet quality increased the odds (aOR = 2.15, 95% CI: 1.14–4.09, $p = 0.019$). Pollution exposure (aOR = 29.75, 95% CI: 13.91–63.63, $p < 0.001$). was strongly associated to asthma severity There was no significant associations between asthma severity and other variables, such as age, gender and GERD. In general, familial and environmental factors were significant in determining the severity of asthma in this cohort.

Table 4:Multivariable Multinomial Logistic Regression Analysis of Factors Associated With Asthma Severity (N = 580)

Variable	Adjusted OR (aOR)	95% Confidence Interval	p-value
Age Group (>60 vs ≤40 years)	1.18	0.84 – 1.66	0.331
Gender (Male vs Female)	0.90	0.478 – 1.70	0.746
Smoking Status (No vs Yes)	0.68	0.52 – 0.89	<0.001
Physical Activity (Moderate vs High)	0.50	0.28 – 0.91	0.022
Sleep Quality (Moderate vs Good)	0.53	0.25 – 1.09	0.084
Diet Quality (Moderate vs Good)	2.15	1.14 – 4.09	0.019
Pollution Exposure (Low vs High)	29.75	13.91 – 63.63	<0.001
Pollen Exposure	1.62	1.25 – 2.12	<0.001
Dust Exposure	1.34	0.64 – 2.79	0.424
Pet Allergy	0.74	0.32 – 1.68	0.481
Family History of Asthma (No vs Yes)	34.58	16.33 – 73.22	<0.001
History of Allergies	0.94	0.49 – 1.81	0.874
Gastroesophageal Reflux (GERD)	1.73	0.75 – 3.95	0.192

Note: aOR, Adjusted Odds Ratio; CI, Confidence Interval; GERD, Gastroesophageal Reflux Disease

DISCUSSION

This study presents a clear assessment of clinical characteristics, patterns of lung function test, and environmental factors of the severity of asthma on patients living with extrinsic asthma in the context of a low- and middle-income country (LMIC). The results show that there is a great burden of partially controlled and uncontrolled asthma, where the frequency of symptoms and airflow limitation is clearly associated with the worsening of disease severity.18,19 Critically, as per the new regional evidence, several environmental and clinical factors, including exposure to the ambient air pollution, pollen, dust exposure, smoking status, history of allergies, pet allergy, and family history of asthma, were significantly associated with the asthma severity and the lung functional impairment indicating their overwhelming contribution in asthma outcomes among this group of people.20 The presence of partially controlled and uncontrolled asthma (58.6%), as it was in this cohort, is similar to findings in South Asia and other LMICs, where both studies have reported poor asthma control in over half of patients based on clinical follow-up.21 This trend has been explained by previous Pakistani and Indian studies that as a result of delayed diagnosis, inconsistent use of inhaled corticosteroids, inadequate symptom perception, and continued exposure to environmental triggers.22 Superiority in similar control distributions has also been indicated by multicenter analysis of the Global Asthma Network which further confirms that poor management of asthma is widespread challenge in settings with limited resources.23

Consistent with previous studies, the results of this research illustrate that there is a high and progressive burden amid clinical symptoms and asthma severity. Previous trials in Asia and Middle East have found that wheezing, dyspnea, nocturnal symptoms, and bronchoconstriction during exercise progressively become higher with poorly controlled asthma, which has shown the suitability of symptoms-classification of GINA.24 Our evidence builds on this evidence by demonstrating that not only is subjectively increased symptom burden supported, but also that spirometric impairment supports this evidence objectively. Decline in lung function was also present with asthma severity and almost all uncontrolled patients with asthma had severe airflow obstruction (FEV1/FVC <60%). The given observation is consistent with other cohort studies that have shown the low FEV1 and FEV1/FVC ratios to be strong predictors of inadequate asthma control, recurrent exacerbations, and chronic disease progression.24,25 Asthma populations in the context of adult respiratory disease have shown similar spirometric patterns in India, Bangladesh, and urban China, in which structural remodelling and sustained airways inflammation are prevalent in the poorly controlled disease.26

In this study, self-reported exposure to the environment has been measured, but current regional evidence indicates the existence of high levels of air pollution in Pakistan. According to recent air quality reports, Pakistan still appears to be amongst the most polluted nations in the world with concentrations of PM2.5 reported as many as 13 times above the recommended safe levels set by the World Health

Organization (WHO). 27 Researches done in the Punjab has recorded a large level of correlation between air quality indices and asthma exacerbation especially within the urban and peri-urban populations. This evidence is aligned with our findings and proving that there is evident exposure-response gradient, which supports the causal plausibility of the airway injury caused by pollution in LMIC settings.18,19 On one hand, research in Lahore22 and other cities has shown progressive aggravation of respiratory symptoms and lung dysfunction as well as worsening asthma attacks with increasing air pollution. On the same note, a study conducted in Karachi12 has revealed that environmental exposure like dust and particulate matter are key triggers to asthma symptoms in a good percentage of patients. These results align with the findings of this current study that found exposure to pollution to be a powerful independent predictor of asthma severity. As compared to this, other environmental factors and allergen-related exposures like dust, and pollen and pet allergy were also found to be significantly related to the severity of asthma or airflow limitation. Although the sensitizing effect of allergen has been identified as having an effect on asthma phenotypes in high-income countries, numerous regional studies have also demonstrated weak or poor associations in LMICs, perhaps because of homogeneous patterns of exposure, under-appreciation of sensitization, or overwhelming influences of ambient pollution on allergen-specific responses.28

Lifestyle factors, such as BMI, diet, sleep quality, and physical activity had no significant links with asthma severity in this cohort. Earlier research conducted on high-income nations identified obesity and smoking as two important modifying factors on asthma control, but the results of South Asian citizens had been inconsistent.29 The age- and sex-specific BMI percentiles applied to pediatric population provided an adequate classification of children of different ages and enhanced better comparability to the existing literature.33 Even though obesity has been identified as a risk factor that can be modified to improve asthma control as described in the GINA 2025 recommendations, BMI was not significantly linked with asthma severity in the current study. This observation could be due to the large percentage of underweight individuals and the nutritional trends in the region where the study population was based. However, periodic measurement of body weight still plays a clinical role in the management of asthma.8 Smoking is significantly associated but relatively low proportion of active smokers, which are expected according to the results of other LMIC-based cohort studies.30 The perceived relationship between family history of asthma and the severity of the disease confirms previous findings that asthma is genetically and familially contributed. Curiously, family history was found less common in patients who had obstruction and uncontrolled asthma and is also reported in some of regional studies.31 This could be the result of the previous contact with healthcare, improvement of the competent identification of the symptoms, or the increase in adherence rates in people with the known risk of the disease, which results in the comparatively well-preserved lung performance even in case of genetic predisposition.32 This underlines the necessity to implement environmental risk prevention measures, regular lung functional check up and context-specific type of public health interventions, within the framework of asthma management in Pakistan and other such areas.

CONCLUSION

This study demonstrates that there is an increased burden of partially controlled and uncontrolled extrinsic asthma in Pakistan. The symptom burden and objective airflow limitation were significantly associated with asthma severity. Ambient air pollution, pollen, dust exposure, smoking status, history of allergies, pet allergy, and family history of asthma, was found to be the most notable modifiable aspect identified with poor asthma control and lung function, as well as, being the key component of asthma morbidity in the environment of low and middle-income countries. These results indicate the relevance of clinical evaluation with spirometry and environmental risk mitigation in the management of asthma.

LIMITATIONS AND RECOMMENDATIONS

The cross-sectional design does not allow causation of exposure to asthma severity. Environmental exposures were measured based on self-reported measures as opposed to the direct environmental monitoring data in terms of PM2.5 or PM10 levels. Nonetheless, the results were discussed in relation to the available regional data that proved high indexes of air pollution throughout Pakistan. The single-center environment can limit the generalizability of the study to other areas. Airway inflammation biomarkers and adherence to treatment were not measured which could further refine severity classification. However future studies may include asthma follow-up along with routine spirometry to improve the severity assessment. Considering the strong relationship between ambient air pollution and severity of asthma, it is recommended that the government should conduct regular air quality monitoring programs. In the light of symptom burden and airflow limitations, clinicians should conduct regular spirometry to assess patients' lung function.

REFERENCES

1. Reza MI, Ambhore NS. Inflammation in asthma: mechanistic insights and the role of biologics in therapeutic frontiers. Biomedicines. 2025 May 30;13(6):1342. doi: 10.3390/biomedicines13061342.
2. Ghrairi N, Elhechmi YZ. Physiopathology of allergic asthma: a comprehensive review. Scand J Immunol. 2025 May;101(5):e70032. doi: 10.1111/sji.70032.
3. World Health Organization. Asthma [Internet]. Geneva: World Health Organization; 2024 [cited 2026 Jan 19]. Available from: https://www.who.int/en/news-room/fact-sheets/detail/asthma
4. Wang Z, Li Y, Gao Y, Fu Y, Lin J, Lei X, Zheng J, Jiang M. Global, regional, and national burden of asthma and its attributable risk factors from 1990 to 2019: a systematic analysis for the Global Burden of Disease Study 2019. Respir Res. 2023;24:169. doi: 10.1186/s12931-023-02475-6
5. Maqbool U, Shahid M, Tabassum F, Lakhiar TQ, Mangrio LA, Iqbal M. Asthma burden among general population in Pakistan: a scoping review. Int J Community Med Public Health. 2025;12(4):1911–5. doi: 10.18203/2394-6040.ijcmph20250946
6. Akashanand, Khatib MN, Balaraman AK, Roopashree R, Kaur M, Srivastava M, Barwal A, Prasad GS, Rajput P, Vishwakarma T, Puri S. Patterns and trends in burden of asthma and its attributable risk factors from 1990 to 2021 among South Asian countries: a systematic analysis for the Global Burden of Disease Study 2021. J Asthma. 2025 Jun 3;62(6):1020–31. doi.org/10.1080/02770903.2025.2453810
7. Rajvanshi N, Kumar P, Goyal JP. Global initiative for asthma guidelines 2024: an update. Indian Pediatr. 2024 Aug;61(8):781–6. doi.org/10.1007/s13312-024-3260-7
8. Global Initiative for Asthma. Global Strategy for Asthma Management and Prevention, 2022 update [Internet]. 2022 [cited 2026 Jan 19]. Available from: https://ginasthma.org/wp-content/uploads/2022/05/GINA-2022-Main-Report-Tracked-20220503-WMS.pdf
9. Kant S. Air pollution: an alarming threat to respiratory health. Indian J Allergy Asthma Immunol. 2025;39(1):1–3. doi: 10.4103/ijaai.ijaai_26_25
10. Lee JX, Phipatanakul W, Gaffin JM. Environment and the development of severe asthma in inner city population. Curr Opin Allergy Clin Immunol. 2023 Apr;23(2):179–84. doi: 10.1097/ACI.0000000000000890.
11. Mphahlele R, Lesosky M, Masekela R. Prevalence, severity and risk factors for asthma in school-going adolescents in KwaZulu Natal, South Africa. BMJ Open Respir Res. 2023 May 16;10(1). doi.org/10.1136/bmjresp-2022-001498
12. Iram S, Qaisar I, Shabbir R, Pomee MS, Schmidt M, Hertig E. Impact of air pollution and smog on human health in Pakistan: a systematic review. Environments. 2025 Feb 3;12(2):46. doi.org/10.3390/environments12020046
13. Islam MS, Huq S, Cunningham S, Schwarze J, Islam AA, Amin M, Raza F, Satpathy R, Rauta PR, Ahmed S, Mahmood H.; RESPIRE. Community-based asthma assessment in young children: adaptations for a multicentre longitudinal study in South Asia. Ther Adv Infect Dis. 2022 Jul 18;9:20499361221103876. doi: 10.1177/20499361221103876.
14. Global Asthma Network. Global Asthma Network Manual for Global Surveillance: Prevalence, Severity, Management and Risk Factors – Adult Questionnaire Modules [Internet]. GAN; Updated Manual. Available from: https://globalasthmanetwork.org/publications/manual/Global_Asthma_Network_Manual.pdf [cited 2025 Feb 10]
15. Global Initiative for Asthma. Global Strategy for Asthma Management and Prevention 2025 Update [Internet]. GINA; 2025 [cited 2026 Jan 31]. Available from: https://ginasthma.org/wp-content/uploads/2025/05/GINA-2025_tracked-for-archive-WMSA.pdf [cited 2025 Feb 10]
16. International Physical Activity Questionnaire (IPAQ). IPAQ Short Form. 2002. Available from:
17. https://repo.niddk.nih.gov/media/studies/mapp2sps/Forms/MAPPII_IPAQ_v2.0.20170303.pdf [cited 2025 Feb 10]
18. World Health Organization. WHO STEPwise Surveillance (STEPS) Instrument for NCD Risk Factors: Question by Question Guide [Internet]. Geneva: WHO; 2025. Available from: https://cdn.who.int/media/docs/default source/ncds/ncd surveillance/steps/part5.pdf [cited 2025 Feb 10]
19. Cheng J, Liu Z, Li D, Zhu Y, Luo J, Zhang Y.Associations among air pollution, asthma and lung function: a cross-sectional study. Sci Rep. 2025;15:11347. doi: 10.1038/s41598-025-88807-6
20. Kelchtermans J, Mentch F, Hakonarson H. Ambient air pollution sensitivity and severity of pediatric asthma. J Expo Sci Environ Epidemiol. 2024 Sep;34(5):853–60. doi: 10.1038/s41370-023-00573-7.
21. Melén E, Zar HJ, Siroux V, Shaw D, Saglani S, Koppelman GH, et al. Asthma inception: epidemiologic risk factors and natural history across the life course. Am J Respir Crit Care Med. 2024 Sep 15;210(6):737–54. doi.org/10.3390/environments12020046

22. Singh S, Salvi S, Mangal DK, Singh M, Awasthi S, Mahesh PA, Kabra SK, Mohammed S, Sukumaran TU, Ghoshal AG, Barne M. Prevalence, time trends and treatment practices of asthma in India: the Global Asthma Network study. ERJ Open Res. 2022 May 30;8(2):00528-2021. doi: 10.1183/23120541.00528-2021.
23. Iqbal MZ, Alqahtani SS, Shahid S, Mubarak N. Socio-demographic environmental and clinical factors influencing asthma control in community pharmacies of Lahore Pakistan. Sci Rep. 2025;15:10587. doi: 10.1038/s41598-025-95373-4
24. Muthukumaru U, Wadhawan S, Loh L. Burden and unmet needs in asthma care in the Asia-Pacific region. Public Health Challenges. 2022;1(3):1–12. doi: 10.1002/puh2.15
25. Rathod MB, Budensab A, Bhalla S, Mahesh NK, Alex E, Jesudas M. Spirometric assessment of pulmonary function tests in asthma patients. Cureus. 2024 Feb 26;16(2):e54979. doi: 10.7759/cureus.54979.
26. Arismendi E, Ribo P, García A, Torrego A, Bobolea I, Casas-Saucedo R, Palomino R, Picado C, Muñoz-Cano R, Valero A.Asthma control according to GINA 2023: does changing the criteria improve asthma control? J Clin Med. 2024;13(22):6646. doi: 10.3390/jcm13226646
27. Long JW, Jiang YL. Association of small airway functional indices with respiratory symptoms and comorbidity in asthmatics: a national cross-sectional study. J Clin Med Res. 2024 May 29;16(5):220. doi.org/10.14740/jocmr5158
28. Aslam R, Sharif F, Baqar M, Nizami AS, Ashraf U. Role of ambient air pollution in asthma spread among various population groups of Lahore City: a case study. Environ Sci Pollut Res. 2023 Jan;30(4):8682–97.doi.org/10.1007/s11356-022-19086-1
29. Gupta N, Mapondela KB. Allergy testing in lower middle income countries. Clin Exp Allergy. 2024 Jan 1;54(1).doi.org/10.1111/cea.14443
30. Kalayci O, Miligkos M, Beltrán CF, El-Sayed ZA, Gómez RM, Hossny E, Le Souef P, Nieto A, Phipatanakul W, Pitrez PM, Xepapadaki P. The role of environmental allergen control in the management of asthma. World Allergy Organ J. 2022 Mar 8;15(3):100634.doi.org/10.1016/j.waojou.2022.100634
31. Gashi V, Ahmetaj Y, Ahmetaj L, Rama MS, Shahini M. Current lifestyle and risk for asthma: sedentary lifestyle, obesity, and ETS. Allergol Immunopathol (Madr). 2025 Jul;53(4):169–77.doi.org/10.15586/aei.v53i4.1364
32. Sio YY, Chew FT. Risk factors of asthma in the Asian population: a systematic review and meta-analysis. J Physiol Anthropol. 2021;40(1):22. doi.org/10.1186/s40101-021-00273-x
33. Sultana R, Ghani M, Smith A, Ashraf S, Bashir S. Factors influencing the asthma control among children. Med Res Arch. 2022 Jul 31;10(7).doi.org/10.18103/mra.v10i7.2942
34. World Health Organization. WHO Child Growth Standards: BMI-for-age [Internet]. Geneva: World Health Organization; 2007. Available from: https://www.who.int/tools/child-growth-standards

