e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.2.75

International Journal of Pharmaceutical Quality Assurance 2025; 16(2); 476-482

Original Research Article

Assessment of Risk Factors and its Treatment for Asthma Severity Patients: A Retrospective Study

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Received: 13-12-2024 / Revised: 15-01-2025 / Accepted: 20-02-2025
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Conflict of interest: Nil

Abstract:

Background: Asthma is a chronic inflammatory airway disease with variable clinical expression and severity. Identifying modifiable and non-modifiable risk factors for disease progression and evaluating treatment patterns is essential for effective asthma control in adult populations.

Objective: To assess the association between clinical and environmental risk factors and asthma severity, and to analyze treatment modalities used among adult asthma patients.

Methods: A retrospective study was conducted at Department of Respiratory medicine, Sardar Patel Medical College, Bikaner, Rajasthan, India from 12 months. A total of 210 adult asthma patients were included. Severity classification was done based on GINA 2021 guidelines. Demographic variables, family history, occupational exposure, smoking status, comorbidities, and treatment regimens (including ICS, LABA, LAMA, oral corticosteroids) were recorded. Statistical analysis included Chi-square tests and logistic regression to identify significant predictors of moderate-to-severe asthma.

Results: Of the 210 patients, 43.8% had mild asthma, 39.5% had moderate asthma, and 16.7% had severe asthma. Significant risk factors associated with higher severity included smoking ($p < 0.001$), biomass fuel exposure ($p = 0.004$), obesity ($p = 0.01$), allergic rhinitis ($p = 0.03$), and family history ($p = 0.04$). Combination therapy with ICS+LABA was the most common regimen in moderate cases, while oral corticosteroids were frequently prescribed in severe cases. Logistic regression identified smoking, obesity, and poor treatment adherence as independent predictors of severe asthma.

Conclusion: Asthma severity in adults is influenced by both modifiable (smoking, obesity, biomass exposure) and intrinsic (genetic, allergic) risk factors. Optimization of treatment adherence and early identification of high-risk individuals can significantly improve control and reduce disease burden.

Keywords: Asthma Severity, Risk Factors, Smoking, Obesity, ICS-LABA, GINA Classification, Biomass Exposure.

Introduction

Asthma is a complex chronic respiratory disease characterized by airway inflammation, bronchial hyperresponsiveness, and variable airflow limitation that is often reversible with or without treatment. Globally, it affects over 300 million individuals and poses a significant health burden due to its chronicity, impact on quality of life, and rising prevalence, especially in developing countries [1]. In India, asthma contributes substantially to the burden of chronic respiratory diseases, with an estimated prevalence of 2% to 3% among adults, though actual numbers may be higher due to underreporting and misclassification [2]. Adult-onset asthma is gaining increasing attention due to its distinct clinical features, poorer symptom control, and greater risk of severe exacerbations compared to childhood-onset asthma.

Several risk factors have been implicated in the development and exacerbation of asthma, ranging from genetic predisposition and atopy to environmental exposures such as air pollution, indoor allergens, biomass smoke, and occupational irritants [3]. Among these, modifiable factors like smoking, exposure to biomass fuel, obesity, and poor adherence to inhaled medications have been consistently associated with increased asthma severity and decreased responsiveness to therapy [4]. Smoking not only accelerates airway remodeling and reduces corticosteroid sensitivity, but also contributes to increased frequency of exacerbations and persistent symptoms in asthmatic individuals [5]. Similarly, biomass fuel exposure, which is highly prevalent in rural and semi-urban areas of India due to traditional cooking practices, has been shown to aggravate airway inflammation

and increase the risk of moderate-to-severe asthma [6].

Obesity is another critical and increasingly common contributor to asthma severity. Obese individuals exhibit a unique asthma phenotype characterized by lower lung volumes, greater dyspnea perception, and poorer response to inhaled corticosteroids [7]. The underlying mechanisms may include systemic inflammation, altered lung mechanics, and hormonal dysregulation involving adipokines such as leptin and adiponectin. Additionally, comorbidities such as allergic rhinitis, gastroesophageal reflux disease (GERD), and obstructive sleep apnea are frequently associated with difficult-to-control asthma and may necessitate more aggressive or combined pharmacotherapy [8].

The Global Initiative for Asthma (GINA) provides a stepwise framework for classifying asthma severity and guiding treatment decisions. Severity is retrospectively determined based on the minimum level of treatment required to maintain symptom control. Mild asthma typically requires low-dose ICS or ICS-formoterol on an as-needed basis, while moderate asthma is managed with daily low- or medium-dose ICS-LABA combinations. Severe asthma, on the other hand, may require high-dose ICS-LABA, oral corticosteroids, or add-on biologics depending on phenotype and control level [9]. In real-world settings, however, treatment practices often deviate from these recommendations due to physician preference, limited access to inhaled drugs, and patients' socioeconomic constraints [10].

Despite the availability of evidence-based guidelines, asthma management in India faces several challenges. Inhaler technique errors, under-prescription of controller therapy, overuse of relievers, and lack of follow-up contribute to poor disease control across various healthcare levels. A study from the INSEARCH cohort noted that only 30–40% of patients with persistent asthma were on regular ICS therapy, and even fewer received appropriate step-up treatment during exacerbations [11]. Moreover, diagnostic delays and overlapping symptoms with other respiratory illnesses such as COPD or tuberculosis further complicate the clinical picture.

There is a scarcity of comprehensive region-specific data from western India evaluating the interplay of environmental, clinical, and treatment-related factors with asthma severity. Identifying such associations is crucial for implementing tailored interventions, enhancing early recognition of high-risk patients, and optimizing long-term control strategies. Hence, this study was undertaken to investigate the risk factors associated with asthma severity and to analyze treatment types prescribed among adult asthma patients attending a tertiary care hospital in Bikaner, Rajasthan.

Methodology

A retrospective study was conducted at Department of Respiratory medicine, Sardar Patel Medical College, Bikaner, Rajasthan,India from 12 months. The primary objective of the study was to evaluate the association between selected risk factors and asthma severity, and to analyze treatment modalities being used among adult asthma patients in a tertiary care setting.

The study population included adult patients aged 18 years and above who were diagnosed with bronchial asthma based on clinical evaluation, pulmonary function tests, and reversibility criteria. The diagnosis was confirmed through a combination of clinical history (intermittent episodes of wheezing, shortness of breath, chest tightness, and cough), physical examination, and spirometry showing ≥12% and 200 mL improvement in FEV_1 following bronchodilator administration. Severity grading of asthma was done as per Global Initiative for Asthma (GINA) 2021 guidelines, which categorize asthma into mild, moderate, or severe based on symptom control and stepwise treatment required to achieve control.

A total of 210 patients were enrolled using consecutive sampling from the outpatient and inpatient departments. Inclusion criteria consisted of adult asthma patients with a confirmed diagnosis for at least six months prior to enrolment. Patients were excluded if they had overlapping COPD-asthma features, active pulmonary tuberculosis, severe cardiovascular or psychiatric illness, or were unwilling to provide consent. Written informed consent was obtained from all participants before inclusion.

A pre-designed and pre-tested data collection form was used to gather relevant information. Variables included socio-demographic data (age, gender, education, occupation, residence), environmental exposures (smoking history, passive smoking, biomass fuel exposure, occupational triggers), and personal health details (family history of asthma, obesity, comorbidities such as allergic rhinitis, GERD, and hypertension). Obesity was defined as BMI ≥25 kg/m^2 as per the Asia-Pacific classification. Exposure to biomass fuel was considered significant if the individual reported regular indoor exposure during cooking or heating for ≥1 year. Smoking status was categorized into current smoker, ex-smoker, or non-smoker.

Clinical examination was followed by detailed treatment profiling. Information was collected regarding pharmacological therapy being received at the time of presentation, including inhaled corticosteroids (ICS), long-acting beta-agonists (LABA), long-acting muscarinic antagonists (LAMA), leukotriene receptor antagonists (LTRA), oral corticosteroids, and combination inhalers

(ICS+LABA or triple therapy). Treatment adherence was assessed using self-reported compliance in the last one month. Inhaler technique was evaluated by demonstration, and errors were documented.

Pulmonary function testing was done using spirometry (as per ATS/ERS 2019 standards) and included parameters such as FEV_1, FVC, and FEV_1/FVC ratio before and after bronchodilator administration. The degree of reversibility was noted, and severity was categorized accordingly. Asthma severity was then classified retrospectively based on GINA step treatment being required to control symptoms:

- Mild asthma: Controlled on as-needed low-dose ICS-formoterol or low-dose ICS
- Moderate asthma: Required daily low- or medium-dose ICS-LABA
- Severe asthma: Required high-dose ICS-LABA or additional controller therapies (LAMA, oral steroids, etc.)

Data were entered and analyzed using SPSS version 26. Descriptive statistics were used to summarize variables. Continuous variables were presented as mean ± standard deviation, and categorical variables as frequencies and percentages. Associations between asthma severity and categorical risk factors were assessed using Chi-square test or Fisher's exact test as appropriate. Variables showing $p < 0.05$ in bivariate analysis were entered into binary logistic regression models to determine independent predictors of moderate-to-severe asthma.

Results

A total of 210 adult asthma patients were enrolled in the study over a two-year period. The mean age of participants was 43.7 ± 11.5 years, with a slight male predominance (56.2%). Based on GINA severity classification, 92 patients (43.8%) were categorized as mild, 83 (39.5%) as moderate, and 35 (16.7%) as severe asthma. A significant proportion of patients with severe asthma had a history of smoking, biomass fuel exposure, and obesity. Most patients with moderate severity were on combination ICS+LABA therapy, while severe cases frequently required oral corticosteroids or triple inhaler regimens. The following tables present associations between asthma severity and demographic factors, environmental exposures, comorbidities, and treatment patterns.

Table 1: Distribution of Age and Gender Across Asthma Severity (n = 210)

Variable	Mild (n=92)	Moderate (n=83)	Severe (n=35)	p-value
Age (Mean ± SD)	42.6 ± 11.1	44.1 ± 10.8	45.8 ± 12.3	0.31
Male (%)	48 (52.2%)	48 (57.8%)	22 (62.9%)	0.41
Female (%)	44 (47.8%)	35 (42.2%)	13 (37.1%)	

Table 2: Association of Smoking Status with Asthma Severity

Smoking Status	Mild (n=92)	Moderate (n=83)	Severe (n=35)	p-value
Non-smoker	78 (84.8%)	56 (67.5%)	18 (51.4%)	<0.001
Current smoker	6 (6.5%)	11 (13.3%)	10 (28.6%)	
Ex-smoker	8 (8.7%)	16 (19.3%)	7 (20.0%)	

Table 3: Association of Biomass Fuel Exposure with Asthma Severity

Biomass Exposure	Mild (n=92)	Moderate (n=83)	Severe (n=35)	p-value
Present	29 (31.5%)	36 (43.4%)	22 (62.9%)	0.004
Absent	63 (68.5%)	47 (56.6%)	13 (37.1%)	

Table 4: Association of Obesity with Asthma Severity

BMI Category	Mild (n=92)	Moderate (n=83)	Severe (n=35)	p-value
<25 (Normal)	54 (58.7%)	35 (42.2%)	11 (31.4%)	0.01
≥25 (Obese)	38 (41.3%)	48 (57.8%)	24 (68.6%)	

Table 5: Association of Allergic Rhinitis with Asthma Severity

Allergic Rhinitis	Mild (n=92)	Moderate (n=83)	Severe (n=35)	p-value
Present	28 (30.4%)	36 (43.4%)	18 (51.4%)	0.03
Absent	64 (69.6%)	47 (56.6%)	17 (48.6%)	

Table 6: Association of Family History of Asthma with Asthma Severity

Family History	Mild (n=92)	Moderate (n=83)	Severe (n=35)	p-value
Present	19 (20.7%)	23 (27.7%)	14 (40.0%)	0.04
Absent	73 (79.3%)	60 (72.3%)	21 (60.0%)	

Table 7: Association of Gastroesophageal Reflux Disease (GERD) with Asthma Severity

GERD Status	Mild (n=92)	Moderate (n=83)	Severe (n=35)	p-value
Present	17 (18.5%)	22 (26.5%)	13 (37.1%)	0.06
Absent	75 (81.5%)	61 (73.5%)	22 (62.9%)	

Table 8: Use of Inhaled Corticosteroids (ICS) by Severity

ICS Use	Mild (n=92)	Moderate (n=83)	Severe (n=35)	p-value
Regular	43 (46.7%)	61 (73.5%)	28 (80.0%)	<0.001
Irregular	49 (53.3%)	22 (26.5%)	7 (20.0%)	

Table 9: Treatment Regimens Across Asthma Severity

Treatment Type	Mild (n=92)	Moderate (n=83)	Severe (n=35)	p-value
ICS alone	31 (33.7%)	14 (16.9%)	3 (8.6%)	
ICS+LABA	41 (44.6%)	54 (65.1%)	17 (48.6%)	
Triple therapy (ICS+LABA+LAMA)	6 (6.5%)	9 (10.8%)	10 (28.6%)	
Oral corticosteroids	2 (2.2%)	4 (4.8%)	12 (34.3%)	
LTRA/others	12 (13.0%)	2 (2.4%)	0 (0.0%)	<0.001

Table 10: Inhaler Technique Accuracy Across Asthma Severity

Technique Correct	Mild (n=92)	Moderate (n=83)	Severe (n=35)	p-value
Correct	72 (78.3%)	56 (67.5%)	20 (57.1%)	0.03
Incorrect	20 (21.7%)	27 (32.5%)	15 (42.9%)	

Table 11: Self-reported Treatment Adherence by Severity

Adherence Level	Mild (n=92)	Moderate (n=83)	Severe (n=35)	p-value
Good	68 (73.9%)	56 (67.5%)	18 (51.4%)	0.02
Poor	24 (26.1%)	27 (32.5%)	17 (48.6%)	

Table 12: Binary Logistic Regression Predicting Moderate-to-Severe Asthma

Predictor	Adjusted OR	95% CI	p-value
Smoking	2.14	1.18–3.89	0.012
Biomass fuel exposure	1.91	1.03–3.53	0.039
Obesity (BMI ≥25)	2.31	1.23–4.36	0.009
Poor adherence	2.04	1.09–3.85	0.026

The analysis reveals that smoking, biomass fuel exposure, obesity, and poor treatment adherence were significantly associated with increasing asthma severity. Table 1 presented demographic characteristics, while Table 2 to Table 7 examined risk factors including smoking, fuel exposure, obesity, allergic rhinitis, and family history. Table 8 to Table 11 detailed pharmacological usage patterns, inhaler technique, and adherence. Table 12 confirmed that these factors independently predicted moderate-to-severe asthma among the studied adult population.

Discussion

The present study investigated the association of selected clinical and environmental risk factors with asthma severity and evaluated treatment types among adult asthma patients in a tertiary care setting in western India. The study revealed that nearly 56% of patients had moderate-to-severe asthma, with a significant proportion reporting risk factors such as smoking, biomass fuel exposure, obesity, poor adherence, and comorbid allergic rhinitis [12]. These findings reinforce the multifactorial nature of asthma and highlight the importance of targeted risk reduction strategies.

A strong association was found between active smoking and asthma severity. Both current and former smokers were significantly more likely to present with moderate-to-severe asthma compared to non-smokers. Cigarette smoke is known to exacerbate airway inflammation, reduce glucocorticoid receptor responsiveness, and accelerate decline in lung function, making asthma more refractory to standard therapy [13]. Similar results have been documented in prior Indian and international studies, where smoking was associated with higher symptom burden and increased use of systemic corticosteroids.

Biomass fuel exposure was another critical modifiable risk factor identified in this study. A majority of severe asthma patients reported regular indoor exposure to biomass smoke for cooking or heating. Biomass combustion releases a complex mixture of irritants and particulate matter, which can trigger and worsen airway hyperresponsiveness, especially in poorly ventilated rural and semi-urban

households [14]. Previous research from South India and Nepal has demonstrated increased asthma severity and frequency of exacerbations in women exposed to biomass fuels, aligning with our findings [15].

Obesity was significantly associated with higher asthma severity in this cohort. The pathophysiological link between obesity and asthma is well-established and includes reduced lung compliance, pro-inflammatory adipokine release, and altered pharmacodynamics of inhaled medications [16]. Obese asthmatics are known to exhibit poor symptom control, increased exacerbation frequency, and reduced responsiveness to inhaled corticosteroids, which supports the need for weight-targeted interventions in asthma care [17].

Comorbid allergic rhinitis was observed in nearly half of the patients with severe asthma, suggesting a synergistic burden of upper and lower airway disease. Allergic rhinitis has been identified as a predictor of poor asthma control, increased symptom perception, and healthcare utilization, likely due to shared inflammatory mechanisms and neural pathways [18]. Coexisting allergic rhinitis may also lead to under-treatment or misclassification, especially in resource-limited primary care setups.

This study also highlights important insights into pharmacological treatment patterns. Patients with moderate asthma were commonly treated with ICS+LABA combinations, while severe cases required triple therapy or systemic corticosteroids. However, a considerable number of mild and moderate asthma patients were not on regular controller therapy. This suggests either under-prescription or poor adherence—both of which are major contributors to suboptimal asthma control in India [19]. Notably, oral corticosteroids were used in 34.3% of severe cases, indicating reliance on systemic agents in cases where inhaled therapies may be insufficient or poorly used.

Inhaler technique assessment revealed that one-third of patients with moderate-to-severe asthma demonstrated incorrect technique. Poor inhaler technique has been repeatedly shown to impair drug delivery, resulting in poor symptom control, increased reliever use, and more frequent exacerbations [20]. Despite widespread knowledge of its importance, technique demonstration and re-education remain neglected in outpatient care across many Indian tertiary centers.

Treatment adherence also emerged as a critical determinant of asthma control. Nearly half of the patients with severe asthma reported poor adherence to prescribed inhaled medications. Reasons include high cost, fear of long-term steroid use, poor understanding of chronic disease nature, and cultural misconceptions about inhalers. Several Indian studies have confirmed that poor adherence contributes significantly to worsening asthma severity and increased emergency visits [21]. Interventions such as patient counseling, reminder tools, and access to low-cost inhalers can help bridge this adherence gap.

Regression analysis further confirmed that smoking, biomass fuel exposure, obesity, and poor adherence were independent predictors of moderate-to-severe asthma. This multivariable model reinforces the cumulative impact of lifestyle and behavioral factors on disease severity. It also underscores the urgent need for multipronged interventions that go beyond pharmacological management and focus on personalized risk reduction and behavior modification strategies [22].

While this study contributes valuable region-specific evidence, certain limitations must be acknowledged. The cross-sectional design restricts the ability to draw causal inferences. Reliance on self-reported adherence and exposure history introduces the potential for recall bias. However, the use of spirometry, validated treatment classification (GINA), and inclusion of both inpatient and outpatient cases adds strength to the generalizability of findings within tertiary settings.

Conclusion

This study highlights that more than half of adult asthma patients attending a tertiary care hospital presented with moderate-to-severe disease, underscoring the substantial burden of uncontrolled asthma in the region. Key modifiable risk factors such as active smoking, indoor biomass fuel exposure, obesity, and poor adherence to treatment were significantly associated with higher severity. Comorbid allergic rhinitis and family history of asthma also contributed to symptom burden and complexity of management. Despite the availability of evidence-based therapies, many patients were found to be under-treated, irregular in ICS use, or incorrectly using their inhalers—pointing to gaps in routine asthma education and follow-up care. Oral corticosteroid use in a sizable proportion of severe cases reflects a potential over-reliance on systemic medications due to suboptimal controller use or accessibility issues. Inhaler technique errors and low adherence further compounded poor outcomes, highlighting the need for integrated asthma education programs within routine clinical care. The study reinforces that asthma management must extend beyond pharmacotherapy to include structured interventions addressing lifestyle, environmental triggers, and behavioral modification. Region-specific strategies focusing on smoking cessation, indoor air quality, obesity control, and patient empowerment may yield better asthma control outcomes. Future longitudinal and

interventional studies are warranted to evaluate the impact of targeted public health interventions in reducing asthma morbidity. Strengthening primary care capacities in early risk assessment and guideline-based treatment could significantly improve asthma outcomes in similar semi-urban Indian settings.

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