Original Article

Pulmonary Function Characteristics and Asthma Control Profiles Among Adult Asthma Patients at A Referral Hospital In Indonesia: A Retrospective Study

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Abstract

Background: Asthma is a heterogeneous chronic airway disease characterized by variable respiratory symptoms and airflow limitation. In secondary healthcare settings, objective assessment using spirometry is often underutilized, and discrepancies between symptom-based assessment and lung function may occur. This study aimed to describe the demographic, clinical, and pulmonary function characteristics of asthma patients and to examine their relationship with asthma control at Lawang Hospital.

Method: This retrospective cross-sectional study included asthma patients who underwent spirometry at the Pulmonology Outpatient Clinic of Lawang Hospital between 2022 and 2023. Medical record data included demographics, smoking history, comorbidities, atopic history, asthma symptoms, asthma control assessed using the Asthma Control Test (ACT) and Global Initiative for Asthma (GINA) criteria, spirometric parameters, and prescribed therapies. Pulmonary function patterns were classified as obstructive, restrictive, mixed, or normal. Associations were analyzed using chi-square tests, meanwhile correlations between ACT scores and spirometric values were assessed using Spearman's correlation.

Results: Among 173 patients, most had a history of atopy (70.52%) and no family history of atopy (60.12%). Good asthma control based on ACT was observed in 72.83%, whereas only 1.16% were well-controlled according to GINA criteria. Most were partially controlled (89.60%) and had at least one asthma-related risk factor (78.03%). Pulmonary function patterns were obstructive (39.31%), restrictive (20.23%), mixed (27.17%), and normal (13.29%). No significant associations were found between patient characteristics and asthma control ($P>0.05$). Only the FEV_1/FVC ratio showed a weak but significant correlation with ACT scores ($P=0.012$).

Conclusion: Asthma patients demonstrated diverse pulmonary abnormalities with limited correlation between symptoms and spirometry. Routine spirometry remains important to complement clinical assessment.

Keywords: asthma, asthma control, FEV_1/FVC, pulmonary function test, spirometry

INTRODUCTION

Asthma is a heterogeneous chronic airway disease characterized by variable respiratory symptoms, airway inflammation, and reversible airflow limitation. Clinically, asthma presents with recurrent wheezing, dyspnea, chest tightness, and cough that vary in intensity and over time.[1] Despite advances in understanding asthma pathophysiology, its diagnosis and assessment remain challenging due to marked interindividual variability in clinical presentation and disease course.[2]

Globally, asthma affects approximately 300 million individuals and remains a major contributor to morbidity, healthcare utilization, and reduced quality of life.[3] Epidemiological studies demonstrate substantial variation in asthma prevalence across age groups, sex, and geographic regions, with higher prevalence observed in adult women and in industrialized countries.[4,5] In adults, asthma frequently persists or presents later in life and is often associated with comorbidities, environmental exposures, and incomplete symptom control.[6,7]

Current asthma guidelines emphasize the importance of objective lung function testing to support diagnosis, assess airflow limitation, and guide management.[1] Spirometry remains the most widely recommended tool, providing key parameters such as forced expiratory volume in one second (FEV_1), forced vital capacity (FVC), and the FEV_1/FVC ratio.[8,9] However, in routine clinical practice, particularly in secondary healthcare settings, diagnosis and follow-up often rely predominantly on clinical symptoms and short-term treatment response, which may lead to misdiagnosis or suboptimal disease control.[2,10]

Asthma control is commonly assessed using symptom-based tools such as the Asthma Control Test (ACT) and guideline-based classifications proposed by the Global Initiative for Asthma (GINA).[1] Nevertheless, the relationship between symptom-based control scores and objective pulmonary function parameters remains inconsistent, with several studies reporting weak or absent correlations.[11,12] This discrepancy underscores the need to characterize real-world asthma populations better using combined clinical and spirometric assessments.

In Indonesia, data describing pulmonary function profiles and asthma control in routine clinical settings are limited. Understanding local patient characteristics and spirometric patterns is essential to improve asthma management and optimize guideline implementation. Therefore, this study aimed to describe the demographic, clinical, and pulmonary function characteristics of asthma patients at Lawang Hospital and to evaluate the relationship between spirometric findings and asthma control.

METHOD

This study is using a retrospective, descriptive analytic cross-sectional design to describe pulmonary function

characteristics and asthma control profiles and to evaluate their associations in routine clinical practice. Data were obtained from the medical records of adult asthma patients attending the Pulmonology Outpatient Clinic at Lawang Hospital, Malang. The study period covered August 2022 to November 2023 and utilized spirometry records and clinical documentation generated during routine outpatient care.

The study protocol was reviewed and approved by the Health Research Ethics Committee of Dr. Saiful Anwar General Hospital, Malang (Ethical Approval No. 400/243/K.3/102.7/2025). Given the retrospective nature of the study and the use of anonymized secondary data, the ethics committee waived the requirement for individual informed consent. All procedures were conducted in accordance with ethical principles for medical research involving human subjects.

The study population consisted of all asthma patients attending the Pulmonology Outpatient Clinic at Lawang Hospital, Malang. The research sample included all patients diagnosed with asthma who underwent spirometry between 2022 and 2023. All eligible patients with complete spirometry data recorded during the study period were included, and no exclusion criteria were applied.

The primary outcomes of this study were 1) pulmonary function profiles of asthma patients based on spirometry results; and 2) spirometric parameters, including %FEV_1, %FVC, and the FEV_1/FVC ratio. Meanwhile, the secondary outcomes were 1) asthma control status, assessed using ACT scores and categorized according to GINA control classification; 2) associations between patient demographic and clinical characteristics (age, sex, smoking history, occupation-related inhalation exposure, comorbidities, atopic history, asthma risk factors) and asthma control status; 3) associations between pulmonary function patterns and asthma control status; and 4) correlations between ACT scores and spirometric parameters (%FEV_1, %FVC, and FEV_1/FVC ratio).

Data were collected retrospectively from medical records using a structured data extraction form developed by the research team. Extracted variables included demographic characteristics (age, sex, occupation), smoking history, comorbidities, age of asthma onset, asthma symptoms, history of atopy and family atopy, asthma risk factors, asthma control status, spirometric findings, asthma diagnosis (stable or exacerbation), and prescribed pharmacological therapy.

Asthma control was assessed using the ACT and categorized according to the GINA criteria as well-controlled, partially controlled, or uncontrolled.[1] Meanwhile, pulmonary function testing was performed using spirometry as part of routine clinical evaluation and interpreted by pulmonologists. Spirometric parameters included FVC, FEV_1, and the FEV_1/FVC ratio. Pulmonary function patterns were classified as obstructive, restrictive, mixed (obstructive–restrictive), or normal based on established international standards.[8,9]

Data analysis was conducted using SPSS version 27 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize patient characteristics and spirometric profiles, with categorical variables presented as frequencies and percentages and continuous variables as mean±standard deviation or median (range).

Associations between patient characteristics and asthma control categories were analyzed using the chi-square test. Correlations between ACT scores and spirometric parameters were assessed using Spearman's rank correlation coefficient. Statistical significance was defined as $P<0.05$ with a 95% confidence interval.

RESULT

A total of 173 asthma patients who underwent spirometry between August 2022 and November 2023 were included in the analysis. The majority were female (72.25%) and most frequently aged 45–54 years. Housewives constituted the largest occupational group.

More than half of patients had a history of atopy, while most reported no family history of atopy. Smoking exposure was common, predominantly passive smoking. Most patients had no documented comorbidities. Bronchodilator reversibility data were not consistently available in the medical records and, therefore, were not included in the analysis, which represents a limitation of this study. Detailed demographic and clinical characteristics are summarized in Table 1.

Table 1. Characteristic and Demographic

Characteristic	n	%
Sex		
Male	48	27.75
Female	125	72.25
Age (years)		
15-34	56	32.37
35-54	85	49.13
>55	32	18.5
Occupation		
Housewife	81	46.82
Employee	17	9.83
Trader	2	1.16
Student	12	6.94
Retired	5	2.89
Teacher	1	0.58
Farmer	11	6.36
Salesperson	3	1.73
Laborer	5	2.89
Security guard	2	1.16
Employee	3	1.73
Private employee	23	13.29
Unemployed	8	4.62
Smoking History		
Current smoker	25	14.45
Passive smoker	87	50.29
Comorbidities		
Diabetes mellitus	4	2.30
Hypertension	15	8.62
Heart disease	2	1.15
Obesity	4	2.30
COPD	1	0.57
Dyslipidemia	1	0.57
No comorbidities	147	84.48
History of Atopy		
No history of atopy	51	29.48
History of atopy	122	70.52
Dermatitis	2	1.55
Dust	3	2.33
Cold air	3	2.33
Seafood	1	0.78
Urticaria	11	8.53
Rhinitis	109	84.50

Characteristic	n	%
No family history of atopy	104	60.12
With a family history of atopy	69	39.88
Dust	11	14.47
Cold air	23	30.26
Seafood	2	2.63
Urticaria	3	3.95
Asthma	10	13.16
Rhinitis	27	35.53
Symptoms		
Dyspnea	130	75.14
Cough	146	84.39
Wheezing	74	42.77
Chest tightness	31	17.92
Chest pain	1	0.58
Others	3	1.73
Asthma Control Test (ACT)		
25	2	1.16
20-24	126	72.83
<19	45	26.01
GINA Asthma Control		
Well-controlled (0)	2	1.16
Former smoker	16	9.25
Non smoker	45	26.01
Partially controlled (1-2)	155	89.60
Uncontrolled (3-4)	16	9.25
Risk factors		
Risk factors present (+)	135	78.03
Dust	47	29.38
Cold air	58	36.25
Poor medication adherence	38	23.75
Fatigue	13	8.13
Smoke exposure	3	1.88
Stress	1	0.63
No risk factors (-)	38	21.97
Asthma control assessment (GINA)		
Fully controlled	23	13.29
Partially controlled	137	79.19
Uncontrolled	13	7.51
History of exacerbation (past 12 months)		
Diagnosis		
Mild-moderate	57	32.95
Severe	2	1.16
Life-threatening	0	0.00
Therapy		
ICS/LABA	38	21.97
ICS/LABA + Add-on (LAMA/Oral steroid)	89	51.45
Other regimens	46	26.58
Pulmonary Function Pattern		
Obstructive	68	39.31
Restrictive	35	20.23
Mixed	47	27.17
Normal	23	13.29

Based on the ACT, most patients had ACT scores ≥20, indicating generally acceptable symptom control. ACT is a patient-reported questionnaire ranging from 5 to 25, with higher scores reflecting better asthma control. Scores are categorized as well-controlled (20–25), partially controlled (16–19), and uncontrolled (≤15). In this study, the majority of patients fell within the well-controlled category based on ACT.

However, when classified according to GINA criteria, most patients were categorized as having partially controlled asthma, with only a small proportion classified as well-controlled. GINA classification is based on multiple clinical parameters, including symptom frequency, reliever use, activity limitation, and night-time symptoms, rather than a single composite score.

The apparent discrepancy between ACT and GINA classifications may reflect the subjective nature of ACT compared with the multidimensional assessment used in GINA criteria. Importantly, although ACT suggested generally acceptable symptom control (ACT ≥20), a substantial proportion of these patients still met criteria for partially controlled asthma according to GINA, indicating that symptom perception alone may underestimate disease control. Asthma-related risk factors were also known

to be present in most patients. The distribution of asthma control status according to ACT and GINA criteria is presented in Table 1.

Spirometric evaluation revealed that obstructive pulmonary function was the most common pattern, followed by mixed obstructive–restrictive and restrictive patterns. A smaller proportion of patients had normal pulmonary function. Mean values of %FEV_1, %FVC, FEV_1/FVC ratio, and other spirometric indices demonstrated wide variability across the study population. Pulmonary function profiles and spirometric parameters are also detailed in Table 1.

Table 2. Association Between Patient Characteristics and Asthma Control Based on GINA Criteria (Chi-square test)

Parameter	Fully controlled (n=23)	Partially controlled (n=137)	Uncontrolled (n=13)	P
Age				
>40 years	8 (34.7%)	81 (59.12%)	8 (61.54%)	0.058
≤40 years	15 (65.22%)	56 (40.88%)	5 (38.46%)	
Sex				
Male	4 (17.39%)	43 (31.39%)	1(7.69%)	0.933
Female	19 (82.61%)	94 (68.61%)	12 (92.31%)	
Smoking History				
Tobacco exposure (+) (current, passive, former smoker	20 (86.96%)	99 (72.26%)	9 (69.23%)	0.169
No tobacco exposure	3 (13.04%)	38 (27.74%)	4 (30.77%)	
Occupation				
High likelihood of inhalational exposure (housewives, laborers, traders, farmers)	13 (56.52%)	75 (54.74%)	11 (84.62%)	
Low likelihood of inhalational exposure (employees, students, retirees, teachers, salespersons, security guards, private employees, unemployed)	10 (43.48%)	62 (45.26%)	2 (15.38%)	0.207
Comorbidities				
Present	3 (13.04%)	21 (15.33%)	3 (23.08%)	0.471
Absent	20 (86.96%)	116 (84.67%)	10 (76.92%)	
History of atopy				
Present	19 (82.61%)	94 (68.61%)	9 (69.23%)	0.557
Absent	4 (17.39%)	43 (31.39%)	4 (30.77%)	
Family history of atopy				
Present	7 (30.43%)	55 (40.15%)	7 (53.85%)	0.574
Absent	16 (69.57%)	82 (59.85%)	6 (46.15%)	
Asthma risk factor				
Present	18 (78.26%)	105 (76.64%)	12 (92.31%)	0.466
Absent	5 (21.74%)	32 (23.36%)	1 (7.69%)	
%FEV1				
<60%	10 (43.48%)	54 (39.42%)	4 (30.77%)	0.478
≥60%	13 (56.52%)	83 (60.58%)	9 (69.23%)	
FEV1/FVC				
<0.75	10 (43.48%)	77 (56.20%)	3 (23.08%)	0.240
≥0.75	13 (56.52%)	60 (43.80%)	10 (76.92%)	
%FVC				
<80%	15 (65.22%)	103 (75.18%)	8 (61.54%)	0.915
≥80%	8 (34.78%)	34 (24.82%)	5 (38.46%)	

Table 3. Sub-analysis of the Association Between Pulmonary Function Patterns and Asthma Control Based on GINA Criteria (Chi-square test)

Parameter	Fully controlled (n=24)	Partially controlled (n=51)	Uncontrolled (n=32)	P
Obstructive pattern				
Yes	8	52	8	0.178
No	15	83	5	
Restrictive pattern				
Yes	4	30	1	0.684
No	19	107	12	
Mixed Restrictive and obstructive pattern				
Yes	6	38	3	0.915
No	17	99	10	

Chi-square analysis showed no statistically significant associations between asthma control status and patient demographic or clinical characteristics, including age, sex, smoking history, occupation-related inhalation exposure, comorbidities, atopic history, family atopy, asthma risk factors, or spirometric thresholds (%FEV$_1$, %FVC, and FEV$_1$/FVC) (all P>0.05). These findings are summarized in Table 2.

Sub-analysis demonstrated no significant differences in pulmonary function patterns (obstructive, restrictive, or mixed) across asthma control categories (well-controlled, partially controlled, and uncontrolled) using the chi-square test (P>0.05), as shown in Table 2. The distribution of spirometric patterns according to asthma control status is presented in Table 3.

Table 4. Correlation analysis between ACT scores and pulmonary function

Correlation	r	P
ACT score vs %FEV$_1$	0.039	0.611
ACT score vs FEV$_1$/FVC	0.192	0.173
ACT score vs %FVC	0.064	0.400

Spearman correlation analysis identified a weak but statistically significant positive correlation between ACT scores and the FEV$_1$/FVC ratio (rho=0.192, P=0.012). No significant correlations were observed between ACT scores and %FEV$_1$ or %FVC (P>0.05). These correlations are summarized in Table 4 and illustrated in Figure 5.

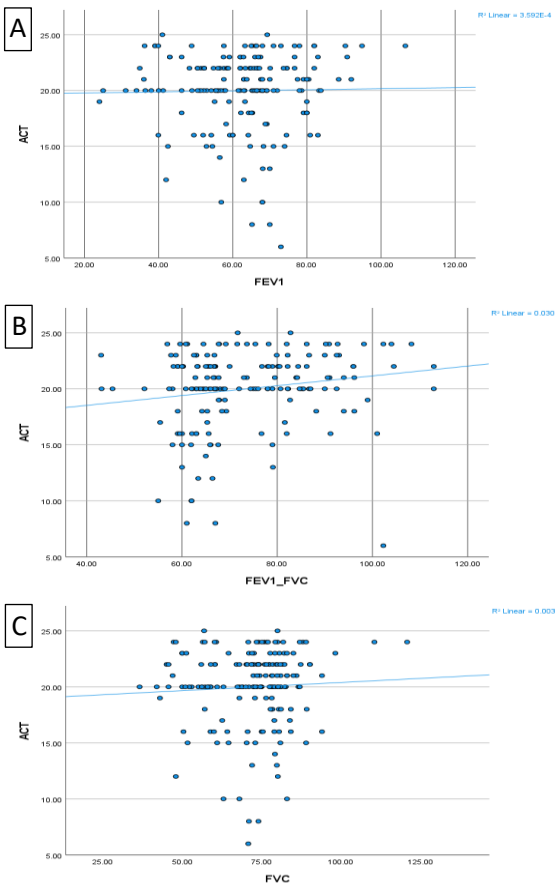

Figure 5. A) Correlation between ACT scores and %FEV$_1$ using Spearman analysis; B) Correlation between ACT scores and %FEV$_1$/FVC using Spearman analysis; C) Correlation between ACT scores and %FVC using Spearman analysis.

DISCUSSION

This study provides a real-world overview of pulmonary function characteristics and asthma control profiles among adult asthma patients attending a secondary referral hospital in Indonesia. By integrating clinical assessment with spirometric evaluation, this study addresses an important gap in routine asthma management, where symptom-based evaluation often predominates over objective lung function assessment.[1,2]

The predominance of female patients and middle-aged adults in this cohort is consistent with epidemiological data indicating higher asthma prevalence among adult women, particularly after puberty and into later adulthood.[4,5] Hormonal influences, obesity, and systemic inflammation have been proposed as contributing factors to this sex disparity, although these mechanisms were not directly assessed in the present study.[7] The high proportion of patients with an atopic history further supports the recognized role of atopy in asthma pathogenesis, particularly in adult populations.[13]

Despite most patients having ACT scores ≥20, indicating generally acceptable symptom control, only a small proportion were classified as well-controlled according to GINA criteria. This discrepancy highlights the known limitations of symptom-based assessment tools when used in isolation and reinforces guideline recommendations that asthma control should incorporate both symptom burden and risk assessment, including lung function and exacerbation history.[1,6] The high prevalence of partially controlled asthma observed in this study is comparable to findings from other clinical settings, where incomplete control remains common despite treatment availability.[11]

Spirometric evaluation revealed that obstructive pulmonary function was the most frequent pattern, followed by mixed obstructive–restrictive impairment. This finding aligns with the known heterogeneity of asthma pathophysiology and the presence of airway remodelling in long-standing disease, which may contribute to persistent airflow limitation.[13,14] The presence of restrictive or mixed patterns may also reflect suboptimal effort, obesity, air trapping (pseudo restriction), or coexisting conditions, highlighting the complexity of interpreting spirometric findings in asthma.[8,9]

Notably, no significant associations were found between demographic or clinical characteristics and asthma control status. These findings are consistent with previous studies demonstrating that asthma control is influenced by complex, multifactorial interactions rather than isolated patient characteristics.[12] Similarly, pulmonary function patterns were not significantly associated with asthma control categories, underscoring that objective airflow limitation does not always correlate with symptom perception or reported control.[11]

The weak but significant correlation between ACT scores and the FEV_1/FVC

ratio suggests that airflow limitation contributes modestly to symptom burden, while %FEV$_1$ and %FVC showed no meaningful correlation with symptom-based control. This finding supports prior evidence that spirometric indices and patient-reported outcomes assess distinct dimensions of asthma and should be interpreted complementarily rather than interchangeably.[12]

It is important to note that the ACT is a patient-reported outcome measure that reflects the patient's subjective perception of asthma control over the preceding four weeks. Although ACT has been widely validated,[15,16] it may not fully capture objective airway limitation or underlying pathophysiological changes. Discrepancies between ACT scores and spirometric findings may arise due to individual differences in symptom perception, including adaptation to chronic symptoms, psychological factors, and health literacy.[17,18] Therefore, ACT and spirometry should be interpreted as complementary tools rather than interchangeable measures in assessing asthma control.

In addition, the classification of occupational exposure into categories of low and high likelihood should be interpreted with caution. Occupational exposure is highly context-dependent and influenced by environmental conditions, intensity and duration of exposure, and the use of protective measures. Individuals within similar occupational groups may experience substantially different levels of inhalational exposure. Previous studies have highlighted the limitations of using broad occupational categories as proxies for exposure, particularly in low- and middle-income settings where informal work environments are common, potentially leading to misclassification bias.[19,20]

Overall, these findings emphasize the added value of spirometry in complementing symptom-based assessment to better characterize asthma severity and heterogeneity. Routine integration of pulmonary function testing may enhance diagnostic accuracy, risk stratification, and long-term management, particularly in secondary healthcare settings.

This study has several limitations that should be considered when interpreting the findings. The retrospective cross-sectional design limits the ability to establish causal relationships or assess longitudinal changes in asthma control and pulmonary function. Data were obtained from medical records, which may be subject to incomplete documentation, reporting bias, and variability in clinical assessment. The study was conducted at a single secondary referral hospital, which may limit the generalizability of the findings to other healthcare settings or populations.

Additionally, asthma diagnosis and control were assessed using routinely recorded clinical data and symptom-based tools, without confirmation using longitudinal spirometric follow-up or inflammatory biomarkers such as fractional exhaled nitric oxide or blood eosinophil counts. Potential confounding factors,

including medication adherence, inhaler technique, environmental exposures, and socioeconomic status, could not be fully evaluated. Despite these limitations, the study provides valuable real-world insights into asthma control and pulmonary function profiles in routine clinical practice

CONCLUSION

In this study, asthma control showed no significant association with demographic characteristics, clinical profiles, or categorical pulmonary function patterns among adult asthma patients at a secondary referral hospital. Symptom-based control assessed by the ACT demonstrated limited alignment with objective lung function, with only a weak but statistically significant relationship observed between ACT scores and the FEV_1/FVC ratio, while no meaningful associations were identified with %FEV_1 or %FVC. These findings indicate that patient-reported symptom control and spirometry impairment represent complementary but distinct dimensions of asthma, underscoring that reliance on symptoms alone may not adequately reflect underlying airflow limitation. Integrating routine spirometry with clinical assessment may therefore enhance the evaluation of asthma control and support more comprehensive disease management in routine practice.

Future studies should explore longitudinal outcomes, incorporate inflammatory biomarkers such as fractional exhaled nitric oxide (FeNO) or blood eosinophils, and evaluate treatment adherence and inhaler technique to better understand determinants of asthma control and pulmonary function decline.

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