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Association Between Asthma Control Tests and Lung Function Parameters Among Asthma Patients in a Tertiary Care Setting

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ABSTRACT

Background: Asthma is a chronic inflammatory airway disease characterized by reversible airflow limitation and variable respiratory symptoms. Monitoring asthma control using patient-reported tools like the Asthma Control Test (ACT) alongside objective lung function assessment such as spirometry (FEV_1) is essential to optimize therapy, particularly in tertiary care settings.

Objectives: To assess the correlation between ACT scores and lung function parameters (FEV_1 % predicted) among adult asthma patients attending a tertiary care hospital and to analyze their distribution according to asthma control status.

Methods: This cross-sectional study included 125 adult asthma patients diagnosed as per Global Initiative for Asthma (GINA) guidelines. ACT scores were recorded to categorize patients into well-controlled (ACT ≥20) and poorly controlled (ACT <20) asthma groups. Spirometry was performed to measure FEV_1 and classify obstruction severity. Correlations between ACT scores, FEV_1 % predicted, and quality of life (QOL) measures were analyzed using Pearson correlation coefficients.

Results: Among the 125 patients (mean age distribution: 46.4% aged 18–39, 53.6% male), 54.4% were well-controlled and 45.6% poorly controlled by ACT criteria. Lung function assessment showed 12% with normal FEV_1, 56% with mild obstruction, 16.8% moderate, and 15.2% severe. A strong positive correlation was observed between ACT scores and FEV_1 % predicted ($r = 0.752$; $p < 0.001$). ACT scores also showed a moderate correlation with quality of life ($r = 0.271$; $p = 0.002$), and quality of life correlated moderately with FEV_1 % predicted ($r = 0.567$; $p = 0.001$). The majority of patients reported mild to severe impairments in symptom, activity, emotional functioning, and environmental domains.

Conclusion: The study demonstrates a significant positive correlation between ACT scores and lung function parameters, supporting the complementary roles of patient-reported outcomes and spirometry in asthma monitoring. Integrating ACT assessment with spirometric evaluation can enhance personalized management and improve outcomes in tertiary care settings, especially in resource-limited environments.

Keywords: *Pregnancy and periodontitis, Diabetes mellitus, Risk factor, glycemic control and periodontitis.*

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1. INTRODUCTION

Asthma is a chronic inflammatory airway disorder characterized by reversible airflow limitation, bronchial hyperresponsiveness, and variable respiratory symptoms, including wheezing, cough, chest tightness, and shortness of breath. The disease affects individuals of all ages but commonly begins in childhood and remains a global health concern due to its high prevalence and impact on quality of life. Over 262 million people worldwide are affected, with approximately 461,000 deaths annually — the majority occurring in low- and middle-income countries (LMICs) such as India. Factors contributing to poor asthma outcomes in these regions include rapid urbanization, increased exposure to air pollution and allergens, and limited access to standardized healthcare services [1-3].

Effective asthma management requires comprehensive assessment and control to prevent exacerbations, reduce morbidity, and enhance daily functioning. The Asthma Control Test (ACT) is a validated, patient-administered questionnaire that quantifies recent symptom burden and evaluates treatment effectiveness. Meanwhile, lung function measurement through spirometry, particularly forced expiratory volume in one second (FEV_1), provides objective markers of airway obstruction, severity, and disease progression [4-6]. Despite advances in guideline-based pharmacotherapy endorsed by the Global Initiative for Asthma (GINA), many patients still experience suboptimal asthma control, leading to increased hospitalizations, emergency visits, and decreased health-related quality of life (HRQoL).

GINA recommends integrating symptom-based assessments like ACT with spirometric indices to guide personalized treatment, especially in tertiary care settings where patients often present with complex or severe disease phenotypes. Several studies in India and other LMICs highlight challenges such as delayed diagnosis, underutilization of spirometry, limited patient education, and resource constraints — all contributing to insufficient asthma control and lung function decline. Recent evidence has demonstrated a strong positive correlation between ACT scores and lung function parameters, notably FEV_1, reinforcing ACT's utility as a clinical monitoring tool. [7-8]

This study aims to evaluate the correlation between Asthma Control Test scores and lung function parameters among adult asthma patients attending a tertiary care hospital. Improving understanding of this relationship in resource-limited tertiary care contexts will facilitate better clinical monitoring, individualized management, and patient education to enhance asthma outcomes.

2. METHODOLOGY

Study Design and Setting

This cross-sectional observational study was conducted at a tertiary care hospital, focusing on adult patients diagnosed with asthma according to the Global Initiative for Asthma (GINA) guidelines. The study was carried out over a duration of 18 months, from July 2023 to December 2024.

Study Population

- **Inclusion Criteria:**
  - Adults aged 18 years and above
  - Clinically diagnosed with asthma based on GINA criteria
  - Patients attending the outpatient and inpatient departments of the tertiary care hospital
  - Willingness to participate and provide informed consent
- **Exclusion Criteria:**
  - Patients with chronic obstructive pulmonary disease (COPD) or other significant respiratory illnesses
  - Recent respiratory infections or asthma exacerbation within the last four weeks
  - Inability to perform reliable spirometry or complete the Asthma Control Test (ACT)

Sample Size

The sample size was calculated based on previous studies evaluating the correlation between ACT scores and lung function parameters, aiming for adequate power to detect a significant association at a 95% confidence level. A total of 125 patients were enrolled consecutively.

3. DATA COLLECTION

1. Patient Demographics and Clinical History

A structured questionnaire was used to collect demographic data (age, sex, occupation), asthma duration, smoking status, comorbidities, and current asthma treatment details.

2. Asthma Control Assessment

Asthma control was assessed using the Asthma Control Test (ACT), a validated, patient-administered questionnaire consisting of five items assessing symptoms, use of rescue medications, and effect on daily activities over the past four weeks. ACT scores range from 5 (poor control) to 25 (complete control). Scores were categorized as follows:

- Well-controlled: ACT score ≥20
- Partly controlled: 16–19
- Poorly controlled: ≤15

3. Lung Function Measurement

Spirometry was performed using a calibrated spirometer adhering to the American Thoracic Society (ATS) guidelines. The key parameters measured included:

- Forced Expiratory Volume in 1 second (FEV_1)
- Forced Vital Capacity (FVC)
- FEV_1/FVC ratio

The highest values from at least three acceptable maneuvers were recorded. Lung function results were expressed as absolute values and percent predicted based on normative data adjusted for age, sex, height, and ethnicity.

Data Analysis

- The correlation between ACT scores and lung function parameters, particularly FEV_1 and FEV_1/FVC ratio, was analyzed using Pearson or Spearman correlation coefficients depending on data distribution.
- Descriptive statistics summarized demographic data, ACT categories, and spirometric values.
- Comparisons between asthma control groups (well-controlled, partly controlled, poorly controlled) and lung function were performed using ANOVA or Kruskal-Wallis tests as appropriate.
- A p-value <0.05 was considered statistically significant.

Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee of the tertiary care hospital. All participants provided written informed consent before enrollment. Confidentiality and anonymity of patient data were maintained throughout the study.

4. RESULTS

Demographic and Baseline Characteristics

Of 125 asthma patients included, the majority were aged 18–59 (91.2%), with 46.4% in the 18–39 group, 44.8% in 40–59, and 8.8% in 60–65. Males outnumbered females (53.6% vs 46.4%). Urban residents comprised 56.8%, with 43.2% from rural backgrounds. Educational attainment showed 20% were graduates and above, while 12% were illiterate. Nearly half were skilled or semiskilled workers (24.8% each). Asthma duration ranged: 17.6% <1 year, 46.4% for 1–5 years, and 36% >5 years (Table 1).

Asthma Control Test (ACT) Scores

By Asthma Control Test, 54.4% of patients were well controlled (ACT≥20), while 45.6% had poor control (ACT<20), despite being managed in a tertiary care center (Table 2)(Figure 1)

Lung Function Parameters and correlation analyses

Spirometry results showed that only 12.0% of patients had normal lung function (FEV_1 ≥80%), while the majority exhibited mild obstruction (56.0%, FEV_1 60–79%). Moderate obstruction (FEV_1 40–59%) was present in 16.8%, and severe obstruction (FEV_1 <40%) affected 15.2% of patients, indicating that most had mild to moderate airflow limitation (Table 3) (Figure 2). Correlation analyses demonstrated a strong positive correlation between Asthma Control Test (ACT) scores and FEV_1 % predicted ($r=0.752$, $p<0.001$), suggesting that better symptom control is closely associated with improved lung function. Additionally, a moderate positive correlation was observed between FEV_1 % predicted and quality of life (QOL) ($r=0.567$, $p=0.001$), and a weaker yet significant correlation between ACT scores and QOL ($r=0.271$, $p=0.002$). These results are summarized in Table 4.(Figure 3)

Quality of Life (Mini AQLQ) Domains

Emotional functioning was most impaired, with 75.2% severe and 19.2% very severe impairment. Symptom and activity domains showed moderate to severe impact in most patients. Environmental factors were also significantly affected (Table 5).

Table 1. Baseline Demographic Characteristics of Study Participants (n=125)

Characteristic	Frequency (n)	Percentage (%)
Age 18–39	58	46.4
Age 40–59	56	44.8
Age 60–65	11	8.8
Male	67	53.6
Female	58	46.4
Urban	71	56.8
Rural	54	43.2
Illiterate	15	12.0
Graduate and above	25	20.0
Skilled	31	24.8
Semiskilled	31	24.8
<1 year asthma	22	17.6
1–5 years asthma	58	46.4
>5 years asthma	45	36.0

Table 2. Asthma Control Test (ACT) Score Categories (n=125)

Level of Asthma Control	**Frequency (n)**	**Percentage (%)**
Well controlled (ACT ≥20)	68	54.4
Poorly controlled (ACT <20)	57	45.6

Mean ACT score = 19.62 ± 2.36

Table 3. Distribution of Lung Function (FEV_1 Predicted % and Severity) (n=125)

FEV_1 % Predicted Category	Frequency (n)	Percentage (%)
Normal (≥80%)	15	12.0
Mild obstruction (60–79%)	70	56.0
Moderate obstruction (40–59%)	21	16.8
Severe obstruction (<40%)	19	15.2

Mean FEV_1 predicted value = 65.78 ± 13.84%

Table 4: Pearson Correlations among ACT, FEV_1 % Predicted, and Quality of Life (QOL) (n = 125)

Variables	Correlation Coefficient (r)	p-value
ACT vs FEV_1 % Predicted	0.752	<0.001
ACT vs Quality of Life (QOL)	0.271	0.002
FEV_1 % Predicted vs QOL	0.567	0.001

Table 5: Summary of Quality of Life (Mini AQLQ) Domain Impairments in Asthma Patients (n = 125)

Domain	No impairment n (%)	Mild n (%)	Moderate n (%)	Severe n (%)	Very severe n (%)
Symptom	–	18 (14.4)	80 (64.0)	26 (20.8)	1 (0.8)
Activity	–	14 (11.2)	71 (56.8)	36 (28.8)	4 (3.2)
Emotional Functioning	–	–	7 (5.6)	94 (75.2)	24 (19.2)
Environmental Factors	–	13 (10.4)	85 (68.0)	27 (21.6)	–

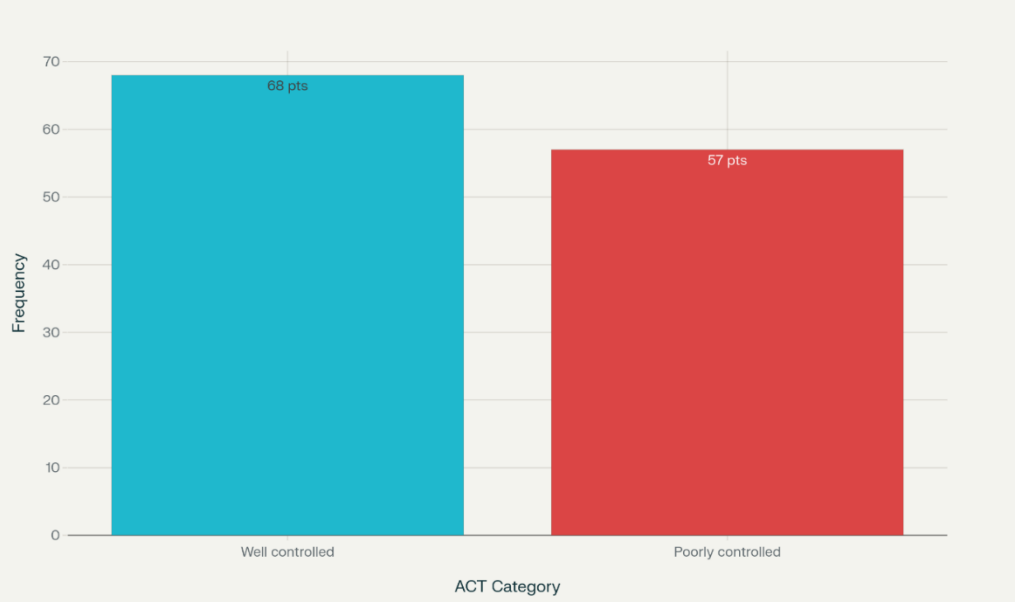

Figure 1: Distribution of Patients by Asthma Control Test (ACT) Categories

Bar diagram showing the number of asthma patients in each ACT score category (Well-controlled: 68 patients, poorly controlled: 57 patients), out of a total of 125. This visualization highlights the proportion in each group according to their disease control status.

Bar diagram showing the distribution of patients by ACT categories (Well-controlled vs Poorly controlled)

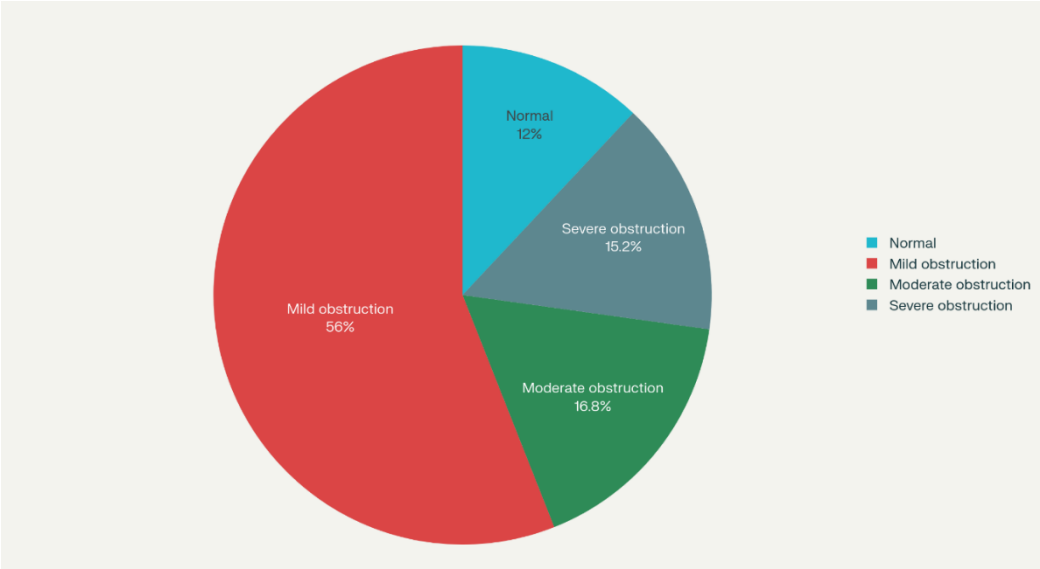

Figure 2: Severity Distribution of Lung Function Based on FEV_1 % Predicted

Pie chart illustrating the severity of lung function impairment among asthma patients, categorized as Normal, Mild, Moderate, and Severe obstruction according to FEV_1 % predicted values. This figure demonstrates the spread and prevalence of each obstruction level in your study cohort.

Pie chart illustrating severity distribution of lung function based on FEV_1 % predicted

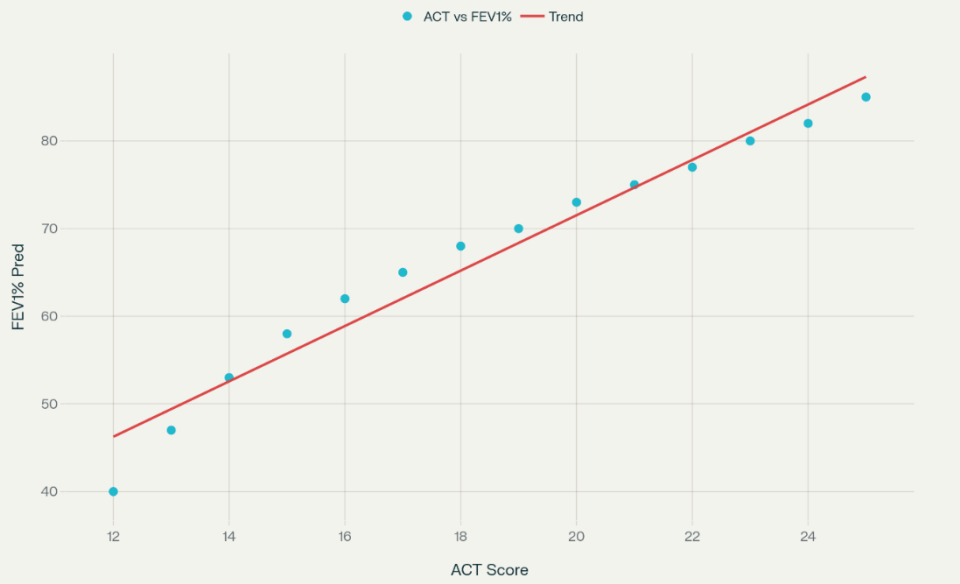

Figure 3: Correlation Between ACT Score and FEV_1 % Predicted

Scatter plot with regression line displaying the relationship between Asthma Control Test (ACT) scores and lung function (FEV_1 % predicted). The strong positive correlation (r=0.75) indicates that better asthma control aligns with higher lung function values in your population.

Scatter plot with regression line showing positive correlation between ACT scores and FEV_1 % predicted values (r=0.75)

5. DISCUSSION

The present study explored the correlation between Asthma Control Test (ACT) scores and lung function parameters, particularly FEV_1, among asthma patients in a tertiary care setting. A strong positive correlation emerged between ACT scores and FEV_1 % predicted, underlining the utility of ACT for routine asthma monitoring. This finding aligns with several recent reports but must be interpreted against the backdrop of comparative research and current clinical guidelines.

COMPARATIVE ANALYSIS WITH RECENT AND INTERNATIONAL STUDIES

Multiple studies have investigated the relationship between symptom-based asthma control tools (such as ACT) and objective lung function measures (like spirometry). For instance, sustained improvements in patient outcomes, including reduced length of hospital stay (LOS) and stable readmission rates, were documented after systematic implementation of asthma management protocols at both community and tertiary hospitals—a finding supporting the importance of comprehensive and standardized asthma care frameworks [9]. These protocols, which often include regular ACT scoring alongside spirometry, reinforce the need to monitor both symptom burden and physiological impairment for optimal disease management.

Interventional approaches that enhance patient education, treatment adherence, and access to controller medications (especially inhaled corticosteroids) are critical. In India and other low- and middle-income countries (LMICs), gaps in inhaled medication access often translate to underuse of controller therapy, perpetuating suboptimal control and poor lung function outcomes despite guideline recommendations [10]. The introduction of combination inhalers (ICS-formoterol) and a shift away from SABA monotherapy have shown significant reductions in acute exacerbations compared to conventional regimens [10]. However, as comparative evidence from Moroccan cohorts indicates, improvements in lung function parameters may lag behind or be only partially predicted by symptom-based scores alone, emphasizing the need for periodic spirometric monitoring, as recommended by international guidelines [11].

A study in India assessing ACT and spirometry found that while the ACT provided a fast and accessible estimate of disease control, its correlation with FEV_1 was not universally significant—echoing findings from broader meta-analyses, which have shown moderate agreement at best between these metrics [12]. This discordance highlights that ACT and spirometry evaluate complementary, rather than identical, dimensions of asthma control. Moreover, studies have found significant discrepancies between patient-reported symptom control and objective lung function, leading to over- or underestimation of disease stability if only a single modality is used [13,14]. For example, some patients may under-perceive symptoms despite poor lung function ("poor perceivers"), whereas others may report troublesome symptoms even with near-normal spirometry ("over-perceivers") [14].

In pediatric and adult populations, FEV_1 and FEV_1/FVC often show only weak-to-moderate correlations with ACT scores, supporting the argument for integrated control assessment [15]. Recent research comparing the ACT to newer lung function

tools such as impulse oscillometry found similarly modest relationships, further confirming that no single measure fully captures the multidimensional nature of asthma control [15].

Interpretation and Implications

Taken together, these results suggest that while ACT is a valuable screening and monitoring instrument—especially in resource-limited and high-volume settings—its effectiveness is maximized when used in tandem with objective lung function measurement. Tertiary care hospitals, where complex and severe cases are managed, particularly benefit from dual assessment strategies to avoid missed deterioration in asymptomatic patients or unnecessary medication escalation in those with subjective complaints but preserved physiology.

The need for local adaptation of global guidelines is especially pronounced in LMICs. Barriers to spirometry, limited follow-up capacity, and poor inhaler availability remain significant challenges, but as shown by interventions in both high- and low-resource settings, sustained improvement in asthma control and outcomes is possible when both symptom-based and physiologic criteria are systematically applied.

6. CONCLUSION

In summary, the observed significant correlation between ACT scores and FEV_1 mirrors and reinforces findings in the literature, but also underscores the limitations of using either assessment tool alone. Comparative research repeatedly demonstrates that combining ACT with periodic spirometry provides a more comprehensive and reliable assessment of asthma control, ensuring that management strategies are robust, evidence-based, and responsive to both patient experience and physiological status

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