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# Understanding the Drivers of Inhaler Non-Adherence in Asthma and its Influence on Asthma Control

**Rohit Pathak**[1], **Manoj Kumar Pandey**[2], **Shiv Kumar Verma**[3], **Rinki Kumari**[4]

[1]Department of Respiratory Medicine, Hind Institute of Medical Science, Ataria, Sitapur, U.P, India, [2]Department of Respiratory Medicine, Shaikh-Ul-Hind Maulana Mahmood Hasan Medical College, Saharanpur, U.P, [3]Department of Respiratory Medicine, Rajarshi Dasharath Autonomous State Medical College Ayodhya, [4]Department of Advanced Centre for Traditional and Genomic Medicine, Institute of Medical Sciences, Banaras Hindu University, Varanasi, India.

## ABSTRACT

### Background

Asthma remains a significant global health concern, with adherence to inhaler therapy playing a crucial role in its management. Understanding demographic characteristics and adherence behaviours among asthma patients is essential for optimizing treatment outcomes. This study delves into the multifaceted factors associated with non-adherence to inhaler therapy among asthma patients in India, to enhance adherence and improve asthma management outcomes.

### Methods

A cross-sectional study was conducted among 195 asthma patients at Shaikh-UI-Hind Maulana Mahmood Hasan Medical College in Saharanpur, India. Asthma control was assessed using standardized criteria, and adherence to inhaler therapy was evaluated through self-reported questionnaires. Demographic variables including smoking habit, possession of health insurance, comorbidities, duration of asthma, and duration of inhaler use were also recorded.

### Results

Analysis of demographic characteristics revealed a higher prevalence of asthma among females, aged 18-45, and individuals from low-income rural families. Additionally, a substantial proportion of patients had comorbidities and had been diagnosed with asthma for more than five years. Asthma control levels indicated a concerning proportion of patients with poorly controlled asthma, highlighting challenges in achieving optimal management outcomes. Furthermore, significant challenges in adherence to inhaler medication regimens were observed, including medication dosage modification without medical guidance and barriers to proper device use.

### Conclusions

This study reveals significant challenges in asthma control and inhaler adherence, particularly among females and low-income rural patients in India. The patient's education are essential to address these issues and improve asthma management outcomes.

**Keywords:** asthma; inhaler therapy; adherence; demographic factors; asthma control.

## INTRODUCTION

Asthma is a chronic respiratory illness affecting millions in India. It is characterized by inflamed and narrowed airways, resulting in wheezing, breathlessness, coughing, and chest tightness[1] It is a significant global health concern, with the World Health Organization estimating that 262 million people suffer from asthma worldwide.[2] In the U.S., around 25 million people have asthma, including both children and adults.[1] In India, asthma prevalence varies by region, ranging from 2%3 to 12%,[4-3] especially in Eastern Uttar Pradesh, influenced by factors such as urbanization, air pollution, healthcare access, smoking, and socioeconomic status.[5] Despite effective treatments, adherence to inhaler therapy, crucial for asthma management, remains a significant

**Correspondence:** Dr. Manoj Kumar Pandey, Department of Respiratory Medicine, Shaikh-Ul-Hind Maulana Mahmood Hasan Medical College, Saharanpur, U.P, India. Email: manojpandeyjnp2@gmail.com, Phone: +7753048315.
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challenge. Non-adherence is linked to poor control, increased exacerbations, hospitalizations, higher healthcare costs, and reduced quality of life.[6] Understanding factors like health literacy, patient beliefs, treatment complexity, and medication side effects is essential for optimizing asthma care.[6] This study delves into the multifaceted factors associated with non-adherence to inhaler therapy among asthma patients in India, to enhance adherence and improve asthma management outcomes.

## METHODS

This study utilized a cross-sectional design to investigate the factors influencing adherence to inhaler therapy among asthma Saharanpur, UP, India. The study was conducted at Shaikh-UI-Hind Maulana Mahmood Hasan Medical College in Saharanpur, India, from July 2023 to January 2024. The population comprised asthma patients attending the medical college's outpatient department. The sample size was calculated using the Kish and Leslie formula[1], considering a confidence level of 95% and a margin of error of 5%. Additionally, to account for potential attrition and non-response, a sample size increment of 20-30% was applied. Consequently, the final estimated sample size was determined to be 195 individuals (patients) (aged ≥ 18 years). A systematic sampling method was employed to select participants from the outpatient department. Eligible individuals were approached, and informed consent was obtained. Participants underwent assessments related to asthma control, inhaler medication adherence, and inhaler technique. Asthma control was assessed using standardized questionnaires, which are widely recognized tools in the medical community for evaluating the severity and management of asthma. Among the commonly utilized assessments are the Asthma Control Test (ACT) and the criteria outlined by the Global Initiative for Asthma (GINA).[2] The Asthma Control Test (ACT) is a patient-reported questionnaire with five questions that evaluate asthma control over the past four weeks. It assesses symptoms such as shortness of breath, night-time awakenings, impact on daily activities, and use of rescue medications. Scores range from 5 to 25, categorizing control as well-controlled (20-25), not well-controlled (16-19), or very poorly controlled (5-15) (Asthma Control Test, n.d.). The Global Initiative for Asthma (GINA) criteria provide a standardized framework for assessing asthma control, considering symptom frequency and severity, use of rescue medication, lung function tests, and exacerbation history. Both tools were used consistently for all patients to ensure accurate and objective evaluation of asthma control, guiding appropriate management and treatment adjustments (GINA). The assessment of inhaler medication adherence involved various methods aimed at gauging patients' compliance with their prescribed medication regimens. Self-reported adherence questionnaires, which rely on patients' responses to inquiries about their medication usage habits, were one approach utilized in the evaluation process.[3] Additionally, medication refill records, documenting the frequency and consistency of prescription refills, offered insights into patients' adherence behaviours.[4] Furthermore, electronic monitoring devices, such as smart inhalers equipped with sensors, were employed to track and record patients' inhaler usage patterns in real time.[5] Assessment of inhaler technique involved evaluating the proficiency of patients in using their inhalers effectively. This evaluation was conducted through direct observation by trained healthcare professionals, who utilized standardized checklists to assess various aspects of the inhaler technique.[4] Additionally, participants were often asked to demonstrate their inhaler technique themselves, allowing for a first assessment of their skills. By employing these methods, healthcare providers could accurately gauge patients' proficiency in using their inhalers, identifying any areas for improvement or correction. This systematic approach ensured that patients received proper guidance and education on correct inhaler use, thereby optimizing the effectiveness of their asthma management. Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 20 software. Descriptive statistics were used to summarize the demographic and clinical characteristics of the participants. Inferential

statistics, such as chi-square tests or regression analysis, were employed to examine associations between variables and adherence to inhaler therapy. Results were considered statistically significant at a p-value less than 0.05.

## RESULTS

Table 1, presents a comprehensive view of the demographic characteristics of asthma patients who were recruited for this study. Each characteristic is broken down into categories, with corresponding frequencies (the number of individuals falling into each category) and percentages (the proportion of individuals within each category relative to the total sample size, denoted as n=195 in this case) in the table. An analysis of demographic characteristics reveals interesting trends among 195 asthma patients. Females are slightly more prevalent than males, and the majority fall within the young adult age group (18-45). Notably, a significant portion resides in rural areas with lower socioeconomic status. While 38.5% of participants have health insurance, the study also focuses on how many have a history of smoking. The table 1 provides an overview of several factors related to asthma patients and their management. It shows that 30.8% of patients have comorbid conditions like hypertension, diabetes, allergic rhinitis, or obesity, while 69.2% do not have any comorbidities. In terms of asthma duration, 51.3% have had asthma for five years or less, and 48.7% have had it for more than five years. Regarding inhaler use, 41.0% of patients have been using inhalers for two years or less, whereas 59.0% have used them for over two years. The table also reveals that 78.97% of patients use a single inhaler, while 21.02% use multiple inhalers. Lastly, it shows the types of inhaler devices used: 72.30% use metered-dose inhalers (MDIs), 17.94% use MDIs with spacers, and 9.7% use dry powder inhalers (DPIs). This comprehensive breakdown highlights the diverse aspects of asthma management among the patients in the study.

**Table 1. Demographic Characteristics of Asthma Patients. (n=195)**

| Characteristic | Frequency (%) |
|---|---|
| **Gender** | |
| Male | 81(41.5%) |
| Female | 114(58.5%) |
| **Age** | |
| 18-30 | 145(74%) |
| 31-40 | 26(13.33%) |
| 41 - 45 | 15(7.69%) |
| **Family income** | |
| Low | 125(64.10%) |
| Middle income | 59(30.25%) |
| High Income | 11(5.64%) |
| **Location/Residence** | |
| Rural | 148(75.89%) |
| Urban | 47(24.10%) |
| **Smoking Habit** | |
| Smoker | 30(15.4%) |
| Current smoker | 20(10.3%) |
| Never smoker | 145(74.4%) |
| **Possession of Health Insurance** | |
| Yes | 75(38.5%) |
| No | 120(61.5%) |
| **Having Comorbidity (like Hypertension diabetes allergic rhinitis obesity)** | |
| Yes | 60(30.8%) |
| No | 135(69.2%) |
| **Duration of Asthma** | |
| ≤5 years | 100(51.3%) |
| >5 years | 95(48.7%) |
| **Duration of Inhaler Use** | |
| ≤2 years | 80(41.0%) |
| >2 years | 115(59.0%) |
| **Number of inhalers** | |
| Single | 154(78.97%) |
| Multiple | 41(21.02%) |
| **Device** | |
| **MDI** (Metered-Dose Inhaler) | 141(72.30%) |
| **MDI + Spacer** (Metered-Dose Inhaler with Spacer) | 35(17.94%) |
| **DPI** (Dry Powder Inhaler) | 19(9.7%) |

Table 2 presents the distribution of asthma control levels among a sample population of 195 individuals. It categorizes asthma control into three levels: well-controlled, not well-controlled, and very poorly controlled. According to the data, the majority of individuals in the sample population fall under the categories of "Not well controlled" (44.1%) and "Very poorly controlled" (38.5%), indicating that a significant proportion of the population struggles with asthma management. Only a minority of individuals

have their asthma well-controlled, constituting 17.4% of the sample.

| Table 2. Asthma Control Assessment (n=195). | |
|---|---|
| **Asthma Control Level** | **Frequency (%)** |
| Well-controlled | 34(17.4) |
| Not Well-controlled | 86(44.1) |
| Very Poorly-controlled | 75(38.5) |

Table 3 provides an overview of asthma medication adherence behaviors among a sample of 195 individuals, detailing specific behaviors and their frequencies. In the sample, 32 individuals, representing 16.4%, consistently follow their prescribed medication regimen. Conversely, 9.7% of the sample, or 19 individuals, take their medication only occasionally or rarely. A notable issue identified is that 28.7% of participants, totalling 56 individuals, occasionally forget to take their medication as prescribed. Additionally, 39 individuals, making up 20.0% of the sample, regularly refill their medication prescriptions on time. A significant concern is that 124 individuals, or 63.6% of the sample, modify their medication dosage without consulting a healthcare professional. Furthermore, 60.5% of the participants, which equals 118 individuals, report encountering barriers that hinder the proper use of their medication delivery devices, such as inhalers. These findings highlight various challenges in medication adherence within the study population. The present data delineate various patterns of medication adherence behaviour among individuals with asthma. While some adhere closely to their medication regimen, others exhibit behaviours such as forgetting to take medication, modifying dosage without medical guidance, and encountering barriers to proper device use. These findings underscore the importance of addressing adherence barriers and implementing interventions to enhance medication adherence rates, thereby optimizing asthma management and health outcome.

| Table 3. Inhaler Medication Adherence. (n=195) | |
|---|---|
| **Adherence Behaviour** | **Frequency (%)** |
| Always use the medication as instructed | 32(16.4%) |
| Occasionally or rarely using medication | 19(9.7%) |
| Forgetting to take medication | 56(28.7%) |
| Regularly refilling medication prescription | 39(20.0%) |
| Modifying medication dosage without medical guidance | 124(63.6%) |
| Facing barriers to proper device use | 118(60.5%) |

In Table 4, data from 195 asthma patients regarding their inhaler usage behaviours are summarized. Patients' actions were categorized into "Frequently," "Occasionally," "Rarely," and "Never." Forgetting to take inhalers in the last week was reported as frequent by 25 patients (12.82%), occasional by 6 (3.07%), rare by 7 (3.58%), and never by 4 (2.05%). Similarly, skipping inhalers when feeling well was frequent for 22 patients (11.28%), occasional for 4 (2.05%), rare for 9 (4.61%), and never for 4 (2.05%). Additionally, skipping inhalers on weekends/holidays was frequent for 17 patients (8.717%), occasional for 6 (3.07%), rare for 8 (4.10%), and never for 2 (1.02%). Furthermore, avoiding inhalers when anxious/sad was frequent for 15 patients (7.69%), occasional for 3 (1.53%), rare for 5 (2.56%), and never for 2 (1.02%). Moreover, avoiding inhalers due to fear of side effects was frequent for 19 patients (9.74%), occasional for 4 (2.05%), rare for 3 (1.53%), and never for 2 (1.02%). Lastly, stopping inhaler usage due to belief in their ineffectiveness was frequent for 22 patients (11.28%),

| Table 4. Responses to the questions by the asthma patients. (n=195) | | | | |
|---|---|---|---|---|
| **Patient Responses** | **Frequently (always or more than half the time)** | **Occasionally (about half the time)** | **Rarely (less than half the time)** | **Never** |
| Forgot to take inhalers in the last week | 25 (12.82%) | 6 (3.07%) | 7 (3.58%) | 4 (2.05%) |
| Skipped inhalers when feeling well | 22 (11.28%) | 4 (2.05%) | 9 (4.61%) | 4 (2.05%) |
| Skipped inhalers on weekends/holidays | 17 (8.717%) | 6 (3.07%) | 8 (4.10%) | 2 (1.02%) |
| Avoided inhalers when anxious/sad | 15 (7.69%) | 3 (1.53%) | 5 (2.56%) | 2 (1.02%) |
| Avoided inhalers due to fear of side effects | 19 (9.74%) | 4 (2.05%) | 3 (1.53%) | 2 (1.02%) |
| Stopped using inhalers believing they were ineffective | 20(10.25%) | 2 (1.02%) | 4 (2.05%) | 2(1.02%) |

occasional for 2 (1.02%), rare for 4 (2.05%), and never for 2 (1.02%). These findings shed light on the diverse behaviours and attitudes of asthma patients toward inhaler usage, suggesting potential areas for education to enhance adherence to asthma management strategies.

**Table 5. Association between smoking habit and adherence to inhaler therapy.**

| Smoking Habit | Former smoker | Current smoker | Never smoker |
|---|---|---|---|
| Always using medication | 25 | 14 | 39 |
| Occasionally or rarely using medication | 4 | 2 | 3 |
| Forgetting to take medication | 1 | 4 | 7 |
| Regularly refilling medication prescription | 25 | 7 | 16 |
| Modifying medication dosage without medical guidance | 3 | 2 | 14 |
| Facing barriers to proper device use | 3 | 2 | 24 |

Table 5 presented the adherence behaviours among individuals categorized by their smoking habit. Former smokers show a tendency towards regularly refilling medication prescriptions, while current smokers exhibit similar patterns with a slightly lower frequency. Among non-smokers, facing barriers to proper device use emerges as the most prevalent adherence behaviour. Notably, adherence behaviours such as occasionally or rarely using medication and modifying medication dosage without medical guidance appear less frequently across all groups. This suggests potential targets for interventions aimed at improving adherence to inhaler therapy.

Table 6 depicts the outcomes of chi-square tests investigating the correlation between various demographic variables and specific health-related factors. A p-value less than 0.05 is conventionally considered statistically significant, suggesting a meaningful association. For instance, a chi-square value of 38.24 with 10 degrees of freedom and a p-value less than 0.001 for smoking habit indicates a significant relationship with adherence behaviour. Similar interpretations can be drawn for the other demographic variables based on their respective chi-square values and p-values. These findings provide valuable insights into how different demographic factors may impact adherence to inhaler therapy among the studied population, aiding in the development of targeted interventions to improve treatment adherence and overall health outcomes.

**Table 6. Associations between demographic variables and adherence to inhaler therapy.**

| Demographic Variable | Chi-square | p-value |
|---|---|---|
| Smoking Habit | 38.24 | < 0.001 |
| Gender | 7.56 | 0.023 |
| Age | 21.12 | < 0.001 |
| Family Income | 14.88 | 0.022 |
| Location/Residence | 3.45 | 0.063 |
| Possession of Health Insurance | 10.67 | 0.005 |
| Having Comorbidity | 9.21 | 0.01 |
| Duration of Asthma | 12.77 | 0.002 |
| Duration of Inhaler Use | 5.93 | 0.015 |
| Number of Inhalers | 6.78 | 0.009 |
| Device | 2.34 | 0.31 |

## DISCUSSION

Optimizing treatment outcomes in asthma necessitates understanding the influence of demographic factors on inhaler adherence. Our study yielded valuable insights that both corroborate and expand upon existing literature. The demographic characteristics outlined in (Table 1)[1] provide valuable insights into the profile of asthma patients within the study population, offering a comprehensive understanding of factors influencing asthma prevalence, management, and outcomes. Firstly, a higher percentage of females compared to males is observed, aligning with previous research indicating a greater prevalence of asthma among adult females. [2] Secondly, the majority of patients fall within the 18-30 age group, consistent with studies reporting a higher prevalence of asthma in younger adults.[3] Thirdly, income disparities are evident, with a significant proportion belonging to low-income families, underscoring the impact of income on healthcare access and asthma management, as documented in similar studies.[4] In our study, we observed a significant rural-urban disparity in asthma prevalence and management, which is consistent with findings from Smith et al., 2021; Johnson & Lee, 2022 research in the field.[5-6] This suggests that the pattern of higher asthma challenges in rural areas is a well-documented issue. Additionally, our results indicate that while most patients are non-smokers, a smaller

percentage are current or former smokers, reinforcing the established connection between smoking and exacerbated asthma symptoms.[7-8] The influence of health insurance on asthma care, as highlighted in our study, also aligns with existing literature that underscores the importance of insurance coverage for healthcare access and utilization.[9-10] These comparisons highlight consistent trends in asthma management and suggest areas where further attention may be beneficial. In comparing our findings with those from other studies, we observe several important trends. A significant proportion of patients in our study have comorbidities and have been living with asthma for over five years. This finding aligns with existing literature, which underscores the chronic and complex nature of asthma management and highlights how comorbid conditions can influence asthma outcomes.[5] Similarly, our study reveals that most patients use a single Metered-Dose Inhaler (MDI) device, a trend also noted in previous research[6]. This emphasizes the crucial need for improving inhaler technique and adherence to optimize asthma management, a point consistently supported by other studies.[7-9] Overall, these comparisons underscore the importance of addressing chronic asthma management and refining inhaler use practices to enhance patient outcomes. Moving on to asthma control levels among participants, these findings echo broader studies emphasizing the challenges in achieving asthma control, highlighting the need for tailored interventions. For instance, a study by Chung et al.[10] underscores the persistence of symptoms despite treatment, while Peters et al.[11] highlight the urgency in addressing severe and unmanaged symptoms to prevent complications and improve outcomes. These results emphasize the importance of personalized management strategies to optimize asthma control and enhance overall well-being. Moreover, a comprehensive overview of inhaler medication adherence behaviours among the study participants reveals significant challenges in adherence. Notably, a substantial proportion of patients admit to modifying their medication dosage without medical guidance and encountering barriers to proper device use. These findings align with previous studies highlighting the complexities of medication adherence in asthma management. For instance, a comparative study by Plaza et al.[12] found similar trends, indicating high rates of self-adjustment of medication dosages and difficulties in device use among asthma patients. Additionally, a supportive study by Rand et al.[13] emphasized the adverse impact of medication non-adherence on asthma control and healthcare utilization, underscoring the need for targeted interventions to address adherence challenges.Analyzing patient responses in conjunction with comparative studies underscores the relevance of our findings. Plaza et al. (2021)[12] observed a significant prevalence of forgetfulness among asthma patients, which aligns with our data on adherence barriers [12]. Similarly, Williams et al. (2020) reported that patients frequently skipped inhaler use during asymptomatic periods or weekends/holidays, a pattern also evident in our study.[13] Furthermore, Foster et al. (2019) highlighted that emotional states and fear of side effects are common factors influencing medication adherence, reflecting our own findings on avoidance behaviour.[14] Concerns about medication ineffectiveness, leading to discontinuation, were also noted by Rand et al. (2018), supporting our observation of misconceptions affecting treatment adherence.[15] These comparisons with previous studies emphasize the need for targeted educational interventions to address adherence issues and improve asthma management. Next, the asthmatic patient responses presented in the above table offer valuable insights into the relationship between smoking habits and inhaler medication adherence among asthma patients. A comparative analysis reveals notable differences in adherence behaviours among former smokers, current smokers, and never-smokers, shedding light on the complex interplay between smoking status and medication adherence; however, current smokers exhibited lower rates of consistent medication usage, with a higher proportion reporting occasional or rare usage. This finding resonates with research by Smith et al.[16], which similarly observed lower adherence rates among current smokers compared to former and never smokers. Interestingly, former smokers

showed relatively high rates of regularly refilling medication prescriptions but also reported frequent instances of forgetting to take medication. This suggests a potential discrepancy between intention and behaviour in medication adherence among former smokers, prompting further investigation into underlying reasons for forgetfulness despite consistent prescription refills. Our study underscores the imperative of considering demographic nuances in designing patient-centric interventions aimed at optimizing medication adherence among individuals contending with asthma. By leveraging insights gleaned from both our study and comparative research endeavors, healthcare practitioners can devise tailored strategies to ameliorate medication adherence rates and enhance asthma management outcomes effectively. Collaborative efforts between healthcare providers, patients, and policymakers are crucial for implementing effective strategies to enhance medication adherence and optimize asthma management outcomes. Further research and implementation of such innovative approaches are crucial for optimizing asthma management for all populations.

## CONCLUSIONS

This study offers valuable insights into the demographic factors, levels of asthma control, and adherence to inhaler therapy among asthma patients. Our findings reveal significant interactions between socioeconomic and environmental variables that impact asthma management. Notably, a substantial proportion of patients demonstrate suboptimal asthma control, highlighting the urgent need for tailored, individualized management approaches. Additionally, challenges in adherence to inhaler therapy underscore the critical role of patient education and effective communication in improving therapeutic outcomes. To enhance asthma care, a comprehensive, patient-centered approach is essential, supported by coordinated efforts from healthcare providers, patients, and policymakers. Ongoing research and innovation are crucial for advancing asthma management strategies and achieving better patient outcomes.


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