Original Article

Suboptimal compliance to aerosol therapy in pediatric asthma: A prospective cohort study from Eastern India

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ABSTRACT

Background: Suboptimal compliance to aerosol medication is common in pediatric asthma. Accordingly, the objective of this study is to assess noncompliance to aerosol therapy in childhood asthma and determine contributory factors. **Materials and Methods:** A prospective cohort study was conducted among pediatric patients attending asthma clinic. Patients (n = 215) having "mild" and "moderate" asthma severity rating were included. The total study duration was 12 months (June 2016–June 2017), with an active recruitment phase of 6 months. The minimum period for follow-up was 90 days. Caregivers were instructed to maintain an "asthma diary" for daily dosages of inhalers. At follow-up, the diary entries were corroborated with the amount of inhaler medication unused. Subsequently, medication compliance ratio (CR) was calculated according to the following formula: CR = number of medication doses taken/number of medication doses prescribed. CR% >80 was considered as "good compliance". **Results:** A total of 169 patients (78.6%) returned for follow-up. The mean compliance to asthma medication was suboptimal (75.3%). The children were primarily prescribed inhaled corticosteroids and short-acting beta-agonist (SABA)-based regimens on index visit. Leukotriene receptor antagonist was added in select cases (67.9%). Nearly 45.6% of the patients had "good compliance." CR correlated with the sociodemographic profile and disease severity. Higher socioeconomic status and proper inhaler technique reflected better symptom control. Fear of side effects, behavioral difficulties, and economic restrictions were the identified causes of medication default. **Conclusion:** In the Eastern part of India, compliance to aerosol therapy in pediatric asthma is suboptimal. Sociodemographics, disease severity, and inhaler technique are important determinants.

KEY WORDS: Asthma, education, patient compliance, treatment, predictors

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BACKGROUND

Preventive medication is the cornerstone of treatment for children with asthma, and studies have reported an adherence rate of 50%–70%.[1] As per the *Global Initiative for Asthma* (GINA), 2017,[2] quick relievers, inhaled short-acting beta-agonist (SABA), or oral corticosteroids (OCS) and/or controllers such as inhaled corticosteroids (ICS) with or without concomitant use of long-acting beta-2-agonists (LABA), or leukotriene receptor antagonists (LTRAs), can be used for asthma therapy in children. However, suboptimal adherence to maintenance treatment, particularly aerosolized formulations, is one of the prime concerns in worsening pediatric asthma symptomatology.[1,3] Contributing factors

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to medication noncompliance such as unnecessary medication, toxicity, treatment failure, increased incidence of adverse events, medical complications, cost of therapy, and increased morbidity have resulted in poor disease control, suboptimal quality of life, and overuse of the health-care system.[4]

Study rationale

Knowledge on the use of and compliance to asthma treatment in real life may offer opportunities to optimize asthma treatment in children by new adherence interventions. Absence of robust Indian data prompted us to investigate our objectives, which were to study compliance to aerosol therapy in pediatric asthma and determine contributory factors. The data described herein offer, for the first time, an insight into aerosol treatment compliance rate in eastern part of India.

MATERIALS AND METHODS

Ethics and consent

This prospective cohort study was conducted after the protocol approval by the institutional ethics committee (MC/KOL/IEC/NON SPON/234/12-2015) at Calcutta Medical College and Hospital (CMCH), Kolkata. The study design conformed to the Declaration of Helsinki II. Written informed consent and assent were obtained from the participants and caregivers, as appropriate. Patients below 5 years of age were excluded (because of possible wheezing symptoms that can be misinterpreted as asthma).

Study population

The source population comprised of pediatric patients (age: 5–12 years) attending the asthma clinic at CMCH, Kolkata. Patients with "mild" and "moderate" asthma severity rating as per the *GINA* 2017[2] guidelines were included. The cohort included patients who were previously receiving controller therapy (CTT) (inhaler). For verification of the total asthma cohort, all medical records were reviewed by a senior pulmonologist. Patients having "uncontrolled" asthma, immunocompromised status, or any other major illnesses were excluded.

Study design

The study period was 12 months (June 2016–June 2017), with an active recruitment phase of 6 months. Each patient was followed up for a minimum period of 90 days from the date of enrollment. Caregivers and children (>5 years) were interrogated according to a standard protocol and were asked to maintain an "asthma" diary for daily dosages of inhalers. Following enrollment, the natural course of disease, complications, and the importance of aerosol therapy were explained. Use of spacers with metered-dose inhaler (MDI) was encouraged. The parents were told to monitor symptoms daily and maintain the asthma diary. Compliance ratio (CR) for the prescribed medications was assessed on follow-up after 90 days as follows:

$$CR = \frac{\text{Number of doses of medication taken}}{\text{Number of doses of medication prescribed}}$$

The caregiver was instructed to put an entry into the asthma diary, every time a medication dose was taken. They were instructed to bring this diary at every follow-up, along with the medication. Entries were corroborated with the amount of medication unused, which gave an indirect estimate of usage in the follow-up period. Thorough history was taken in case of any discrepancy. Good compliance was assumed when the CR% >80, i.e., >80% of prescribed number of doses were taken.

Follow-up

On follow-up (after 90 days), patient diary was checked, and the caregiver was interrogated using a standard prevalidated questionnaire to determine medication compliance. History regarding day–night symptoms and exacerbation was recorded, followed by a thorough clinical examination. The decision to "step-up" or "step-down" therapy or continue the same therapy was made. Patient and caregiver education programs were conducted regularly.

Statistical analysis

Baseline characteristics were analyzed by descriptive statistics and were presented as mean ± standard deviation (SD) or median (interquartile range [IQR]), as indicated. Normality was tested using Kolmogorov–Smirnov goodness-of-fit test. Proportions were described with 95% confidence interval (95% CI). A clustered analysis was done to check the timing of prescriptions, to identify patients with periodic asthma. A bivariate analysis was done to assess for variables affecting CR. Significant factors were subsequently compared through multivariate logistic regression. A two-tailed $P < 0.05$ was considered statistically significant. Analyses were conducted using SPSS for Windows version 20.0 (SPSS Inc., Chicago, IL, USA).

Sample size

Because the prevalence of medication adherence in pediatric asthma is approximately 30%–70% (average 50%),[5-7] it was calculated that 150 patients would be required to detect an average responder rate of 60%. Expected variation (type-1 probability error) was kept at 5% with 80% power. Considering 40% dropout rate, 215 patients were enrolled overall over a period of 6 months.

RESULTS

Sociodemographics

Baseline patient characteristics are described in Table 1. The study participants comprised 215 children with asthma, aged 5–12 years (mean = 8.0, SD = 1.72) and residing mostly in urban areas (61.9%). The cohort had a male preponderance (56.6%). Most participants identified

Table 1: Baseline data for 215 patients

Determinants	*n* (%)
Age groups (years)	
5-7	87 (40.5)
8-10	106 (42.4)
11-12	22 (10.2)
Mean±SD	8±1.72
Residence	
Rural	82 (38.1)
Urban	133 (61.9)
Religion	
Hinduism	112 (52.1)
Islam	103 (47.9)
SES[a]	
Upper	41 (19.1)
Middle	118 (54.9)
Lower	56 (26.0)
Gender	
Male	122 (56.7)
Female	93 (43.3)
Education	
Schoolgoing	207 (96.3)
Nonschoolgoing	8 (3.7)
ICS monotherapy	69 (32)
Education of caregiver	
None	36 (16.7)
Primary	29 (13.5)
Secondary	50 (23.3)
Graduate	58 (27)
Postgraduate	42 (19.5)
Comorbidities	
None	93 (43.2)
Obesity	44 (20.4)
Rhinosinusitis	31 (14.4)
Allergic condition	47 (21.8)
Asthma severity[§]	
Mild	69 (32.01)
Moderate	146 (67.9)
Severe persistent	0
Duration of CTT (months)	
>3	188 (87.4)
<3	27 (12.6)
Family history of asthma	
Yes	112 (52.1)
No	103 (47.9)
Use of concomitant medication**	21 (9.8)
ICS+LTRA prescriptions	146 (67.9)

[§]As per the GINA 2017 guidelines, **Frequency of simultaneous use of any other medication except for asthma (e.g., multivitamins), [a]As per the updated modified B.G. Prasad Classification. SD: Standard deviation, CTT: Controller therapy, ICS: Inhaled corticosteroids, LTRA: Leukotriene receptor antagonist, GINA: Global Initiative for Asthma

themselves as Hindu (52.1%) or Muslim (47.9%). Most children were schoolgoing (96.3%); however, majority of the caregivers had not completed graduation (53.5%). The average socioeconomic status (SES) across families fell within "middle class" (54.9%), classified as per the updated B.G. Prasad classification.[8]

At follow-up (after 90 days), 169 children (78.6%) were available for examination (loss to follow-up: 21.3%). Majority of the participants returning were in the age category of 5–7 years (44.9%) and 8–10 years (36.7%) and identified themselves as Hindu (63.9%) from "middle class" SES (68.6%) [Table 2].

Table 2: Available data from 169 patients at first-follow up

Determinants	*n* (%)
Gender, *n* (%)	
Male	109 (62.7)
Female	60 (35.5)
Age (years), *n* (%)	
5-7	76 (44.9)
8-10	62 (36.7)
11-13	31 (18.3)
Family SES[a], *n* (%)	
Upper	39 (23)
Middle	116 (68.6)
Lower	14 (8.3)
Religion, *n* (%)	
Hindu	108 (63.9)
Islam	61 (36)
Asthma symptom control[§], *n* (%)	
Well controlled	77 (45.6)
Partly controlled	75 (44.4)
Uncontrolled	17 (10.1)
SABA utilization**, *n* (%)	
<1 canister/month	166 (98.2)
>1 canister/month	3 (1.8)
Visits to emergency[##], median (IQR)	0.6 (0.2-0.8)
Use of relief medication[#], median (IQR)	4 (0-14)
Exposure to smoke/allergen, *n* (%)	
Yes	73 (43.2)
No	96 (56.8)
Proper inhaler technique, *n* (%)	
Yes	109 (64.5)
No	60 (35.5)
Compliance ratio, *n* (%)	
>0.8	77 (45.6)
<0.8	92 (54.4)
Mean compliance ratio (%)	75.3

[§]As per the GINA 2017 guidelines, **1 canister: 200 metered dose, [#]Use of relief medication for asthma per week, [##]Number of visits to emergency for asthma attacks in the last 90 days, [a]As per the updated B.G. Prasad Classification. SES: Socioeconomic status, SABA: Short-acting beta-agonist, IQR: Interquartile range

Disease characteristics

At index visit, majority of the patients were found to have "moderate" asthma (67.9%), with a positive family history (52.1%). Most patients were on ICS (mostly budesonide, twice daily) and SABA (need basis), as two separate inhalers. An LTRA (montelukast) was found in majority of the prescriptions (67.9%). Significant proportions (87.4%) were receiving controller medications for >3 months. The commonly encountered comorbidities were obesity (20.4%), rhino-sinusitis (14.4%), and allergic conditions (21.8%) [Table 1].

Information related to the current disease status was recorded at follow-up [Table 2]. Level of symptom control was identified as "well controlled" in 45.6%, "partly controlled" in 44.4%, and "uncontrolled" in 10.1% of patients (categorized as per the GINA 2017 guidelines). None of the patients required LABA/OCS in the follow-up period.

The median (IQR) number of emergency visits in the follow-up period was 0.6 (0.2–1.0). SABA utilization was assessed as per residual doses in the drug canisters. Most

patients had used <1 SABA canister or 200 metered doses per month (98.6%). The median (IQR) number of SABA canisters used per month was 4 (0–14) [Table 2].

The patients were classified according to the level of compliance (good vs. poor compliance) [Table 3]. Statistically significant differences ($P < 0.001$) were noted in the "level of symptom control." In the "well-controlled" subgroup, children with good compliance (CR >0.8) were in a higher majority (71.5% vs. 31.2%, $P < 0.001$). On the other hand, proportions with poor compliance (CR <0.8) were statistically significantly higher in subgroups, namely, "partly controlled" (29.3% vs. 70.7%, $P < 0.001$) and "uncontrolled" (11.8% vs. 88.2%, $P < 0.001$) [Table 3].

Compliance to inhaled medications

The mean CR% was 75.3 (95% CI: 68.8–81.8) [Table 2]. The study cohort represented a wide range of compliance (0%–100%). Approximately 45.6% (95% CI: 38–53.1) of the patients had good compliance (CR% >80%). The mean ± SD age of the patients with good compliance was 9 ± 1.63 years, which was higher when compared to patients with poor compliance (CR% <80%) (8 ± 0.5 years). Compliance for ICS and ICS/LTRA was similar at 77.5% (95% CI: 71.2–83.8) and 73.5% (95% CI: 66.8–80.1), respectively. Good compliance was observed in 46.8% (95% CI: 35.1–58.4) of ICS users and 44.4% (95% CI: 36.3–52.4) of ICS/LTRA users.

Several factors were identified impacting medication compliance; however, SES ($r = 0.632$, $P < 0.001$), inhaler technique ($r = 0.616$, $P < 0.001$), and level of symptom control ($r = 0.809$, $P < 0.001$) demonstrated statistically significant correlation to the degree of compliance [Table 4].

Results in the correlation matrix [Table 4] were confirmed in the bivariate analysis between the level of compliance and major determinants [Table 5]. CR% was statistically significantly higher in children belonging to upper or middle SES (odds ratio [OR]: 3.4, 95% CI: 1.8–6.4, $P < 0.001$) and having proper inhaler technique (OR: 5.7, 95% CI: 3.1–10.4, $P < 0.001$). As expected, the level of symptom control in patients with poor compliance was more likely to be "partly controlled" (OR: 2.3, 95% CI: 1.1–5.1, $P < 0.037$) or "uncontrolled" (OR: 4.8, 95% CI: 2.3–10.1, $P < 0.001$).

However, previous findings [Table 5] were not confirmed on multivariate analysis. Patients with good compliance continued to demonstrate "well-controlled" symptomatology (OR: 2.6, 95% CI: 1.1–5.2, $P = 0.002$) [Table 6].

Causes of default

Several factors for noncompliance were observed. Fear of side effects (23%), behavioral difficulties (21.9%), and economic restriction (17%) were the most commonly encountered reasons [Figure 1].

Table 3: Compliance ratio versus symptom control on follow-up visit (*n*=169)

Level of symptom control[§]	CR >0.8, *n* (%)	CR <0.8, *n* (%)	*P*
Well controlled (*n*=77)	53 (71.5)	24 (31.2)	<0.001***
Partly controlled (*n*=75)	22 (29.3)	53 (70.7)	<0.001***
Uncontrolled (*n*=17)	2 (11.8)	15 (88.2)	<0.001***

***$P<0.001$, statistically significant, [§]As per the GINA 2017 guidelines. CR: Compliance ratio, GINA: Global Initiative for Asthma

Table 4: Correlation between select variables with compliance ratio (*n*=169)

Determinants	*r*	*P*
Age	−0.066	0.393
Religion	0.129	0.092
Gender	−0.093	0.226
SES[a]	0.632	<0.001***
Comorbidity	0.150	0.051
Education	0.047	0.543
Education of caregiver	−0.136	0.077
Residence	−0.142	0.064
Family history of asthma	−0.006	0.930
Duration of CTT	0.0346	0.652
Asthma severity[§]	−0.006	0.933
Asthma symptom control[§]	0.809	<0.001***
SABA utilization	0.123	0.112
Exposure to smoke/allergen	−0.017	0.818
Proper inhaler technique	0.616	<0.001***

***$P<0.001$, statistically significant, [§]As per the GINA 2017 guidelines. [a]As per the updated B.G. Prasad Classification. CTT: Controller therapy, SABA: Short-acting beta-agonist, SES: Socioeconomic status, *r*: Pearson's correlation, GINA: Global Initiative for Asthma

DISCUSSION

Medication noncompliance can be broadly categorized as unintentional (not understood) and intentional (understood but not followed).[9] Unintentional causes include misunderstanding of prescribed regimens, incorrect aerosol device technique, and language barrier. As described in previous sentence, unintentional (not understood) causes are different from intentional (understood but not followed) causes. In most cases, unintentional reasons are encountered and are perhaps easier to rectify.

Determinants of compliance

Route of administration: Oral versus aerosol

Put simply, oral route is generally more preferred because taking a capsule or liquid syrup is reasonably simple and quick, assuming normal swallowing reflex and consciousness. However, children tend to have a low tolerance of disagreeable taste. Moreover, associated risks of choking and limited dose flexibility are additional concerns.

MDI and dry powder inhaler (DPI) require multiple steps for correct use (MDI: shaking, exhaling, actuating, slow inhalation, and breath-hold; DPI: multistep preparation, breath-hold). In many ways, usage can be more complex in pediatric age group. In our setting, most patients were using MDI with a spacer (98%); hence, correct device technique

Table 5: Compliance ratio versus select variables and bivariate analysis (*n*=169)

Determinants	*n*	CR	OR	95% CI	*P*
Religion					
Hinduism	108	78.5	1.6	0.8-3.0	0.197
Islam	61	69.4			
SES[a]					
Upper/middle	155	79.4	3.4	1.8-6.4	<0.001***
Lower	14	52.8			
Gender					
Male	109	75.8	1.8	1.0-3.4	0.061
Female	60	68.3			
Education of caregiver					
Graduate and above	79	79.4	1.4	0.7-2.8	0.337
Below graduate	90	72.6			
Atopic condition					
Yes	48	78.8	1.7	0.9-3.7	0.123
No	121	68.2			
Asthma severity[§]					
Mild	77	73.2	1.2	0.6-2.2	0.639
Moderate	92	69.2			
Asthma symptom control[§]					
Well controlled	77	88.5	1		
Partly controlled	75	76.3	2.3	1.1-5.1	0.037*
Uncontrolled	17	61.2	4.8	2.3-10.1	<0.001***
Proper inhaler technique					
Yes	109	79.7	4.1	2.2-7.7	<0.001***
No	60	48.7			
Duration of CTT (months)					
<3	150	75.8	1.1	0.6-2.2	0.708
>3	19	72.5			

*$P<0.05$, ***$P<0.001$, statistically significant, [§]As per the GINA 2017 guidelines, [a]As per the updated B.G. Prasad Classification. CTT: Controller therapy, OR: Odds ratio, CI: Confidence interval, CR: Compliance ratio, SES: Socioeconomic status, GINA: Global Initiative for Asthma

Table 6: Compliance ratio versus select variables and multivariate analysis (*n*=169)

Determinant	Logistic OR	95% CI	*P*
Upper/middle SES[a]	1.8	1.6-4.2	0.852
Well controlled symptom[§]	2.6	1.1-5.2	0.002**
Proper inhaler technique	1.1	0.5-2.5	0.802

**$P<0.01$, statistically significant, [§]As per the GINA 2017 guidelines, [a]As per the updated B.G. Prasad Classification. SES: Socioeconomic status, OR: Odds ratio, CI: Confidence interval, GINA: Global Initiative for Asthma

was an important concern. As a result, demonstration of inhaler technique was particularly stressed at follow-up. There were no issues relating to LTRA tablet intake or "steroid phobia." Medication procurement or affordability was a minor issue because most patients received the medicines from hospital formulary free of cost.

Disease severity

Preliminary studies have revealed an inverse correlation between medication compliance and disease severity.[10,11] In many cases, patients with frequent or uncontrolled symptoms are not necessarily prompted to take their medications. On the contrary, our study data reflected that compliance seemed unrelated to disease severity and patients with good compliance had much better symptom control. However, the design of our study was not suitable to investigate the association between adherence and exacerbations as we did not censor on severe asthma exacerbation.

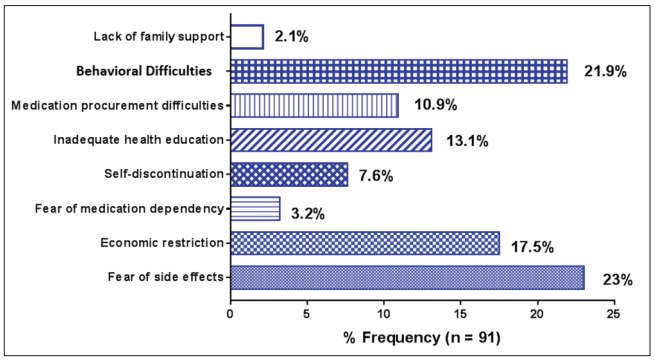

Figure 1: Major causes of default among patients with poor compliance

Compliance to guidelines

Unfortunately, compliance to treatment guidelines or physician instructions was also suboptimal in many of our study cases. This was largely attributed to ignorance on caregiver's part. Sociodemographic factors and therapy-related issues such as device severity, medication type, and cost did not significantly affect medication compliance rates, unlike previous studies, where such factors were found to be associated with an increased risk of hospital admission and asthma-related mortality.[5-7,12]

Age and gender

Interestingly, we did not find any correlation with age and gender with medication compliance. However, studies have reported that compliance falls with increasing age because the age at which children assume the responsibility of taking their medication reflects parents' confidence in their ability.[8,13,14] In practice, however, parents and children may not be aware of the limits of responsibilities. When the parent or the child believes the other to be primarily responsible for remembering to take medication, compliance is lower.[15]

Socioeconomic and family functions

Few studies have indicated that SES and medication compliance in children are unrelated.[16,17] We found a similar trend in our study. Social belief and family function have been regarded as important determinants of medication compliance. Studies have shown that conflicts within families affect children psychologically, and have an adverse impact on medication compliance rates.[16-18] However, in our study, we found that poor understanding of the disease or treatment process was more impacting on compliance rates than social factors.

Health education, knowledge, and communication

Many studies have failed to correlate knowledge, attitude, and practices regarding asthma therapy with the level of medication compliance,[19-21] which was also reflected in our study. This reiterates that simply providing information does not necessarily improve treatment compliance.

Physician interaction was an important determinant in our setting, and studies have reported that collaborative and polite physician interactions reported higher compliance rates.[22,23] Clark *et al*.[24] pointed out that when pediatricians were taught to provide simple messages combined with basic communication and counseling strategies, it resulted in improved asthma outcomes. Thus, apart from health education, it is also important to address parent beliefs and concerns and tailor patient-specific treatment strategies.

Complexity of regimens

Studies have reported that medication compliance in asthma is higher with once-daily oral nonsteroidal regimens compared to twice-daily ICS regimens.[25] The combination of ICS and SABA is associated with superior adherence in separate inhalers; however, data on combined medication are not available. There is low-level evidence that suggests reducing dosing frequency of prescribed medication improves compliance.[11,26] In our study, all patients received SABA (need-based only) in a separate inhaler, and dosing frequency remained unrelated to the degree of compliance.

Reminders

"Forgetting" and failing to take medicines was one of the most commonly cited reasons for noncompliance in our study.[11] Therefore, an integral part of our counseling at follow-up was to ensure that patients were compliant to prescribed regimens.

Quantifying compliance with aerosol regimens

The compliance rate in ICS versus ICS/LTRA users was similar across all age groups, although the absolute rates were relatively low. This could be due to the study methodology, although variations in compliance rates have been reported due to different study designs, adherence measures, and populations studied.[13] Children might be adherent to ICS, stop it due to few symptoms (but use rescue medication as needed), and be adherent to ICS again when symptoms return.

Type of inhaled medication: Inhaled corticosteroids versus SABA

Lower adherence to ICS in our study indicated that many patients could be using ICS as a rescue medication. This usually happens as a result of improper ICS prescribing, where patients are not asked to return for a follow-up visit. Resultantly, children who need long-term ICS therapy experience unmonitored discontinuation of therapy without corresponding order from their pediatrician.

Several studies have acknowledged that ICS is being used "as needed" (when asthma symptoms worsen) for mild asthma.[27-29] Because SABAs are used as quick relievers of symptoms and are used only when required, excessive SABA use indicates poor asthma control. We found no correlation between SABA utilization rates and medication compliance in our study. Moreover, SABA usage as a predictor of asthma-related outcomes/subsequent exacerbations and association between compliance to CTT to excessive SABA use is still unclear.

Overall, this study has many merits and reports important trends. It had a large population-based cohort with detailed information on prescriptions and comorbidities. The design precluded selection bias due to nonresponder or recall bias. Patients were registered in the asthma clinic, and data were collected as part of routine patient care, irrespective of any research question, thereby minimizing any interviewer bias. In addition, we were able to study age-, gender-, religion-, and SES-specific asthma treatment patterns by capturing outpatient prescription data.

Therefore, our study, perhaps the first of its kind in eastern part of India, could broaden the existing concept with regard to "compliance" to pediatric asthma medication. The entity itself involves active, voluntary, cooperative relationship between patients, caregivers, and health-care professionals in taking mutually acceptable measures to produce preventive and therapeutic health improvements.

However, there were few methodological limitations in this study. First, compliance was operationalized as "compliance ratio," which may not reflect the actual compliance. Just because a patient filled a patient diary does not guarantee that it was used, or used as prescribed, and in case of inhalers, used with the correct technique. Second, there was a lack of dispensing data on the actual drug intake. Third, some patients on dual therapy could be primarily monotherapy users who added another agent only for specific time periods. Fourth, the fact that a prescription reading "2 puffs 3 times daily" could result in wide variations in interpretations. Fifth, the severity of asthma can significantly influence adherence and outcomes; however, in our study, there was little opportunity to assess its impact directly (excluded).

CONCLUSION

In eastern part of India, the mean compliance to asthma medication in children is suboptimal (75.3%), although wide variations exist. Loss to follow-up is a major concern. Children are primarily prescribed ICS- and SABA (as required)-based regimens on index visit. LTRA is added in select cases. Factors such as sociodemographics and disease severity largely influence inhaled medication compliance rates. Higher SES and proper inhaler technique reflect better symptom control. Fear of side effects, behavioral difficulties, and economic restriction are the common causes of medication default.

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Conflicts of interest

There are no conflicts of interest.

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