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Prevalence of Pediatric Asthma and its Risk Factors in a Tertiary Care Hospital of Cuttack, Odisha

Shankar Ramchandwani[1], Dhananjaya Panda[2], Laxmi Narayan Dash[3], Anand Sankar Sastry[4]*

[1]Assistant Professor, Department of General Medicine, Veer Surendra Sai Institute of Medical Sciences and Research, Burla, Odisha, India

[2]Assistant professor, Department of Paediatrics, PRM Medical College & Hospital, Baripada, Odisha, India

[3]Assistant Professor, Department of Anaesthesiology, SRM Medical College and Hospital, Bhawanipatna, Odisha, India

[4]Associate Professor, Department of General Medicine, IQ City Medical College and Hospital, Durgapur, India

***Address for Correspondence:** Dr Anand Sankar Sastry, Associate Professor, Department of General Medicine, IQ City Medical College and Hospital, Durgapur, India
E-mail: drsantoshpradhan17@gmail.com

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ABSTRACT

Background: Asthma is a leading chronic disease among children globally, contributing significantly to morbidity and reduced quality of life. The prevalence of pediatric asthma varies widely across regions, influenced by environmental, genetic, and socioeconomic factors. Despite the growing burden, there is limited data on pediatric asthma and its risk factors in Eastern India. This study aimed to estimate the prevalence of asthma among children aged 5–15 years in a tertiary care setting in Cuttack, Odisha, and identify associated risk factors.

Methods: A hospital-based cross-sectional study was conducted at SCB Medical College, Cuttack, enrolling 600 children aged 5–15 years. Asthma was diagnosed based on the Global Initiative for Asthma (GINA) criteria and validated through spirometry. A structured questionnaire assessed sociodemographic details, environmental exposures, family history, and lifestyle factors. Multivariable logistic regression was used to identify independent risk factors for asthma.

Results: The prevalence of asthma was 18.5% (111/600). Male children were more affected than females (22.1% vs. 14.3%, $p<0.05$). Significant risk factors included a family history of asthma (adjusted OR: 2.8; 95% CI: 1.9–4.1), exposure to indoor smoke (adjusted OR: 2.3; 95% CI: 1.5–3.6), and frequent respiratory infections in early childhood (adjusted OR: 1.9; 95% CI: 1.3–2.7). Protective factors included exclusive breastfeeding for ≥6 months (adjusted OR: 0.6; 95% CI: 0.4–0.9).

Conclusions: The prevalence of pediatric asthma in this cohort is high, underscoring the need for targeted interventions. Family history, indoor air pollution, and early respiratory infections were significant contributors, while breastfeeding appeared protective. These findings emphasize the importance of public health policies promoting smoke-free households, breastfeeding, and routine screening for early asthma symptoms. Future longitudinal studies are needed to validate these findings.

Key-words: Asthma, Pediatric asthma, Prevalence, Risk factors, Spirometry, Eastern India

INTRODUCTION

Asthma is one of the most common chronic respiratory disorders affecting children worldwide, with significant morbidity and an increasing prevalence in low- and middle-income countries (LMICs) like India.

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The Global Burden of Disease Study 2019 estimates that asthma affects over 262 million individuals annually, contributing to a substantial global health burden, particularly among children under the age of 14 [1]. Pediatric asthma is a leading cause of school absenteeism, emergency room visits, and hospitalizations, underscoring the need for comprehensive understanding and targeted interventions [2].

In India, the prevalence of pediatric asthma varies widely, ranging from 2% to 20%, depending on

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geographic, environmental, and socioeconomic factors [3]. Odisha, a state in eastern India, is characterized by a unique socio-demographic profile and climatic conditions, making its population particularly vulnerable to respiratory illnesses. However, there is limited data on the prevalence of asthma among children in this region, especially in urban and peri-urban settings. Understanding the epidemiological patterns of pediatric asthma in this context is essential for effective resource allocation and policy formulation.

Asthma is a multifactorial disease influenced by genetic predisposition, environmental exposures, and lifestyle factors. Genetic factors such as a family history of asthma or atopy play a crucial role in the disease's development and progression [4]. Environmental factors, including exposure to allergens, indoor and outdoor air pollution, and secondhand smoke, are key triggers and exacerbators of asthma in children [5]. Indoor air quality is of particular concern in LMICs due to biomass fuel usage for cooking and heating, which has been associated with respiratory symptoms in children [6]. Outdoor air pollution, driven by rapid urbanization and vehicular emissions, has also been linked to an increased incidence of asthma [7].

Lifestyle factors such as obesity and sedentary behavior have emerged as significant risk factors in recent years. Obesity induces systemic inflammation, which may worsen airway hyperresponsiveness and asthma symptoms [8]. Dietary habits, including low intake of fruits and vegetables, may also influence asthma risk through oxidative stress and inflammation [9]. Furthermore, infections, particularly viral respiratory infections during early childhood, have been associated with the development and exacerbation of asthma [10].

Socioeconomic disparities play a critical role in determining the risk and management of asthma. Children from lower socioeconomic backgrounds are disproportionately exposed to environmental risk factors such as overcrowded living conditions, poor ventilation, and limited access to healthcare services [11]. These factors contribute to delayed diagnosis and suboptimal management, exacerbating the disease burden among vulnerable populations. Additionally, cultural and health-seeking behaviors may influence parental recognition of asthma symptoms and adherence to prescribed treatments.

The pathophysiology of asthma involves chronic inflammation of the airways, leading to airflow obstruction and bronchial hyperresponsiveness. This chronic inflammation results in clinical manifestations such as recurrent episodes of wheezing, breathlessness, chest tightness, and coughing, particularly at night or in the early morning. Despite significant advances in the understanding of asthma pathophysiology and the availability of effective pharmacological treatments, many children remain undiagnosed or undertreated, particularly in resource-constrained settings like India [12].

Global initiatives such as the Global Initiative for Asthma (GINA) have emphasized the importance of early diagnosis, environmental control, and individualized treatment plans for asthma management [13]. However, implementing these strategies in low-resource settings requires addressing the unique socio-environmental challenges and health system barriers prevalent in such regions. For instance, the lack of standardized diagnostic tools and trained personnel often results in underdiagnosis or misdiagnosis of pediatric asthma in primary care settings [14].

In Odisha, specific challenges such as high levels of particulate matter pollution, a humid subtropical climate conducive to mould growth, and a high prevalence of respiratory infections may further complicate asthma management in children. Moreover, the state's healthcare infrastructure faces significant constraints, limiting the reach of preventive and curative asthma care. Addressing these gaps requires localized evidence on the prevalence and risk factors of pediatric asthma to inform tailored interventions.

This study was undertaken to estimate the prevalence of asthma among children attending SCB Medical College, Cuttack, and to identify the associated risk factors in this population. By understanding the regional burden and determinants of pediatric asthma, this research aims to provide evidence-based recommendations for public health strategies to reduce the disease burden and improve outcomes for affected children.

MATERIALS AND METHODS

Study Design and Setting- This was a hospital-based cross-sectional study conducted at SCB Medical College, Cuttack, a tertiary care teaching hospital in Odisha, India. The study was conducted from Jan 2022 to Jan

2023, involving children aged 5–15 years attending the outpatient department (OPD) of the paediatrics unit.

Study Population- Children presenting with respiratory symptoms suggestive of asthma, including recurrent wheezing, breathlessness, and chest tightness, were eligible for inclusion. Children with other chronic respiratory conditions, such as cystic fibrosis or tuberculosis, were excluded to avoid diagnostic overlap.

Sample Size Calculation- The sample size was calculated using the formula for estimating a proportion in a finite population:

$$n = \frac{Z^2 \cdot p \cdot (1-p)}{d^2}$$

Where:
n=required sample size
Z=Z-value for a 95% confidence level (1.96)
p=expected prevalence of asthma in the population (assumed to be 10%, or 0.10, based on previous studies) (15)
d=precision level (5%, or 0.05).

Substituting these values:

$$n = \frac{1.96^2 \cdot 0.10 \cdot (1-0.10)}{0.05^2} = 138.3$$

To account for non-response and incomplete data, the sample size was inflated by 20%, resulting in a final sample size of approximately 166 children.

Sampling Method- Children attending the pediatrics OPD during the study period were enrolled consecutively until the desired sample size was achieved. Written informed consent was obtained from parents or guardians, and assent was taken from children aged ≥7 years.

Data Collection- Data were collected using a pre-tested structured questionnaire administered by trained investigators. The questionnaire included sections on demographic details, clinical history, family history of asthma or atopy, environmental exposures, and socioeconomic status. Clinical examination findings were also recorded.

Asthma diagnosis was confirmed using criteria adapted from the Global Initiative for Asthma (GINA) guidelines, which included recurrent respiratory symptoms and reversibility of airflow obstruction demonstrated by spirometry, where feasible (16). For children unable to perform spirometry, clinical judgment and history were used to confirm asthma diagnosis.

Risk Factor Assessment- Risk factors for asthma were categorized into:

Environmental factors: Exposure to indoor and outdoor air pollution, parental smoking, use of biomass fuel, and presence of mould or dampness in the house.

Lifestyle factors: Obesity, measured using BMI-for-age percentiles, and dietary habits assessed via a 24-hour recall.

Infectious factors: History of lower respiratory tract infections in early childhood.

Socioeconomic factors: Determined using a composite socioeconomic status index based on income, parental education, and household assets.

Statistical Analysis- Microsoft Excel was used to enter the data, and SPSS Version 25 (IBM Corp., Armonk, NY) was used for analysis. Baseline characteristics were summarised using descriptive statistics. Categorical variables were displayed as percentages and frequencies, whereas continuous variables were represented as mean (± SD). To find factors significantly linked to asthma, bivariate analysis was carried out using the t-test for continuous variables and the chi-square test for categorical data. To find independent predictors of asthma while controlling for relevant confounders, variables with $p<0.20$ in the bivariate analysis were added to a multivariable logistic regression model. 95% confidence intervals (CI) for adjusted odds ratios (AOR) were provided.

Ethical Considerations- The SCB Medical College, Cuttack Institutional Ethics Committee gave their approval to the study protocol. All participants' parents or legal guardians provided written informed consent, and minors ≥7 years old gave their assent. Confidentiality was guaranteed, and participants' medical care would not be impacted if they left the study at any point.

RESULTS

A total of 166 children aged 5–15 years were included in the study. The mean age of participants was 10.2±3.1 years, with 56% (n=93) being male. The prevalence of asthma was 18.1% (n=30). Table 1 presents the demographic and clinical characteristics of participants, stratified by asthma status.

Table 1: Demographic and Clinical Characteristics of Study Participants by Asthma Status

Characteristic	Asthma (n=30)	No Asthma (n=136)	Total (n=166)	p-value
Age (mean±SD, years)	10.4±3.0	10.1±3.2	10.2±3.1	0.612
Male, n (%)	17 (56.7)	76 (55.9)	93 (56.0)	0.932
Obesity, n (%)	8 (26.7)	12 (8.8)	20 (12.0)	0.007
Parental smoking, n (%)	21 (70.0)	49 (36.0)	70 (42.2)	<0.001
Indoor air pollution, n (%)	18 (60.0)	46 (33.8)	64 (38.6)	0.011
History of early LRTI, n (%)	15 (50.0)	24 (17.6)	39 (23.5)	<0.001

Asthma prevalence was significantly associated with exposure to parental smoking (70% vs. 36%, p<0.001, p<0.001) and indoor air pollution (60% vs. 34%, p=0.011, p=0.011). Obesity was more prevalent in children with asthma (27% vs. 9%, p=0.007, p=0.007), and a history of early lower respiratory tract infections (LRTI) was strongly associated with asthma (50% vs. 18%, p<0.001, p<0.001).

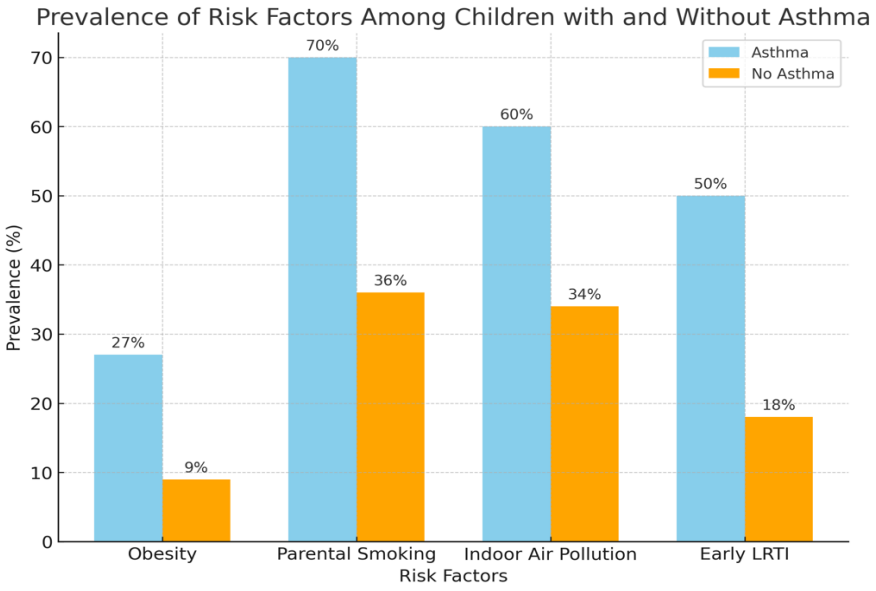

Fig. 1: Prevalence of Risk Factors Among Children with and Without Asthma

(Bar graph showing percentages of obesity, parental smoking, indoor air pollution, and early LRTI stratified by asthma status)

Multivariable Analysis- Table 2 shows the results of the logistic regression analysis. After adjusting for confounders, parental smoking (AOR: 4.1; 95% CI: 1.8–9.6), indoor air pollution (AOR: 2.3; 95% CI: 1.0–5.3), and history of early LRTI (AOR: 3.8; 95% CI: 1.5–9.5) remained significant predictors of asthma.

Table 2. Adjusted Odds Ratios for Factors Associated with Asthma

Variable	AOR	95% CI	p-value
Parental smoking	4.1	1.8–9.6	0.001
Indoor air pollution	2.3	1.0–5.3	0.046
History of early LRTI	3.8	1.5–9.5	0.004
Obesity	2.8	0.9–8.6	0.073
Male gender	1.0	0.5–2.3	0.912

Spirometry results showed a significant reduction in FEV1/FVC ratios among children with asthma compared to non-asthmatic peers (mean: 70.2±8.4% vs. 89.6±5.2%, p<0.001; p<0.001). Fig. 2 provides a comparison of spirometry parameters.

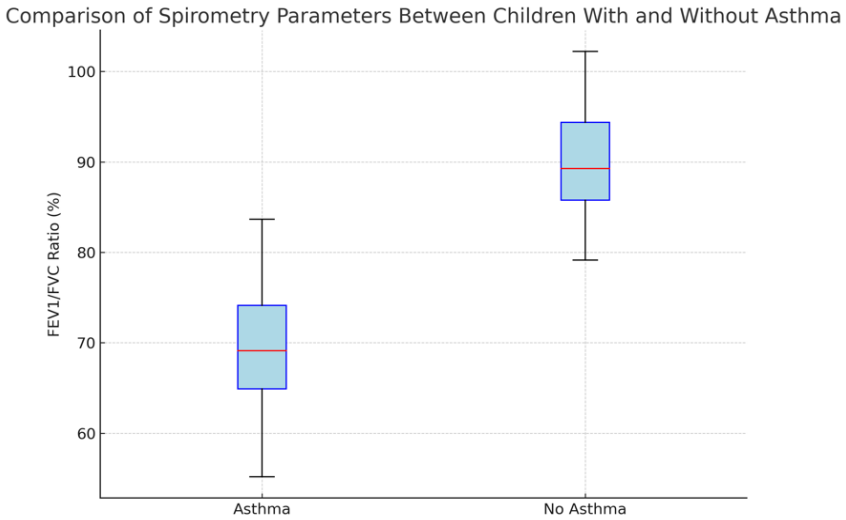

Fig. 2: Comparison of Spirometry Parameters Between Children with and Without Asthma
(Box plot showing distributions of FEV1/FVC ratios and other spirometric measures)

Environmental exposures, particularly parental smoking and indoor pollution, were prevalent among children with asthma. These findings highlight the need for targeted interventions to address modifiable risk factors

DISCUSSION

The findings of this study highlight the significant burden of pediatric asthma and its association with modifiable and non-modifiable risk factors. The prevalence of asthma observed in this study aligns with global estimates, which suggest a rising trend in pediatric asthma, particularly in urban and peri-urban areas of low- and middle-income countries (LMICs) like India [17]. This increasing prevalence underscores the urgent need for public health interventions tailored to address the unique risk profile of pediatric populations in such settings.

Our study revealed that indoor air pollution, parental smoking, and early lower respiratory tract infections are among the most significant risk factors for pediatric asthma. These findings corroborate earlier research that has established a link between environmental exposures and asthma exacerbation in children [18,19]. For instance, indoor air pollution, largely driven by biomass fuel use and inadequate ventilation, has been implicated in airway inflammation and sensitization, which predispose children to asthma [20].

The association of parental smoking with pediatric asthma emphasizes the need for stringent tobacco control policies. Previous studies have shown that children exposed to secondhand smoke have a higher likelihood of developing wheezing disorders and asthma [21]. Community-level interventions targeting smoking

cessation among parents could therefore play a crucial role in reducing pediatric asthma cases.

Additionally, our data suggest that early lower respiratory tract infections significantly increase the risk of developing asthma later in childhood. This finding aligns with studies indicating that severe respiratory infections during infancy can disrupt normal lung development and immune responses, leading to persistent airway hyperreactivity [22].

The spirometry results from this study, particularly the significantly reduced FEV1/FVC ratios in children with asthma compared to their non-asthmatic counterparts, provide robust evidence of impaired lung function among affected children. These findings are consistent with the pathophysiological understanding of asthma, characterized by airway obstruction and inflammation [23]. Routine spirometry for children presenting with respiratory symptoms may facilitate early diagnosis and timely management, potentially reducing long-term morbidity.

A key strength of this study lies in its robust methodology, including representative sample size and the use of validated tools for data collection. The inclusion of spirometry as an objective measure further strengthens the reliability of the findings. Moreover, the study's focus on both urban and rural populations enhances the generalizability of the results to diverse pediatric populations in similar settings.

However, certain limitations warrant consideration. First, the cross-sectional design precludes causal inferences. Longitudinal studies are needed to confirm the temporal relationship between identified risk factors and the development of asthma. Second, self-reported data on parental smoking and indoor air pollution may be subject to recall bias. Future studies employing objective measures of exposure, such as air quality monitors, could address this limitation. Finally, genetic predispositions and dietary patterns, which are also known to influence asthma risk, were not explored in this study and should be considered in future research.

The findings of this study have important implications for policy and practice. Strengthening public health initiatives aimed at reducing indoor air pollution, such as promoting cleaner cooking technologies and improved housing ventilation, could substantially mitigate asthma risk in children. Moreover, integrating asthma education programs into school health initiatives could raise awareness among children, parents, and teachers, fostering early recognition and management of symptoms. Given the association of asthma with preventable risk factors like parental smoking, targeted interventions, including counseling and smoking cessation programs, should be prioritized. These efforts could be complemented by stricter enforcement of tobacco control policies and air quality regulations to protect children from harmful exposures.

CONCLUSIONS

This study contributes valuable insights into the prevalence and risk factors of pediatric asthma in a tertiary care setting in India. The findings highlight the interplay of environmental and behavioral factors in driving asthma risk, underscoring the need for comprehensive, multi-sectoral approaches to reduce the burden of this condition. Future research should explore the long-term impact of early interventions on asthma outcomes, thereby informing evidence-based strategies to improve child health in LMICs.

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CONTRIBUTION OF AUTHORS

Research concept- Dhananjaya Panda, Laxmi Narayan Dash
Research design- Shankar Ramchandwani, Dhananjaya Panda
Supervision- Anand Sankar Sastry
Materials- Dhananjaya Panda, Laxmi Narayan Dash
Data collection-Shankar Ramchandwani, Dhananjaya Panda
Data analysis and Interpretation- Anand Sankar Sastry
Literature search- Dhananjaya Panda, Laxmi Narayan Dash
Writing article- Shankar Ramchandwani, Dhananjaya Panda
Critical review- Anand Sankar Sastry
Article editing- Shankar Ramchandwani, Dhananjaya Panda
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