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Paediatric asthma prevalence and environmental factors: A community-based cross-sectional study.

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Abstract

Background
Pediatric asthma is a critical public health issue with its origins in a complex array of environmental, socio-economic, and potentially genetic factors. Understanding these can aid in crafting targeted preventive measures and management strategies.
Aim and Objectives: This study aims to determine the prevalence of pediatric asthma within a representative sample and investigate its associations with environmental conditions, socio-economic status, and familial health history, aiming to unravel the condition's multifaceted causes.

Materials and methods
This cross-sectional analysis involved 100 children and adolescents aged 0-18 years. Through interviews and medical record reviews, data were gathered on asthma diagnoses, environmental exposures, socio-economic status, physical activity, and family health history. Chi-square tests and logistic regression analyses identified key asthma predictors.

Results
The study found a 22% prevalence of asthma, highest among 6-12-year-olds (54.5%), and more common in males (59%). Critical environmental risk factors included poor indoor air quality (affecting 73% of asthmatic children), environmental tobacco smoke exposure (40%), and high outdoor air pollution (50%). Additionally, 68% of affected children came from lower socio-economic backgrounds. The most potent asthma predictor was poor indoor air quality (odds ratio = 4.5), alongside significant influences from tobacco smoke, outdoor pollution, sedentary lifestyles, and family asthma history.

Conclusions
The study found a prevalence of pediatric asthma at 22%, with the highest burden among school-aged children and males. Environmental and socio-economic factors such as poor indoor air quality, exposure to tobacco smoke, and lower socio-economic status were significantly associated with asthma. These findings underscore the need for targeted interventions to reduce environmental exposures and improve health outcomes in children.

Recommendations
To reduce pediatric asthma prevalence, prioritize interventions targeting indoor air quality improvement, reduce exposure to tobacco smoke, address outdoor pollution, and promote physical activity, especially in socio-economically disadvantaged areas.

Keywords: *Pediatric asthma, Environmental factors, Socio-economic status, Indoor air quality, Outdoor air pollution.*
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Introduction

Asthma remains one of the most prevalent chronic diseases among children globally, affecting millions and posing a significant burden on health care systems and families[1]. Characterized by chronic inflammation of the airways, asthma symptoms include wheezing, shortness of breath, chest tightness, and coughing, which vary in severity and frequency among individuals 2,3. The etiology of pediatric asthma is multifactorial, with a wide range of genetic, environmental, and socio-economic factors contributing to its onset and exacerbation[4].

Recent studies have highlighted the role of environmental pollutants, both indoor and outdoor, as critical triggers for asthma symptoms[5]. Indoor air quality, influenced by the presence of allergens such as dust mites, pet dander, and mold, alongside exposure to tobacco smoke, has been strongly linked to the development and worsening of asthma in children[6]. Moreover, outdoor air pollution, stemming from vehicle emissions and industrial activities, continues to be a significant concern. Socio-economic factors also play a pivotal role, with evidence suggesting that children from lower socio-economic backgrounds are at a higher risk due to increased exposure to adverse environmental conditions and limited access to healthcare resources[7]. Genetic predisposition further complicates the asthma landscape, with family history being a strong predictor of asthma in children. The interaction between genes and the environment is complex, indicating that both hereditary and external factors are integral to understanding asthma pathogenesis[8].

Despite the extensive research, gaps remain in our understanding of how specific environmental and socio-economic factors contribute to asthma prevalence and severity, especially in diverse populations. This study aims to fill these gaps by examining the prevalence of pediatric asthma and exploring its association with a broad range of environmental, socio-economic, and genetic factors in a representative population. By doing so, we seek to contribute valuable insights into the multifaceted nature of asthma, potentially guiding public health strategies and interventions aimed at reducing the burden of this chronic condition among children.

Aim and objectives

This study aims to investigate the prevalence of pediatric asthma and explore its associations with environmental, socio-economic, and genetic factors to inform targeted prevention and management strategies.

Determine Prevalence Across Age and Gender: Establish asthma prevalence in children and adolescents, focusing on age-related and gender differences.

Assess Environmental Impact: Investigate how indoor and outdoor environmental exposures, such as pet dander, dust mites, mold, and air pollution, influence asthma prevalence and severity.

Evaluate Socioeconomic and Residential Impact: Examine the correlation between socioeconomic status and asthma, and compare prevalence in urban vs. rural areas.

Assess Lifestyle and Hereditary Factors: Evaluate how children's physical activity levels, exposure to tobacco smoke, and the presence of asthma or allergic conditions in family members influence their risk of developing asthma.

Methodology

Study design and setting

This cross-sectional study was conducted at the Government General Hospital in Jangaon, Telangana, between April 2023 and December 2023. The Government General Hospital in Jangaon is a secondary-level public healthcare facility catering to both urban and rural populations in Telangana. It serves as a referral center for neighboring primary health centers and provides outpatient, inpatient, pediatric, and emergency services. The hospital plays a vital role in delivering primary and specialized pediatric care in the region, making it an appropriate setting for studying community-level health issues like pediatric asthma.

Population and sampling

The study population comprised children and adolescents aged 0-18 years who visited the Government General Hospital in Jangaon, Telangana, during the study period from April 2023 to December 2023. A total of 100 participants were selected through a systematic random sampling technique to ensure a representative sample of the pediatric population attending the outpatient department (OPD) of the hospital.

Inclusion criteria

Age Range: Participants must be aged between 0 and 18 years.

OPD Visit: Must have visited the OPD of the Government General Hospital during the study period.

Residency: Participants must be residents of Jangaon or its surrounding areas to ensure the study reflects the local pediatric population.

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Exclusion criteria

Children diagnosed with chronic pulmonary diseases other than asthma (e.g., cystic fibrosis, bronchiectasis, or congenital lung anomalies), as these could confound the identification and assessment of asthma. Participants with incomplete clinical records or missing information related to key study variables such as environmental exposures, physical activity, or family history.
Children with acute respiratory infections at the time of data collection, to prevent misclassification of transient symptoms as asthma.

Bias mitigation

To minimize selection bias, systematic random sampling was employed during outpatient visits. Interviewer bias was reduced by training the data collectors using a standardized questionnaire. Recall bias was mitigated by corroborating parental responses with hospital medical records where possible.

Study sample size

The sample size of 100 was chosen based on feasibility and resource availability during the study period. Although no formal sample size calculation was done due to logistical constraints, the selected size was considered sufficient to detect meaningful trends in asthma prevalence and associated risk factors in the local pediatric population. Future studies with larger, calculated sample sizes are recommended for more precise estimates.

Data collection

Data were collected through structured interviews with parents or guardians and review of medical records for diagnostic confirmation. The questionnaire included items on demographic information (age, gender), environmental exposures (indoor air quality, exposure to tobacco smoke, urban vs. rural residency), lifestyle factors (physical activity levels), and family history of asthma or allergic diseases.
Environmental Exposure Assessment: Indoor air quality was assessed based on reports of exposure to common indoor allergens (pet dander, dust mites, mold). Outdoor air pollution exposure was evaluated based on the proximity of participants' residences to busy roads or industrial areas. Socioeconomic status (SES) was determined using parental education and occupation, and urban or rural residency was identified based on the participant's home address.

Statistical analysis

Prevalence rates were calculated as percentages. Chi-square tests were used to examine associations between asthma prevalence and categorical variables (e.g., gender, socioeconomic status, environmental exposures). Logistic regression analysis was performed to identify significant predictors of asthma among the studied factors. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to estimate the strength of associations.

Ethical considerations

Ethical approval for the study was obtained from the Institutional Ethics Committee of the Government General Hospital, Jangaon. Informed consent was acquired from the parents or guardians of all participants before data collection. Participant confidentiality and data privacy were strictly maintained throughout the study.

Results

Participant flow

During the study period, 135 children aged 0–18 years attended the outpatient department. Of these, 120 were screened for eligibility. Twenty participants were excluded: 8 had chronic pulmonary conditions other than asthma, 7 had incomplete records, and 5 declined consent. A total of 100 children were confirmed eligible and included in the study.

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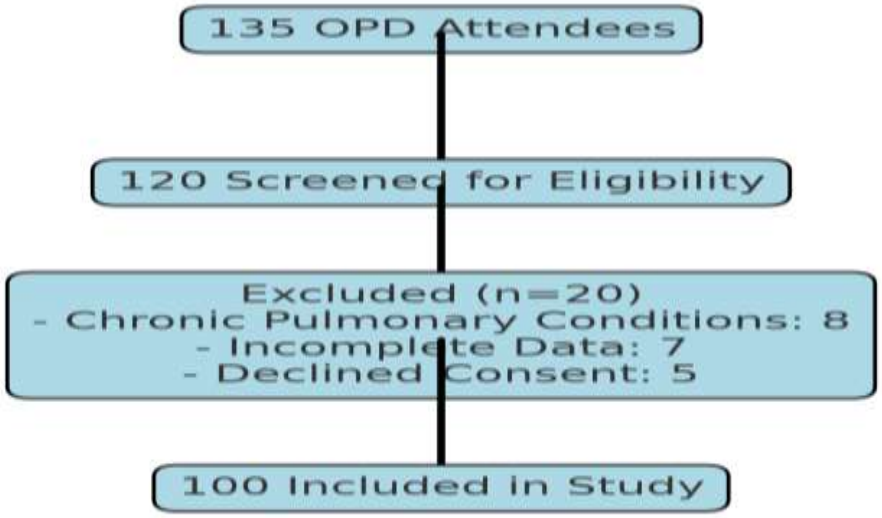
Figure 1. Participant flow diagram



Socio-demographic characteristics

Among the 100 participants, 56 were males and 44 were females. The age distribution was as follows:
0–5 years: 30 participants
6–12 years: 42 participants
13–18 years: 28 participants

Prevalence of pediatric asthma

Among the 100 children enrolled in the study, 22 were diagnosed with asthma, resulting in a prevalence of 22%. This indicates that more than one in five children in the study population had physician-confirmed asthma.

A breakdown of the asthma cases revealed that the condition was most prevalent among children aged 6–12 years, accounting for 54.5% (12 out of 22) of asthmatic participants. This was followed by the 13–18-year age group (31.8%, 7 out of 22) and the 0–5-year age group (13.6%, 3 out of 22).

In terms of gender distribution, 59% (13/22) of asthmatic children were male, while 41% (9/22) were female, suggesting a higher prevalence of asthma among boys in this sample. (Table 1, Figure 1).

Table 1: Prevalence of pediatric asthma

Parameter	Detail	Value
Total Sample	Children and adolescents assessed	100
Asthma Prevalence	Diagnosed with asthma	22% (22/100)
Age Distribution	0-5 years	13.6% (3/22)
	6-12 years	54.5% (12/22)
	13-18 years	31.8% (7/22)
Gender Disparity	Male	59% (13/22)
	Female	41% (9/22)

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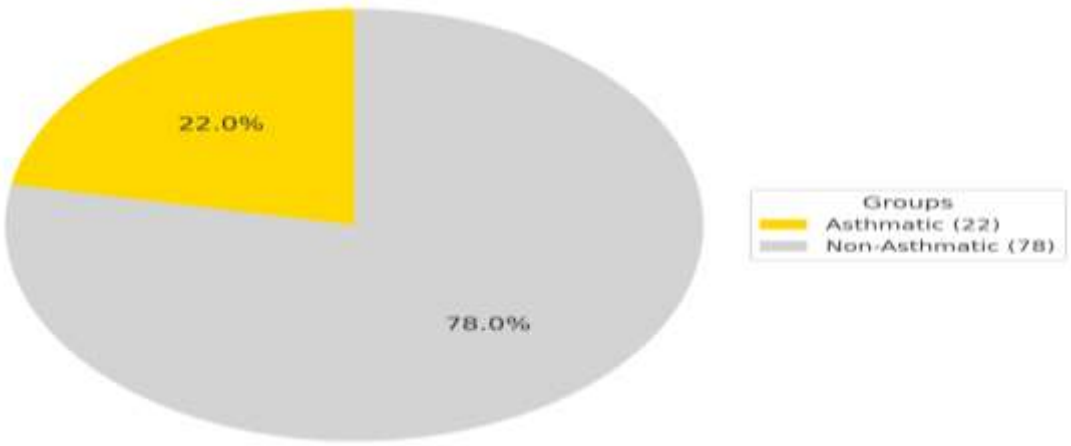

Figure1.Prevalence of pediatric asthma

Environmental factors

Exposure to poor indoor air quality was reported by 73% of the asthmatic participants, with specific pollutants including pet dander (45%), dust mites (60%), and mold (35%). Additionally, 40% of children with asthma were exposed to environmental tobacco smoke. Urban residency was more common among asthmatic participants (65%) compared to those residing in rural areas (35%). Socioeconomic status analysis showed that 68% of the asthmatic children came from lower socioeconomic backgrounds (Table 2).

Table 2: Environmental factors

Factor	Detail	Affected Asthmatic Children
Indoor Air Quality	Poor air quality due to pet dander, dust mites, and mold	73%
Exposure to Smoke	Environmental tobacco smoke	40%
Urban vs. Rural Residence	Urban dwellers	65%
	Rural residents	35%
Socioeconomic Status	Lower socioeconomic backgrounds	68%

Environmental and health-related factors

Fifty percent of the children with asthma lived in areas with high levels of outdoor air pollution, such as near busy roads or industrial zones. Only 30% of the asthmatic children engaged in regular physical activity, significantly lower than their non-asthmatic counterparts. A family history of asthma or allergic diseases was present in 55% of the cases (Table 3).

Table 3: Environmental and health-related factors

Factor	Detail	Affected Asthmatic Children
Outdoor Air Pollution	High levels near busy roads or industrial areas	50%
Physical Activity	Engaged in regular physical activity	30%
Family History	History of asthma or allergic diseases	55%

Statistical analysis

Chi-square tests revealed significant associations between pediatric asthma and several factors: indoor air quality ($p < 0.01$), exposure to cigarette smoke ($p < 0.05$), urban living ($p < 0.05$), lower socioeconomic status ($p < 0.01$), outdoor air pollution ($p < 0.05$), and lack of physical activity ($p < 0.01$). Logistic regression analysis identified poor indoor air quality as the strongest predictor of asthma (odds ratio = 4.5, 95% CI 2.1-9.7). Other significant predictors included exposure to cigarette smoke (odds ratio = 2.8, 95% CI 1.3-6.0), outdoor air pollution (odds ratio = 3.0, 95% CI 1.4-6.3), a sedentary lifestyle (odds ratio = 2.2, 95% CI 1.1-4.5), and a family history of asthma (odds ratio = 3.5, 95% CI 2.0-6.1) (Table 4).

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Table 4: Statistical analysis

Analysis Type	Factor	Outcome
Chi-Square Tests	Indoor air quality	$p < 0.01$
	Exposure to cigarette smoke	$p < 0.05$
	Urban living environment	$p < 0.05$
	Lower socioeconomic status	$p < 0.01$
	Outdoor air pollution	$p < 0.05$
	Lack of physical activity	$p < 0.01$
Logistic Regression Analysis	Poor indoor air quality	Odds ratio = 4.5, 95% CI 2.1-9.7
	Exposure to cigarette smoke	Odds ratio = 2.8, 95% CI 1.3-6.0
	Outdoor air pollution	Odds ratio = 3.0, 95% CI 1.4-6.3
	Sedentary lifestyle	Odds ratio = 2.2, 95% CI 1.1-4.5
	Family history	Odds ratio = 3.5, 95% CI 2.0-6.1

Discussion

This study found a 22% prevalence rate of pediatric asthma among children and adolescents aged 0-18 years, which aligns with global trends but is slightly higher than some previous studies conducted in similar socio-economic settings. The increased prevalence in the 6-12 year age group underscores the critical period of late childhood for asthma onset, possibly due to increased exposure to school environments and outdoor activities. The gender disparity observed, with a higher prevalence in males, is consistent with existing literature suggesting hormonal, anatomical, and possibly lifestyle-related differences in asthma susceptibility between genders.

Environmental and socio-economic factors

The strong association between poor indoor air quality and asthma prevalence in this study highlights the significant impact of environmental factors on respiratory health. This finding corroborates with global research indicating that indoor pollutants such as pet dander, dust mites, and mold play pivotal roles in the exacerbation of asthma symptoms. This study further identifies a clear socio-economic gradient, with a higher asthma prevalence among children from lower socio-economic backgrounds[9,10]. This association points to the compounded effects of living conditions, access to healthcare, and environmental exposures on asthma risk, echoing findings from other regions and suggesting a universal pattern [11].

Lifestyle factors

The lower engagement in physical activity among asthmatic children compared to their non-asthmatic counterparts could be both a cause and an effect of asthma severity. Physical activity is known to improve respiratory health, yet children with asthma may avoid activity due to fear of exacerbating symptoms [12,13]. This cycle highlights the need for tailored interventions encouraging safe physical activity among asthmatic children[14].

Comparative analysis

Comparing these study findings to existing studies reveals both consistencies and variances in asthma prevalence and associated factors, reflecting the complex interplay of genetics, environment, and lifestyle unique to each population. Notably, this study's emphasis on the specific environmental and socio-economic contexts of Jangaon, Telangana, provides valuable localized insights that contribute to the broader understanding of pediatric asthma.

Generalizability

While this study provides valuable insights into the prevalence and determinants of pediatric asthma within the Jangaon district, the findings may have limited generalizability beyond similar socio-demographic and environmental settings. The study was conducted at a single secondary-level public hospital serving a mix of urban and rural populations, which enhances its relevance to comparable semi-urban Indian regions. However, differences in healthcare access, environmental exposures, and socioeconomic profiles in other districts or states may affect the external applicability of the results. Larger, multi-center studies across diverse geographical areas are recommended to confirm and broaden the applicability of these findings.

Conclusion

This study found a pediatric asthma prevalence of 22% in the study population, with the highest burden observed among children aged 6–12 years and a greater prevalence in males. The findings underscore the significant influence of environmental exposures, particularly poor indoor air quality and tobacco smoke, as well as socioeconomic disadvantage and family history, in contributing to asthma risk. These results highlight the urgent need for targeted public health interventions focusing on environmental

improvements and education to mitigate asthma incidence in children.

Limitations

This study has several limitations. Firstly, the cross-sectional design restricts the ability to establish temporal or causal relationships between environmental exposures and asthma outcomes. While associations were identified, we cannot determine whether exposure preceded disease onset. Secondly, data on environmental exposures and lifestyle factors were primarily collected through parental self-report, which introduces the risk of recall bias. Although medical records were reviewed to confirm asthma diagnoses, the subjective nature of some exposure data may affect accuracy.
Thirdly, the study was conducted at a single public hospital in Jangaon, which may limit the generalizability of findings to broader or more diverse populations.
Lastly, the relatively small sample size and lack of objective environmental measurements (e.g., air quality indices, allergen testing) constrained the depth of exposure analysis.

Recommendations

To mitigate pediatric asthma, the following recommendations are proposed: 1) Improve indoor air quality in homes and schools by reducing allergens, mold, and tobacco smoke exposure. 2) Implement policies that limit exposure to environmental tobacco smoke, particularly in households and public places. 3) Address outdoor air pollution through stricter regulations and public health initiatives. 4) Promote physical activity in children to enhance lung function and reduce sedentary behaviors. 5) Target educational programs and interventions in socio-economically disadvantaged communities, focusing on asthma awareness, prevention strategies, and early diagnosis, particularly for children with a family history of asthma.

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List of abbreviations

SES - Socioeconomic Status
OPD – Outpatient Department
OR – Odds Ratio
CIs – Confidence Intervals

Source of funding

The study has no funding.

Conflict of interest

The authors declare no conflict of interest.

Author contributions

NK-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript.PP-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript, revision of the manuscript.KV-Review of literature and preparing the first draft of the manuscript. Statistical analysis and interpretation.RN- Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript.IS-Review of literature and preparing the first draft of the manuscript. Statistical analysis and interpretation

Data availability

Data is available upon request.

Author biography

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