Research Article

Asthma-Related Symptom Burden Identified by School-Based Screening Among Apparently Asymptomatic Children in Western Uttar Pradesh: A Cross-Sectional Study

Tanya Khatter[1], Bindu T Nair[2*], Poonam Chhillar Vij[3], Deepakshi Teotia[1]

[1] Resident, Department of Paediatrics, Sharda School of Medical Sciences &Research, Sharda University, Greater Noida, UP, India . Email ID – tanya.khatter@sharda.ac.in
[2*]Professor in Department of Paediatrics, Sharda School of Medical Sciences &Research, Sharda University, Greater Noida, UP, India . Email ID: bindu.nair@sharda.ac.in
[3] Assistant Professor in Department of Paediatrics, Sharda School of Medical Sciences &Research, Sharda University, Greater Noida, UP, India . Email ID: poonam.vij@sharda.ac.in

*Corresponding Author:
Dr. Bindu T Nair, Professor, Professor, Department of Pediatrics, Sharda School of Medical Sciences &Research, Sharda University, Greater Noida, UP, India.
ORCID ID: 0000 0003 4957 0437

Abstract

Background: Asthma-related symptoms in school-aged children may be intermittent or mild and may not be apparent during a brief health assessment. Structured questionnaires can provide a practical approach to identifying symptom burden and children who may require further clinical evaluation. This study described the frequency and pattern of asthma-related symptoms identified by a 14-item questionnaire among apparently asymptomatic school children aged 8–14 years in Western Uttar Pradesh, India.

Methods: This cross-sectional school-based study included 370 children aged 8–14 years who were apparently asymptomatic at the time of screening. A 14-item yes/no asthma screening questionnaire developed by the American College of Allergy, Asthma and Immunology was administered. Each affirmative response contributed one point to a total score of 0–14. For the present study, more than five affirmative responses were defined as a positive questionnaire screen. Symptom frequencies and questionnaire-score distribution were summarized descriptively.

Results: The mean questionnaire score was 3.46 ± 3.60; the median was 2 (interquartile range 1–4), with a range of 0–14. Difficulty breathing around smoke or odors was the most frequently reported symptom (143/370, 38.65%), followed by frequent cough (124/370, 33.51%), difficulty breathing or coughing while walking upstairs (106/370, 28.65%), chest tightness or pain (103/370, 27.84%), and difficulty breathing or coughing while playing (100/370, 27.03%). Overall, 83 children (22.43%) met the study-defined threshold for a positive questionnaire screen.

Conclusion: Systematic symptom enquiry identified a substantial burden of asthma-related symptoms among children who were not presenting with active respiratory illness. Environmental and exertional symptoms were particularly frequent. Questionnaire positivity should be interpreted as a screening signal requiring appropriate clinical assessment and should not be considered equivalent to a confirmed diagnosis of asthma.

Keywords: asthma; children; school health; screening; symptom burden; questionnaire.

INTRODUCTION

Asthma is one of the most common chronic respiratory diseases of childhood and is characterized by variable respiratory symptoms and variable expiratory airflow limitation.

School-based health programmes provide an opportunity to identify respiratory symptoms in children who are not actively seeking healthcare. Questionnaire-based screening is inexpensive, non-invasive and scalable, and school-based asthma questionnaires have been developed and evaluated for identifying children at risk of previously unrecognized asthma or respiratory symptoms [1–3]. However, questionnaire responses are intended for case finding or risk identification and do not, by themselves, establish the diagnosis of asthma [4,5].

The burden of asthma symptoms among Indian school children has been documented across different regions. Studies from Delhi, North India and rural Indian populations have reported wheeze, exercise-related symptoms, cough and other asthma-like symptoms in school-aged children, while also demonstrating substantial under-recognition of asthma [6–10]. These findings support the potential value of systematic symptom enquiry in school settings, particularly where access to healthcare may be variable. Global and regional asthma literature similarly demonstrates substantial symptom burden across pediatric populations and supports the need for context-specific school health approaches [11–13].

The present study focused specifically on the symptom profile revealed by a structured 14-item asthma screening questionnaire among children who were apparently asymptomatic at the time of school screening. The objective was to describe the frequency of individual asthma-related symptoms, the distribution of questionnaire scores and the proportion of children meeting the study-defined threshold for a positive screening result.

MATERIALS AND METHODS

This was a cross-sectional, school-based observational study conducted in Western Uttar Pradesh, India, over an 18-month period. The study included school children aged 8–14 years. Institutional ethical approval was obtained before commencement of the study, permission was obtained from the participating school, and appropriate consent and assent procedures were followed according to the study protocol.

Children aged 8–14 years who were apparently asymptomatic at the time of screening were eligible. Children with a previous diagnosis of asthma, those receiving asthma or other respiratory medications, and children with acute or chronic respiratory illness such as tuberculosis or active cough, wheeze or coryza were excluded.

A 14-item yes/no asthma screening questionnaire developed by the American College of Allergy, Asthma and Immunology (ACAAI) for children aged 8–14 years was administered by the researcher [2]. The questionnaire assesses symptoms during activity, nocturnal symptoms, chest symptoms, wheeze, cough, environmental triggers, cold-weather symptoms and asthma-related healthcare utilization. The instrument was originally evaluated as a school-based approach for identifying children at risk of undiagnosed or poorly controlled asthma [2].

Each affirmative response was assigned one point, producing a total score from 0 to 14. For the present study, more than five affirmative responses were defined as a positive questionnaire screen. This threshold was treated as a study-defined screening criterion and not as a diagnostic criterion for asthma.

Statistical analysis

Categorical variables were summarized as frequencies and percentages. Questionnaire scores were summarized using mean ± standard deviation, median with interquartile range and range. Statistical analysis was performed using IBM SPSS Statistics version 25.0. Because the primary purpose of this manuscript was descriptive, no additional inferential claims were made beyond the analyses documented in the study.

RESULTS

A total of 370 school children aged 8–14 years were included. The mean age was 12.06 ± 1.00 years. There were 222 girls (60.0%) and 148 boys (40.0%). The largest class group was class 7, comprising 224 children (60.54%).

Table 1: Frequency of individual asthma-related symptoms

Questionnaire item	Positive responses, n	Positive responses, %
Difficulty breathing or coughing when playing	100	27.03%
Difficulty breathing or coughing when walking upstairs	106	28.65%
Dislike of running or playing sports	76	20.54%
Waking at night with coughing or breathing difficulty	83	22.43%
Difficulty taking a deep breath	68	18.38%
Wheezing sounds in the chest	78	21.08%
Chest feels tight or hurts	103	27.84%
Cough a lot	124	33.51%
Breathing worse outdoors or around dust/pets	83	22.43%
Difficulty breathing in cold weather	81	21.89%
Difficulty breathing around smoke/odors	143	38.65%
Colds make the child cough or wheeze	93	25.14%
Doctor’s visit for asthma during the year	81	21.89%
Hospital stay for asthma during the year	62	16.76%

Difficulty breathing around smoke or odors was the most commonly endorsed symptom, reported by 143 children (38.65%). Frequent cough was reported by 124 (33.51%). Exertional symptoms were also common: 106 children (28.65%) reported difficulty breathing or coughing while walking upstairs and 100 (27.03%) reported similar symptoms while playing. Chest tightness or pain was reported by 103 children (27.84%) (Table 1).

Cold- and infection-associated symptoms were also reported. Ninety-three children (25.14%) stated that colds made them cough or wheeze, while 81 (21.89%) reported difficulty breathing in cold weather. Nocturnal symptoms were reported by 83 children (22.43%). Wheezing sounds were reported by 78 (21.08%), and difficulty taking a deep breath by 68 (18.38%) (Table 1).

Asthma-related healthcare utilization was reported by a smaller but clinically relevant subgroup. Eighty-one children (21.89%) reported a doctor's visit for asthma or breathing difficulty during the year, and 62 (16.76%) reported a hospital stay for asthma or breathing difficulty during the year (Table 1).

Table 2: Distribution of questionnaire scores

Measure	Value
Mean ± SD	3.46 ± 3.60
Median (25th–75th percentile)	2 (1–4)
Range	0–14
Screen-positive (>5 affirmative responses)	83/370 (22.43%)
Screen-negative	287/370 (77.57%)

The questionnaire score showed substantial variation across the cohort. The median score was 2, although scores ranged from 0 to 14. Overall, 83 children (22.43%) met the study-defined threshold for a positive screen, while 287 (77.57%) were negative (Table 2).

Symptom pattern among apparently asymptomatic children

The findings demonstrate that being apparently asymptomatic at the time of school screening did not equate to an absence of respiratory symptoms when children were systematically questioned about symptoms occurring during activity, sleep, environmental exposure or intercurrent illness. Environmental triggers, cough and exertional breathing difficulty were prominent components of the reported symptom profile.

DISCUSSION

The principal finding of this study was the frequency with which asthma-related symptoms were reported in children who were not presenting with active respiratory illness at the time of screening. More than one in five children met the study-defined questionnaire threshold for a positive screen, while individual symptoms were reported considerably more frequently. This distinction is important because symptom reporting and a positive screening score identify children who may merit further evaluation; neither establishes a clinical diagnosis of asthma.

Difficulty breathing around smoke or odors was the most frequently endorsed questionnaire item. Environmental exposures are relevant to childhood respiratory symptoms, and air pollution and other irritants may contribute to respiratory morbidity in children.[14,15] However, an affirmative response to an exposure-related question is not specific for asthma and may reflect transient airway irritation or other respiratory conditions. The present finding therefore supports the value of asking specifically about environmental triggers but should not be interpreted as evidence that the symptom is asthma-specific.

Frequent cough was the second most common response. Cough is common in childhood and has a broad differential diagnosis, including recurrent viral infections, upper-airway disease, environmental irritation, asthma and other respiratory disorders. Its relatively high frequency in this cohort reinforces the importance of interpreting individual questionnaire responses within a broader symptom pattern rather than treating isolated cough as diagnostic of asthma.

Exercise-related symptoms were also frequently reported. Difficulty breathing or coughing while walking upstairs or playing may identify children whose symptoms become apparent during increased ventilatory demand. Exercise-associated respiratory symptoms are relevant to asthma assessment, but they may also occur with poor conditioning, obesity, anaemia, cardiac disease, dysfunctional breathing and other conditions. School questionnaires therefore have a role in case identification rather than serving as a substitute for clinical assessment and objective testing [4,5].

Nocturnal cough or breathing difficulty was reported by 22.43% of participants, while wheezing sounds were reported by 21.08%. These symptoms are clinically relevant in asthma assessment, particularly when they are recurrent and variable [4,5,14]. Nevertheless, because this study did not systematically establish asthma using diagnostic clinical assessment and

objective lung-function testing, these responses cannot be translated directly into a prevalence estimate of confirmed asthma.

The overall score distribution further illustrates a spectrum of symptom burden. The mean score was 3.46, the median was 2, and scores ranged from 0 to 14. Most children therefore had relatively few affirmative responses, while a smaller subgroup accumulated enough responses to cross the study-defined screening threshold. This pattern supports the practical concept of questionnaire thresholds for case finding, while also emphasizing that respiratory symptoms exist along a continuum.

The use of the ACAAI 14-item questionnaire provides a structured approach to symptom enquiry. In the original evaluation, the questionnaire was designed to identify children at risk for undiagnosed or poorly controlled asthma, and its performance varied according to the threshold used [2]. Earlier school-based questionnaire research has similarly demonstrated that direct student questionnaires can identify children with symptoms suggestive of asthma and can provide a feasible approach to school screening [1,3]. The present study was descriptive and therefore does not attempt to reproduce or independently validate the diagnostic performance reported in those studies.

The symptom frequencies observed in the present cohort are also consistent with the broader Indian literature demonstrating that asthma-like symptoms are common among school children. Studies from Delhi and other Indian regions have documented wheeze, exercise-related symptoms, cough and underdiagnosis of asthma among school populations [6–10]. In particular, the observation that some children reported healthcare utilization for asthma or breathing difficulty despite being apparently asymptomatic at screening highlights the episodic nature of respiratory symptoms and the possibility that symptoms may be missed during brief clinical encounters.

School-based screening may therefore be useful when integrated into a defined clinical pathway. The practical value of screening is not simply the identification of a numerical proportion of questionnaire-positive children, but the opportunity to identify children whose symptoms warrant further history-taking, examination and, where appropriate, objective assessment. Screening programmes should have a clear mechanism for referral and follow-up so that identification is linked to clinical care.[4,5] Evidence from school-based asthma education and prevention programmes also supports the broader role of schools in asthma case identification, education and referral, although such programmes are not equivalent to diagnostic screening [16–20].

The present findings should nevertheless be interpreted cautiously. A questionnaire response is subject to recall and reporting bias, and several individual items are nonspecific. The study population was recruited from selected schools in Western Uttar Pradesh and may not represent children from other geographic, socioeconomic or educational settings. In addition, the study was cross-sectional and cannot assess persistence, seasonality or temporal relationships of symptoms.

Strengths

School-based recruitment allowed systematic symptom enquiry among children who were not actively seeking healthcare. The 14-item questionnaire captured multiple respiratory symptom domains rather than relying on a single symptom. The study included 370 children within a defined age range of 8–14 years. The analysis remained focused on descriptive symptom burden and did not overinterpret questionnaire positivity as confirmed asthma.

Limitations

The cross-sectional design prevents assessment of symptom persistence, seasonality and temporal relationships. Questionnaire responses are subject to recall, comprehension and reporting bias. The cohort was recruited from selected schools in Western Uttar Pradesh, limiting generalizability to other regions and school populations. No systematic diagnostic clinical assessment, spirometry with bronchodilator reversibility, or FeNO testing was performed to confirm asthma.

CONCLUSION

Systematic school-based questioning identified a substantial burden of asthma-related respiratory symptoms among children who were not presenting with active respiratory illness. Difficulty breathing around smoke or odors, frequent cough, exertional respiratory symptoms, chest tightness and cold-associated symptoms were among the most frequently reported findings. More than one-fifth of the cohort met the study-defined threshold for a positive questionnaire screen. These findings support structured symptom enquiry as an initial school-health case-finding strategy. However, questionnaire positivity should lead to clinical evaluation and, where appropriate, objective testing rather than being treated as a definitive diagnosis of asthma.

Declarations
Competing interests: The authors declare no competing interests.
Funding: No external funding was reported for this study.
Data availability: The data underlying this manuscript are available from the corresponding author, subject to institutional and ethical permissions.

References

1. Redline S, Gruchalla RS, Wolf RL, Yawn BP, Cartar L, Gan V, et al. Development and validation of school-based asthma and allergy screening questionnaires in a 4-city study. Ann Allergy Asthma Immunol. 2004;93(1):36-48. doi:10.1016/S1081-1206(10)61445-7.
2. Amin P, Levin L, Smith A, Davis B, Nabors L, Bernstein JA. Asthma screening of inner city and urban elementary school-aged children. J Asthma. 2013;50(10):1049-55. doi:10.3109/02770903.2013.846370.
3. Joseph CL, Foxman B, Leickly FE, Peterson E, Ownby D. Prevalence of possible undiagnosed asthma and associated morbidity among urban schoolchildren. J Pediatr. 1996;129(5):735-742. doi:10.1016/S0022-3476(96)70158-60.
4. Global Initiative for Asthma. Global strategy for asthma management and prevention: 2025 update. Fontana, WI: GINA; 2025.
5. Agarwal R, Dhooria S, Aggarwal AN, Maturu VN, Sehgal IS, Muthu V, et al. Guidelines for diagnosis and management of bronchial asthma: Joint ICS/NCCP (I) recommendations. Lung India. 2015;32(Suppl 1):S3-S42.
6. Chhabra SK, Gupta CK, Chhabra P, Rajpal S. Prevalence of bronchial asthma in schoolchildren in Delhi. J Asthma. 1998;35(3):291-6. doi:10.3109/02770909809068220.
7. Kaur J, Chugh K, Sachdeva A, Labani S. Under diagnosis of asthma in school children and its related factors. Indian Pediatr. 2007;44(6):425-8.
8. Venn A, Yemaneberhan H, Bekele Z, Lewis S, Parry E, Britton J, et al. Prevalence of asthma symptoms in 7th- and 8th-grade school children in a rural region in India. J Asthma. 2008;45(3):183-186. doi:10.1080/02770900701840220.
9. Singh S, Salvi S, Miele CH, et al. Prevalence, time trends and treatment practices of asthma in India: the Global Asthma Network study. ERJ Open Res. 2022;8(2):00528-2021.
10. Patra PK, Bhattarai D, Prasad A, Jain H, Ranjan S, Ranjan A. Prevalence and risk factors of asthma among school going children in urban area of North India. J Family Med Prim Care. 2021;10(1):421-426. doi:10.4103/jfmpc.jfmpc_1517_20.
11. Daniel RA, Aggarwal P, Kalaivani M, Gupta SK. Prevalence of asthma among children in India: a systematic review and meta-analysis. Lung India. 2022;39(4):357-367. doi:10.4103/lungindia.lungindia_706_21.
12. Asher MI, et al. Trends in worldwide asthma prevalence. Eur Respir J. 2020;56(6):2002094.
13. Wong GWK, et al. Pediatric asthma control in Asia. Allergy. 2013;68(4):524-30.
14. van Aalderen WM. Childhood asthma: diagnosis and treatment. Scientifica (Cairo). 2012;2012:674204.
15. Mukharesh L, Phipatanakul W, Gaffin JM. Air pollution and childhood asthma. Curr Opin Allergy Clin Immunol. 2023;23(2):100-110. doi:10.1097/ACI.0000000000000881.
16. Perry TT, Halterman JS, Brown RH, Hunter CR, Randle SM, Rettiganti M, et al. Results of an asthma education program delivered via telemedicine in rural schools. Ann Allergy Asthma Immunol. 2018;120(4):401-408. doi:10.1016/j.anai.2018.01.017.
17. Urrutia-Pereira M, Avila J, Solé D. The Program for the Prevention of Childhood Asthma: a specialized care program for children with wheezing or asthma in Brazil. J Bras Pneumol. 2016;42(1):42-47. doi:10.1590/S1806-37562016000004480.
18. Carvalho Coelho AC, Cardoso LSB, de Souza-Machado C, Souza-Machado A. The impacts of educational asthma interventions in schools: a systematic review of the literature. Can Respir J. 2016;2016:8476206. doi:10.1155/2016/8476206.
19. Clark NM, et al. Open Airways Schools. J Asthma. 2016;53(6):604-10.
20. Clark NM, Brown R, Joseph CL, Anderson EW, Liu M, Valerio MA. Effects of a comprehensive school-based asthma program on symptoms, parent management, grades, and absenteeism. Chest. 2004;125(5):1674-1679. doi:10.1378/chest.125.5.1674.