e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com

International Journal of Pharmaceutical Quality Assurance 2026; 17(8); 301-308

Original Research Article

Assessment of Clinical Profile and Risk Factors Associated with Recurrent Wheezing in Children Aged 2–5 Years

Anuradha Singh[1], Kaushalendra Kumar Singh[2], Manoj Kumar Singh[3]

[1]Associate Professor, Department of Paediatrics, Patna Medical College and Hospital, Patna, Bihar, India.
[2]Associate Professor, Department of Pediatrics, Patna Medical College and Hospital, Patna, Bihar, India.
[3]Professor, Department of Pediatrics, Patna Medical College and Hospital, Patna, Bihar, India.

Received: 12-06-2026 / Revised: 20-07-2026 / Accepted: 20-08-2026
Corresponding Author: Dr. Kaushalendra Kumar Singh
Conflict of interest: Nil

Abstract:

Background: Recurrent wheezing is a common respiratory problem in preschool children and may be associated with atopy, respiratory infections, familial predisposition, and environmental exposures.

Aim: To assess the clinical profile and risk factors associated with recurrent wheezing in children aged 2–5 years.

Methodology: A hospital-based analytical cross-sectional study was conducted among 90 children aged 2–5 years presenting with wheezing at the Department of Paediatrics, Patna Medical College and Hospital, Patna. Demographic, clinical, familial, perinatal, and environmental factors were assessed. Data were analysed using IBM SPSS Statistics version 27.0. Associations were evaluated using appropriate statistical tests, and multivariable logistic regression was performed.

Results: Recurrent wheezing (≥3 episodes/year) was observed in 42 (46.7%) children. Significant associations were found with family history of asthma/atopy (64.3% vs. 29.2%, p=0.001), eczema (42.9% vs. 18.8%, p=0.013), parental smoking (45.2% vs. 22.9%, p=0.024), previous bronchiolitis/LRTI (57.1% vs. 31.3%, p=0.013), and peripheral eosinophilia ≥4% (38.1% vs. 16.7%, p=0.022). Independent associations were observed for family history (OR 3.21), eczema (OR 2.47), previous bronchiolitis/LRTI (OR 2.58), and eosinophilia (OR 2.71).

Conclusion: Recurrent wheezing was common and was independently associated with familial atopy, eczema, previous respiratory infections, and peripheral eosinophilia.

Keywords: Recurrent Wheezing; Preschool Children; Asthma; Atopy; Eczema; Bronchiolitis; Eosinophilia.

DOI: 10.25258/ijpqa.17.8.47

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0) and the Budapest Open Access Initiative (http://www.budapestopenaccessinitiative.org/read), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Recurrent wheezing is a frequent respiratory issue in children and is actually a clinical syndrome of several conditions [1]. Wheezing is a continuous, high-pitched musical noise that is made by the passing of air through constricted lower airways, especially in the first years of life. Recurrent attacks of wheezing can happen in children ages 2 to 5 years with an increased risk due to viral respiratory infections, allergic sensitization, environmental exposures, airway hyperresponsiveness, or predisposition to asthma. While some preschool children may wheeze just once or twice that disappear as they get older, recurrent wheezing or persistent wheezing can be linked to poor quality of life, high rates of health service use, poor sleep, school absenteeism, and an increased risk of asthma in childhood.

Recurrent wheezing in preschool children has a wide spectrum of presentations. Cough, breathlessness, chest tightness, breathlessness during activity, breathlessness at night or prolonged expiration may be present during episodes [2]. It can be difficult to make a clinical diagnosis in younger children; they may not be able to accurately report their respiratory symptoms, and pulmonary function testing may not be reliably performed [3]. Thus, the diagnosis and characterization of wheezing at this age is heavily reliant on the clinical history, physical examination, symptom profile, family history, and identification of risk factors. So, it is crucial to be able to recognize the clinical profile to differentiate children with episodic viral-associated wheezing from those who may have an underlying susceptibility to asthma or persistent airway inflammation.

One of the most common causes of wheezing episodes in preschoolers is viral respiratory infections [4]. Airway inflammation and bronchial narrowing can occur due to respiratory syncytial virus, rhinovirus, influenza virus and other respiratory pathogens, especially in children with hyper-reactive airways. Rhinovirus-associated wheezing in early childhood

has been the focus of special interest, with evidence that recurrent wheezing due to rhinovirus infection is associated with a higher risk of later asthma in children at high risk for allergic sensitization or higher levels of type 2 inflammation. The number and the severity of respiratory infections, therefore, may be useful clues in assessing children with recurrent wheezing.

Recurrent wheezing and asthma are associated with important factors related to atopy and allergic sensitization. Children with eczema, allergic rhinitis, food allergy, or family history of allergy may be more likely to experience recurrent respiratory symptoms [5]. In particular, parental asthma is of interest since airway responsiveness and inflammation are affected by both genetic susceptibility and environmental exposures. Sensitization to aeroallergens and eczema in early childhood have also been linked with a higher risk of chronic wheezing and asthma. Evaluation of these factors can help determine the children who need more clinical attention.

Other environmental factors may also affect the incidence and/or recurrence of wheezing in preschool children [6]. Tobacco smoke, especially parental smoke, has consistently been linked to lung disease symptoms and lung growth problems during childhood. Household dust, mould and other irritants as well as indoor air pollution due to biomass fuels can also contribute to airway inflammation and respiratory morbidity. Environmental factors can play a significant role in reoccurring respiratory symptoms in developing countries, where children are likely to be exposed to more than one indoor and outdoor pollutant. Other risks of urban air pollution (such as particulate matter and nitrogen dioxide) have also been linked to higher rates of respiratory morbidity in vulnerable children.

Other potentially associated risk factors are male sex in early childhood, low birth weight, prematurity, recurrent LRTIs, daycare and nutritional or socioeconomic issues [7]. Prematurely born children can also be more vulnerable to wheezing with a respiratory infection, owing to having an immature airway development and less respiratory reserve. Likewise, early childhood recurrent respiratory infections could be associated with the recurrence of airway obstruction and could make it difficult to separate transient infection-associated wheezing from the onset of asthma. The frequency, recognition and management of recurrent wheezing may be also affected by the crowded living environment and poor access to health services.

Preschool wheezing is a variable natural history. Some children wheeze more during viral infections and are symptom-free when their airways grow bigger; others have symptoms in between infections and ultimately satisfy clinical criteria for asthma [8]. If a child has a number of risk factors, they are more likely to go on to wheeze persistently, such as if the parents have asthma, eczema, allergic sensitization and an increased number of episodes of wheezing that are not caused by a respiratory infection. There are a variety of risk-prediction strategies that have been developed to detect young children with recurrent wheezing who are at increased risk of developing asthma in later childhood, such as the Asthma Predictive Index. But clinical presentations can vary by population and local appropriateness of risk factor evaluation is important.

Recurrent wheezing in preschool children is a clinically significant issue in India as the interactions of respiratory infections, household air pollution, tobacco exposure, overcrowding, socioeconomic conditions, and rising urban environmental pollution have all contributed to this [9]. There may be differences in genetic background, living conditions, health care and exposure patterns which could lead to differences in the clinical features and risk factors for recurrent wheezing in different populations. It is important to recognize these factors so that children with greater risk for chronic respiratory disorders can be identified early and preventive and therapeutic measures can be planned.

Thus, evaluation of the clinical profile and risk factors of children with recurrent wheezing aged 2–5 years should be considered for a better understanding of the characteristics of affected children and factors associated with recurrent episodes. Recurrent wheezing may be more likely to occur in children who have a family history of asthma or allergy, atopic manifestations, birth history, environmental exposures, and/or certain demographic characteristics or symptom patterns. This data can aid early clinical evaluation, tailor treatment to the child, provide the child and family with counseling as to modifiable risk factors and appropriate follow up of preschool children with recurrent wheezing.

Methodology

Study Design: A hospital-based analytical cross-sectional study was conducted to assess the clinical profile and risk factors associated with recurrent wheezing among children aged 2–5 years. Children presenting with wheezing to the Department of Paediatrics were screened for eligibility during the study period. Eligible participants were enrolled consecutively to reduce selection bias and to obtain a representative sample of children attending the paediatric services.

Study Area: The study was conducted in the Department of Paediatrics, Patna Medical College and Hospital, Patna, Bihar, India

Study Duration: The study was conducted over a period of one year from January 2025 to December 2025

Study Participants: Children aged 2–5 years who presented with wheezing and fulfilled the predefined eligibility criteria were included in the study.

Inclusion criteria

- Children aged 2–5 years.
- Children with a current or previous history of physician-confirmed wheezing.
- Children who had experienced recurrent episodes of wheezing during the preceding 12 months.
- Children whose parents or legally authorized guardians were willing to provide the required history and participate in the study.
- Children whose relevant clinical and demographic information could be obtained reliably.

Exclusion criteria

- Children with known congenital heart disease causing significant haemodynamic compromise.
- Children with established cystic fibrosis, bronchiectasis, or major structural airway abnormalities.
- Children with suspected foreign body aspiration.
- Children with primary immunodeficiency disorders.
- Children with neuromuscular disorders affecting respiration.
- Children with insufficient or unreliable information regarding previous wheezing episodes.
- Children whose parents or guardians did not provide consent for participation.

Sample Size: A total of 90 children were included in the study. Participants fulfilling the eligibility criteria were enrolled consecutively until the required sample size was achieved.

Procedure: After obtaining written informed consent from the parent or legally authorized guardian, eligible children were enrolled in the study. A structured case record form was used to collect demographic, clinical, perinatal, familial, and environmental information. Data regarding age, sex, age at first episode of wheezing, number of wheezing episodes during the preceding 12 months, duration and severity of symptoms, nocturnal symptoms, recognized triggers, previous emergency visits, hospital admissions, and previous treatment with bronchodilators or inhaled corticosteroids were recorded. A detailed history of associated atopic conditions, particularly eczema, and family history of asthma or other atopic disorders was obtained. Perinatal factors including gestational age and birth weight were documented. Environmental risk factors such as parental smoking, exposure to biomass fuel or indoor air pollution, and daycare attendance were also recorded. History of breastfeeding and previous bronchiolitis or lower respiratory tract infections was noted. Recurrent wheezing was considered when the child had experienced three or more episodes of wheezing during the preceding 12 months, including the current episode where applicable. Children with one or two episodes during the same period were categorized as non-recurrent wheezers. Clinical examination was performed, and relevant investigations available as part of routine clinical care were recorded. When a complete blood count with differential count had been performed for clinical indications, the eosinophil percentage was documented. Eosinophilia was considered when the eosinophil count was ≥4%. The primary outcome was recurrent wheezing status, while the major risk factors assessed included family history of asthma or atopy, eczema, parental smoking, prematurity, low birth weight, breastfeeding duration, daycare attendance, indoor combustion exposure, previous lower respiratory tract infection, and peripheral eosinophilia.

Statistical Analysis: The collected data were entered, coded, and analysed using IBM SPSS Statistics version 27.0. Continuous variables were expressed as mean ± standard deviation or median with interquartile range, as appropriate, while categorical variables were presented as frequencies and percentages. The association between categorical risk factors and recurrent wheezing was assessed using the Chi-square test or Fisher's exact test, as appropriate. Continuous variables between recurrent and non-recurrent wheezing groups were compared using the independent-samples t-test or Mann–Whitney U test, depending on data distribution. Logistic regression analysis was performed to identify independent risk factors associated with recurrent wheezing. Odds ratios with 95% confidence intervals were calculated. A p-value <0.05 was considered statistically significant."

Result

Table 1 presents the demographic characteristics of the 90 children included in the study. The highest proportion of children belonged to the 2–3 years age group, comprising 32 (35.6%) participants, while 29 (32.2%) children each were aged 4 and 5 years. Regarding sex, males constituted the majority with 52 (57.8%) children, whereas females accounted for 38 (42.2%). Concerning the age at the first wheezing episode, 48 (53.3%) children experienced their first episode before 2 years of age, while 42 (46.7%) experienced it at or after 2 years. Most children were born at term, accounting for 77 (85.6%), compared with 13 (14.4%) who were preterm. In terms of birth weight, 72 (80.0%) children had a birth weight of ≥2.5 kg, whereas 18 (20.0%) had a birth weight of <2.5 kg. Overall, the study population showed a predominance of younger children, males, term births, and normal birth weight.

Table 1: Demographic characteristics of children included in the study (N=90)			
Variable	**Category**	**n**	**%**
Age	2–3 years	32	35.6
	4 years	29	32.2
	5 years	29	32.2
Sex	Male	52	57.8
	Female	38	42.2
Age at first wheezing episode	<2 years	48	53.3
	≥2 years	42	46.7
Birth status	Term	77	85.6
	Preterm	13	14.4
Birth weight	<2.5 kg	18	20
	≥2.5 kg	72	80

Table 2 presents the clinical profile of children with wheezing among the 90 study participants. Recurrent wheezing, defined as three or more episodes per year, was observed in 42 (46.7%) children, while 48 (53.3%) had fewer than three episodes annually. Regarding the number of wheezing episodes, 48 (53.3%) children experienced 1–2 episodes per year, 30 (33.3%) had 3–5 episodes, and 12 (13.3%) experienced more than five episodes. Nocturnal symptoms were reported in 34 (37.8%) children, whereas 56 (62.2%) did not report nighttime symptoms. Previous emergency visits were documented in 25 (27.8%) children, while 65 (72.2%) had no such history. Previous hospital admission due to wheezing was reported in 17 (18.9%) children and was absent in 73 (81.1%). Previous bronchodilator use was relatively common, reported by 47 (52.2%) children. In contrast, previous inhaled corticosteroid use was reported in only 19 (21.1%), indicating less frequent prior corticosteroid exposure.

Table 2: Clinical profile of children with wheezing (N=90)			
Clinical characteristic	**Category**	**n**	**%**
Recurrent wheezing	Yes (≥3 episodes/year)	42	46.7
	No (<3 episodes/year)	48	53.3
Number of wheezing episodes/year	1–2	48	53.3
	3–5	30	33.3
	>5	12	13.3
Nocturnal symptoms	Present	34	37.8
	Absent	56	62.2
Previous emergency visit	Yes	25	27.8
	No	65	72.2
Previous hospital admission	Yes	17	18.9
	No	73	81.1
Previous bronchodilator use	Yes	47	52.2
	No	43	47.8
Previous inhaled corticosteroid use	Yes	19	21.1
	No	71	78.9

Table 3 shows the distribution of potential risk factors according to recurrent wheezing status among the 90 children. A family history of asthma/atopy was present in 27 (64.3%) children with recurrent wheezing compared with 14 (29.2%) with non-recurrent wheezing. Eczema was also more frequently observed among recurrent cases (42.9% vs. 18.8%), as was parental smoking (45.2% vs. 22.9%). Prematurity was reported in 21.4% of recurrent cases compared with 8.3% of non-recurrent cases, while low birth weight was present in 28.6% and 12.5%, respectively. Exclusive breastfeeding for less than six months was documented in 47.6% of recurrent cases compared with 27.1% of non-recurrent cases. Daycare attendance was reported in 40.5% of recurrent cases versus 25.0% of non-recurrent cases. Indoor biomass/combustion exposure was present in 50.0% of recurrent cases compared with 31.3% of non-recurrent cases. Previous bronchiolitis/LRTI was more common among recurrent cases (57.1% vs. 31.3%), while peripheral eosinophilia ≥4% was observed in 38.1% versus 16.7%, respectively. Overall, several potential risk factors were more frequently observed among children with recurrent wheezing."

Table 3: Distribution of potential risk factors according to recurrent wheezing status (N=90)				
Risk factor	**Category**	**Recurrent wheezing n (%)**	**Non-recurrent wheezing n (%)**	**Total**
Family history of asthma/atopy	Present	27 (64.3)	14 (29.2)	41
	Absent	15 (35.7)	34 (70.8)	49
Eczema	Present	18 (42.9)	9 (18.8)	27
	Absent	24 (57.1)	39 (81.2)	63
Parental smoking	Present	19 (45.2)	11 (22.9)	30
	Absent	23 (54.8)	37 (77.1)	60
Prematurity	Yes	9 (21.4)	4 (8.3)	13
	No	33 (78.6)	44 (91.7)	77
Low birth weight	Yes	12 (28.6)	6 (12.5)	18
	No	30 (71.4)	42 (87.5)	72
Exclusive breastfeeding <6 months	Yes	20 (47.6)	13 (27.1)	33
	No	22 (52.4)	35 (72.9)	57
Daycare attendance	Yes	17 (40.5)	12 (25.0)	29
	No	25 (59.5)	36 (75.0)	61
Indoor biomass/combustion exposure	Present	21 (50.0)	15 (31.3)	36
	Absent	21 (50.0)	33 (68.8)	54
Previous bronchiolitis/LRTI	Yes	24 (57.1)	15 (31.3)	39
	No	18 (42.9)	33 (68.8)	51
Peripheral eosinophilia ≥4%	Present	16 (38.1)	8 (16.7)	24
	Absent	26 (61.9)	40 (83.3)	66

"Table 4 demonstrates the association of clinical and environmental risk factors with recurrent wheezing among the 90 children studied. A family history of asthma/atopy was significantly associated with recurrent wheezing, being present in 64.3% of recurrent cases compared with 29.2% of non-recurrent cases (χ^2=11.12, p=0.001). Similarly, eczema was significantly more frequent among children with recurrent wheezing (42.9% vs. 18.8%; p=0.013), as was parental smoking (45.2% vs. 22.9%; p=0.024). Exclusive breastfeeding for less than 6 months also showed a statistically significant association (47.6% vs. 27.1%; p=0.048). Previous bronchiolitis/LRTI was significantly more common among recurrent cases (57.1% vs. 31.3%; p=0.013), while peripheral eosinophilia ≥4% was significantly associated with recurrent wheezing (38.1% vs. 16.7%; p=0.022). In contrast, prematurity, low birth weight, daycare attendance, and indoor biomass/combustion exposure did not demonstrate statistically significant associations, with p-values of 0.092, 0.058, 0.125, and 0.072, respectively.

Table 4: Association of clinical and environmental risk factors with recurrent wheezing (N=90)				
Risk factor	**Recurrent n/N (%)**	**Non-recurrent n/N (%)**	**χ^2/Fisher's exact**	**p-value**
Family history of asthma/atopy	27/42 (64.3)	14/48 (29.2)	11.12	0.001
Eczema	18/42 (42.9)	9/48 (18.8)	6.2	0.013
Parental smoking	19/42 (45.2)	11/48 (22.9)	5.1	0.024
Prematurity	9/42 (21.4)	4/48 (8.3)	2.84	0.092
Low birth weight	12/42 (28.6)	6/48 (12.5)	3.6	0.058
Exclusive breastfeeding <6 months	20/42 (47.6)	13/48 (27.1)	3.91	0.048
Daycare attendance	17/42 (40.5)	12/48 (25.0)	2.35	0.125
Indoor biomass/combustion exposure	21/42 (50.0)	15/48 (31.3)	3.23	0.072
Previous bronchiolitis/LRTI	24/42 (57.1)	15/48 (31.3)	6.15	0.013
Peripheral eosinophilia ≥4%	16/42 (38.1)	8/48 (16.7)	5.26	0.022

Table 5 presents the multivariable logistic regression analysis of factors independently associated with recurrent wheezing among the 90 children. Family history of asthma/atopy remained a significant independent factor, with an adjusted odds ratio (OR) of 3.21 (95% CI: 1.28–8.06; p=0.013), indicating higher odds of recurrent wheezing among children with such a history. Eczema was also independently associated with recurrent wheezing (adjusted OR 2.47, 95% CI: 1.01–6.07; p=0.048). Similarly, previous bronchiolitis/LRTI showed a significant association (adjusted OR 2.58, 95% CI: 1.08–6.18; p=0.034), while peripheral eosinophilia ≥4% was another significant factor (adjusted OR 2.71,

95% CI: 1.02–7.20; p=0.045). In contrast, parental smoking showed a borderline but statistically non-significant association (p=0.061). Exclusive breastfeeding for less than six months, prematurity, and low birth weight were also not independently associated with recurrent wheezing, with p-values of 0.149, 0.345, and 0.239, respectively. Overall, family history, eczema, previous bronchiolitis/LRTI, and peripheral eosinophilia emerged as independent factors associated with recurrent wheezing.

Table 5: Multivariable logistic regression analysis of factors associated with recurrent wheezing (N=90)

Risk factor	Adjusted OR	95% CI	p-value
Family history of asthma/atopy	3.21	1.28–8.06	0.013
Eczema	2.47	1.01–6.07	0.048
Parental smoking	2.36	0.96–5.79	0.061
Exclusive breastfeeding <6 months	1.89	0.80–4.49	0.149
Previous bronchiolitis/LRTI	2.58	1.08–6.18	0.034
Peripheral eosinophilia ≥4%	2.71	1.02–7.20	0.045
Prematurity	1.74	0.55–5.53	0.345
Low birth weight	1.82	0.67–4.96	0.239

Discussion

The aim of the present study was to examine the clinical profile and risk factors related to recurrent wheezing in 90 children aged 2-5 years. Of the children, 46.7% had recurrent wheezing (3 or more episodes per year) and 53.3% had 1–2 episodes of wheezing per year. There was a higher proportion of younger children (35.6% 2–3-year-old), and of males (57.8%) suggesting that symptoms of recurrent respiratory infections occurred at an earlier stage in the preschool age group. This is similar to the age-related patterns reported previously. When children are under 5 years of age, the mean age of children with recurrent wheezing is 36.1 months versus 25.0 months for the control group as observed by Srisingh et al. 2017, suggesting that children with recurrent wheezing are more often seen during the preschool years [10]. Likewise, the meta-analysis by Bao et al., 2017 found that male sex was also an important predictor of subsequent asthma, with a pooled OR of 1.70, but may not be a direct cause of asthma [11]."

"One remarkable finding of the present study is that 53.3% of the children had wheezed for the first time before 2 years old. The early onset is of clinical interest since wheezing in infancy and early preschool years may be a predictor of a higher likelihood of chronic respiratory problems. Castro-Rodríguez et al. 2000 showed that children under the age of three who wheezed often and had additional risk factors were significantly more likely to have asthma during childhood. Those children who met the stringent Asthma Predictive Index were 4.3–9.8 times more likely to develop active asthma, and over 95% of children with a negative stringent index did not develop active asthma during the school years [12]. This young age of onset in the present study underlines the need for children with early wheezing, especially if they have other atopic features, to be monitored.

The strongest association that was observed in the present study was with family history of asthma or atopy, with 64.3% of children with recurrent wheezing having a family history of the disease compared with 29.2% of children without recurrent wheezing, and this was observed to be independent after adjustment. This finding is in line with previous evidence of the value of familial predisposition. Among the children who were at risk of developing asthma, Bao et al. 2017 reported a pooled OR of 2.20 for family history of asthma in the preschool children. Likewise, in a birth-cohort study, Tariq et al., 1998, discovered family history of atopy to be the greatest risk factor for atopy, with children of mothers with asthma having about three times the odds of asthma (OR 3.0, 95% CI 1.6–5.8) at 4 years of age [13]. The size and direction of these findings corroborate the current observation that atopic susceptibility in the family is an important risk factor for recurrent preschool wheezing.

Recurrent cases were also much more likely to have eczema (42.9% vs. 18.8%) in the current study. The relationship between atopic dermatitis and subsequent respiratory disease was the same before and after adjustment, although the association was somewhat weaker after adjustment. A pooled OR of 2.02 for AD as a predictor of asthma in preschool children was reported by Bao et al. 2017. The Asthma Predictive Index was also expanded by Castro-Rodríguez et al., 2000 to include a major risk factor, which was eczema. Such observations indicate that eczema might be a surrogate for an underlying atopic phenotype but might have a similar effect as family history of atopy and eosinophilic inflammation.

This study confirmed the association between previous bronchiolitis or lower respiratory tract infection and recurrent wheezing, where its presence was seen in 57.1% of recurrent cases versus 31.3% of non-recurrent cases. The previous studies are very supportive of this observation. Lower respiratory tract infection was reported as important risk factor for

recurrent wheezing with OR of 5.33 (95% CI 2.33–12.23) in bivariate analysis by Srisingh et al. 2017. More recently, Wang et al. 2021 conducted a meta-analysis of 32 studies, comprising 292,844 participants, and identified a 2.46-fold higher risk of then subsequently wheezing or developing asthma in children that had had bronchiolitis before 2 years of age (95% CI 2.14-2.82) [14]. The present results thus support the concept that important early-life respiratory infections contribute to the development of recurrent airway symptoms."

"Another factor independently associated was peripheral eosinophilia ≥4%, which had an adjusted OR of 2.71 in the present study. The results are in line with the biological relevance of eosinophilic airway inflammation in preschool wheezers. Lee et al. 2019 found evidence that links blood eosinophils with eosinophilic airway inflammation and that higher eosinophils are related to having more attacks and chronic wheezing [15]. In addition, eosinophilia was added as a small risk factor in the "Asthma Predictive Index" devised by Castro-Rodríguez et al., 2000. The present association therefore suggests that peripheral eosinophilia may be of supportive value if used in the context of clinical and atopic characteristics in assessing recurrent wheezing but should not be used as a sole diagnostic marker.

In recurrent cases, 45.2% of parents smoked, but only 22.9% of the non-recurrent cases had parents who smoked. This association was not statistically significant in the multivariable model, but the adjusted OR was still statistically significant at 2.36. This is in line with the previous evidence. Passive smoking was also found to be a risk factor for recurrent wheezing (OR 2.37, 95% CI 1.09–5.13) by Srisingh et al. 2017. Likewise, Burke et al. 2012 conducted a meta-analysis of 79 prospective studies and identified an increased risk for wheezing in children ≤2 years of age due to postnatal maternal smoking (OR 1.70, 95% CI 1.24–2.35) [16]. Further, an Indian study by Sharma and Banga 2007 also reported that maternal smoking (OR 1.5), paternal smoking (OR 1.3), and exposure > seven cigarettes per day from both parents (OR 1.9) were independently associated with recent wheezing [17]. Lack of independent significance in the present study may be due to sample size or confounding and not necessarily to the lack of an environmental contribution.

Recurrent cases were more likely to have experienced prematurity or low birth weight, but these differences were not statistically significant. This is in contrast with the large meta-analysis by Been et al., 2014, which included more than 1.5 million children, and showed that wheezing disorders in childhood were associated with preterm birth (adjusted OR 1.46; 95% CI 1.29–1.65), and very preterm birth (adjusted OR 2.81) [18]. This difference may be attributable to the relatively small number of children studied here and the fact that the majority of children had normal birth weight. By the same token, the proportion of recurrent cases who were shorter exclusive breastfeeding was more pronounced but less significant after adjustment. In children, Xue et al. 2021 found a possible protective association with breastfeeding for ≥ 6 months as compared with breastfeeding shorter in duration, with an OR of 0.76 (95% CI 0.68–0.85) [19]. This may have been due to measurement variance in the definition of outcome and in study design.

The results show that atopic predisposition in the family, eczema, previous bronchiolitis or lower respiratory tract infection and peripheral eosinophilia are associated specifically with recurrent wheezing among children 2-5 years of age. Environmental tobacco exposure and early life exposures, like breastfeeding and low birth weight, had clinically significant differences, but were not independently significant. The results are generally in agreement with other studies which have shown that recurrent wheezing in preschool children is polyetiological, with a complex interplay between genetic susceptibility, atopic inflammation, early respiratory infections and environmental factors."

Conclusion

The present study concluded that recurrent wheezing was a common clinical problem among children aged 2–5 years, affecting 46.7% of the study population. Recurrent wheezing was associated with multiple clinical and atopic characteristics, particularly an early onset of wheezing, family history of asthma or atopy, eczema, previous bronchiolitis or lower respiratory tract infection, and peripheral eosinophilia. Among these factors, family history of asthma/atopy, eczema, previous bronchiolitis/LRTI, and peripheral eosinophilia remained independently associated with recurrent wheezing after multivariable adjustment. Parental smoking, shorter breastfeeding duration, prematurity, and low birth weight showed differences between groups but were not independently significant. Early recognition of atopic and respiratory risk factors, along with appropriate clinical assessment, counselling regarding modifiable exposures, and regular follow-up, may help identify children at greater risk of persistent or recurrent respiratory symptoms.

References

1. Wright AL. Epidemiology of asthma and recurrent wheeze in childhood. Clinical reviews in allergy & immunology. 2002;22(1):33.
2. Auscultate C. A. Recurrent cough (worse at night and early morning) B. Recurrent wheezing C. Recurrent shortness of breath (SOB) D. Recurrent chest tightness (may worsen moderate activity). Family Practice Guidelines. 2014 Feb 10:139.

3. Beydon N, Davis SD, Lombardi E, Allen JL, Arets HG, Aurora P, Bisgaard H, Davis GM, Ducharme FM, Eigen H, Gappa M. An official American Thoracic Society/European Respiratory Society statement: pulmonary function testing in preschool children. American journal of respiratory and critical care medicine. 2007 Jun;175(12):1304-45.
4. Doss AM, Stokes JR. Viral infections and wheezing in preschool children. Immunology and Allergy Clinics of North America. 2022 Nov 1;42(4):727-41.
5. Tan RA, Corren J. The relationship of rhinitis and asthma, sinusitis, food allergy, and eczema. Immunology and Allergy Clinics. 2011 Aug 1;31(3):481-91.
6. Lynch SV, Wood RA, Boushey H, Bacharier LB, Bloomberg GR, Kattan M, O'Connor GT, Sandel MT, Calatroni A, Matsui E, Johnson CC. Effects of early-life exposure to allergens and bacteria on recurrent wheeze and atopy in urban children. Journal of Allergy and Clinical Immunology. 2014 Sep 1;134(3):593-601.
7. Vrijlandt EJ, Kerstjens JM, Duiverman EJ, Bos AF, Reijneveld SA. Moderately preterm children have more respiratory problems during their first 5 years of life than children born full term. American journal of respiratory and critical care medicine. 2013 Jun;187(11):1234-40.
8. Tregoning JS, Schwarze J. Respiratory viral infections in infants: causes, clinical symptoms, virology, and immunology. Clinical microbiology reviews. 2010 Jan;23(1):74-98.
9. Evans GW, Kantrowitz E. Socioeconomic status and health: the potential role of environmental risk exposure. Annual review of public health. 2002 May;23(1):303-31.
10. Srisingh K, Weerakul J, Srijuntongsiri S, Ngoenmak T. Risk Factors of Recurrent Wheezing in Children Under 5 Years of Age. Journal of the Medical Association of Thailand. 2017 Feb 1;100(2):183.
11. Bao Y, Chen Z, Liu E, Xiang L, Zhao D, Hong J. Risk factors in preschool children for predicting asthma during the preschool age and the early school age: a systematic review and meta-analysis. Current allergy and asthma reports. 2017 Dec;17(12):85.
12. Castro-Rodríguez JA, Holberg CJ, Wright AL, Martinez FD. A clinical index to define risk of asthma in young children with recurrent wheezing. American journal of respiratory and critical care medicine. 2000 Oct;162(4):1403-6.
13. Tariq MS, Matthews SS, Hakim ME, Stevens SM, Arshad DS, Hide MD. The prevalence of and risk factors for atopy in early childhood: a whole population birth cohort study. Journal of allergy and clinical immunology. 1998 May 1;101(5):587-93.
14. Wang G, Han D, Jiang Z, Li M, Yang S, Liu L. Association between early bronchiolitis and the development of childhood asthma: a meta-analysis. BMJ open. 2021 May;11(5):e043956.
15. Lee YJ, Fujisawa T, Kim CK. Biomarkers for Recurrent Wheezing and Asthma in Preschool Children. Allergy, Asthma & Immunology Research. 2019 Jan 1;11(1):16-28.
16. Burke H, Leonardi-Bee J, Hashim A, Pine-Abata H, Chen Y, Cook DG, Britton JR, McKeever TM. Prenatal and passive smoke exposure and incidence of asthma and wheeze: systematic review and meta-analysis. Pediatrics. 2012 Apr 1;129(4):735-44.
17. Sharma SK, Banga A. Prevalence and risk factors for wheezing in children from rural areas of north India. InAllergy & Asthma Proceedings 2007 Nov 1 (Vol. 28, No. 6, p. 647).
18. Been JV, Lugtenberg MJ, Smets E, Van Schayck CP, Kramer BW, Mommers M, Sheikh A. Preterm birth and childhood wheezing disorders: a systematic review and meta-analysis. PLoS medicine. 2014 Jan 28;11(1):e1001596.
19. Xue M, Dehaas E, Chaudhary N, O'Byrne P, Satia I, Kurmi OP. Breastfeeding and risk of childhood asthma: a systematic review and meta-analysis. ERJ open research. 2021 Oct;7(4):00504-2021.