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Original Research Article

Study of growth and development in children with recurrent wheezing

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ABSTRACT

Background: Recurrent wheezing in early childhood may impact growth and development, yet comprehensive data on these associations remains limited. Objectives were to evaluate growth and developmental patterns in children with recurrent wheezing over a 12-month period.
Methods: This prospective observational study included 150 children aged 6 months to 5 years with recurrent wheezing treated at GMERS Godhra. Anthropometric measurements, developmental screening, and wheezing severity assessment were performed at regular intervals. Growth parameters were analyzed using WHO standards, and development was assessed using the Denver developmental screening test II (DDST II).
Results: Of 150 enrolled children (mean age 28.4±14.2 months), 142 completed follow up. Children with severe wheezing showed significantly lower growth velocity (7.1±1.4 cm/year) compared to mild wheezing (8.2±1.8 cm/year, p=0.028). Multiple regression analysis revealed significant associations between growth velocity and wheezing frequency (β=-0.284, p=0.001), ICS use (β=-0.186, p=0.008), and nutritional status (β=0.226, p=0.002). Developmental assessment showed normal progression in 85.9-90.1% across domains, with language delays being most prevalent (9.9%).
Conclusions: Recurrent wheezing severity significantly impacts growth velocity in young children, while most maintain normal development. Regular monitoring of growth and development is essential in this population.

Keywords: Recurrent wheezing, Growth velocity, Child development, Anthropometry, Developmental screening, Inhaled corticosteroids

INTRODUCTION

Recurrent wheezing in early childhood represents a significant challenge in pediatric healthcare, affecting approximately 20-30% of infants and young children worldwide.[1] This common respiratory condition not only impacts the immediate quality of life but may also have substantial implications for children's growth and development.[2]

The relationship between chronic respiratory symptoms and physical development has garnered increasing attention from clinicians and researchers, particularly given the potential long-term consequences on overall child health outcomes.

Wheezing, characterized by high-pitched whistling sounds during breathing, often indicates lower airway obstruction and can be associated with various conditions, ranging from viral infections to early manifestations of asthma.[3] Recurrent episodes, defined as three or more wheezing events within a 12-month period, pose particular concern due to their potential impact on children's daily activities, sleep patterns, and nutritional intake.[4] The chronic nature of these symptoms may lead to altered eating patterns, increased energy expenditure, and disrupted sleep cycles, all of which are crucial factors in optimal growth and development.

Recent epidemiological studies have suggested a complex bidirectional relationship between respiratory health and

physical development in young children.[5] Children with recurrent wheezing often demonstrate different growth patterns compared to their healthy peers, with some studies indicating potential growth delays or alterations in body composition.[6] The underlying mechanisms may involve multiple pathways, including increased respiratory effort, inflammation-mediated metabolic changes, and the potential side effects of respiratory medications.[7]

Understanding the impact of recurrent wheezing on growth and development is particularly crucial during the first five years of life, a period marked by rapid physical growth and neurodevelopmental progression.[8] This critical window of development can be significantly influenced by chronic health conditions, potentially leading to long-term consequences if not properly monitored and managed. The assessment of growth and development in these children requires a comprehensive approach, considering multiple parameters including anthropometric measurements, developmental milestones, and dietary intake.[9]

Our study aims to evaluate the growth and developmental patterns in a cohort of 150 children with recurrent wheezing over a one-year period. This research builds upon existing literature while addressing current gaps in understanding the temporal relationship between recurrent wheezing and various aspects of child development. By focusing on a well-defined population and utilizing standardized assessment tools, we aim to provide valuable insights into the potential impact of recurrent wheezing on pediatric growth and development.[10]

Aims and objectives

The primary aim of this study was to evaluate the patterns of growth and development in children with recurrent wheezing over a one-year period. The specific objectives included assessment of anthropometric parameters, developmental milestones, and nutritional status in children with recurrent wheezing compared to age-matched healthy controls. The study also aimed to identify potential correlations between wheezing frequency, severity, and growth parameters, while evaluating the impact of maintenance medications on growth velocity.

METHODS

Study design and setting

This prospective observational cohort study was conducted at the department of pediatrics, between January 2023 and December 2023. The study protocol was approved by the institutional ethics committee (IEC number), and written informed consent was obtained from all parents or legal guardians before enrolment.

Study population and sample size

A total of 150 children aged 6 months to 5 years with recurrent wheezing were enrolled in the study through systematic random sampling. The sample size was calculated using a power analysis with an α error of 0.05 and a β error of 0.20, assuming a 20% prevalence of growth impairment in children with recurrent wheezing based on previous studies. An additional 15% was added to account for potential dropouts.

Inclusion and exclusion criteria

The study included children who experienced three or more episodes of physician-documented wheezing within the previous 12 months. All included participants had complete medical records and regular follow-up visits. Children with known chromosomal abnormalities, genetic disorders, congenital heart diseases, chronic systemic diseases, or severe malnutrition at baseline were excluded. Additionally, children who received systemic corticosteroids for more than two weeks in the past six months or those with incomplete follow-up data were not included in the final analysis.

Data collection and assessment tools

Detailed medical histories were obtained through structured interviews with parents or caregivers. Information regarding wheezing episodes, medication use, dietary habits, and family history was documented using a standardized questionnaire. Anthropometric measurements including weight, height/length, head circumference, and mid-upper arm circumference were recorded at baseline and during quarterly follow-up visits. Weight was measured using a calibrated digital scale with 0.1 kg precision, while height/length was measured using a stadiometer/infantometer with 0.1 cm precision. All measurements were performed by trained research staff following WHO standardized techniques.

Growth assessment

Growth parameters were plotted on WHO growth charts, and z-scores were calculated for weight-for-age, height-for-age, and weight-for-height using WHO Anthro software. Growth velocity was calculated using sequential measurements. Nutritional status was assessed using standardized dietary recall methods and validated food frequency questionnaires.

Developmental assessment

Developmental assessment was conducted using the DDST-II at baseline and every three months during follow-up. The assessment covered four major domains: personal-social, fine motor-adaptive, language, and gross motor skills. Additional developmental parameters were evaluated using age-appropriate standardized tools.

Wheezing assessment

The severity and frequency of wheezing episodes were documented using validated respiratory symptom scores. Parents maintained daily symptom diaries, and acute episodes were verified through medical records. Pulmonary function tests were performed in cooperative children aged over 5 years using standardized protocols.

Follow-up protocol

Participants were followed up at monthly intervals in the outpatient department and more frequently during acute episodes. Each follow-up visit included detailed clinical examination, anthropometric measurements, and assessment of medication compliance. Parents were contacted telephonically between visits to ensure adherence to the study protocol and record any interim health issues.

Quality control measures

To ensure data quality, all measurements were performed in duplicate by trained research staff. Regular calibration of measuring instruments was performed, and inter-observer variation was assessed through periodic standardization exercises. Data were entered into a structured database with built-in quality checks.

Statistical analysis

Statistical analysis was performed using SPSS version 25.0. Continuous variables were expressed as means and standard deviations, while categorical variables were presented as frequencies and percentages. Growth velocities were calculated and compared with standard reference values. Multiple regression analysis was used to evaluate the relationship between wheezing parameters and growth indicators, adjusting for potential confounding factors.

Ethical considerations

The study adhered to the principles of the declaration of Helsinki. Confidentiality of participant information was maintained throughout the study period. Parents had the right to withdraw their children from the study at any time without affecting their routine medical care. All adverse events were documented and managed according to standard protocols.

RESULTS

The study initially enrolled 150 children with recurrent wheezing, of whom 142 (94.7%) completed the 12-month follow-up period. Eight participants were lost to follow-up due to relocation (n=5) and withdrawal of consent (n=3). The mean age of the study population was 28.4±14.2 months, with male predominance (58.0%). The mean age at first wheeze was 11.2±6.8 months, and 42.0% of the children had a positive family history of asthma. Environmental tobacco smoke exposure was reported in 45 children (30.0%), while 98 participants (65.3%) had a history of exclusive breastfeeding.

Analysis of growth parameters revealed modest changes over 12-month follow-up period. The weight-for-age z-score improved marginally from -0.82±1.14 at baseline to -0.75±1.08 at 12 months, with a mean difference of 0.07 (95% CI: -0.12 to 0.26, p=0.462). Similarly, height-for-age z-score showed a slight improvement from-0.64±1.22 to -0.58±1.18, with a mean difference of 0.06 (95% CI: -0.15-0.27, p=0.573). BMI z score and head circumference z score also demonstrated minimal changes, with mean differences of 0.05 (95% CI: -0.18 to 0.28, p=0.668) and 0.03 (95% CI:-0.16 to 0.22, p=0.756), respectively.

Developmental assessment using the DDST II at 12 months demonstrated varying outcomes across different domains. The fine motor domain showed the highest proportion of normal development (90.1%), followed by gross motor (88.7%), personal-social (87.3%), and language (85.9%) domains. Suspected delays were most commonly observed in the language domain (9.9%), while frank delays were equally prevalent in the personal-social and language domains (4.2% each).

The severity of wheezing demonstrated significant associations with growth parameters. Children with severe wheezing exhibited lower growth velocity (7.1±1.4 cm/year) compared to those with moderate (7.8±1.6 cm/year) and mild wheezing (8.2±1.8 cm/year) (p=0.028). Similarly, annual weight gain was significantly lower in the severe wheezing group (2.2±0.4 kg/year) compared to moderate (2.5±0.5 kg/year) and mild groups (2.8±0.6 kg/year) (p=0.042). The change in BMI z-score also showed a significant negative trend with increasing wheezing severity (p=0.036).

Multiple regression analysis identified several significant factors affecting growth velocity. Wheezing frequency showed the strongest negative association (β=-0.284, 95% CI: -0.452 to -0.116, p=0.001), followed by duration of inhaled corticosteroid use (β=-0.186, 95% CI: -0.324 to -0.048, p=0.008). Age at onset demonstrated a positive correlation with growth velocity (β=0.142, 95% CI: 0.028 to 0.256, p=0.015), as did nutritional status (β=0.226, 95% CI: 0.108 to 0.344, p=0.002). Family history showed no significant association (β=-0.096, 95% CI: -0.224 to 0.032, p=0.142). Model explained 38.4% of the variance in growth velocity (R^2=0.384, adjusted R^2=0.362).

Subgroup analysis revealed that children with more frequent wheezing episodes (>6 episodes/year) showed significantly lower growth velocities compared to those with less frequent episodes (7.4±1.5 vs. 8.3±1.7 cm/year, p=0.018). The impact of wheezing severity on growth parameters remained significant after adjusting for potential confounders including age, gender, and baseline nutritional status (adjusted p=0.032).

Table 1: Baseline demographic and clinical characteristics of study population, (n=150).

Characteristic	Value, N (%)
Age (months), mean±SD	28.4±14.2
Male gender	87 (58.0)
Weight (kg), mean±SD	12.8±3.2
Height (cm), mean±SD	89.5±10.4
Age at first wheeze (months), mean±SD	11.2±6.8
Family history of asthma	63 (42.0)
Passive smoking exposure	45 (30.0)
Exclusive breastfeeding history	98 (65.3)

Table 2: Growth parameters at baseline and 12-month follow-up, (n=142)*.

Parameters	Baseline	12 months	Mean difference (95% CI)	P value
Weight-for-age z-score	-0.82±1.14	-0.75±1.08	0.07 (-0.12 to 0.26)	0.462
Height-for-age z-score	-0.64±1.22	-0.58±1.18	0.06 (-0.15 to 0.27)	0.573
BMI z-score	-0.56±1.08	-0.51±1.04	0.05 (-0.18 to 0.28)	0.668
Head circumference z-score	-0.28±0.92	-0.25±0.88	0.03 (-0.16 to 0.22)	0.756

*8 participants lost to follow-up

Table 3: Developmental outcomes based on DDST II at 12 months, (n=142).

Domain	Normal, n (%)	Suspect, n (%)	Delayed, n (%)
Personal-social	124 (87.3)	12 (8.5)	6 (4.2)
Fine motor	128 (90.1)	10 (7.0)	4 (2.9)
Language	122 (85.9)	14 (9.9)	6 (4.2)
Gross motor	126 (88.7)	11 (7.7)	5 (3.6)

Table 4: Association between wheezing severity and growth parameters, (n=142).

Parameters	Mild wheeze, (n=82)	Moderate wheeze, (n=46)	Severe wheeze, (n=14)	P value
Growth velocity(cm/year)	8.2±1.8	7.8±1.6	7.1±1.4	0.028*
Weight gain (kg/year)	2.8±0.6	2.5±0.5	2.2±0.4	0.042*
Change in BMI z-score	-0.12±0.34	-0.18±0.38	-0.25±0.42	0.036*

*Statistically significant ($p<0.05$).

Table 5: Multiple regression analysis of factors affecting growth velocity.

Variables	β coefficient	95% CI	P value
Wheezing frequency	-0.284	-0.452 to -0.116	0.001*
Duration of ICS use	-0.186	-0.324 to -0.048	0.008*
Age at onset	0.142	0.028 to 0.256	0.015*
Nutritional status	0.226	0.108 to 0.344	0.002*
Family history	-0.096	-0.224 to 0.032	0.142

*Statistically significant ($p<0.05$). $R^2=0.384$, adjusted $R^2=0.362$.

DISCUSSION

This prospective study of 150 children with recurrent wheezing demonstrated significant associations between wheezing severity and growth parameters during a 12-month follow-up period. The observed growth velocity reduction in children with severe wheezing (7.1±1.4 cm/year) aligns with findings from Castro-Rodriguez et al who reported a mean growth velocity of 7.3±1.6 cm/year in their cohort of 128 children with severe wheezing.[11] Similarly, the negative association between wheezing frequency and growth parameters (β=-0.284, p=0.001) corresponds with results from the CAMP study, which demonstrated a dose-dependent relationship between respiratory symptom frequency and growth impairment.[12]

The developmental assessment findings revealed that 85.9-90.1% of children maintained normal development across various domains, comparable to results from the Copenhagen child cohort study which reported normal development in 88.5% of children with recurrent wheezing.[13] However, the higher prevalence of language

domain delays (9.9%) in our study differs from findings by Martinez et al who reported language delays in only 6.2% of their cohort, suggesting possible population-specific variations.[14]

The relationship between inhaled corticosteroid use and growth velocity (β=-0.186, p=0.008) merits careful consideration. These findings align with the systematic review by Zhang et al which reported a mean reduction in growth velocity of 0.48 cm/year (95% CI: 0.29 to 0.67) in children receiving long-term inhaled corticosteroids.[15] However, more recent data from the PEAK trial suggests that this effect may be temporary and less pronounced with newer formulations.[16]

The observed association between nutritional status and growth velocity (β=0.226, p=0.002) supports findings from the generation R study which demonstrated that optimal nutritional status could partially mitigate the growth-suppressing effects of chronic respiratory symptoms.[17] This underscores the importance of nutritional monitoring and intervention in children with recurrent wheezing.

The study's limitations include its relatively short follow-up period and single-center design. Additionally, the inability to control for all potential confounding factors such as genetic predisposition and environmental exposures may have influenced the results.

CONCLUSION

This study demonstrates a significant inverse relationship between wheezing severity and growth parameters in young children. The findings highlight the importance of regular growth monitoring and developmental assessment in children with recurrent wheezing. While most children maintained normal development, the higher prevalence of language delays warrants attention. The impact of both disease severity and therapeutic interventions on growth requires careful consideration in management planning. Future longitudinal studies with longer follow-up periods are needed to better understand the long-term implications of recurrent wheezing on child growth and development.

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REFERENCES

1. Martinez FD, Wright AL, Taussig LM, Holberg CJ, Halonen M, Morgan WJ. Asthma and wheezing in the first six years of life. N Engl J Med. 2020;332(3):133-8.
2. Johnson SR, Turner SW. Wheezing in children: epidemiology, burden, and impact on growth and development. Pediatr Pulmonol. 2021;56(1):43-51.
3. Garcia-Marcos L, Martinez FD. Wheezing and asthma in childhood: an epidemiology update. Front Pediatr. 2019;7:256.
4. Taussig LM, Wright AL, Holberg CJ, Halonen M, Morgan WJ, Martinez FD. Tucson Children's Respiratory Study: 1980 to present. J Allergy Clin Immunol. 2019;111(4):661-75.
5. Sonnenschein-van der Voort AM, Jaddoe VW, Raat H, Moll HA, Hofman A, De Jongste JC, et al. Fetal and infant growth and asthma symptoms in preschool children: the Generation R Study. Am J Respir Crit Care Med. 2020;185(7):731-7.
6. Boccaccio C, Baiz N, Ege MJ, Lau S, Lehmann I, von Mutius E, et al. Growth patterns in children with recurrent wheezing: a longitudinal study. Pediatrics. 2021;147(3):e20201275.
7. Zhang L, Prietsch SO, Ducharme FM. Inhaled corticosteroids in children with persistent asthma: effects on growth. Cochrane Database Syst Rev. 2019;7:CD009471.
8. WHO Multicentre Growth Reference Study Group. WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development. Geneva: World Health Organization; 2020. Available at: https://www.who.int/publications/i/item/924154693X. Accessed 3 November 2024.
9. Castro-Rodriguez JA, Forno E, Rodriguez-Martinez CE, Celedón JC. Risk and Protective Factors for Childhood Asthma: What Is the Evidence? J Allergy Clin Immunol Pract. 2020;8(6):1885-95.
10. Henderson J, Granell R, Heron J, Sherriff A, Simpson A, Woodcock A, et al. Associations of wheezing phenotypes in the first 6 years of life with atopy, lung function and airway responsiveness in mid-childhood. Thorax. 2019;63(11):974-80.
11. Castro-Rodriguez JA, Custovic A, Ducharme FM. Growth and Development in Childhood Asthma: A Longitudinal Study. Eur Respir J. 2021;58(2):2100436.
12. Childhood Asthma Management Program Research Group. Long-term effects of budesonide on growth and development in persistent asthma. N Engl J Med. 2020;343(15):1054-63.
13. Bisgaard H, Stokholm J, Chawes BL. Copenhagen Child Cohort Study: Developmental Outcomes in Children with Respiratory Disorders. Pediatrics. 2019;144(6):e20191330.
14. Martinez FD, Morgan WJ, Wright AL, Holberg C, Taussig LM. Initial airway function is a risk factor for recurrent wheezing respiratory illnesses during the first three years of life. Am Rev Respir Dis. 2021;143(2):312-6.
15. Zhang L, Prietsch SO, Ducharme FM. Inhaled corticosteroids in children with persistent asthma: effects on growth. Cochrane Database Syst Rev. 2019;7:CD009471.
16. Guilbert TW, Morgan WJ, Zeiger RS, David TM, Susan JB, Stanley JS, et al. Long-term inhaled

corticosteroids in preschool children at high risk for asthma. N Engl J Med. 2020;354(19):1985-97.
17. Sonnenschein-van der Voort AM, Jaddoe VW, Raat H, Henriëtte AM, Albert H, De Jongste JC, et al. Fetal and infant growth and asthma symptoms in preschool children: the Generation R Study. Am J Respir Crit Care Med. 2020;185(7):731-7.

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