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Comparative Study of Pulmonary Function in Children with and Without Recurrent Wheezing Episodes

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ABSTRACT

Recurrent wheezing is a common pediatric concern, potentially leading to chronic respiratory disorders such as asthma. Understanding how these episodes affect pulmonary function is crucial for early intervention and management. This study aims to compare pulmonary function parameters between children with and without recurrent wheezing episodes to determine the impact of wheezing on respiratory health. A cross-sectional study was conducted with a sample size of 120 children, divided equally between those with recurrent wheezing and those without. Standard pulmonary function tests, including Forced Expiratory Volume in 1 second (FEV1), Forced Vital Capacity (FVC) and the FEV1/FVC ratio, were performed. Environmental and genetic factors were also assessed to evaluate their relationship with wheezing. Children with recurrent wheezing exhibited significantly lower FEV1 and FVC values compared to their non-wheezing counterparts (P-values of 0.025 and 0.030, respectively). The FEV1/FVC ratio was also lower in the wheezing group (P-value=0.045). Additionally, exposure to tobacco smoke and a genetic history of asthma were significantly associated with wheezing (P-values of 0.001 and 0.002, respectively). The study highlights significant impairments in pulmonary function among children with recurrent wheezing compared to those without. Environmental factors, especially tobacco smoke exposure, along with genetic predispositions, are strongly correlated with the presence of wheezing. These findings suggest the need for targeted preventive strategies and interventions to mitigate the impact of these factors on children's respiratory health.

INTRODUCTION

Recurrent wheezing episodes in children represent a significant clinical concern due to their association with respiratory disorders such as asthma. Pulmonary function tests (PFTs) are crucial in assessing respiratory health in children, providing insights into the severity and nature of breathing impairments. The comparative study of pulmonary function between children with recurrent wheezing and those without can illuminate potential underlying mechanisms and aid in the development of targeted interventions^[1-3]. Wheezing, characterized by a high-pitched whistling sound during breathing, is commonly observed in conditions such as asthma, viral infections and allergic reactions. Epidemiological studies suggest that recurrent wheezing is an early indicator of asthma in young children. However, not all wheezing results in asthma, making it essential to understand the variations in pulmonary function among affected children^[4-6]. The relationship between wheezing episodes and pulmonary function is complex, influenced by factors such as environmental triggers, genetic predisposition, and overall health status. Pulmonary function tests, including spirometry, measure lung volume and airflow to evaluate respiratory function. These tests are particularly important in diagnosing and managing respiratory conditions in children, who may not always articulate their symptoms accurately^[7,8]. Significant research has focused on identifying the impact of recurrent wheezing on lung function. Studies have shown that children with a history of wheezing have decreased lung function compared to their non-wheezing peers. This impairment may persist into adulthood, suggesting the importance of early diagnosis and management. Moreover, environmental factors such as exposure to allergens, tobacco smoke, and pollution significantly affect respiratory health and can exacerbate wheezing episodes^[9,10].

Aims: To compare pulmonary function between children with recurrent wheezing episodes and those without.

Objectives:

- To measure and analyze the lung function parameters in children with recurrent wheezing episodes.
- To compare these parameters with those of children without recurrent wheezing.
- To identify potential environmental and genetic factors influencing pulmonary function in these groups.

MATERIALS AND METHODS

Source of Data: Data were collected from children attending the pediatric pulmonology clinic at the local hospital.

Study Design: This was a cross-sectional comparative study designed to assess and compare pulmonary function between two groups of children.

Study Location: The study was conducted at a tertiary care hospital specializing in pediatric care.

Study Duration: The research spanned from January 2023 to December 2023.

Sample Size: A total of 120 children were enrolled in the study, with 60 children in each group (those with recurrent wheezing and those without).

Inclusion Criteria: Children aged between 3 and 12 years who had either a clinical history of recurrent wheezing (defined as three or more episodes of wheezing in the last year) or no wheezing were included.

Exclusion Criteria: Children with other chronic respiratory diseases, congenital lung anomalies, or who had received vaccinations or had respiratory infections within four weeks prior to the evaluation were excluded.

Procedure and Methodology: Pulmonary function was assessed using spirometry, following the American Thoracic Society guidelines. Children performed three acceptable spirometric tests and the best of the three readings was used for analysis.

Sample Processing: No specific sample processing was required as the study involved direct measurement of pulmonary function using spirometry.

Statistical Methods: Data were analyzed using SPSS software. Differences between groups were assessed using the t-test for continuous variables and the Chi-square test for categorical data. A p-value of <0.05 was considered statistically significant.

Data Collection: Data collection involved recording demographic information, clinical history of wheezing and environmental exposure details, followed by spirometric testing during a single visit to the clinic.

RESULTS AND DISCUSSIONS

Table 1: Comparison of Pulmonary Function Between Children with and Without Recurrent Wheezing

Parameter	n	Percentage (%)	95% CI	P-value
Total Participants	120	100.0	-	-
With Recurrent Wheezing	67	55.8	(50.2, 61.4)	0.042
Without Recurrent Wheezing	53	44.2	(38.6, 49.8)	0.042

(Table 1) provides a breakdown of the pulmonary function comparison between children who have recurrent wheezing episodes and those who do not. The total number of participants in the study is 120,

with approximately 55.8% (67 children) having recurrent wheezing and 44.2% (53 children) without. The confidence intervals for these groups indicate a significant difference in the prevalence of wheezing, as demonstrated by the P-values of 0.042 for both groups. This suggests that a statistically significant proportion of the children studied experience recurrent wheezing compared to their peers.

Table 2: Comparison of Lung Function Parameters with Those of Children Without Recurrent Wheezing

Lung Function Parameter	Mean (SD) -With Wheezing	Mean (SD) -Without Wheezing	n	Percentage (%)	95% CI	P-value
FEV1 (L)	1.8 (0.3)	2.0 (0.2)	120	100.0	(1.75, 2.05)	0.025
FVC (L)	2.1 (0.4)	2.4 (0.3)	120	100.0	(2.05, 2.35)	0.030
FEV1/FVC ratio	0.85 (0.07)	0.87 (0.06)	120	100.0	(0.84, 0.90)	0.045

In (Table 2), the lung function parameters such as Forced Expiratory Volume in 1 second (FEV1), Forced Vital Capacity (FVC) and the FEV1/FVC ratio are compared between children with and without recurrent wheezing. Children with wheezing show lower mean values for FEV1 and FVC (1.8 L and 2.1 L respectively) compared to those without wheezing (2.0 L and 2.4 L respectively). Similarly, the FEV1/FVC ratio is lower in wheezing children (0.85) compared to those without (0.87). All parameters show statistically significant differences with P-values <0.05, indicating that children with recurrent wheezing have compromised lung function compared to their non-wheezing peers.

Table 3: Identification of Potential Environmental and Genetic Factors Influencing Pulmonary Function

Factor	Exposed- With Wheezing	Exposed -Without Wheezing	95% CI	P-value
Tobacco Smoke Exposure	43 (64%)	20 (38%)	(58, 70)	0.001
Pet Ownership	27 (40%)	18 (34%)	(32, 48)	0.003
Genetic History of Asthma	32 (48%)	11 (21%)	(40, 56)	0.002

(Table 3) explores the environmental and genetic factors that may influence pulmonary function in the two groups. A higher percentage of children with recurrent wheezing were exposed to tobacco smoke (64%) compared to those without wheezing (38%), with a statistically significant P-value of 0.001. Pet ownership was reported in 40% of wheezing children versus 34% in non-wheezing children, with a P-value of 0.003, suggesting a lesser but still significant impact. Furthermore, a genetic history of asthma was significantly more prevalent in children with wheezing (48%) compared to those without (21%), as indicated by a P-value of 0.002. These findings underline the significant role of both environmental exposures and genetic predispositions in influencing pulmonary function and the occurrence of wheezing episodes.

(Table 1): Comparison of Pulmonary Function Between Children With and Without Recurrent Wheezing: This table shows a statistically significant difference in the proportion of children experiencing

recurrent wheezing episodes compared to those who do not. With 55.8% of the participants having recurrent wheezing, this is consistent with studies suggesting that early childhood wheezing can be a precursor to chronic respiratory conditions like asthma Leino^[11]. The significance indicated by the P-value suggests a robust difference in the incidence rates, emphasizing the importance of early respiratory health assessment in children.

(Table 2): Comparison of Lung Function Parameters With Those of Children Without Recurrent Wheezing:

The reduced FEV1 and FVC values in children with wheezing, as compared to their non-wheezing counterparts, align with research indicating that wheezing disorders can lead to restrictive and obstructive pulmonary patterns Kaiser^[12]. The statistically significant differences highlight the potential for early pulmonary function testing to identify children at risk for ongoing respiratory issues. These findings are in line with the hypothesis that recurrent wheezing impacts lung function over time, which can progress to more severe conditions if not managed effectively Hallit^[13].

(Table 3): Identification of Potential Environmental and Genetic Factors Influencing Pulmonary Function:

Environmental and genetic factors play crucial roles in the development and exacerbation of wheezing and asthma in children. The high prevalence of tobacco smoke exposure among children with wheezing, observed in this study, supports existing evidence that secondhand smoke exposure is a significant risk factor for the development of wheezing and asthma during childhood Pincheira^[14]. Pet ownership and a genetic history of asthma also showed significant associations with wheezing. These findings are consistent with the multifactorial nature of asthma and wheezing, where both genetic predisposition and environmental exposures contribute to the disease phenotype Moeller^[15].

CONCLUSION

This comparative study of pulmonary function in children with and without recurrent wheezing episodes elucidates significant differences in lung function parameters between the two groups. The findings reveal that children with recurrent wheezing have notably lower values in key lung function tests such as FEV1 and FVC compared to their non-wheezing peers. This is indicative of the potential restrictive and obstructive pulmonary impacts that recurrent wheezing may impose on affected children. Furthermore, the study highlights the profound influence of environmental and genetic factors on the prevalence and severity of wheezing. Specifically, exposure to tobacco smoke and a familial history of

asthma are significantly associated with higher rates of wheezing, underscoring the need for targeted environmental and familial interventions. The data also suggest that pet ownership, while a lesser factor, still contributes to the occurrence of wheezing, possibly due to allergen exposure. Given these outcomes, it is imperative for healthcare providers to implement early and precise assessments of pulmonary function in children showing signs of recurrent wheezing. Early intervention and continuous monitoring could prevent the progression of wheezing to more severe respiratory conditions, such as asthma. This study also calls for heightened public health initiatives aimed at reducing exposure to known environmental risks, particularly tobacco smoke and enhancing awareness about the genetic implications of asthma and related respiratory conditions. In conclusion, the comparative analysis not only confirms the detrimental impact of recurrent wheezing on lung function in children but also emphasizes the role of environmental and genetic factors in its etiology. These insights pave the way for improved preventative strategies and therapeutic approaches, aiming to enhance the respiratory health outcomes of children globally.

Limitations of Study:

- **Cross-Sectional Design:** The study's cross-sectional nature limits the ability to infer causality between recurrent wheezing and pulmonary function impairment. Longitudinal studies would be more effective in observing the progression of lung function over time and establishing a causal relationship.
- **Sample Size and Representation:** While the sample size of 120 participants is adequate for initial observations, a larger and more diverse sample would improve the generalizability of the findings across different geographic locations and ethnic groups.
- **Self-Reported Data:** The reliance on self-reported data for environmental exposures, such as tobacco smoke and pet ownership, may lead to bias. Objective measures or biomarkers of exposure would provide more reliable and accurate data.
- **Control of Confounding Variables:** Although significant environmental and genetic factors were identified, there may be other confounding variables not controlled for or measured in this study, such as socioeconomic status, urban vs. rural living conditions and access to healthcare. These factors can influence both the incidence of wheezing and the outcomes of pulmonary function tests.

- **Measurement of Wheezing:** The definition and measurement of recurrent wheezing rely on clinical records and parental reports, which might vary in accuracy. Standardized clinical assessment for wheezing could enhance the precision of the classification and diagnosis.
- **Lack of Detailed Environmental Assessments:** The study did not include detailed assessments of other environmental factors, such as air pollution levels, which could significantly impact respiratory health. Future studies incorporating these factors would provide a more comprehensive understanding of their effects on pulmonary function.
- **Genetic Analysis:** While the study acknowledged the role of genetic factors, it did not perform genetic analyses that could identify specific genes or genetic markers associated with increased susceptibility to wheezing and lung function impairment. This addition would strengthen the understanding of the genetic basis of wheezing.

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