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Original Article

Prevalence of Congenital Heart Diseases in Children with Pneumonia — Observations from the Pediatric Respiratory ICU of a Tertiary Care Hospital

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ABSTRACT

Introduction: *Congenital heart disease (CHD) and pneumonia are significant contributors to pediatric morbidity and mortality, particularly in low-resource settings. This study explores the prevalence of CHD among children with pneumonia in a pediatric respiratory ICU in Bangladesh.* ***Methods & Materials:*** *A prospective observational study was conducted over eight months, including 258 children aged 2–12 months diagnosed with pneumonia. Data collection included demographic details, clinical presentations, CHD diagnosis via echocardiography, and ICU management. CHD prevalence and its association with pneumonia types and congestive cardiac failure (CCF) were analyzed.* ***Results:*** *CHD was present in 21.32% (n=55) of the study population, with significantly higher prevalence in recurrent (44.74%) and persistent pneumonia cases (34.21%) compared to acute pneumonia (8.33%). Among CHD patients, 52.73% had CCF, compared to 16.75% in non-CHD patients. On auscultation, murmurs was detected in 63.64% of CHD cases. Ventricular septal defect (18.18%), patent ductus arteriosus (21.82%), and atrial septal defect (41.81% combined) were the most common CHD types observed.* ***Conclusion:*** *This study demonstrates the significant prevalence of CHD among children with pneumonia, particularly in recurrent and persistent cases, and its association with adverse outcomes such as CCF. These findings underscore the need for early cardiac screening, multidisciplinary care, and improved ICU management strategies to address the dual burden of CHD and pneumonia in resource-limited settings.*

Keywords: *Congenital Heart Disease, Pneumonia, Pediatric ICU, Recurrent Pneumonia, Congestive Cardiac Failure, Echocardiography*

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INTRODUCTION

Congenital heart diseases (CHD) represent a significant global health burden, contributing substantially to pediatric morbidity and mortality worldwide. Accounting for approximately 1% of live births, CHD is among the most prevalent congenital anomalies, with complex pathophysiology and varied presentations influencing prognosis and survival outcomes [1,2]. Despite advancements in medical and surgical interventions, the burden of CHD remains disproportionately high in low- and middle-income countries (LMICs), where healthcare systems are often ill-equipped to address the complexities of timely diagnosis and management [3,4]. Limited resources, inadequate access to specialized care, and delayed intervention exacerbate the challenges faced by pediatric populations in these settings, underscoring the need for localized research and tailored interventions [5]. In addition to its standalone impact, CHD increases vulnerability to coexisting conditions, such as respiratory infections. Children with CHD are at heightened risk for severe pneumonia and other respiratory complications due to factors such as compromised pulmonary circulation, heart failure, and immune dysfunction [1,6,7]. Pneumonia has been shown to result in prolonged hospital stays, higher ICU admissions, and increased need for mechanical ventilation among children with CHD (8). The interplay of CHD and pneumonia exacerbates disease severity, often requiring advanced ICU management and interventions to mitigate mortality risk. Pulmonary hypertension, commonly observed in this cross section observational study further complicates clinical outcomes, emphasizing the need for vigilant preoperative and postoperative care. Pneumonia remains the leading cause of death among children under five years old globally, with LMICs bearing the highest burden of cases and fatalities [4]. Bangladesh, as a representative LMIC, exemplifies the overlapping challenges of CHD and pneumonia, where limited pediatric ICU facilities further constrain the ability to address severe respiratory conditions in vulnerable populations [8,9]. Epidemiological data from Bangladesh highlight the dual burden of these conditions, with pneumonia contributing significantly to pediatric mortality and CHD being a critical underlying risk factor in severe respiratory cases. However, the association between CHD and

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pneumonia in pediatric respiratory ICUs remains underexplored, with a paucity of comprehensive data specific to this context [10]. Children admitted to pediatric respiratory ICUs often represent the most severe cases of disease, compounded by underlying comorbidities such as CHD. These units serve as critical settings for understanding disease patterns, clinical challenges, and potential interventions for improving outcomes in this vulnerable population. Studies show that ICU admissions for respiratory conditions in children with CHD often require prolonged mechanical ventilation, frequent reintubation, and complex postoperative management [2]. Moreover, CHD increases susceptibility to nosocomial infections, further complicating recovery and leading to significant healthcare resource utilization [1,5]. Despite the evident burden, research addressing the prevalence of CHD among children with pneumonia in pediatric ICUs in Bangladesh is scarce. This knowledge gap limits the ability to develop evidence-based policies and targeted interventions. The present study aims to bridge this gap by assessing the prevalence of CHD in children with pneumonia admitted to a pediatric respiratory ICU in a tertiary care hospital in Bangladesh. By highlighting this association, the study seeks to inform clinical management practices and public health strategies to improve outcomes for this high-risk population. This research holds particular relevance in its potential to provide actionable insights for resource-limited settings like Bangladesh, where the integration of cardiac and respiratory care remains a critical challenge. The findings will contribute to a growing body of evidence supporting the need for specialized ICU protocols, early risk stratification, and comprehensive care approaches tailored to the needs of children with CHD and concurrent respiratory conditions.

METHODS & MATERIALS

This study was conducted in the Pediatric Respiratory Intensive Care Unit (ICU) of Bangladesh Shishu Hospital and Institute**,** a tertiary care hospital in Bangladesh, over a period of eight months from January 2024 to September 2024. The study population comprised 258 pediatric patients diagnosed with pneumonia and admitted to the pediatric respiratory ICU during this time frame. Eligibility criteria included children aged between 2 months and 12 months at the time of admission. The study focused exclusively on this age group to ensure consistency in developmental and immunological characteristics, which are critical in evaluating the association between congenital heart disease and pneumonia outcomes. Patients outside the specified age range or those with incomplete medical records were excluded from the study. All patients admitted during the study period were systematically assessed using clinical, radiological, and laboratory evaluations to confirm a diagnosis of pneumonia as per World Health Organization (WHO) guidelines. Data collection included demographic details, clinical presentations, and comorbid conditions, with particular emphasis on identifying congenital heart disease through echocardiographic confirmation. Comprehensive information on patient management, including ICU interventions such as mechanical ventilation and oxygen therapy, was also recorded. Ethical approval for the study was obtained from the institutional review board of Shishu Hospital and Institute, and informed consent was secured from the parents or legal guardians of all participants before inclusion in the study. This structured and systematic methodology ensured the reliable collection of data for evaluating the prevalence of congenital heart disease and its impact on the clinical outcomes of pneumonia in a resource-limited setting. The collected data will provide a robust basis for identifying patterns and informing future research and clinical strategies for pediatric care.

RESULTS

Table – I: Baseline characteristics distribution of the participants (*n*=258)

Variable	Frequency (n)	Percentage (%)
Age		
2–4 months	72	27.91%
5–7 months	70	27.13%
8–10 months	65	25.19%
11–12 months	51	19.77%
Mean ± SD Age	7.2 ± 3.1 months	
Gender		
Boy	152	58.91%
Girl	106	41.09%

The study included a total of 258 pediatric patients diagnosed with pneumonia and admitted to the Pediatric Respiratory ICU. The age distribution of the participants revealed that the largest groups were children aged 2–4 months (27.91%) and 5–7 months (27.13%), followed by those aged 8–10 months (25.19%) and 11–12 months (19.77%). The mean age of the participants was 7.2 months, with a standard deviation of ±3.1 months. In terms of gender distribution, boys comprised the majority of the study population, accounting for 58.91% (n=152), while girls constituted 41.09% (n=106). These baseline characteristics provide a clear demographic overview of the study population.

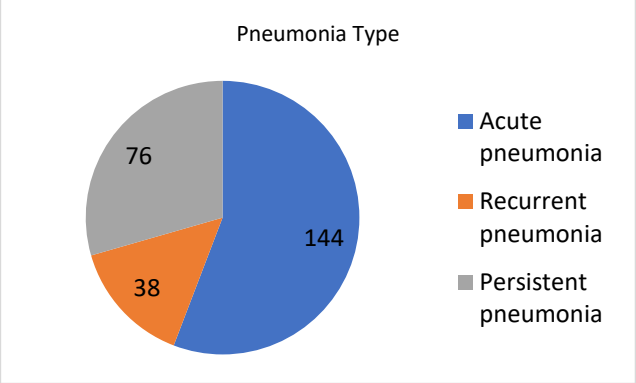

Figure – 1: Distribution of Pneumonia types among the participants (*n*=258)

The distribution of pneumonia types among the participants revealed that the majority of cases were classified as acute pneumonia, accounting for 55.81% (n=144) of the study population. Recurrent pneumonia was observed in 14.73% (n=38) of the participants, while persistent pneumonia was present in 29.46% (n=76).

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Table – II: Distribution of Congenital Heart Disease (CHD) Among Pneumonia Cases (*n*=258)

CHD	Frequency	Percentage (%)
Acute Pneumonia (n=144)		
CHD Present	12	8.33%
CHD Absent	132	91.67%
Recurrent Pneumonia (n=38)		
CHD Present	17	44.74%
CHD Absent	21	55.26%
Persistent Pneumonia (n=76)		
CHD Present	26	34.21%
CHD Absent	50	65.79%
Total (n=258)		
CHD Present	55	21.32%
CHD Absent	203	78.68%

The prevalence of congenital heart disease (CHD) among the study population varied significantly across different types of pneumonia. Among patients with acute pneumonia (n=144), only 8.33% (n=12) had CHD, while the majority, 91.67% (n=132), did not. In contrast, CHD was significantly more common in cases of recurrent pneumonia (n=38), with 44.74% (n=17) affected and 55.26% (n=21) unaffected. Similarly, CHD was present in 34.21% (n=26) of patients with persistent pneumonia (n=76), whereas 65.79% (n=50) did not have CHD. Overall, across all pneumonia cases (N=258), 21.32% (n=55) of participants were found to have CHD, while 78.68% (n=203) were CHD-free.

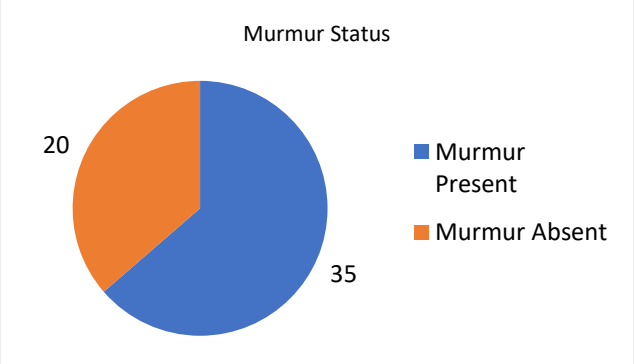

Figure – 2: Murmur in Patients with CHD (*n*=55)

Among the 55 patients diagnosed with congenital heart disease (CHD), 63.64% (n=35) were found to have an murmur, while 36.36% (n=20) did not exhibit a murmur.

Table – III: Association Between Congenital Heart Disease (CHD) and Congestive Cardiac Failure (CCF) (*n*=258)

CCF Status	CHD Present (n=55)		CHD Absent (n=203)	
	n	%	n	%
CCF Present	29	52.73%	34	16.75%
CCF Absent	26	47.27%	169	83.25%

The association between congenital heart disease (CHD) and congestive cardiac failure (CCF) revealed a significant disparity in prevalence. Among patients with CHD (n=55), 52.73% (n=29) were diagnosed with CCF, while 47.27% (n=26) did not exhibit CCF. In contrast, among patients without CHD (n=203), only 16.75% (n=34) had CCF, with the majority, 83.25% (n=169), being free of CCF.

Table – IV: Types of Congenital Heart Defects (CHD) Observed (*n*=55)

Type of Defect	Frequency (n)	Percentage (%)
Atrial Septal Defect (ASD) - Small	14	25.45%
Atrial Septal Defect (ASD) - Moderate	6	10.91%
Atrial Septal Defect (ASD) - Large	3	5.45%
Ventricular Septal Defect (VSD)	10	18.18%
Patent Ductus Arteriosus (PDA)	12	21.82%
ASD + VSD	3	5.45%
VSD + PDA	1	1.82%
ASD + Tricuspid Regurgitation (TR)	2	3.64%
Atrioventricular (AV) Canal Defect	1	1.82%
Severe Ebstein's Anomaly	1	1.82%
Bicuspid Aortic Valve + ASD + PDA	1	1.82%
Tricuspid Regurgitation (TR)	1	1.82%

Among the 55 patients with congenital heart defects (CHD), atrial septal defect (ASD) was the most commonly observed defect, with 25.45% (n=14) of cases classified as small ASD, followed by moderate ASD in 10.91% (n=6) and large ASD in 5.45% (n=3). Ventricular septal defect (VSD) accounted for 18.18% (n=10) of cases, while patent ductus arteriosus (PDA) was identified in 21.82% (n=12). Complex defects, such as ASD with VSD (5.45%, n=3), VSD with PDA (1.82%, n=1), and ASD with tricuspid regurgitation (3.64%, n=2), were less common. Other rare defects included atrioventricular (AV) canal defect, severe Ebstein's anomaly, bicuspid aortic valve combined with ASD and PDA, and isolated tricuspid regurgitation, each accounting for 1.82% (n=1) of cases. This distribution highlights the diversity of CHD presentations, with a predominance of septal and ductal defects.

DISCUSSION

The current study highlights the intersection of congenital heart disease (CHD) and pneumonia in a pediatric respiratory ICU population, providing insights into the prevalence of CHD and its association with clinical outcomes such as recurrent pneumonia and congestive cardiac failure (CCF). Our findings indicate that CHD was present in 21.32% of children with pneumonia, with a significantly higher prevalence among those with recurrent (44.74%) and persistent pneumonia (34.21%) compared to acute pneumonia (8.33%). These findings align with studies conducted in similar settings, which have also identified CHD as a major underlying cause of recurrent and persistent pneumonia in children [11,12]. For instance, Bolursaz et al. reported that 20.17% of recurrent pneumonia cases in a tertiary center in Tehran were attributed to CHD, underscoring its critical role in complicating respiratory infections [11]. The association between CHD and pneumonia outcomes is particularly concerning given the increased susceptibility to severe infections and the compounding impact of comorbidities such

as CCF. Our study observed that 52.73% of CHD patients experienced CCF, compared to only 16.75% of non-CHD patients. This finding aligns with the epidemiologic data from Sommers et al., who reported that CCF was present in 33.4% of pediatric patients with CHD, highlighting the significant cardiovascular burden in this population [13]. Furthermore, studies by Evers et al. and Rahayuningsih et al. have emphasized that CHD-associated alterations in cardiopulmonary mechanics and immune function exacerbate the severity and recurrence of pneumonia, particularly in left-to-right shunt defects such as ventricular septal defect (VSD) and patent ductus arteriosus (PDA) [14,15]. Auscultation murmur, commonly used as an initial diagnostic tool for CHD, was observed in 63.64% of CHD patients in our study, highlighting its utility yet limitations in clinical settings. Comparative studies reinforce this finding, as Khalilian et al. and Brunetti et al. have reported similar diagnostic challenges, noting that auscultation alone may miss a significant number of CHD cases without confirmatory imaging such as echocardiography [16,17]. The prevalence of specific CHD types in our cohort aligns with global trends. VSD (18.18%), PDA (21.82%), and atrial septal defect (ASD) (41.81% combined for all sizes) were the most frequently observed defects. These results are consistent with findings from studies in Central India and East Africa, which also identified VSD and PDA as predominant CHD types in pediatric populations [18,19]. Notably, the prevalence of complex defects, though lower in frequency, underscores the need for specialized care, as such anomalies often contribute to poor clinical outcomes [20]. The significantly higher prevalence of CHD among children with recurrent and persistent pneumonia emphasizes the need for integrated management approaches in resource-limited settings like Bangladesh. Comparative studies, including those by El-Saied et al. and Saad et al., have highlighted similar challenges, noting that early diagnosis and targeted interventions for CHD can substantially reduce the burden of respiratory complications [12,21]. However, the scarcity of pediatric ICUs equipped to handle the dual burden of CHD and pneumonia in low-resource settings exacerbates these challenges. In conclusion, the findings of this study add to the growing body of evidence on the interplay between CHD and pneumonia in children, highlighting the critical need for early detection, multidisciplinary care, and robust health infrastructure. The prevalence and clinical burden of CHD, particularly in recurrent and persistent pneumonia cases, call for increased attention to congenital cardiac screening and comprehensive management strategies tailored to the needs of high-risk pediatric populations.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

This study highlights the critical intersection of congenital heart disease (CHD) and pneumonia in pediatric patients admitted to a tertiary respiratory ICU in Bangladesh. CHD was significantly more prevalent among children with recurrent and persistent pneumonia compared to acute cases, emphasizing the importance of early cardiac screening in high-risk populations. Additionally, the strong association between CHD and congestive cardiac failure (CCF) underscores the compounded clinical burden in affected children, necessitating comprehensive management strategies. The findings also demonstrate the diagnostic limitations of relying solely on auscultation murmurs, underscoring the need for echocardiographic confirmation. By identifying the types of CHD most commonly associated with severe pneumonia, this study provides evidence to guide early detection, risk stratification, and integrated care approaches in resource-limited settings. These insights are critical for improving outcomes in pediatric populations vulnerable to the dual burden of CHD and respiratory infections.

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Conflict of interest: None declared

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