

A Prospective Study on Prevalence of Congenital Heart Diseases in Children with Down Syndrome

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ABSTRACT

Background and Aim: Down syndrome (DS) is the most prevalent genetic disorder in humans around the globe. Variations in pattern and risk factors for congenital heart diseases significantly contributes to the increasing morbidity and mortality among Down syndrome children. The present study aimed to determine the prevalence of congenital heart diseases among Down syndrome children.

Methodology: This prospective study was carried out on 46 Down syndrome children in the Department of Pediatric, Shalamar Hospital Lahore from November 2020 to June 2022. The study protocol was approved by the research and ethical committee. Demographic details, outcomes, and diagnosis on echocardiography were extracted from the proforma and medical record. Data such as date of birth, maternal age, parity, and parental consanguinity were collected. Antenatal history such as obesity, maternal passive smoking, and diabetes confirmed the antenatal infections. Data regarding children including gender, birth weight, maturity, and plurality were considered. For data analysis, SPSS version 25 was used.

Results: Of the total 46 Down syndrome children, there were 29 (63%) male and 17 (37%) females. The overall mean age was 3.61 ± 2.3 years with an age range from 0 to 15 years. Majority of the Down syndrome children 32 (69.6%) were under 5 years followed by 9 (19.6%) in 5-10 years and 5 (10.8%) in between 10 and 15 years. The prevalence of congenital heart disease was 26 (56.5%) in Down syndrome children. Of the total 26 Down syndrome children with congenital heart disease, the incidence of cyanotic and acyanotic heart disease were 5 (10.8%) and 21 (45.7%) respectively. Out of 56.5% cases of congenital heart disease, ventricular septal defect (VSD) was the most prevalent congenital heart disease found in 12 (46.2%) cases followed by Atrio-ventricular canal defect 7 (26.9%), Tetralogy of fallot 4 (15.4%), and atrial septal defect 3 (11.5%).

Conclusion: Our study concluded that the prevalence of congenital heart disease was 56.5% among Down syndrome children. Majority of congenital heart diseases were acyanotic. Male are more susceptible to congenital heart diseases. Ventricular septal defect (VSD) was the most prevalent congenital heart disease. Early diagnosis, referral, and prompt intervention can prevent congenital heart diseases among Down syndrome children.

Keywords: Congenital heart diseases, Prevalence, down syndrome children

INTRODUCTION

Down syndrome is one of the prevalent chromosomal disorders in humans caused by the full or partial presence of the third copy of chromosome. The estimated prevalence of Down syndrome or trisomy 21 is 1/700 live births [1, 2]. Major organ malformations, hypotonia, facial features characteristics, delay in physical growth, and disability are significantly caused by trisomy 21 [3]. Children's survival and progress could be affected by congenital heart diseases (CHD) in Down syndrome children [4]. The incidence of congenital heart diseases in Down syndrome children has increased by approximately 50% in recent decades [5]. Obesity, consanguineous marriages, and diabetes are the reasons for higher frequency in Arab countries [6, 7]. Other risk factors are antibiotic use during pregnancy and use of oral contraceptives. Atrioventricular septal defect (AVSD), tetralogy of Fallot (TOF), patent ductus arteriosus (PDA), ventricular septal defect (VSD), and atrial septal defect (ASD) are the most frequent congenital heart diseases among children with Down syndrome [8].

Genetic and environmental factors contribute as a multifactorial aspect for the etiology of congenital heart diseases [9]. The CHD associated syndrome epidemiological, clinical, and embryological background through modulators, signaling transducers, and transcriptional regulators are significant for the morphogenesis of the heart [10]. For early and effective intervention, knowledge and complications associated with congenital heart disease in Down syndrome children are significantly important. Cardiac abnormalities timely repaired in children with Down syndrome is critical in order to improve life's quality and optimal survival. Despite the higher incidence of congenital heart diseases among Down syndrome children, limited progress has been made for the identification of causes and associated factors. There is paucity of data regarding prevalence of congenital heart diseases among Down syndrome children in

Pakistan. Therefore, the present study aimed to determine the prevalence of congenital heart diseases in children with Down syndrome.

METHODOLOGY

This prospective study was carried out on 46 Down syndrome children in the Department of Pediatric, Shalamar Hospital Lahore from November 2020 to June 2022. The study protocol was approved by the research and ethical committee. Demographic details, outcomes, and diagnosis on echocardiography were extracted from the proforma and medical record. Data such as date of birth, maternal age, parity, and parental consanguinity were collected. Antenatal history such as obesity, maternal passive smoking, and diabetes confirmed the antenatal infections. Data regarding children including gender, birth weight, maturity, and plurality were considered. Clinically diagnosed Down syndrome children were admitted in the Pediatrics unit. Detailed history of the extant complaints such as breathing difficulties, chest infections, poor feeding or failure to thrive, and cyanosis were noted. Family history regarding Down syndrome and congenital heart diseases were taken. Physical examinations included depressed nasal bridge, short neck, protruding tongue, peripheral cyanosis, and clubbing. Patients were then referred to the Cardiology Department for finding congenital heart diseases through echocardiography. Weight scale was used for measuring the patient's weight.

Data analysis was carried out in SPSS version 25. Quantitative variables such as age, maternal age, and weight were expressed as mean and standard deviation. Qualitative variables such as the pattern of congenital heart diseases were described as frequency and percentage. Descriptive statistics was done using 95% confidence interval and 5% level of significance. All the results were presented in tabulated form.

RESULTS

Of the total 46 Down syndrome children, there were 29 (63%) male and 17 (37%) females. The overall mean age was 3.61 ± 2.3 years with an age range from 0 to 15 years. Majority of the Down syndrome children 32 (69.6%) were under 5 years followed by 9 (19.6%) in 5-10 years and 5 (10.8%) in between 10 and 15 years. The prevalence of congenital heart disease was 26 (56.5%) in Down syndrome children. Of the total 26 Down syndrome children with congenital heart disease, the incidence of cyanotic and acyanotic heart disease were 5 (10.8%) and 21 (45.7%) respectively. Out of 56.5% cases of congenital heart disease, ventricular septal defect (VSD) was the most prevalent congenital heart disease found in 12 (46.2%) cases followed by Atrio-ventricular canal defect 7 (26.9%), Tetralogy of fallot 4 (15.4%), and atrial septal defect 3 (11.5%). Gender's distribution is shown in Figure-1. Age-wise distribution is illustrated in Figure-2. Demographic characteristics and parental details are shown in Table-1. Figure-3 depicts the incidence of cyanotic and acyanotic heart diseases. The echocardiograph pattern of congenital heart diseases in Down syndrome is illustrated Figure-4. Different complications observed among Down syndrome children are demonstrated in Figure-5.

>35	19 (41.3)
Nutritional Status	
Underweight	29 (63)
Normal	8 (17.4)
Overweight	9 (19.6)
Paternal age (years)	
<50	21 (45.7)
>50	25 (54.3)

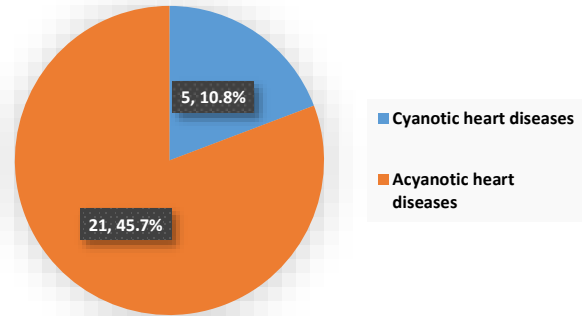


Figure-3: Prevalence of cyanotic and acyanotic heart diseases (n=26)

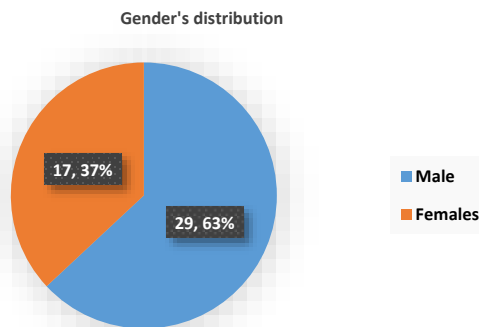


Figure-1: Gender's distribution (n=46)

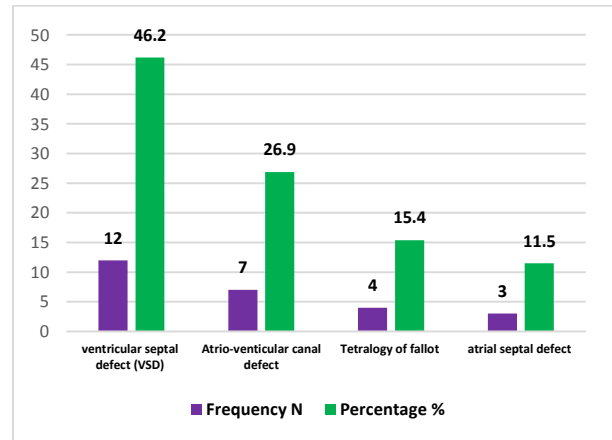


Figure-4: Echocardiography pattern of congenital heart disease (n=26)

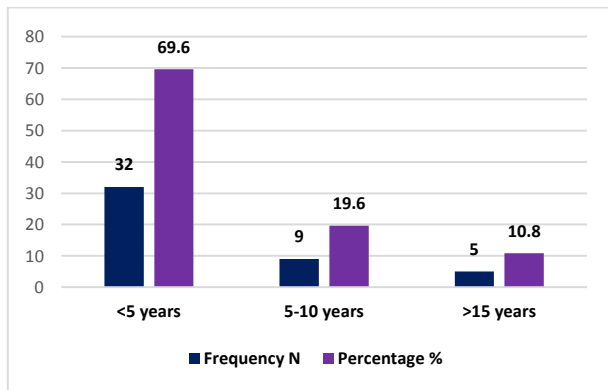


Figure-2: Age-wise distribution of Down syndrome children (n=46)

Table-1: Demographic and parental details of the children with Down syndrome (n=46)

Variables	N (%)
Age (years)	3.61±2.3
Gender	
Male	29 (63)
Female	17 (37)
Socio-economic status	
High	10 (21.7)
Middle	15 (32.6)
Low	21 (45.7)
Maternal Age (years)	
<35	27 (58.7)

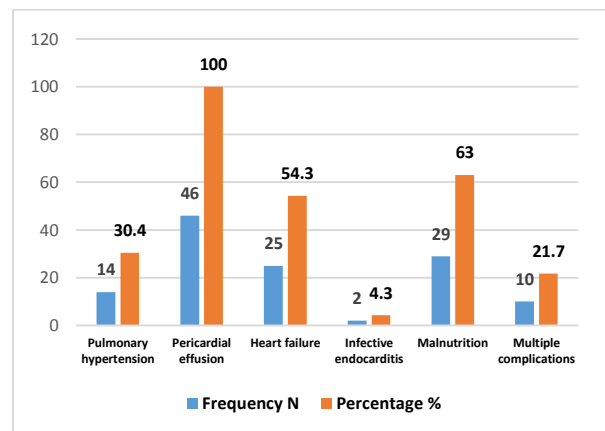


Figure-5: Complications observed in Down syndrome children (n=46)

DISCUSSION

The present study mainly focused on the incidence of congenital heart diseases among children with Down syndrome and found that 56.5% children had congenital heart diseases which is within the range of 40% to 60% reported in previous studies [11-13]. Ko

JM et al [14] and Okeniyi et al [15] reported the prevalence of congenital heart disease was 79.7% and 77.1% respectively among Down syndrome children. The prevalence of CHD was higher due to the referral of children for echocardiography based on possible cardiac defects. In our study, about 58.7% had maternal age below 35 years. During childbearing period, maternal age is significantly associated with Down syndrome [16]. A previous study found that mostly children with Down syndrome were born from a younger mother (<35 years) as reported in the present study [17].

In our study, mostly Down syndrome children were underweight due to recurrent heart failure and pneumonia that results from the shunt lesion in congenital heart diseases. These findings are similar to the previous study results according to which malnutrition was a possible cause for the higher prevalence of underweight children with Down syndrome [18].

Atrioventricular septal defects completely occur in two forms; either in isolation or in combination with other defects such as atrial septal defect, patent ductus arteriosus, ostium secundum, and ventricular septal defect. Tetralogy of Fallot was the prevalent isolated cardiac defects found in cyanotic congenital heart disease. However, ventricular septal defect occurs in combination with Patent Ductus Arteriosus (PDA) found in 4.1% cases [19]. A previous study conducted on 98 children with Down syndrome reported that incidence of congenital heart diseases were found in 61.3% (n=57) cases. The prevalence of ventricular septal defect, atrioventricular septal defect, atrial septal defect, patent ductus arteriosus, and tetralogy of fallot was 33.3%, 22.8%, 21.1%, 14%, and 5.3% respectively [20]. Another study by Egbe et al reported that ventricular septal defect was the most prevalent atrioventricular canal defect (45%) followed by tetralogy of fallots (10%), atrial septal defect (15%), and ventricular septal defect (5%) [21].

Various studies by Pfitzer et al [22], Wolter et al. [23], and Helm et al [24] reported similar results regarding AVSD is the most common congenital heart disease defect among children with Down syndrome. In contrast, Ergaz-Shaltiel et al. [25] found that about 90% cardiac abnormalities among Down syndrome children were from the different defects such as atrial septal defect, PDA, and VSD. Similarly, Weichert et al [26] reported that occurrence of Patent ductus arteriosus with other defects were the most common congenital heart anomalies among children with Down syndrome. Cardiac malformation could be determined by cell characteristics, genetic factors, and specific embryological mechanisms. Other factors are socioeconomic, ethnic, and geography influence the cardiac anomalies formation in Down syndrome children.

Furthermore, sleep apnea and inherited issues of lung parenchymal were the reasons for the children to suffer from pulmonary vascular disease [27]. Yet, The prognosis of left-to-right heart associated abnormalities is better than associated AVSD which is further related to higher mortality rate condition of pulmonary hypertension [28].

It is worth mentioning that Down syndrome children in the present study had mild to severe pericardial effusions which is consistent with the findings of Morsy et al [29] previously reported. The basic causes are still to be determined. However, viral infections, heart failure, and hypothyroidism were the possible causes in children with Down syndrome. Surprisingly, children with Down syndrome who had pericardial effusions in our study had zero cardiac tamponade.

Risk factors associated with maternity have a significant association with congenital heart diseases among Down syndrome children as reported in various studies conducted on national and international levels. According to the Abdel Fattah, Alexandria, and Mokhtar findings that use of oral contraceptive, consanguinity, maternal diabetes, and maternal antibiotics are different independent risk factors for congenital heart diseases among Down syndrome children [30]. Another modest risk factor was maternal smoking during the first trimester. A recent study reported

that the risk of congenital heart disease increases with maternal smoking [31].

Due to the congenital heart disease's higher incidence among Down syndrome children, clinical examinations had limitations in diagnosis of CHD among DS children. So, the patients should have an echocardiography and ECG for early detection and diagnosis of CHD in fetal life. With advances in CHD management, early diagnosis and treatment are required to achieve the best possible results.

CONCLUSION

Our study concluded that the prevalence of congenital heart disease was 56.5% among Down syndrome children. Majority of congenital heart diseases were acyanotic. Male are more susceptible to congenital heart diseases. Ventricular septal defect (VSD) was the most prevalent congenital heart disease. Early diagnosis, referral, and prompt intervention can prevent congenital heart diseases among Down syndrome children.

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