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# Congenital Heart Disease Profile in the Pediatric Inpatient Unit of Dr. Soetomo General Academic Hospital Surabaya: A Study from January to December 2021

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## ABSTRACT

***Introduction:*** Congenital Heart Disease (CHD) is a structural and functional abnormality of the cardiovascular system present at birth. Accurate epidemiological data is crucial for enhancing the quality of healthcare services. The aim of this study was to investigate the profile of children with CHD at Dr. Soetomo General Academic Hospital in Surabaya. ***Methods:*** This descriptive study took place at Dr. Soetomo General Academic Hospital in Surabaya from January 2021 to December 2021, utilizing secondary data obtained from medical records. The study sample consisted of patients aged under eighteen years old with CHD. ***Results:*** This study examined 186 samples of children with congenital heart disease (CHD). Boys were more prevalent (55.38%) than girls (44.62%). Neonates comprised 46,24% of cases. 39.25% showing good nutritional status (39.25% and 34.41% exhibiting severe malnutrition. 58.60% of cases were diagnosed with Atrial septal defect (ASD). 5,91% of patients are also diagnosed with Down syndrome. Non-congenital comorbidities found are pneumonia (17,20%), and sepsis (12,37%). ***Conclusion:*** In this research, we found patients with congenital heart disease were more common in males, most patients were diagnosed for the first time in the neonate age group, and most of the patients had good nutritional status. The most common type of acyanotic congenital heart disease was Atrial Septal Defect (ASD) and the most frequently found cyanotic congenital heart disease was Tetralogy of Fallot (ToF). Down syndrome was the most common congenital disease that accompanied CHD and the predominant co-morbid was pneumonia.

***Keywords:*** congenital heart disease; pediatric; cardiovascular diseases; malnutrition

## INTRODUCTION

Congenital heart disease (CHD) refers to structural and functional abnormalities in the cardiovascular system that are present from birth. Although some cases may go undetected until later stages, they are congenital in nature [1]. CHD can be classified into two categories: cyanotic and acyanotic. Cyanosis manifests as a bluish-purple discoloration of the skin and mucous membranes due to an elevated concentration of deoxygenated hemoglobin. In CHD, cyanosis occurs when deoxygenated blood from the right heart enters the left heart without passing through the lungs, resulting from a defect [2]. On the other hand, acyanotic CHD typically involves defects that do not affect oxygen levels or blood reaching body tissues [2].

Congenital heart disease (CHD) can arise from genetic disorders, and it is also associated with environmental factors such as pregestational diabetes mellitus, maternal rubella, and alcohol abuse during pregnancy [1]. Between 1970 and 2017, there was a global increase in the prevalence of CHD by 10% every 5 years. This increase is largely attributed to improved detection of milder lesions such as ventricular septal defects (VSD), atrial septal defects (ASD), and patent ductus arteriosus (PDA), which account for over 90% of the observed rise. Asia has been reported to have the highest prevalence of overall CHD, with a rate of 9.3 per 1000 live births. Congenital heart disease (CHD) demonstrates the highest mortality rate among various other congenital abnormalities within the first year of life [3].

Acyanotic congenital heart disease encompasses several conditions, including ventricular septal defect (VSD), atrial septal defect (ASD), patent ductus arteriosus (PDA), congenital pulmonary stenosis, congenital aortic stenosis, and aortic coarctation. Cyanotic CHD includes tetralogy of Fallot and transposition of the great arteries. The specific type of CHD determines the range of clinical symptoms, which can vary from mild to severe. Additionally, the presence of comorbidities and other congenital diseases in patients may also influence the clinical presentation [4]. Furthermore, patients with CHD often experience impaired nutritional status [5].

Patients with CHD are susceptible to a range of complications. The most frequently encountered complication is pulmonary dysfunction. Disruptions in the hemodynamic system, such as chronic hypoxia and decreased cardiac output, can lead to complications in the liver and kidneys. Furthermore, CHD can have an impact on the psychosocial and cognitive development of affected individuals. The effective management of CHD and its associated complications necessitates a multidisciplinary and comprehensive approach [2].

## METHODS

This study was a descriptive retrospective observational study conducted using medical records as secondary data. The study population and sample consisted of patients diagnosed with CHD in the Inpatient Unit of the Pediatrics Department at Dr. Soetomo General Hospital Surabaya from January to December 2021. Total sampling was employed to select the samples. The variables observed in this study include gender, age, nutritional status, CHD diagnosis, and congenital and non-congenital comorbidities.

The collected data was subsequently processed using Microsoft Excel and presented in the format of a frequency distribution table. Ethical approval for this study has been obtained from the Ethical Committee for Health Research at Dr. Soetomo General Academic Hospital, Surabaya.

## RESULTS

The total number of samples extracted from medical records between January 2021 and December 2021 was 186. From these data, boys with CHD were more frequent, with 103 cases (55.38%), while girls consist of 83 cases (44.62%).

Table 1 presents the age and nutritional status distribution of patients with congenital heart disease in the pediatric inpatient unit at Dr. Soetomo General Hospital Surabaya. The highest proportion of cases was observed among neonates (aged from birth to 28 days), with 86 patients (46.24%), followed by infants (aged from birth to under 1 year) with 30 patients (16.13%).

As shown in Table 1, the nutritional status of children with CHD admitted to the inpatient unit of Soetomo Hospital during the period from January to December 2021. The findings reveal that a considerable percentage of patients had good nutritional status (39.25%), while a considerable number exhibited severe malnutrition (34.41%). Additionally, moderate malnutrition was prevalent among this population, accounting for 24.19% of cases. When considering malnutrition in its broader context, including severe and moderate malnutrition, the total percentage of affected children in this study amounted to 58,6%. The distribution of patients with good nutritional status varies across different age groups. Among the 73 patients with good nutritional status, 54 of them are neonates.

**TABLE 1:** Age to nutrition distribution.

| | Severe Malnutrition | | Moderate Malnutrition | | Good Nutritional Status | | Over weight | | Obese | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Age Group** | **N** | **(%)** | **N** | **(%)** | **N** | **(%)** | **N** | **(%)** | **N** | **(%)** | **N** | **(%)** |
| Neonates | 12 | 6,5 | 18 | 9,7 | 54 | 29 | 2 | 1,1 | 0 | 0 | 86 | 46,2 |
| Infant | 21 | 11,3 | 5 | 2,7 | 4 | 2,2 | 0 | 0 | 0 | 0 | 30 | 16,1 |
| Toddler (1 to <5 years old) | 20 | 10,8 | 8 | 4,3 | 7 | 3,8 | 0 | 0 | 0 | 0 | 35 | 18,8 |
| Children (5 to <10 years old) | 5 | 2,7 | 9 | 4,8 | 7 | 3,8 | 0 | 0 | 0 | 0 | 21 | 11,3 |
| Teen (10 to <18 years old) | 6 | 3,2 | 5 | 2,7 | 1 | 0,5 | 1 | 0,5 | 1 | 0,5 | 14 | 7,5 |
| Total | 64 | 34,5 | 45 | 24,2 | 73 | 39,2 | 3 | 1,6 | 1 | 0,5 | 186 | 100 |

Table 2 reveals the distribution of congenital heart disease diagnoses in the current study. Among cyanotic heart disease, the most prevalent diagnosis was atrial septal defect (ASD) with 109 patients (58.60%), followed by patent ductus arteriosus with 88 patients (47.31%), and ventricular septal defect with 38 patients (20.43%). Regarding cyanotic heart disease, Tetralogy of Fallot was the most frequently observed condition, accounting for 15 cases (8.06%).

**TABLE 2:** Diagnosis of Congenital Heart Diseases.

| Diagnosis of CHD | N | (%) |
|---|---|---|
| ASD | 109 | 58,6 |
| PDA | 88 | 47,3 |
| VSD | 38 | 20,4 |
| Pulmonal Stenosis | 15 | 8,1 |
| TOF | 15 | 8,1 |
| DORV | 11 | 5,9 |
| TGA | 8 | 4,3 |
| MAPCA | 7 | 3,8 |
| AVSD | 7 | 3,8 |
| Tricuspid Atresia | 5 | 2,7 |
| Ebstein's anomaly | 4 | 2,2 |
| Dextrocardia | 3 | 1,6 |
| PA-IVS | 2 | 1,1 |
| Aortic Coarctation | 2 | 1,1 |
| Truncus Arteriosus | 2 | 1,1 |
| DILV | 1 | 0,5 |
| Dilated Cardiomyopathy | 1 | 0,5 |
| Hypoplastic RV | 1 | 0,5 |

***Source:*** Processed research data.

According to Table 3, the most commonly observed clinical symptoms in patients with congenital heart disease in the pediatric inpatient unit of RSUD Soetomo from January to December 2021 were shortness of breath in 67 patients (36.02%), followed by murmurs in 63 patients (33.87%), and cyanosis in 38 patients (20.43%). Fever was present in 26 patients (13.98%), cough in 20 patients (10.75%), and anemia in 15 patients (8.06%).

**TABLE 3:** Clinical Signs and Symptoms.

| Clinical Signs and Symptoms | N | (%) |
|---|---|---|
| Dyspnea | 67 | 36,0 |
| Murmur | 63 | 33,9 |
| Cyanosis | 38 | 20,4 |
| Fever | 26 | 14,0 |
| Cough | 20 | 10,8 |
| Anemia | 15 | 8,0 |
| Vomit | 13 | 7,0 |
| Ronchi | 12 | 6,5 |
| Diarrhea | 10 | 5,4 |
| Distended abdomen | 10 | 5,4 |
| Flu | 6 | 3,23 |
| Clubbing finger | 5 | 2,69 |
| Fatigue | 4 | 2,15 |
| Nausea | 4 | 2,15 |
| Decreased Appetite | 4 | 2,15 |
| Oxygen Desaturation | 4 | 2,15 |

***Source:*** Processed research data.

Table 4 illustrates the prevalence of concomitant congenital abnormalities in patients diagnosed with congenital heart disease (CHD). It shows that the most common congenital comorbidities observed in this study are Down syndrome and hypothyroidism. In addition to congenital comorbidities, we gathered data on non-congenital comorbidities among patients with CHD. Table 5 presents the prevalence of these non-congenital comorbidities, with pneumonia (17.20%), sepsis (12.37%), and pulmonary hypertension (9.14%) being the most frequently observed conditions.

**TABLE 4:** Congenital Comorbidity.

| Congenital Abnormalities | N | (%) |
|---|---|---|
| Down Syndrome | 11 | 5,9 |
| Hypothyroid | 8 | 4,3 |
| Anorectal Malformation | 6 | 3,2 |
| Laryngomalacia | 5 | 2,7 |
| Malignancy | 4 | 2,2 |
| Hydrocephalus | 3 | 1,6 |
| Microcephaly | 3 | 1,6 |
| Polydactyly | 3 | 1,6 |
| Hernia | 3 | 1,6 |
| Cleft Lip Palate | 3 | 1,6 |
| Hirschsprung Disease | 3 | 1,6 |
| CTEV | 3 | 1,6 |
| Omphalocele | 2 | 1,1 |
| CAH | 2 | 1,1 |
| Low set ear | 2 | 1,1 |
| Pancreas annulare | 2 | 1,1 |
| Developmental sex disorder | 2 | 1,1 |
| Hydronephrosis | 2 | 1,1 |
| Esophageal Atresia | 2 | 1,1 |
| Undescended testicle | 2 | 1,1 |
| Other | 14 | 7,5 |

***Source:*** Processed research data.

**TABLE 5:** Non-congenital Comorbidity.

| Comorbidity | N | (%) |
|---|---|---|
| Pneumonia | 32 | 17,2 |
| Sepsis | 23 | 12,4 |
| Pulmonary Hypertension | 17 | 9,1 |
| Acute Kidney Failure | 10 | 5,4 |
| Cardiac Decompensation | 8 | 4,3 |
| Diarrhea | 7 | 3,8 |
| Early Onset Sepsis | 4 | 2,2 |
| Heart Failure | 4 | 2,2 |
| Developmental delay | 4 | 2,2 |

| | | |
|---|---|---|
| Decubitus Ulcer | 3 | 1,6 |
| Urinary Tract Infection | 2 | 1,1 |
| Brain Abscess | 2 | 1,1 |
| Necrotizing Enterocolitis | 2 | 1,1 |
| Cardiogenic Shock | 2 | 1,1 |
| Hypertension | 2 | 1,1 |
| Respiratory Failure | 2 | 1,1 |
| Other | 15 | 8,1 |

***Source:*** Processed research data.

**DISCUSSION**

In this study, it was observed that the male gender accounted for the highest frequency, with a total of 103 male patients (55.38%) out of 186 patients, while female patients totaled 83 (44.62%). This finding aligns with a previous study conducted at the same hospital, Soetomo General Hospital, during the period from 2018 to 2020, by Alverina, Utamayasa, and Sembiring [6], which also reported a higher prevalence of males. Moreover, similar trends have been reported in previous studies conducted in India, where the male gender was identified as the predominant sex among patients with congenital heart disease [7,8]. The specific mechanisms underlying the increased prevalence of CHD in males remain uncertain. One possible explanation is that this difference could be attributed to the greater vulnerability of the Y chromosome compared to the X chromosome [9].

The prevalence of neonates was found to be higher in this study. This finding may indicate improvements in the early detection of CHD. The increased detection can be attributed to various factors such as antenatal and postnatal screening methods, an effective referral system, or the manifestation of more severe symptoms leading to earlier detection. Previous studies conducted by Yasmine, Utamayasa, and Herwanto, and Kishore et al. have also reported similar trends [10,7].

In this study, the highest percentage was observed in the category of good nutritional status, which consists of 39,2% of cases. However, this condition is not distributed evenly among age groups. Most patients with good nutritional status were found in neonates, which aligns with the findings reported by Alverina, Utamayasa, and Sembiring [6]. According to their research, children with CHD under the age of one predominantly exhibited good nutritional status, accounting for 51.72% [6].

The presence of moderate and severe malnutrition was notable in this study, with a combined prevalence of 58,6% among children with CHD. This finding is consistent with the research conducted by Wulandari, Ontoseno, and Umiastuti [11]. They reported a malnutrition rate of 63.6% in children with cyanotic CHD [11]. Due to their lower percentages of muscle and fat mass, infants and children are more prone to experiencing malnutrition compared to adults, along with increased energy expenditure and limited energy reserves [5].

Numerous studies have established a correlation between CHD and malnutrition. Cyanotic CHD, along with associated pulmonary hypertension and congestive heart failure, has been linked to a decrease in weight gain, growth rate, and height development. Additionally, malnutrition in children with CHD can arise from various factors such as hypermetabolic state, insufficient caloric intake, genetic influences, malabsorption, or the consequences of fluid restriction during hemodynamic interventions [12].

The apparent good nutritional status observed in the majority of neonates can be attributed to the well-tolerated nature of congenital heart defects before birth. During fetal development, the fetus benefits from the redirection of blood flow through the ductus arteriosus and the foramen ovale, which allows the bypassing of most defects. The manifestation of congenital heart defects typically occurs after birth, when the neonate is separated from the maternal circulation and the oxygenation it provides, and the fetal shunts close [2]. As a result, the impact on the nutritional status of neonates with congenital heart defects is not as significant as in other age groups.

The predominant diagnosis of CHD in this study was atrial septal defect (ASD), observed in 109 patients. These findings align with a previous study conducted at Prof. Dr. R. D. Kandou General Hospital in Manado from 2013 to 2017, where ASD was identified as the most frequently diagnosed CHD [4]. However, other studies have reported different results, indicating that ventricular septal defect (VSD) is the most prevalent form of CHD, with ASD often ranking second [7,13]. Aliku et al. conducted research supporting this study, finding patent ductus arteriosus (PDA) as the second most common acyanotic CHD, observed in 88 patients [14].

ASD is typically asymptomatic, and a common clinical manifestation in ASD patients is the presence of a murmur during physical examination. As a result, pediatric patients with ASD are often diagnosed in their teenage years, accompanied by potential complications [2]. The increasing emphasis on screening and early detection of congenital heart disease has contributed to the earlier identification of ASD cases. This is further supported by the high prevalence of murmurs, which serve as the most common symptom detected in this study Meanwhile, the most frequently found cyanotic congenital heart disease in this study was Tetralogy of Fallot (8,1%), which is consistent with a previous study conducted at Dr. Soetomo General Hospital by Alverina, Utamayasa, and Sembiring [6]. According to their findings, Tetralogy of Fallot was identified as the most common form of cyanotic congenital heart disease.

Table 3 shows the clinical symptoms experienced by patients with CHD. It may vary significantly based on the specific diagnosis, severity, and presence of associated conditions [4].

In this study, the most prevalent symptoms were shortness of breath, observed in 63 patients (36.02%), murmurs in 63 patients (33.87%), and cyanosis in 38 patients (20.43%). Similar findings were reported at the Abassia Chest Hospital in Egypt, where shortness of breath was the most frequently observed symptom [15]. In a previous study conducted at Soetomo Hospital from 2018 to 2020, shortness of breath was identified as a prevalent symptom in 89 patients (76.27%), followed by age (92.24%) and cyanosis (86.21%). Findings are consistent with the current research, where these three symptoms were frequently observed [6]. Similar studies conducted in other countries have also reported shortness of breath and cyanosis as common symptoms among pediatric patients with congenital heart disease [8]. The presence of CHD and comorbidities can contribute to the occurrence of shortness of breath in this study. In cases of congenital heart disease, the mixing of oxygenated and non-oxygenated blood reduces the distribution of oxygen, leading to compensatory hyperventilation and resulting in symptoms of shortness of breath. Furthermore, the presence of comorbidities such as pulmonary hypertension, pulmonary edema, and pneumonia can also contribute to the manifestation of shortness of breath [16].

Cyanosis is characterized by a bluish-purple discoloration of the skin and mucous membranes, which arises due to an increased concentration of deoxygenated hemoglobin (at least 4g/dL), typically associated with oxygen saturation levels around 80-85%. In the context of congenital heart disease, cyanosis occurs as a consequence of a defect that permits deoxygenated blood to bypass the lungs and flow directly from the right heart to the left heart [2]. The clinical symptoms of fever, cough, flu-like symptoms, and crackles observed in this study may be attributed to accompanying infectious diseases, such as acute respiratory infections, pneumonia, and sepsis, which were also prevalent in this study [17].

Down syndrome and hypothyroidism are the predominant concomitant congenital abnormalities observed in patients with CHD. This finding is consistent with the study conducted by Yaqoob et al. (2014), which reported that 41,8% of babies with Down syndrome also had CHD.18 There has been a rising trend in the occurrence of Down syndrome accompanied by CHD in recent years [19]. Down syndrome is an autosomal disorder characterized by trisomy of chromosome 21, and it is the most common genetic abnormality associated with intellectual disability, facial dysmorphism, and other phenotypic characteristics [18].

Molecular literature suggests that the increased incidence of CHD in Down syndrome patients may be linked to the overexpression of the DSCAM gene. This overexpression disrupts the transformation and proliferation of mesenchymal cells. Resulting in abnormal adhesion properties of endocardial fibroblasts which causes subsequent cardiac abnormalities [20]. In addition to Down syndrome, hypothyroid disorders are also frequently observed in patients with CHD [21]. Furthermore, intravenous iodine contrast media (ICM) is frequently utilized for diagnostic imaging and therapeutic interventions in patients with CHD. Excessive iodine exposure from ICM can adversely affect thyroid function in both adult and pediatric populations [22].

Patients with CHD often come with other comorbidities, one of the comorbidities that is often found is pneumonia [4,6,8]. Acyanotic CHD is characterized by blood flow from the left to the right side through septal defects or the ductus arteriosus. This results in an excessive circulation of blood within the pulmonary circulation, which can potentially result in the development of pulmonary edema. Pulmonary edema can lead to congestive heart failure and serve as a potential source of infection for the lower respiratory tract [2,23]. Patients with acyanotic CHD with increased blood flow to the lungs commonly exhibit symptoms of pneumonia and congestive heart failure. Shortness of breath is consistently reported as the predominant symptom in these cases. In the present study, congestive heart failure and heart failure were observed in 5 patients. Previous studies have indicated that CHD can contribute to recurrent pneumonia, defined as experiencing two or more episodes of pneumonia within a year [1,23]. Pulmonary hypertension is one of the complications that can occur following congenital heart disease, particularly in acyanotic CHD. In a study conducted in 2019 at Dr. Soetomo Hospital in Surabaya, the prevalence of pulmonary arterial hypertension in acyanotic CHD patients was found to be 7.08% out of 804 patients [24]. In the present study, pulmonary hypertension was observed in 17 patients.

Sepsis can be a complication of pneumonia in CHD with the predominance of respiratory symptoms in patients.17 Decreased blood flow to the lower body causes an increased risk of necrotizing enterocolitis and kidney failure.21 This could underlie the discovery of comorbidities of necrotizing enterocolitis in 2 patients and renal failure in 10 patients in this study. Low nutritional status, which was found in the 109 patients in this study, and other congenital abnormalities may result in an inadequate immune system. A low immune system makes patients susceptible to infections such as pneumonia, Acute Respiratory Infection (ARI), Urinary Tract Infection (UTI), tuberculosis, and other infectious co-morbidities [17,24].

## CONCLUSION

In conclusion, our study found that congenital heart disease was more prevalent in males. The majority of the patients belonged to the neonate age group and had good nutritional status. Atrial Septal Defect was identified as the most common type of acyanotic congenital heart disease, while Tetralogy of Fallot was the predominant cyanotic congenital heart disease observed at the Pediatric Inpatient Unit of Dr. Soetomo General Hospital Surabaya. Down syndrome emerged as the most frequent congenital disease associated with CHD, with pneumonia being the predominant co-morbidity.

**ETHICAL CLEARANCE**

This study received ethical clearance from the Ethical Committee for Health Research Dr. Soetomo General Academic Hospital, Surabaya (no. 0885/LOE/301.4.2/IV/2022) on 22 April 2022

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