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ETIOLOGY AND OUTCOME OF CONGESTIVE HEART FAILURE IN CHILDREN IN A TERTIARY CARE HOSPITAL OF JHARKHAND: A CROSS-SECTIONAL STUDY.

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ABSTRACT

Background
Congestive heart failure (CHF) is an important, growing public health problem causing substantial morbidity and mortality in pediatric patients. The causes vary between developed and developing countries, age, and geographical location. Congenital heart diseases and cardiomyopathy are the most common offenders in developed countries, while infections and anemia are more common in developing areas.

Objective
To determine the etiology and outcome of Congestive heart failure in the Department of Paediatrics, SBMC, Hazaribagh.

Methods
This descriptive, cross-sectional retrospective study involved 82 children diagnosed with CHF. Comprehensive data collection included history taking, physical examinations, and diagnostic tests such as CBC, chest X-rays, and echocardiograms. Statistical analyses were conducted using descriptive statistics to outline the frequency and percentage of various causes and outcomes of CHF.

Results
The study found that 87.8% of heart failure cases were due to cardiac causes with congenital heart diseases being predominant (74%). The most common congenital causes were ventricular septal defect (25.6%), patent ductus arteriosus (14.6%), and dilated cardiomyopathy (11%). Non-cardiac causes accounted for 12.2% of cases. The mortality rate during the study period was 14.7%.

Conclusion
Congenital heart diseases are the leading cause of CHF in children in this region, with a significant mortality rate. The variability of etiological factors, including both cardiac and non-cardiac causes, underscores the complex nature of pediatric heart failure management.

Recommendations
Future research should focus on longitudinal studies to track the long-term outcomes of pediatric heart failure and the effectiveness of various treatments across different regions and socioeconomic conditions. There is also a need for targeted public health interventions to address preventable causes of heart failure in children.

Keywords: *Pediatric Heart Failure, Congestive Heart Failure, Congenital Heart Disease, Etiological Factors*
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INTRODUCTION
Heart failure (HF) has been defined as an abnormality of cardiac structure or function leading to failure of the heart to deliver oxygen at a rate commensurate with the requirements of the metabolizing tissues, despite normal filling pressures (or only at the expense of increased filling pressures) (Jayaprasad, 2016). Heart failure (HF) in children differs from that in adults in many respects. The causes and clinical presentations may differ considerably among children of different age groups and between children and adults. The time of onset of heart failure holds the key to the etiological diagnosis (Picchio et al., 2008). Clinical presentation of heart failure in younger children can be nonspecific requiring a heightened degree of suspicion. Heart failure in children is a progressive clinical and pathophysiological syndrome caused by cardiovascular and non-cardiovascular abnormalities that result in characteristic signs and symptoms including edema, respiratory distress, growth failure, and exercise intolerance, with circulatory,

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neurohormonal, and molecular derangements. In adults, the most common etiology of heart failure is coronary artery disease. In pediatric patients, the pattern of heart failure varies between and within countries, these causes vary between developed and developing countries, age, and geographical location (Hsu and Pearson, 2009). Congenital heart disease and cardiomyopathy are the most common offenders in developed countries. Rheumatic heart disease, infection, and anemia are more common in developing areas (Masarone et al., 2017).

The study aimed to investigate the etiological factors contributing to congestive heart failure in children and analyze the outcomes associated with these factors in a tertiary care setting, to better understand how these influences vary between different geographical and socioeconomic backgrounds.

MATERIAL AND METHODS

Study design

This is a descriptive, cross-sectional retrospective study.

Study setting

The study was carried out at the Department of Paediatrics, Sheikh Bhikhari Medical College (SBMC), Hazaribagh, Jharkhand, India, from August 2021 to July 2023.

Participants

The study included 82 children with heart failure aiming to determine the etiology and mortality and aged from 10 days to 12 years.

Inclusion Criteria

- Patients diagnosed with congestive heart failure (CHF) between August 2021 and July 2023.
- Complete medical records available for review including history taking, physical examination, and laboratory investigations such as complete blood count (CBC), chest X-ray, and echocardiogram.

Exclusion Criteria

- Cases where the cause of heart failure was not recorded.
- Patients with incomplete medical records or missing diagnostic information.

Bias

There was a chance that bias would arise when the study first started, but it was avoided by giving all participants identical information and hiding the group allocation from the nurses who collected the data.

Sample size

To calculate the sample size for this study, the following formula was used for estimating a proportion of a population:

$$n = \frac{Z^2 \times p \times (1-p)}{E^2}$$

Where:

- n = sample size
- Z = Z-score corresponding to the desired level of confidence
- p = estimated proportion in the population
- E = margin of error

Data collection and Procedure

The children in the study were subject to full history taking, physical examination, and laboratory investigations including complete blood count (CBC), chest x-ray, and echocardiogram, and were diagnosed with congestive heart failure. The case records of the children admitted with a clinical diagnosis of heart failure and managed in the medical ward during this period were identified and retrieved for age, gender, clinical symptoms and signs, cause, treatment, and outcome. Symptoms of CHF included diaphoresis, tachypnea, respiratory distress, hepatomegaly, and others as well as medical treatment were recorded.

Congestive heart failure was diagnosed in this study when the patient fulfilled the clinical diagnostic criteria of heart failure outlined below (Andrews et al., 2008):

1. Significant tachycardia for age (>160 beats/min in infancy, >140/min at 2 years, >120/min at 4 years, and >100/min above 6 years.) Where fever was present, a 10 beat/min increase for every 1° C rise in temperature was allowed.
2. Significant tachypnea for age (>60 breaths/min in the newborn, >40 breaths/ min <24 months, 30 breaths/ min in 2 – 5 years, >28 breaths/ min in 5–10 years, and >25 breaths/ min in >10 years).
3. Cardiomegaly (displaced apex beat witha central trachea or cardiothoracic ratio >60% in <5 years and >50% in >5 years on radiography.
4. Tender hepatomegaly of at least 3cm size below the right costal margin with the normal position of the upper border.

The fulfillment of at least three of the four criteria above was diagnostic of congestive heart failure.

Statistical Analysis

Descriptive statistics such as frequencies and percentages were calculated and then study results were presented in tables and graphs using Excel and Word programs.

Ethical considerations

The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

RESULTS

Eighty-seven patients were admitted to the pediatric ward with a clinical diagnosis of congestive heart failure (CHF) over the study period. Five cases were excluded from the study in which the cause of heart failure was not recorded.

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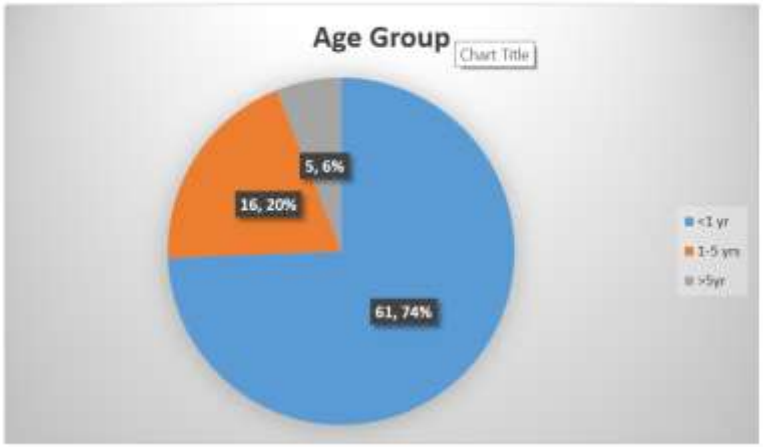
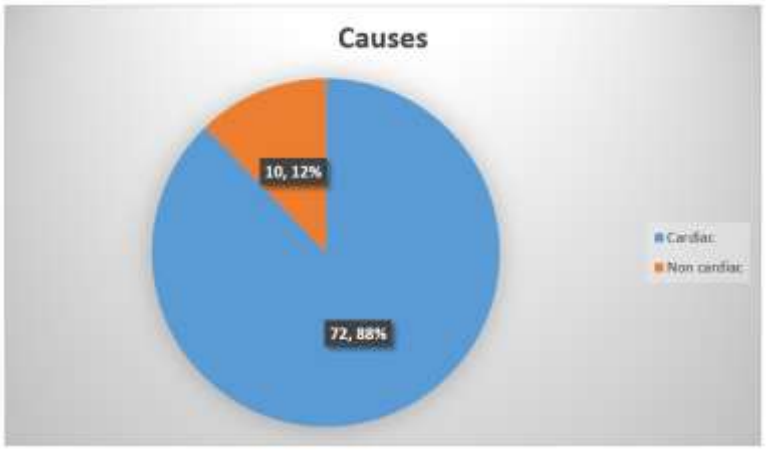
Finally, eighty-two cases (40 males, 42 females) were analyzed. The mean age at presentation of these patients was 13.72 months (range: 10 days– 144 months).

Figure (1): age groups among children with CHF



The study found that common causes of heart failure were heart diseases; 72 patients representing 87.8%, while non cardiac causes were 10 (12.2%) (Figure 2).

Figure (2): common causes of CHF



Congenital heart diseases were 61(74%), while rheumatic heart disease were 14 (17 %.) (Figure 3)

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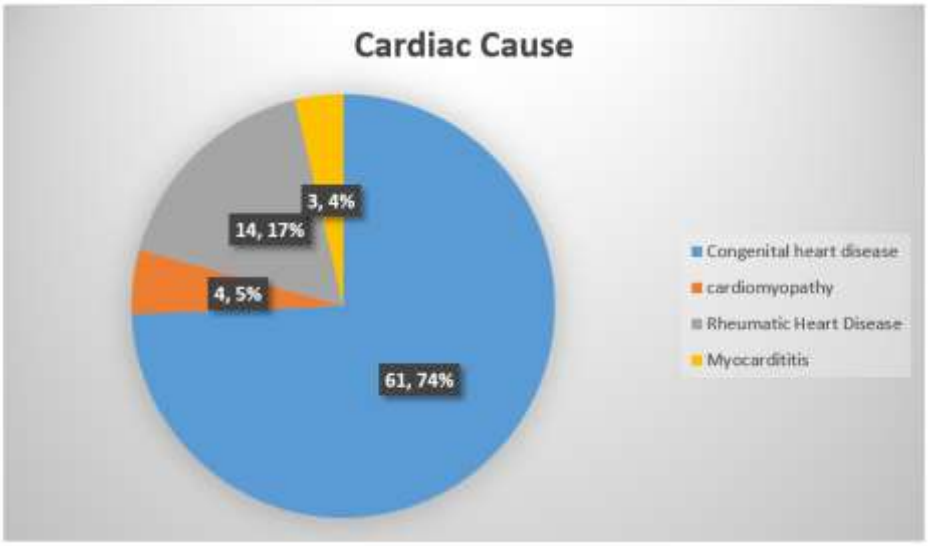
Figure (3) Cardiac causes of children with CHF



The most common congenital cause of heart failure in the study was ventricular septal defect (VSD) 21 (25.6%) followed by patent ductus arteriosus (PDA) 12(14.6%) then dilated cardiomyopathy (DCM) 9(11%) but myocarditis and anemia with chest infection were detected in 4.9%. Overlapping of causes was present in 16 cases (19.5%) i.e., in 16 out of the 82 cases studied, patients exhibited multiple concurrent etiologies contributing to heart failure. This could involve combinations such as congenital heart defects paired with other conditions like myocarditis or anemia, indicating the complexity and multifactorial nature of heart failure management in thesepatients (Table 1).

Table 1: Etiology of heart failure

Cause	Frequency	Percent %
VSD	21	25.6
PDA	12	14.6
Dilated Cardiomyopathy	9	11.0
Myocarditis	4	4.9
Anemia + Chest infection	4	4.9
TGA + VSD	3	3.7
VSD + PDA	3	3.7
Chest Infection	3	3.7
Rheumatic Heart Disease	2	2.4
Primary Pulmonary HTN	2	2.4
Complex Congenital Heart Disease	2	2.4
AV Canal	2	2.4
Anemia	2	2.4
VSD + PS	1	1.2
VSD + MR	1	1.2
VSD + ASD	1	1.2
ToF	1	1.2
TGA + PH	1	1.2
TGA + PDA	1	1.2
ASD	1	1.2
ASD + Infective Endocarditis	1	1.2
ASD + PDA	1	1.2

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Complex Cyanotic DORV + TGA + VSD	1	1.2
Cyanotic Complex Heart Disease	1	1.2
Hypertrophic Cardiomyopathy	1	1.2
Renal	1	1.2
TOTAL	***82***	***100.0***

VSD- ventricular septal defect, PDA- patent ductus arteriosus, TGA- Transposition of the Great Arteries, AVC- Atrioventricular Septal Defects, PS-pulmonary stenosis, MR-mitral regurgitation, ASD-atrial septal defect, TOF- tetralogy of Fallot,PH- pulmonary hypertension, DORV- Double-outlet right ventricle
Table 2 shows Echocardiography findings in the study.

Table 2: Echocardiography finding:

ECHO result	***Frequency***	***Percent %***
VSD	21	25.6
PDA	12	14.6
Dilated Cardiomyopathy	9	11.0
Not done	8	9.8
Myocarditis	4	4.9
TGA + VSD	3	3.7
VSD + PDA	3	3.7
Rheumatic Heart Disease	2	2.4
Primary Pulmonary HTN	2	2.4
Complex Congenital Heart Disease	2	2.4
AV Canal	2	2.4
Normal	2	2.4
VSD + PS	1	1.2
VSD + MR	1	1.2
VSD + ASD	1	1.2
ToF	1	1.2
TGA + PH	1	1.2
TGA + PDA	1	1.2
ASD	1	1.2
ASD + Infective Endocarditis	1	1.2
ASD + PDA	1	1.2
Complex Cyanotic DORV + TGA + VSD	1	1.2
Cyanotic Complex Heart Disease	1	1.2
Hypertrophic Cardiomyopathy	1	1.2
TOTAL	***82***	***100.0***

Twelve patients died during the study; this constituted a mortality rate of 14.7%. (Figure 4).

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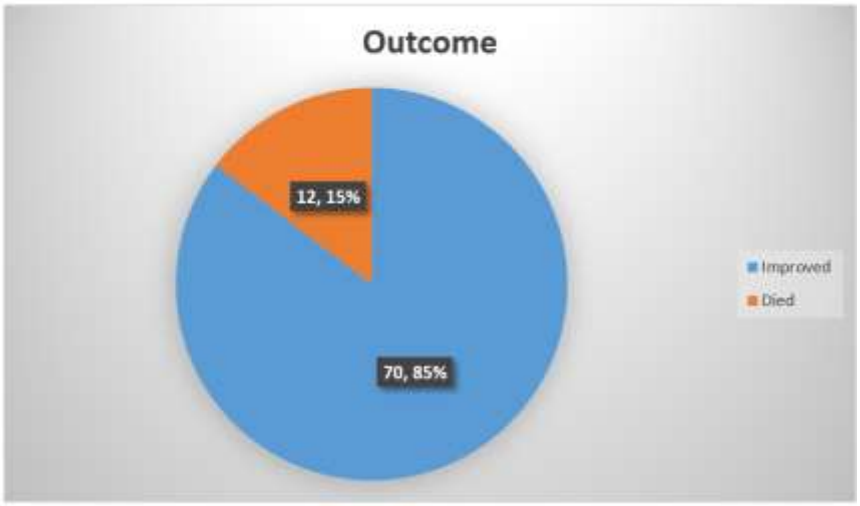
Figure (4): Prognosis and outcome of children with CHF



DISCUSSION

The current study revealed that heart failure constitutes about 2.1% of pediatric hospital admissions. It is difficult to compare rates among hospitals due to different hospital sizes, pediatric age limits, diagnostic criteria, age distribution, and profile of causes. The prevalence of heart failure in Nigeria was 7.02 % (Adekambi et al, 2007) while it constituted 5.8% of the total pediatric admissions in Ibadan (Lagunju and Omokhodion, 2004).

Congestive heart failure in the pediatric population is a common cause of morbidity and mortality and is a serious public health concern, with tremendous socio-economic impact (Hsu and Pearson, 2009).

It is characterized by a progressive left ventricular pump dysfunction, leading to cardiac dilatation, thinned walls, and poor contractility (Hsu and Pearson 2009).

The mean age at presentation was 13.72 months (about 1 year), this is comparable to the results in developed countries where congenital heart disease is the leading cause, (Awori et al, 2007). In developing regions, heart failure presented beyond infancy, 3.7 ± 3.5 years reported in Nigeria (Ogah et al., 2014) and 2 +/- 3.1 years in Sagamu (Nigeria) (Adekambi et al ., 2007), and 4.7 years in Kenya (Ogeng' et al ., 2013), and is comparable with observations that congenital heart defects are constituted less than acquired causes of heart failure. The mean age is also affected by one-year survival rates and is dependent on the cause (Andrews et al., 2008). Accordingly; age distribution is expected to vary between countries and centers.

The male-to-female ratio was in line with Josephat Chinawa et al. 2013, while in some countries males were more predominant (Ogeng'o et al., 2013).

The results revealed that heart disorders were the main cause of heart failure, and congenital heart diseases were the most common followed by cardiomyopathy, It is comparable to the literature reports from developed countries (Hsu and Pearson 2009) and some studies in developing countries as India and Egypt (Ramakrishnan, 2014 and Malamba-Lez et al. 2018). Several other studies support variations in the leading causes of heart failure in children between developed and developing countries (Table 3). These variations may be due to differences in awareness of preventive measures and access to healthcare services.

Isolated VSD constituted the main CHD in the study (25.6%) and this is similar to many studies (Adekambi et al, 2007; Ramakrishnan, 2014; Josephat et al., 2013 and Ejim et al., 2009), while PDA is the second cause. Primary cardiomyopathies are the principal cause of heart failure signs and symptoms in children with a structurally normal heart (Lipshultz et al., 2003 Nugent et al ., 2003).In the current study, it constituted 11%.of the total cases and 13.9% of the cardiac causes. This resembles many studies especially in developed areas (Hsu and Peason 2009; Massin et al., 2008; Ramakrishnan, 2014 and Malamba-Lez et al. 2018). Although infection and anemia are among the common etiologies of heart failure in developing countries (Adekambi et al., 2007; Ogeng ' o et al.,2013) and (Lagunju and Omokhodion, 2004), in the study, it represented only 3.7%, and 2.4% resembling the developed world. (Hsu and Pearson 2009; Massin et al., 2008 and Malamba-Lez et al. 2018).

The mortality rate in this study was 14.6%. This is corresponding to the figure in Belgium. (Massin et al., 2008) and is higher than another study of India (2.85%, Malamba-Lez et al. 2018), but lower than the 24% reported in Nigeria (Ejim et al., 2009). Death due to heart failure differs according to different etiological factors and accessibility to healthcare facilities (Massin et al., 2008). For example, in developed countries, most babies with CHD receive early surgical intervention, (Kay et al., 2001) while in the setup, a significant number may miss the opportunity to have optimal surgical care.

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Generalizability

The generalizability of this study is limited by its single-center design and the specific regional context, which may not reflect broader pediatric populations or healthcare settings. Factors such as demographic variations, local healthcare practices, and socioeconomic conditions could affect the applicability of the findings. Enhancing generalizability could involve expanding the research to multiple centers, increasing the sample size, and incorporating diverse demographic groups. While the study offers valuable regional insights, applying its results more broadly requires caution, and additional studies across varied settings are necessary to confirm the findings' wider relevance.

Conclusion

The study on congestive heart failure (CHF) in children at a tertiary care hospital in Jharkhand provides significant insights into the prevalence and etiology of this condition within the studied region. The findings reveal a high incidence of congenital heart defects as the predominant cause of CHF, supplemented by non-cardiac factors such as infections and anemia. The mortality rate observed aligns with the complexities of managing CHF in pediatric patients, highlighting the challenges in treatment and the critical need for early diagnosis and intervention.

Limitations

The study may not be broadly applicable due to its single-center scope and small sample size, which could bias results. Selection bias and limitations in data accuracy from retrospective medical record reviews may also impact findings. Furthermore, the study may not fully account for all influencing factors like socioeconomic status. Future studies should expand to multiple centers and employ more robust data collection to enhance validity and generalizability.

Recommendation

Based on the study's outcomes, it is recommended to improve healthcare infrastructure and access to specialized pediatric cardiac care in tertiary hospitals to enhance survival rates and treatment outcomes for children with CHF. Establishing specialized cardiac centers and enhancing healthcare services could significantly reduce complications and improve the prognosis for affected children. Further research involving multiple centers and a more diverse population would also be beneficial to verify these findings and extend their applicability to other regions.

List of abbreviations

CHF - Congestive Heart Failure
DCM - Dilated Cardiomyopathy
CBC - Complete Blood Count
VSD- ventriclar septal defect
PDA- patent ductus arteriosus
TGA- Transposition of the Great Arteries
AVC- Atrioventricular Septal Defects
PS-pulmonary stenosis
MR-mitral regurgitation
ASD-atrial septal defect
TOF- tetralogy of Fallot
PH- pulmonary hypertension
DORV- Double-outlet right ventricle

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Conflict of interest

The authors declare no conflict of interest.

REFERENCES

1. Adekambi AF, Ongunlesi TA, Olowu AO, Fetuga MB. Current trends in the prevalence and etiology of childhood congestive cardiac failure in Sagamu J Trop Pediatr. 2007;53 (2):103–106.
2. Andrews RE, Fenton MJ, Ridout DA, Burch M. New onset heart failure due to heart muscle disease in childhood: a prospective study in the United Kingdom and Ireland. Circulation.2008; 117:79–84.
3. Awori MN, Ogendo SW, Gitome SW, Onguti SK, Obonyo NG. Management pathway for congenital heart disease at Kenyatta National Hospital, Nairobi.East Afr MedJ. 2007; 84:312–317.
4. Ejim EC, Ike SO, Anisiuba BC, Onwubere BJ, Ikeh VO: Ventricular septal defects at the University of NigeriaTeaching Hospital, Enugu: a review of echocardiogram records. Trans R Soc Trop Med Hyg 2009, 103:159-161.
5. Hsu DT, Pearson GD. Heart failure in children. Part 1: History. Etiology and pathophysiology. Circulation: Heart Failure. 2009; 2:63–70.
6. Hsu, D., & Pearson, G. (2009). Heart failure in children: part I: history, etiology, and pathophysiology. *Circulation. Heart failure*, 2 1, 63-70. https://doi.org/10.1161/CIRCHEARTFAILURE.108.820217.
7. Jayaprasad, N. (2016). Heart Failure in Children. *Heart Views: The Official Journal of the Gulf Heart Association*, 17, 92 - 99. https://doi.org/10.4103/1995-705X.192556.
8. Josephat M Chinawa, John C Eze, Ikechukwu Ob, Ijeoma Arodiwe, Fortune Ujunwa, Adiele K Daberechi and Herbert A Ob Synopsis of congenital cardiac disease among children attending University of Nigeria
9. Kay JD, Colan SD, Graham TP Jr. Congestive heart failure in pediatric patients. Am Heart J. 2001;142:923–929.
10. Lagunju, I., & Omokhodion, S. (2004). Childhood heart failure in Ibadan. *West African*

journal of medicine, 22 1, 42-5. https://doi.org/10.4314/WAJM.V22I1.27978.

11. Lipshultz SE, Sleeper LA, Towbin JA, Lowe AM, Orav EJ, Cox GF, Lurie PR, McCoy KL, McDonald MA, Messere JE, Colan SD. The incidence of pediatric cardiomyopathy in two regions of the United States. N Engl J Med. 2003; 348: 1647–1655.
12. Malamba-Lez, D., Ngoy-Nkulu, D., Steels, P., Tshala-Katumbay, D., & Mullens, W. (2018). Heart Failure Etiologies and Challenges to Care in the Developing World: An Observational Study in the Democratic Republic of Congo. *Journal of cardiac failure*, 24 12, 854-859. https://doi.org/10.1016/j.cardfail.2018.10.008.
13. Masarone, D., Valente, F., Rubino, M., Vastarella, R., Gravino, R., Rea, A., Russo, M., Pacileo, G., & Limongelli, G. (2017). Pediatric Heart Failure: A Practical Guide to Diagnosis and Management. *Pediatrics and neonatology*, 58 4, 303-312. https://doi.org/10.1016/j.pedneo.2017.01.001.
14. Massin MM, Astadicko I, Dessy H. Epidemiology of heart failure in a tertiary pediatric center. Clin Cardiol. 2008; 31: 388–391.
15. Nugent AW, Daubeney PE, Chondros P, Carlin JB,Cheung M, WilkinsonLC, Davis AM, Kahler SG, Chow CW, Wilkinson JL, Weintraub RG. The epidemiology of childhood cardiomyopathy in Australia. N Engl J Med. 2003; 348: 1639–1646.
16. Ogah, O., Falase, A., Stewart, S., Sliwa, K., Akinyemi, J., Adegbite, G., Alabi, A., Durodola, A., & Ajani, A. (2014). Short-term outcomes after hospital discharge in patients admitted with heart failure in Abeokuta, Nigeria: Data from the Abeokuta Heart Failure Registry. *Cardiovascular Journal of Africa*, 25, 217 - 223. https://doi.org/10.5830/CVJA-2014-040.
17. Ogeng'o JA Gatonga PM Olabu, BO et al Pattern of congestive heart failure in a Kenyan pediatric population. Cardiovasc J Afr. 2013 June; 24(4): 117–120.
18. Picchio, F., Formigari, R., & Balducci, A. (2008). Pediatric heart failure. *Minerva cardioangiologica*, 56 3, 311-9.
19. Ramakrishnan, S. (2014). Pediatric Heart Failure in the Developing World. *Reviews on recent clinical trials*, 9 2, 86-90. https://doi.org/10.2174/1574887109666140908125841.

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