Nutritional Status Of Children With Congenital Heart Disease, In Kolkata, West Bengal

Kasturi Mandal, Subhendu Sekhar Mahapatra, Purbasha Banerjee, Ishika Roy

(Principal, College And School Of Nursing R.N Tagore Hospital, India)
(Professor, Department Of Cardio Thoracic And Vascular Surgery, Ipgme&R And Sskm Hospital)
(Associate Professor, College And School Of Nursing R.N Tagore Hospital, India)
(Assistant Professor, College And School Of Nursing R.N Tagore Hospital, India)

Abstract:

Background*: Proper nutrition is very crucial for children with congenital heart defects (CHD) as it directly impacts their growth, development, and clinical outcomes. Malnutrition is very commonly seen in these children as they have increased metabolic demands and feeding difficulties. Malnourished children with CHD are at a higher risk of poor surgical outcomes, prolonged hospital stays, and increased morbidity and mortality. Adequate nutritional support improves immune function, facilitates recovery from surgery, and enhances overall quality of life.*

Objectives: *The study's objectives were to identify the nutritional status of children with congenital heart disease and to identify the association between nutritional status and various clinical parameters in these children.*

Materials and Methods*: A cross-sectional descriptive study was conducted in a tertiary hospital in Kolkata, West Bengal over a period of 3 months from January 2023 to March 2023. A total of 140 pediatric patients with congenital heart disease, aged between 0-18 years were selected from the outpatient department using a convenient sampling technique. Data collection was done by trained nursing personnel using three pretested data collection instruments. WHO Z- score was used to categorize acute malnutrition. The association between nutritional status and various demographic and clinical parameters was determined using Pearson's chi-square test.*

Results*: Among the 140 children 46.4%, that is 65 children were in the age group of 1-5 years. 104 children were suffering from acyanotic heart disease, among which the majority (61.5%) of the children were diagnosed with VSD. Only 36 patients had cyanotic heart defects and among them majority (75%) were diagnosed with Tetralogy of Fallot. Among all 140 children with CHDs 75 (53.5%) children had pulmonary hypertension. Almost 30% of children were severely underweight. Severe wasting was present in 21% and severe stunting was present in almost 13% of the children. We found a significant association between stunting and age of children with CHD. A significant association was also found between underweight and type of heart disease. Underweight and wasting were associated with the presence of pulmonary hypertension.*

Conclusion: *Malnutrition is very common in children with any type of heart defect. It is also associated with type of heart disease and the presence of pulmonary hypertension. It is very important to screen these children regularly for any deviation in normal nutritional status so that management can be done as soon as possible to prevent the long-term consequences of undernutrition.*

Key Word: *Congenital heart disease, CHD, Congenital cardiac defects, Malnutrition, Nutritional status*

I.   Introduction

Congenital heart disease is one of the common congenital anomalies, affecting approximately 8–12 per 1,000 live births globally[1]. Advances in medical and surgical interventions have significantly improved survival rates among children with CHD. Nutritional status is a critical determinant of growth, development, and clinical outcomes in children with CHD.

Malnutrition is very commonly seen among children with congenital heart disease, irrespective of the nature of the heart defect and the presence or absence of cyanosis[2]. For this reason, children born with heart disease are considered part of a nutritional high-risk group[3]. Malnutrition is a major cause of exacerbation of the severity of CHD by decreasing the body's immune function, delaying recovery from surgery, and increasing the risk of complications associated with the disease condition as well as surgery[4]. On the other hand, adequate nutritional status is associated with improved weight gain, growth parameters, and overall quality of life in this vulnerable population[5].

Children with congenital cardiac defects (CHDs) who are suffering from malnutrition have an increased risk of morbidity and mortality which can be seen as frequent hospitalisation, poor surgical outcomes, deficient age-appropriate growth and an increased risk of death as well[6,7]. Heart failure, cyanosis, multiple heart defects, delayed corrective surgery, anaemia and pulmonary hypertension are some identified risk factors for malnutrition among children with congenital cardiac defects[8-10]. Moreover, in children with CHDs, nutritional deficiency may also result from inadequate nutritional intake due to feeding difficulties and the increased energy expenditure among these children[11]. The nutritional challenges faced by children with CHD are often underreported. Though there are several studies assessing the nutritional status of children with CHD, these studies are very region and culture-specific. Very few studies have been done in Kolkata, West Bengal. This underscores the need for comprehensive assessments of nutritional status and appropriate interventions to address the unique needs of these children. This study aims to evaluate the nutritional status of children with CHD and to identify the association between the nutritional status and clinical parameters.

II.   Material And Methods
A cross-sectional descriptive study was conducted on pediatric patients with congenital heart disease over 3 months, from January 2023 to March 2023 in a tertiary hospital, in Kolkata, West Bengal.

Study Design: Cross-sectional descriptive study

Study Objectives:
1. To identify the nutritional status of the children with congenital heart disease
2. To identify the association between nutritional status and selected demographic and clinical parameters of children with congenital heart disease.

Study Setting: A tertiary hospital, in Kolkata, West Bengal

Study Duration: January 2023 to March 2023.

Sample size: 140 patients.

Sample size calculation: The sample size was estimated using a single population proportion formula, taking the prevalence[8] of malnutrition among the patients with congenital heart disease as 90%, Z = 1.96 and considering the Margin of Error as 5%, the calculated sample is 139. So, 140 children were selected for the study.

Subjects & selection method: The study population was all pediatric patients with congenital heart disease aged between 0 – 18 years seen at outpatient department of a tertiary hospital, Kolkata. A convenient sampling technique was used to include the study participants who fulfilled the inclusion criteria and visited the outpatient department during the data collection period until the sample size was achieved.

Inclusion criteria:
1. All pediatric patients aged between 0 – 18 years with congenital heart disease
2. Patients attending the outpatient department during the data collection period.

Exclusion criteria:
1. All patients with risk factors other than congenital heart disease that may contribute to malnutrition, such as Chronic illness other than CHD, prematurity, and low birth weight were excluded.

Procedure methodology:
Data collection was done by trained nursing personnel by using pretested data collection instruments after obtaining Informed Consent.
Anthropometric measurements are done and documented in the assessment proforma. Weight is measured by the same weighing machine. The length of the children aged under 2 years was taken while they were lying on a flat surface and the height of the children above 2 years of age was taken while they were standing.
WHO Z-score classification[12] of malnutrition is used for the assessment and classification of the nutritional status of children included in the study. Acute malnutrition was defined as the presence of wasting which was measured by weight for height score, chronic malnutrition was defined as stunting which was assessed by height for age score and poor nutritional status was assessed using weight for age score.
Clinical profiles of these children are found in the treatment sheet, and investigation reports and documented in the record analysis proforma.

Finally, the children's caregivers are also interviewed to collect data on demographics, birth histories, and diet.

Data analysis:
Frequency and percentage distribution were calculated to show the demographic and clinical characteristics of the study participants.
WHO Z-scores were used for the interpretation of the nutritional status of the children.
- Wasting is categorized as mild if the weight for height is <-1SD to >-2SD, moderate if the weight for height is <-2SD to >-3SD and severe if the weight for height is <-3SD.
- Mild, moderate and severe stunting if length/height for age is <-1SD to >-2SD, <-2SD to >-3SD and <-3SD respectively.
- Mild, moderate and severe underweight if the weight for age is <-1SD to >-2SD, <-2SD to >-3SD and <-3SD respectively.

Pearson's chi-square test was used to compute the association between nutritional status and various demographic and clinical parameters, such as age, type of heart defect, and presence of pulmonary hypertension.

Ethical consideration: The study was permitted by the institutional ethical committee and informed consent was taken from all the participants before data collection.

III.   Result
Table – 1 Demographic and clinical characteristics of the children

N = 140

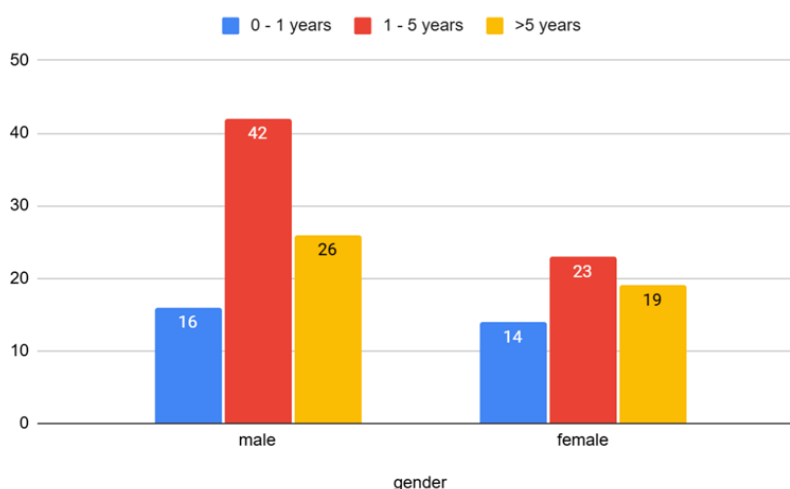| Sample Characteristics	Frequency	Percentage (%)
1. Age		
0-1 Years	30	21.4
1-5 Years	65	46.4
> 5 Years	45	32.2
2. Gender		
Male	84	60
Female	56	40
3. Types of Congenital Heart Disease		
Acyanotic	104	74.3
Cyanotic	36	25.7
4. Pulmonary hypertension		
Present	75	53.6
Absent	65	46.4

N = 140

Figure1: Distribution of gender as per age group

Data presented in Table 1 and figure 1, showed that the majority of the children (46.4%) belonged to the age group of 1 – 5 years. 84 children (60%) of 140 children were male and among them, 42 children belonged to 1 – 5 years age group. Among 56 female children majority, that is 23 children were from the age group of 1 – 5 years. 74.3% of the children had Acyanotic heart disease whereas only 25.7% children had cyanotic heart disease. More than half (53.6%) of the children were detected with pulmonary hypertension.

Table – 2 The distribution of cardiac diagnosis in children with congenital heart disease
N = 140

Type of heart disease	Frequency	Percentage (%)
1. *Acyanotic*		
Atrial Septal Defect (ASD)	16	11.4
Ventricular Septal Defect (VSD)	64	45.7
Patent Ductus Arteriosus (PDA)	10	7.2
VSD + ASD	8	5.7
VSD + PDA	6	4.3
2. *Cyanotic*		
Tetralogy of Fallot (TOF)	27	19.3
Transposition of Great Arteries (TGA)	3	2.1
Total Anomalous Pulmonary Venous Connection (TAPVC)	4	2.9
Tricuspid atresia	1	0.7
Pulmonary stenosis	1	0.7

Data presented in Table 2, shows that the majority of the children (45.7%) were diagnosed with Ventricular septal defect (VSD) which is an Acyanotic heart disease. Among children with cyanotic heart disease, the majority of the children had Tetralogy of Fallot (TOF), which was the second highest (19.3%) among all 140 children with congenital heart defects. Only one patient had Tricuspid atresia and another one had pulmonary stenosis; both of the conditions are cyanotic. The third common diagnosis found was ASD (11.4%).

Table 3: The proportion of underweight, stunted, and wasted among children
N = 140

Variable	Frequency	Percentage (%)
I. *Weight for age*		
Normal	82	58.6
Mild underweight	7	5
Moderate underweight	10	7.1
Severe underweight	41	29.3
II. *Weight for height*		
Normal	86	61.4
Mild wasting	8	5.8
Moderate wasting	16	11.4
Severe wasting	30	21.4
III. *Height for age*		
Normal	100	71.4
Mild stunting	10	7.1
Moderate stunting	12	8.6
Severe stunting	18	12.9

Data presented in Table 3 showed that 29.3% of children were severely underweight, 21.4% were severely wasted, and 12.9% were severely stunted. 58.6% of children had age-appropriate weight, 61.4% had appropriate weight for height, and 71.4% had an age-appropriate height.

58.6% of children were of appropriate weight for their age, and 61.4% and 71.4% of the children were of appropriate weight and height for their age, respectively.

Table 4: Association between nutritional status and age of the children with CHD

	Category of nutritional status	<1year n =30	1-5 year n = 65	>5 year n = 45	Chi-square	p - value	Level of significance
Undernutrition (weight for age)	Normal to mild (> -2SD) n=89	19 (63%)	43 (66%)	27 (60%)	0.4358	0.8042	0.05
	Moderate to severe (<-2SD) n= 51	11 (37%)	22 (34%)	18 (40%)			
Wasting (weight for height/length)	Normal to mild (> -2SD) n=94	23 (77%)	45 (69%)	26 (57%)	3.1508	0.20692	0.05
	Moderate to severe	7 (23%)	20 (31%)	19 (43%)			

	(<-2SD) n=46					
Stunting (height/length for age)	Normal to mild (> -2SD) n=110	27 (90%)	58 (89%)	25 (56%)	20.872 *	0.000029	0.05
	Moderate to severe (<-2SD) n=30	3 (10%)	7 (11%)	20 (44%)			

Data presented in Table 4 showed a significant association between stunting and the children's age. (χ^2 = 20.872; p = 0.000029). Among 45 children in the age group of > 5 years 44% (20) children were affected with moderate to severe stunting which was higher than other age groups.

Table 5: Association between nutritional status and gender of children with CHD

	Category of nutritional status	Male n = 84	Female n = 56	Chi-square	p - value	Level of significance
Undernutrition (weight for age)	Normal to mild (> -2SD) n=89	51 (61%)	38 (68%)	0.7403	0.38953	0.005
	Moderate to severe (<-2SD) n= 51	33 (39%)	18 (32%)			
Wasting (weight for height/length)	Normal to mild (> -2SD) n=94	52 (62%)	42 (75%)	2.6118	0.106073	0.005
	Moderate to severe (<-2SD) n=46	32 (38%)	14 (25%)			
Stunting (height/length for age)	Normal to mild (> -2SD) n=110	63 (75%)	47 (84%)	1.5026	0.22026	0.005
	Moderate to severe (<-2SD) n=30	21 (25%)	09 (16%)			

Data presented in Table 5 showed poor nutritional status in terms of both undernutrition, wasting and stunting is more prevalent in male children which is 39%, 38% and 25% of all male children respectively. However, no significant association was found between gender and nutritional status of the children with CHD.

Table 6: Association between type of heart disease and nutritional status of children with CHD

	Category of nutritional status	Acyanotic heart disease n = 104	Cyanotic heart disease n = 36	Chi-square value	p - value	Level of significance
Undernutrition (weight for age)	Normal to mild (> -2SD) n=89	59 (57%)	30 (83%)	8.1724 *	0.004253	0.05
	Moderate to severe (<-2SD) n= 51	45 (43%)	6 (17%)			
Wasting (weight for height/length)	Normal to mild (> -2SD) n=94	63 (61%)	31 (86%)	7.9036 *	0.004934	0.05
	Moderate to severe (<-2SD) n=46	41 (39%)	5 (14%)			
Stunting (height/length for age)	Normal to mild (> -2SD) n=110	80 (77%)	30 (83%)	0.6527	0.4191	0.05
	Moderate to severe (<-2SD) n=30	24 (23%)	6 (16%)			

Data presented in Table 6 showed that a significant association was found between underweight and type of heart disease (χ^2 = 8.1724; p = 0.004253) and wasting and type of heart disease (χ^2 = 7.9036; p = 0.004934). 43% of children with Acyanotic heart disease had moderate to severe undernutrition, compared to only 17% of children with cyanotic heart disease. 39% of children with Acyanotic heart disease had moderate to severe wasting, compared to only 14% of children with cyanotic heart disease.

Table 7: Association with pulmonary hypertension and nutritional status of children with CHD

	Category of nutritional status	Presence of pulmonary hypertension n = 75	Absence of pulmonary hypertension	Chi-square	p-value	Level of significance
Undernutrition (weight for age)	Normal to mild (> -2SD) n=89	40 (53%)	49 (75%)	7.3116 *	0.006851	0.05
	Moderate to severe (<-2SD) n= 51	35 (47%)	16 (25%)			
Wasting (weight for height/length)	Normal to mild (> -2SD) n=94	41 (55%)	53 (82%)	11.3975 *	0.000735	0.05
	Moderate to severe (<-2SD) n=46	34 (45%)	12 (18%)			
Stunting (height/length for age)	Normal to mild (> -2SD) n=110	55 (73%)	55 (85%)	2.6325	0.104698	0.05
	Moderate to severe (<-2SD) n=30	20 (27%)	10 (15%)			

Data presented in Table 7 showed that, a significant association was found between being underweight and the presence of pulmonary hypertension (χ^2 = 7.3116; p = 0.006851) and wasting and the presence of pulmonary hypertension (χ^2 = 11.3975; p = 0.000735). 47% and 45% of children with pulmonary hypertension were suffering from moderate to severe undernutrition and wasting respectively as compared to 25% and 18% of children without pulmonary hypertension.

IV.   Discussion

CHD is an abnormality in the heart's structure at birth that has a multifactorial nature of inheritance. The already known risk factors are exposure to harmful substances, smoking and drinking habits during pregnancy, viral infections at the early stage of pregnancy, diabetes mellitus, hypertension, and advanced maternal age[13]. Growth is considered the golden indicator of children's overall well-being, and in turn impairment of growth has both short and long-term consequences[14].

The present study was conducted to identify the nutritional status of children with congenital heart disease and its associated factors. In this study, we found a higher percentage of Acyanotic heart disease than cyanotic heart disease, which was aligned with other studies[15,16].

VSD was found to be the most common (45.7%) congenital heart disease, which was similar to another study, where VSD was the most common (43%) CHD[17].

We found a significant association between stunting and the age of the children (χ^2 = 20.872, p= 0.000029) similar to another study conducted in Nigeria where a significant association (χ^2 = 24.9, p= 0.03) between stunting and age of the children with CHD was found[18].

We find a significant association of type of heart disease with undernutrition and wasting (p= 0.004 and p= 0.005 respectively) similar to another study conducted where also a significant association of type of heart disease was found with underweight and wasting (p= 0.034 and p= 0.014). In both of these studies, no significant association was found between type of heart disease and stunting[19].

In contrast to our study where we didn't find any significant relationship between stunting and type of heart disease, in a study conducted by Agustini W et al. a significant association was found between stunting and type of heart disease (0.048)[17].

In some studies, it has been found that children with congenital heart disease having pulmonary hypertension are more likely to develop poor nutritional status[20,21]; in the present study presence of pulmonary hypertension in children with CHD was found to be significantly associated with being underweight and wasting

($\chi 2 = 7.3116$, p= 0.006851 and $\chi 2 = 11.3975$, p= 0.000735 respectively) but there was no significant association of stunting was found with presence of pulmonary hypertension.

The present study investigated the nutritional status of children with congenital heart disease and its associated factors in terms of age, gender, type of heart disease and presence of pulmonary hypertension. This study has a few limitations, it is a single-centre study that has been conducted in a tertiary care centre in Kolkata, West Bengal and the sample size of the study was small which can reduce the statistical power of the study.

V. Conclusion

Poor nutritional conditions are common in children with congenital heart disease. Our data suggested that stunting of children with CHD is associated with age whereas undernutrition and wasting were significantly associated with type of congenital heart disease and the presence of pulmonary hypertension.

Authors contribution:
- Study concept and design, analysis and interpretation & critical revision of the manuscript: **Prof. (Dr.) Kasturi Mandal**
- Study conceptualization and designing, tool development and methodology: **Prof. Subhendu Sekhar Mahapatra**
- Data collection and study supervision: **Ms. Purbasha Banerjee**
- Contribution to data organization and preparation of the manuscript: **Ms. Ishika Roy**

References

[1] Liu, Y., Chen, S., Zuhlke, L., Black, G. C., Choy, M. K., Li, N., & Keavney, B. D. (2019). Global Birth Prevalence Of Congenital Heart Defects 1970–2017: Updated Systematic Review And Meta-Analysis Of 260 Studies. International Journal Of Epidemiology, 48(2), 455–463.
[2] Mitchell M, Logan RW, Pollock JCS, Jamieson MPG. Nutritional Status Of Children With Congenital Heart Disease. Br Heart J. 1995;73:277-83.
[3] Oyarzún, M. T., Cerda, J., Cárcamo, P., & Salazar, M. (2020). Nutritional Challenges In Children With Congenital Heart Disease. Pediatric Cardiology, 41(4), 737–744.
[4] Medoff-Cooper, B., Irving, S. Y., Marino, B. S., Garcia-España, J. F., & Ravishankar, C. (2016). Weight Change And Growth Patterns In Infants With Complex Congenital Heart Disease. Cardiology In The Young, 26(2), 288–295.
[5] Leong, M. M., Davies, J. H., & Geary, D. F. (2017). Nutritional Interventions In Children With Congenital Heart Disease: A Systematic Review. Clinical Nutrition, 36(1), 45–53.
[6] Forchielli ML, Mccoll R, Walker WA, Et Al. Children With Congenital Heart Disease: A Nutrition Challenge. Nutr Rev 1994 ; 52 : 348 – 53 .
[7] Freeman LM, Roubenoff R. The Nutrition Implications Of Cardiac Cachexia. Nutr Rev 1994 ; 52 : 340 – 7 .
[8] Okoromah, C. A., Ekure, E. N., Lesi, F. E., Ojo, O. O., & Tijani, B. O. (2011). Prevalence, Profile, And Predictors Of Malnutrition In Children With Congenital Heart Defects: A Case–Control Observational Study. Archives Of Disease In Childhood, 96(4), 354–360.
[9] Varan B, Tokel K, Yilmaz G. Malnutrition And Growth Failure In Cyanotic And Acyanotic Congenital Heart Disease With And Without Pulmonary Hypertension. Arch Dis Child. 1999;81(1):49–52.
[10] De Staebel O. Malnutrition In Belgian Children With Congenital Heart Disease On Admission To Hospital. J Clin Nurs. 2000;9(5):784–91.
[11] Menon G, Poskitt E. Why Does Congenital Heart Disease Cause Failure To Thrive? Arch Dis Child. 1985;60(12):1134–9.
[12] World Health Organisation. Anthropometric Reference Data For International Use. Http://Www.Who.Int/Childgrowth/Publications/Deonis_Habicht_1996/ En/. Accessed 18 Jul 2016.
[13] Malik S, Cleves MA, Honein MA, Romitti PA, Botto LD, Yang S, Et Al. Maternal Smoking And Congenital Heart Defects. Pediatrics. 2008;121:E810-6. Https://Doi.Org/10.1542/Peds.2007-1519 Pmid:18381510
[14] WHO Multicentre Growth Reference Study Group. WHO Child Growth Standards Based On Length/Height, Weight And Age. Acta Paediatr Suppl 2006 ; 450 : 76 – 85 .
[15] Safitri W. Hubungan Penyakit Jantung Bawaan Dengan Status Gizi Anak Di Rumah Sakit Umum Pusat Haji Adam Malikmedan. Thesis. Universitas Sumatera Utara. 2018.
[16] Rahman MA, Utamayasa IKA, Hidayat T, Et Al. Anthropometric Profile Of Children With Cyanotic And Non-Cyanotic Congenital Heart Disease. Media Gizi Indonesia 2020;15(1):1-6.
[17] Agustini W, Yantie NPVK, Gunawijaya E, Et Al. Underweight, Stunted, And Wasted Among Children With Congenital Heart Disease: Acyanotic Versus Cyanotic. Open Access Maced J Med Sci 2022;10(B):610-613
[18] Isezuo, K. O., U. M. Waziri, U. M. Sani, B. I. Garba, M. M. Ahmad, A. Adamu, I. J. Hano, And M. Omar. 2017. "Nutritional Status Of Children With Congenital Heart Diseases At A University Teaching Hospital, North-Western Nigeria". International Journal Of TROPICAL DISEASE & Health 25 (4):1-8. Https://Doi.Org/10.9734/IJTDH/2017/35964.
[19] Amelia, Putri & Yosephine, Astrid & Tobing, Tina & Savira, Maya & Viandy, Vincent & Inglin, Mark. (2023). Association Between Type Of Congenital Heart Disease With Child Growth And Development Status: A Cross-Sectional Study In Medan, Indonesia. Narra J. 3. E414. 10.52225/Narra.V3i3.414.
[20] Tsega, T., Tesfaye, T., Dessie, A., & Teshome, T. (2022). Nutritional Assessment And Associated Factors In Children With Congenital Heart Disease—Ethiopia. PLOS ONE, 17(9), E0269518. Https://Doi.Org/10.1371/Journal.Pone.0269518
[21] Woldesenbet, R., Murugan, R., Mulugeta, F., & Moges, T. (2021). Nutritional Status And Associated Factors Among Children With Congenital Heart Disease In Selected Governmental Hospitals And Cardiac Center, Addis Ababa Ethiopia. BMC Pediatrics, 21, 538. Https://Doi.Org/10.1186/S12887-021-03023-1