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Original Article

Anthropometric Profile of Children with Congenital Heart Disease: Hospital-Based A Cross-Sectional Study

Jadab Kumar Jana[1*], Amartya Acharya[2], Anwesa Pyne[2]

[1]Associate Professor, Department of Paediatrics, Bankura Sammilani Medical College & Hospital, West Bengal, India
[2] Junior Resident, Department of Paediatrics, Bankura Sammilani Medical College & Hospital, West Bengal, India

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Corresponding Author:

Jadab Kumar Jana
Associate Professor, Department of Paediatrics, Bankura Sammilani Medical College & Hospital, West Bengal, India

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ABSTRACT

Introduction: In developing nations, malnutrition is a major issue for children under five. Children with congenital heart disease (CHD) would experience it with greater severity, which would raise their morbidity and mortality rates. Objective: To estimate the burden of malnutrition in children with CHD anthropometrically. Methods: After receiving ethical approval from the Institutional Ethics Committee, this hospital-based descriptive cross-sectional study was conducted in 140 children with CHD who were diagnosed for the first time after being admitted to the paediatric ward. We enrolled these children one after another till the desired sample size was achieved. Repaired CHD, CHD associated with different syndromes, and acquired heart disease were excluded. Basic demographic information, clinical characteristics, investigational details, and management data were gathered using a case record proforma. An anthropometric calculator was used to create Z-scores for each child's weight for age, length/height for age, and weight for length/height. For analysing the data, EpiInfo (3.5.1) software was used. The mean and standard deviation were used to represent continuous variables. In contrast, categorise one as a ratio and a rate. To compare the categorical variables, a chi-square test was used, and a P value <0.05 was considered statistically significant. Results Underweight, stunting, and wasting were present in 87.14%, 57.86%, and 64.29% of cases, respectively. Infants had a worse outcome than older children in terms of their nutritional health. In children with cyanotic CHD and CHD with pulmonary hypertension, malnutrition episodes were more common. The percentage of male and female children who were stunted was 66.67% and 45.76%, respectively. Conclusion: Malnutrition is more pronounced in children with CHD. Infants are more affected than older children. Length/height for age is more affected in male children than their female counterparts – a unique observation of this study.

Keywords*: Children, congenital heart disease, malnutrition, stunting, underweight, wasting*

INTRODUCTION

Congenital heart disease (CHD) is the most common disorder of the heart as well as the commonest of all congenital lesions in children (Schoen F.J.,1999). Mitchel et al.(1971), stated that CHD is "a gross structural abnormality of the heart or intrathoracic great vessels that is actually or potentially of functional significance". It possesses global health problems in terms of morbidity and mortality. According to several studies, the incidence of CHD is 8–10/1000 live births worldwide, with higher rates in preterm, stillbirth, and spontaneous abortion (Alabdulgader, 2001).

In India, CHD accounts for around 10% of infant mortality and has an incidence ranging from 0.8 to 4.2/1000 live births (Ashraf et al., 2009; Vaidyanathan et al., 2011; Phuljhele et al., 2016). It is expected that the proportion of infant deaths

from CHD will increase as infant mortality from straightforward avoidable causes declines (Kumar R.K. & Shrivastava S.,2008) Children and infants with congenital heart disease (CHD) have a range of developmental and weight-gain issues. The delay can occasionally be very moderate, but it can also occasionally lead to a failure to thrive hat has long-term physical or developmental consequences (De Staebel O. 2000).

International literature has identified several factors that may contribute to malnutrition in patients with CHD. These include chromosomal anomalies, chronic hypoxia, recurring infections, malabsorption from an oedematous gastrointestinal system, and feeding difficulties that result in inadequate nutrition. Poor somatic growth, multiple hospitalisations, an unsatisfactory outcome after intervention, and ultimately mortality are all consequences of malnourished children with CHD (Vaidyanathan et al., 2008; Murni et al.,2023). Appropriate nutritional therapy is necessary for children with CHD to reduce morbidity and mortality. Better surgical outcomes, fewer hospital stays, more somatic growth, and a decreased death rate are all associated with proper nutritional care for patients, particularly if it is started early (Torres-Salas, 2007). In the eastern part of our country, India, we have attempted to evaluate the burden of malnutrition anthropometrically because the precise prevalence of malnutrition among children with congenital heart disease is unknown due to a lack of a reporting system and a dearth of research in this field.

OBJECTIVE

The objective of this study was to estimate the burden of malnutrition in children with CHD anthropometrically.

METHODOLGY

Study area: Bankura Sammilani Medical College and Hospital (BSMCH), West Bengal, India, Department of Paediatrics. Study design: hospital-based cross-sectional study. Time frame for study: December 1, 2023, to September 30, 2024. Ethical clearance: Before beginning this study, the Institutional Ethics Committee provided ethical clearances (Memo no.: BSMC/IEC/4737, dated 23.11.2023). Study population: Children aged one month – sixty months old admitted to the paediatric department. Study subjects: Inclusion criteria: (i) Children between the ages of one and sixty months who were admitted to the paediatric ward and suspected of having CHDs were then the subject of pertinent investigations, including a first-time electrocardiography performed for confirmation. (ii) After being fully informed about the research project, the guardians of the enrolled children provided their consent. Exclusion criteria: (i) children with repaired CHD, as well as those younger than one month and older than sixty months; (ii) children with acquired cardiac conditions, such as Kawasaki disease and rheumatic heart disease; (iii) CHD associated with different syndromes; and (iv) guardians who decided not to participate in the study. Study technique: A case record proforma was used to gather information regarding the basic demographics of enrolled children, their anthropometric measurements, and other relevant details from medical records. Cases were selected consecutively from the paediatric ward till we got the required number of samples. Sample Size: 140 {Calculation of sample size: Sample size calculation was done by Cochran's formula, i.e., $n = (Z\alpha)^2 \times P \times (1\text{-}P) / d^2$, where Z is the standard variate at a 95% confidence interval, P is the event of interest—here stunting in CHD is 86% (Mondal et al., 2016) and d, i.e., 6, is the accepted precision error. Putting all data into the above formula, n = 128. Taking a 10% nonresponse rate, the final sample size becomes n = 140. Statistical analysis: An anthropometric calculator (based on WHO Growth Charts 2007 and IAP Growth Charts 2015) was used to generate weight-for-age z-scores (WAZ), length/height-for-age z-scores (L/HAZ), and weight-for-length/height z-scores (WL/HZ) for each child. Data was analysed with the help of EpiInfo software. A Chi-square (X^2) test was done to compare the categorical variables, and a P-value <0.05 was set as statistically significant.

RESULTS

A total of 140 children with CHD were enrolled in the current study. Of which, 75% (n = 105) of children were infants, excluding neonates, and the rest, 25% (n = 35), were above the age of one to five years. The male (57.86%) children outnumbered the female (42.14%) children, and the male-to-female ratio was 1.37:1. Table 1 displays the basic demography of study subjects.

Table 1: Age and gender-wise distribution of cases

Age group/gender	Male (%)	Female (%)	Total (%)
≤ 1 year	60 (42.86)	45 (32.14)	105 (75)
>1-≤5 years	21 (15)	14 (10)	35 (25)
Total (%)	81 (57.86)	59 (42.14)	140 (100)

M: F=1.37:1

Among the study subjects, 82.86% had acyanotic congenital heart disease (ACHD), and the remaining 17.14% had cyanotic congenital heart disease (CCHD), as depicted in Figure 1.

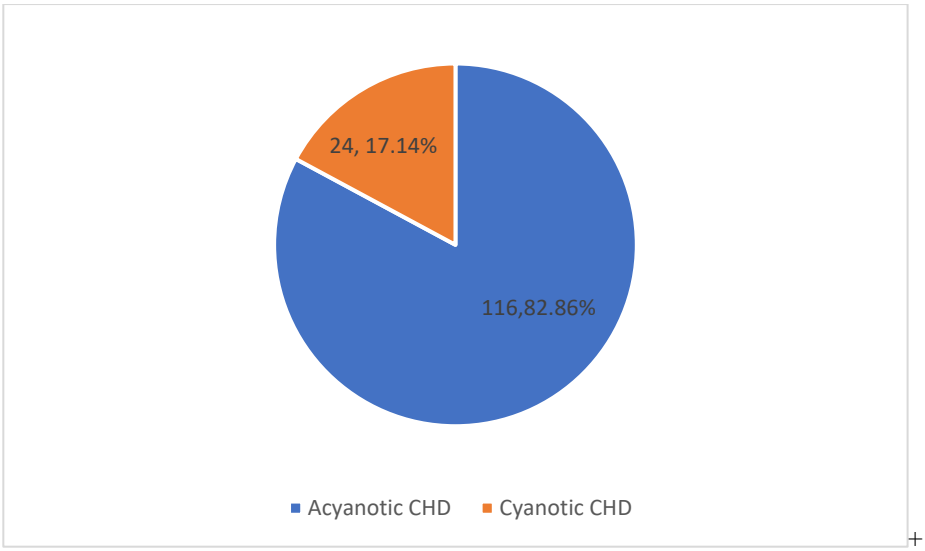

Figure 1: Proportion of ACHD and CCHD

Out of 140 study subjects, 87.14%, 57.86%, and 64.29% of them suffered from underweight, stunting, and wasting, respectively, as depicted in Figure 2.

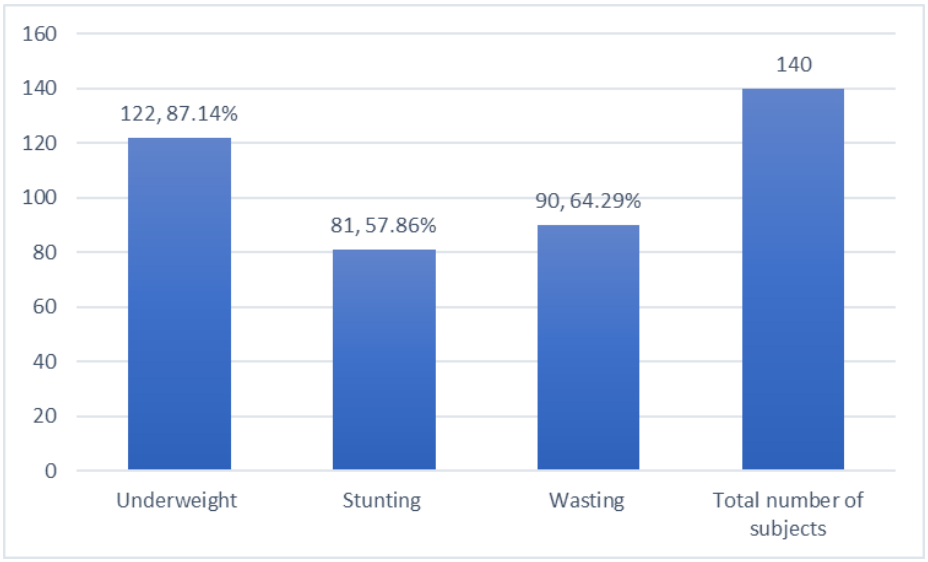

Figure 2: Nutritional status

Table 2 illustrates the age-wise nutritional status based on WAZ, L/HAZ, and WL/HZ. Weight for age and length/height for age were more affected in infants than the older children (91.43% vs 74.26% and 68.57% vs 25.74%). In both conditions, the difference in nutritional status between the two groups was statistically significant (P value <0.05). Whereas, wasting was more common in older children than infants (65.71% vs 63.81%), and it was not statistically significant (P value >0.05).

Table 2: Nutritional status based on WAZ, L/HAZ, and WL/HZ

Age	Underweight (WAZ <-2SD)		Stunted (L/HAZ<-2SD)		Wasted (WL/HZ<-2SD)	
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
1 - 12 months	96(91.43)	9(8.57)	72(68.57)	33(31.43)	67(63.81)	38(36.19)
13-60 months	26(74.26)	9(25.74)	9(25.71)	26(74.29)	23(65.71)	12(34.29)
P value	0.0087		0.0000087		0.8386	

Table 3 represents the comparison of nutritional status between male and female children based on WAZ, L/HAZ, and WL/HZ. Weight for age was more affected in both male and female children than weight for length/height. Whereas, length/height for age in female children was less affected than the male children. Out of 59 female children, 45.76% were stunted. Whereas, out of 81 male children, 66.67% were stunted. The difference in nutritional status among male and female children concerning L/H A was statistically significant, and the P value was 0.014.

Table 3: Gender wise nutritional status based on WAZ, L/HAZ, and WL/HZ

Gender	Underweight (WAZ <-2SD)		Stunted (L/HAZ<-2SD)		Wasted (WL/HZ<-2SD)	
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Male	71(87.65)	10(12.35)	54(66.67)	27(33.33)	53(65.43)	28(34.57)
Female	51(86.40)	8(13.6)	27(45.76)	32(54.24)	37(62.71)	22(37.29)
P value	0.832		0.014		0.74	

Table 4 compares the nutritional status of children with CCHD and ACHD. Of the 24 children with CCHD, 87.5%, 54.17%, and 66.67% of them suffered from underweight, stunting, and wasting, respectively. Of the 124 children with ACHD, 86.07%, 58.62%, and 63.79% of them suffered from underweight, stunting, and wasting, respectively. Children with CCHD experienced a higher incidence of underweight and wasting than children with ACHD. However, they suffered from a lower incidence of stunting than children with ACHD (54.83% vs 58.62%). The difference in nutritional status between the two groups was not statistically significant (P value >0.05).

Table 4: Comparison of nutritional status between CCHD and ACHD

Variable	Underweight (WAZ <-2SD)		Stunted (L/HAZ<-2SD)		Wasted (WL/HZ <-2SD)	
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
CCHD	21(87.5)	3 (12.5)	13(54.17)	11(45.83)	16(67.67)	8(33.33)
ACHD	101(86.07)	15(13.93)	68(58.62)	48(41.38)	74(63.79)	42(36.21)
P value	0.954		0.687		0.789	

The nutritional status of children with CHD with PH and CHD without PH is compared in Table 5. Among the 22 children with PH, underweight, stunted, and wasting comprised 95.45%, 63.63%, and 72.73% of the cases, respectively. In contrast, 85.59%, 56.78%, and 62.71% of the 122 children who did not have PH were underweight, stunted, or wasted, respectively. Even though children with PH suffered more instances of malnutrition than children without PH, there was no statistically significant difference between the two groups (P value > 0.05).

Table 5: Comparison of malnutrition between children with CHD with PH and CHD without PH

Variable	Underweight (WAZ <-2SD)		Stunted (L/HAZ<-2SD)		Wasted (WL/HZ<-2SD)	
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
CHD with PH	21(95.45)	1(4.55)	14(63.63)	8(36.37)	16(72.73)	6(27.27)
CHD without PH	101(85.59)	17(14.41)	67(56.78)	51(43.22)	74(62.71)	44(37.29)
P value	0.2		0.55		0.37	

DISCUSSION

Aiming to evaluate the nutritional status by anthropometry in 140 children with CHD, this institution-based cross-sectional study was carried out. 75% of children were infants, and the rest, 25%, were 13 months to 60 months old. The male (57.86%) child outnumbered the female (42.14%), and the male-to-female ratio was 1.37:1. Similar to the present study, Mondal S et al. (2016) reported the male (58%) preponderance in their study. In contrast to the present study, Villasis Keever et al.(2001) reported more female patients (54.5%) with the M: F ratio being 1:1.1.

In the present study, 82.86% of children had ACHD, and the rest, 17.14%, had CCHD. Similar to the present study, a study from Mumbai showed 82% of children had ACHD (Kasturi L et al., 1999). Contrary to the present, a study by Varan et al. (1999) from Turkey reported the predominance of cyanotic malformation at 65.2% (Rubia et al.,2018). The difference

between the Indian study and the Turkish study may be due to sociodemographic and environmental impacts on CHD in children.

Of the children with CHD, 87.14% were found to be underweight. Among these, severe underweight cases accounted for 56.43%. The results of this study are similar to those of Rubia et al. (2018), who reported that 83.5% of their study participants, who ranged in age from 28 days to 5 years, were underweight. In comparison to older children, infants had greater percentages of severe underweight (61.90% vs. 41.17%). On the other hand, compared to infants, older children had greater percentages of moderate underweight (34.29% vs. 29.52%). Villasis Keever et al.(2001) observed in Mexico those older children had a lower risk of malnutrition, which is consistent with the present observation. The difference between older children and the infants could be caused by the earlier presentation and more severe abnormalities in the infants. Therefore, the nutritional deficit increases with the severity of the cardiac defects.

In the present study, it was observed that 56.86% of cases were stunted. Both higher and lower percentages of stunting with reference to the present observation were reported by different authors across the globe. For instance, Rubia et al.(2018) (60.43%), Hassan BA et al.(2016)(61.9%), and Sjarif et al.(2011) (49.5%) are from India, Egypt, and Indonesia, respectively. This disparity might result from different demographic profiles. 15.08% of Indian infants were included in Rubia et al.'s (2018) study. Whereas the present study included 75% of infants. Hassan et al.(2015) conducted a study in Egyptian children aged 2 months to 72 months of age, and Siarif et al.(2011) included the Indonesian children aged 0-2 years of age.

The present study showed that 64.22% of children with CHD experienced wasting. Similar to this study, authors from Ethiopia and Iraq found wasting rates of 63% and 64%, respectively (Washeel, & Ma'ala. 2019; Assefa, &Tadele, 2020). In contrast to the present research, Vaidyanathan et al.(2008) and Tsega et al. (2022) from India and Ethiopia, respectively, showed wasting rates of 41.3% and 55.9%. Thus, the frequency of wasting varies throughout studies and can be attributed to a number of factors, including study design, study participants, sample size, socioeconomic and environmental factors, and the different study areas.

The present study showed that weight for age was more than weight for length or height in both male and female children, and underweight and wasting were present in 87.65% and 65.43% of male and 86.4% and 62.71% of female children with CHD, respectively. The length/height for age of female children was significantly less affected than that of their male children (45.76% vs. 66.67%), and this difference was statistically significant (P value = 0.014). This is a novel finding from the present study, and no previous reports of it have been found in any literature. Why did it occur? A multicentre study with a large sample size may find its answer.

In accordance with the present study, stunting was more common in children with ACHD than in children with CCHD (58.62% vs. 54.17%). However, children with CCHD had a higher prevalence of wasting than children with ACHD (66.67% vs. 63.79%). This finding is similar to a study conducted by Hassan et al.(2015), who discovered that wasting and stunting were associated with CCHD and ACHD, respectively and in contrast to the present study, Okoromah et al.(2011) reported that wasting and stunting were more common in ACHD than CCHD. It could be explained by recurrent chest infection and malabsorption associated with an oedematous gut wall due to CHF.

Of the children in this study, 15.71% (n = 22) had PH. 95.45%, 63.63%, and 72.73% of them were in underweight, stunted, or wasting conditions, respectively. Conversely, among the children (n = 118) without PH, 85.59%, 56.78%, and 62.71% were underweight, stunted, or wasted, respectively. There was no statistically significant difference between the two groups, despite children with PH experiencing more episodes of starvation than children without PH. As reported by Woldesenbet et al. (2021), compared to children with CHD not linked to PH, 53.2% of children with CHD-associated PH experienced more episodes of underweight. Variations in CHD patterns may account for the low prevalence of underweight in Woldesenbet's study. 82.86% of the participants in the present study had ACHD. However, only 37% of ACHD were included in Woldesenbet's analysis. Left-to-right shunts are comparatively more likely to have PH, which raises energy needs, reduces nutritional intake because of interrupted feeding, and produces easy fatiguability and shortness of breath, all of which can result in malnutrition.

The present study showed that the nutritional status of children with CHD seems to be grave when compared to the nutritional status of children under 5 at the national as well as state level data shown in Table 6.

Table 6: Comparison of nutritional status between the present study and NFHS 5 data of West Bengal and India

Nutritional status	Present study (%)	NFHS – 5, West Bengal (2019-20) (%)	NFHS – 5, India (2019-2021) (%)

Underweight	87.14	32.2	32.1
Stunted	57.86	33.8	35.5
Wasted	64.28	20.3	19.3

Limitations of this study

This study has the following limitations: First, the study area was a tertiary-level health care facility; neonates and children above five years old were excluded, and the children with suspected CHD who did not need inpatient care were also excluded. Henceforth, the aforementioned facts lead to selection bias and can't be generalised. Second, we didn't measure head circumference, skin fold thickness, or mid-upper arm circumference. Third, socioeconomic status was not considered here. Fourth, the nutritional status of study subjects was assessed by only anthropometric data, barring other ways of assessment, like haemoglobin and serum albumin levels.

Strengthening of this study

This study has a noteworthy finding in spite of its many limitations. Female children's length/height for their age was significantly less affected (45.76% vs. 66.67%), and this difference is statistically significant (P value = 0.014).

CONCLUSION

When compared with NFHS 5 data, the nutritional health of children with congenital heart disease was significantly impacted. According to the present study, underweight affected 87.14%, stunting affected 57.86%, and wasting affected 64.29% of children with congenital heart disease. Additionally, compared to the older children, the infants in this study were more malnourished. Children with CHD with PH and CCHD experienced higher malnutrition episodes. The study's most significant conclusion was that male children had higher rates of stunting than female children (66.67% vs. 45.76%). This study showed that children with congenital heart disease had more severe nutritional deficiencies, to varying degrees, as documented in worldwide literature. To reduce the morbidity and mortality associated with congenital heart disease, a special dietary plan should be designed for children with the condition moving forward, in addition to other appropriate treatments.

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DECLARATION

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Conflict of interest: No conflict of interest among authors
Ethical approval: The Institutional Ethics Committee approved this study, vide memo no. BSMC/IEC/4737, dated 23.11.2023.

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