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Patterns Of Malnutrition In Children With Cyanotic And Acyanotic Congenital Heart Disease.

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ABSTRACT

Background: Congenital heart disease (CHD) is a common congenital anomaly in children and is frequently associated with growth failure and malnutrition due to increased metabolic demands, feeding difficulties, recurrent infections, and chronic hypoxia.

Objectives: To assess the nutritional status of children with congenital heart disease and to compare patterns of malnutrition between cyanotic and acyanotic heart lesions.

Methods: This observational, analytical, cross-sectional study was conducted at a tertiary care hospital over a period of three years. Sixty-five children aged between one month and 18 years with echocardiographically confirmed congenital heart disease were enrolled. Anthropometric measurements including weight, height/length, and mid-upper arm circumference were obtained using standardized methods. Nutritional status was evaluated using weight-for-age, height-for-age, and weight-for-height indices based on WHO growth standards, along with IAP and Wellcome Trust classifications where appropriate. Statistical analysis was performed to compare nutritional parameters between cyanotic and acyanotic CHD groups.

Results: Among the 65 children with congenital heart disease studied, malnutrition was highly prevalent with over four-fifths of the study population exhibiting some degree of undernutrition. Children with cyanotic CHD demonstrated significantly higher rates of underweight, stunting, and wasting compared to those with acyanotic CHD. Severity of wasting was also associated with increasing age.

Conclusion: Malnutrition remains a major comorbidity in children with congenital heart disease, particularly among those with cyanotic lesions. Routine nutritional assessment and early, targeted nutritional intervention should be integrated into the comprehensive management of children with CHD to improve growth outcomes and overall prognosis.…

Keywords: *Congenital heart disease, malnutrition, nutritional status, underweight, stunting, wasting, children..*

1. INTRODUCTION

The most common significant birth defect in newborns is congenital cardiac disease, which is a deformity of the heart, aorta, or other large blood arteries. About 0.8% of live babies have congenital cardiac disease. About 30% of all infant congenital abnormalities are caused by congenital cardiac disease. With a relative frequency of 35–30%, VSD is the most prevalent congenital cardiac abnormality. [1].

Congenital heart disorders are conditions that arise from anomalies in the structure of the heart as a result of developmental aberrations at birth. Congenital cardiac disease is becoming more common, however this development is erratic. Denise and others. [2] in a meta-analysis noted an increase in world prevalence from 0.6 per 1,000 live births in 1930 to 9.1 per 1,000 live births presently. Congenital heart disease has been a serious challenge to affected families and relations. This is as a result of a complex interplay between high medical bills, cost of surgery, and heavy nutritional burden [3]. Children with congenital heart disease are more likely to die from starvation, have numerous hospital admissions, and have poor surgery outcomes [3].

A healthy diet promotes a child's overall wellbeing from infancy to maturity, accelerates academic achievement, and improves physical and mental development. Compared to older children, infants and young children are more likely to experience chronic malnutrition. [4] Malnutrition afflicts children with congenital heart disease irrespective of presence or absence of cyanosis [5]. Malnutrition in these children has been linked to hypoxia, increased basal metabolic rate from hemodynamic alterations resulting from the heart abnormalities, and inadequate intake. [6]

Children with congenital heart disease lose body mass due to malnutrition, particularly in the heart muscles. Over time, this will affect the heart's myocardial and pulmonary functions. Additionally, it impacts humoral and cellular immunity, increasing the likelihood of recurrent infection. [7]

Several studies have documented growth impairment and malnutrition among children with congenital heart disease. However, data describing the magnitude and pattern of malnutrition across different types of congenital heart disease remain limited, particularly in resource constrained settings. This study was therefore undertaken to assess the nutritional status of children with congenital heart disease using standard anthropometric indices and to compare nutritional outcomes between cyanotic and acyanotic heart lesions.

2. MATERIALS AND METHODS

The present study was an observational, analytical, cross-sectional study conducted in the Paediatric ward and Paediatric Intensive Care Unit (PICU) of MGM Hospital, Kamothe, a tertiary care centre located approximately 50 km from Mumbai. The study was carried out over a period of 3 years. Children aged from 1 month to 18 years who attended the outpatient department or were admitted to the paediatric ward and had a diagnosis of congenital heart disease confirmed by two-dimensional echocardiography, either prior to admission or during the hospital stay, were included in the study. Patients who had already undergone surgical correction for congenital heart disease were excluded.

The study variables included demographic parameters such as age and gender, along with anthropometric measurements including weight-for-age, height-for-age, and weight-for-height or weight-for-length (for children below 5 years of age). Nutritional status was assessed using standard indicators, namely underweight (based on weight-for-age), stunting (based on height-for-age), and wasting (based on weight-for-height or length). Nutritional classification was performed using the Indian Academy of Pediatrics (IAP) classification for children below 5 years of age based on weight-for-age, and the Wellcome Trust classification for children above 5 years of age.

Statistical analysis was performed using appropriate descriptive and inferential methods. Continuous variables were expressed as means with standard deviations, while categorical variables were summarized as frequencies and proportions. Comparisons between children with cyanotic and acyanotic congenital heart disease were carried out using the chi-square test for categorical variables and independent t-tests or analysis of variance (ANOVA) for continuous variables, as applicable. A p-value of less than 0.05 was considered statistically significant

3. RESULTS

Table 1: Comparison Groups with all parameters

		Groups				
		Cyanotic		Acyanotic		P value
GENDER		CASES	N % distribution	CASES	N % distribution	1.000
	Male	7	46.70%	25	50.00%	
	Female	8	53.30%	25	50.00%	
	TOTAL	15	100	50	100	

AGE	< 1year	10	66.70%	26	52%	0.592
	1 to 5year	4	26.70%	18	36.00%	
	> 5year	1	6.70%	6	12.00%	
WEIGHT FOR AGE	Normal	0	0.00%	12	24.00%	.002*
	Mild Underweight	0	0.00%	0	0.00%	
	Moderate Underweight	6	40.00%	30	60%	
	Severe Underweight	9	60.00%	8	16.00%	
	Very Severe Underweight	0	0.00%	0	0.00%	
HEIGHT FOR AGE	Normal	4	26.70%	32	64.00%	.017*
	Mild stunting	0	0.00%	0	0.00%	
	Moderate stunting	8	53.30%	16	32.00%	
	Severe stunting	3	20.00%	2	4.00%	
WEIGHT FOR HEIGHT/LENGTH	Normal	2	13.33%	18	45.00%	.002*
	Mild wasting	2	13.33%	0	0.00%	
	Moderate wasting	8	53.33%	18	45.00%	
	Severe wasting	3	20.00%	4	10.00%	
	Total	15	100%	50	100%	

Table 2: Distribution according to the age as per the Weight for Height/Length with wasting for children with CHDs-

Weight for height	< 1year		1 to 5year		> 5year		P value
	CASES	%	CASES	%	CASES	%	
No Wasting	13	36.1%	6	27.3%	1	14.3%	0.001
Mild Wasting	0	0.0%	0	0.0%	2	28.6%	
Moderate wasting	21	58.3%	11	50.0%	4	57.1%	
Severe wasting	2	5.6%	5	22.7%	0	0.0%	

Table 3: Distribution NUTRITIONAL STATUS BY WEIGHT FOR AGE < 5 YEARS (IAP CLASSIFICATION) with CHDs against cyanotic and acyanotic heart disease

IAP classification	CHDs			
		Cyanotic	Acyanotic	P value

		CASES	N % distribution	Count	N % distribution	
	Normal	0	0.00%	10	22.70%	.001*
	Grade-1 PEM	2	14.30%	23	52.30%	
	Grade-2 PEM	7	50.00%	7	16%	
	Grade-3 PEM	5	35.70%	4	9.10%	
	Grade-4 PEM	0	0.00%	0	0.00%	
Wellcome Trust Classification Weight for age >5year	Normal	0	0.00%	2	33.30%	.495
	Underweight	1	100.00%	4	66.70%	

Fig 1- Bar diagram showing distribution of malnutrition in CHDs as per MUAC for 6-59month-

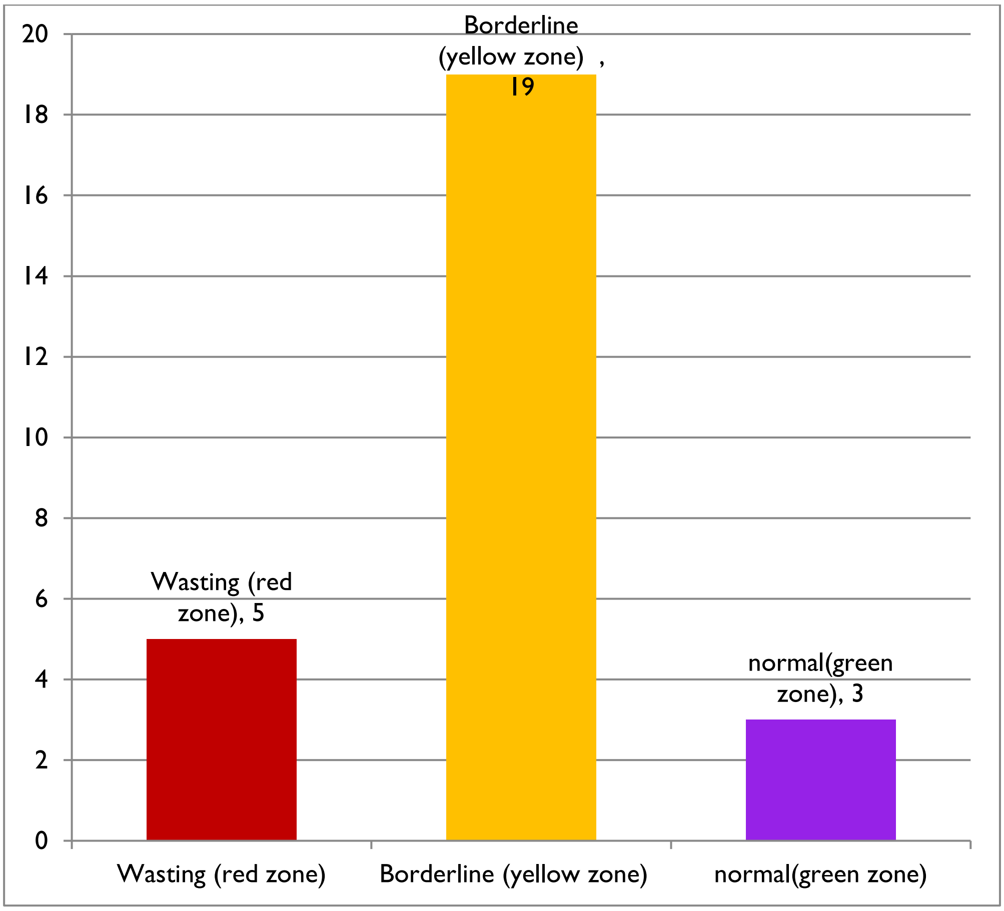
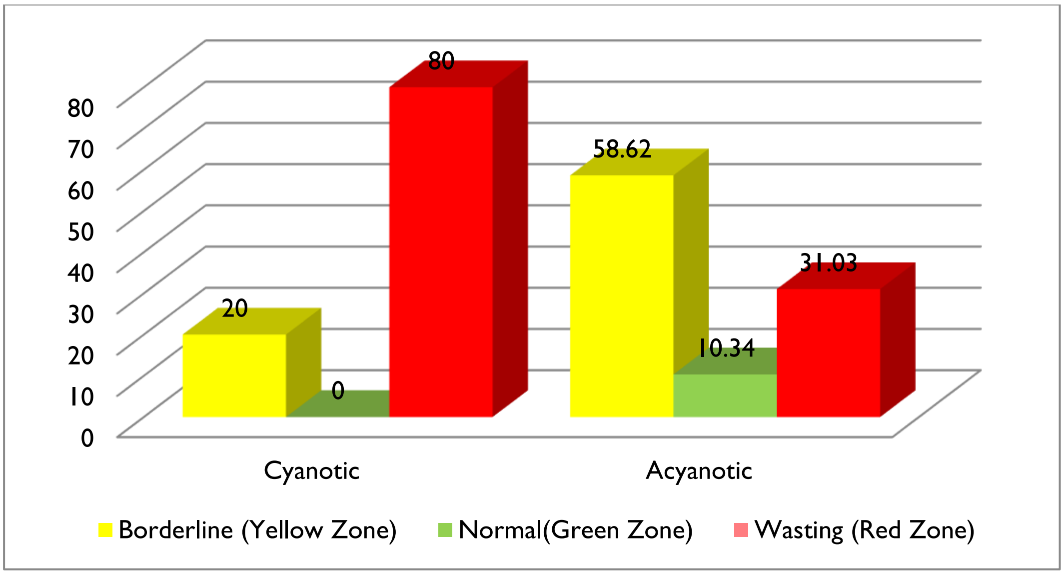


Fig 2-Bar diagram showing distribution according to MUAC (6-59 months) as per Shakir's tape in cyanotic and acyanotic CHD.



A total of 65 children with echocardiographically confirmed congenital heart disease (CHD) were included in the study, of whom 15 (23.1%) had cyanotic CHD and 50 (76.9%) had acyanotic CHD. We had VSD (47.7%) followed by TOF (20%), ASD (15.4%), PDA (7.6%), PFO (3%) and COA (3%), TGA and TAPVC (1.5%).

Table 1 summarizes the demographic characteristics of the study population. The age distribution was comparable between cyanotic and acyanotic CHD groups, with the majority of children in both groups being younger than one year of age, followed by those aged 1–5 years. Gender distribution was also similar across the two groups. No statistically significant association was observed between age or gender and type of CHD.

Nutritional status assessed using anthropometric indicators is presented in Table 1. Weight-for-age differed significantly between the two groups, with children with cyanotic CHD demonstrating a higher severity of undernutrition compared to those with acyanotic CHD ($p = 0.002$). Normal weight-for-age was observed only among children with acyanotic CHD.

Height-for-age assessment revealed a significantly higher prevalence of stunting among children with cyanotic CHD compared to those with acyanotic lesions ($p = 0.017$), as shown in Table 1. Children with acyanotic CHD more frequently demonstrated normal linear growth.

Weight-for-height/length analysis showed that wasting was common in both groups; however, children with cyanotic CHD had significantly more severe wasting compared to those with acyanotic CHD ($p = 0.002$). Normal weight-for-height/length was more commonly observed among children with acyanotic CHD (Table 1).

The age-wise distribution of wasting is detailed in Table 2. Moderate wasting was the most common pattern across all age groups. A statistically significant association was observed between age group and degree of wasting, with greater severity noted particularly in the 1–5-year age group ($p = 0.001$).

Nutritional classification based on weight-for-age for children below five years using the Indian Academy of Pediatrics (IAP) classification is presented in Table 3. Based on the Indian Academy of Pediatrics (IAP) classification, none of the children with cyanotic congenital heart disease had normal nutritional status. Children with cyanotic CHD demonstrated significantly higher grades of protein-energy malnutrition compared to those with acyanotic CHD ($p = 0.001$).

For children older than five years, nutritional status assessed using the Wellcome Trust classification is shown in Table 3. Although underweight was common in both groups, the difference between cyanotic and acyanotic CHD was not statistically significant.

Mid-upper arm circumference (MUAC) assessment for children aged 6–59 months is illustrated in Figures 1 and 2. The majority of children fell within the moderate malnutrition category, with severe malnutrition more frequently observed among children with cyanotic CHD.

4. DISCUSSION

Congenital cardiovascular defects, also known as congenital heart defects (CHD), are structural problems that arise from abnormal formation of the heart or major blood vessels present from birth or manifesting any time after birth or may not manifest at all. The overall incidence of congenital malformation in live birth is 0.8%. Severe malnutrition may occur in children with congenital heart defects due to an imbalance between energy intake and consumption. Malnutrition is a common cause of morbidity in children with congenital heart disease due to frequent hospitalization, poor surgical outcomes, and persistent impairment of somatic growth. The severity of malnutrition ranges from mild undernutrition to failure to thrive. The present study demonstrates a high burden of both acute and chronic undernutrition among children with CHD, with a consistently greater severity observed in those with cyanotic lesions. These findings emphasize the close relationship between the type of cardiac lesion and the pattern of growth impairment.

In our study half the children were <1 years of age, one third were between 1-5year of age and only 10.8% >5year of age. Similar age predominance was also noticed in other studies. A study by Begam Rubia and Anjali Kher conducted in Sawangi hospital Wardha had maximum cases in age group of 1 to 5 years similarly Mondal Swagata, Joy L P D'Souza study showed 23(46%) < 5 years followed by 19(38%) 5-10 years and 8(16%) above 10year.[8]

Children with cyanotic CHD exhibited more severe underweight, stunting, and wasting compared to those with acyanotic CHD. Chronic hypoxemia in cyanotic lesions leads to impaired appetite, inefficient energy utilization, and increased metabolic demands, resulting in sustained growth failure affecting both weight and linear growth. In contrast, acyanotic lesions, particularly those associated with left-to-right shunts, primarily affect weight due to increased caloric expenditure and feeding fatigue, while linear growth may be relatively preserved. This distinction between chronic malnutrition in cyanotic CHD and acute malnutrition in acyanotic CHD has been described in earlier studies [5,6,10,12].

The vulnerability of infants and young children observed in this study is consistent with the physiological demands of early childhood, a period characterized by rapid growth and high nutritional requirements. Even brief disruptions in energy balance during this stage can result in significant growth faltering. Similar age-related patterns of malnutrition have been reported by Begum and Kher and by Mondal and D'Souza, who documented higher prevalence of growth impairment among children below five years of age [8,13].

Stunting, indicative of long-standing nutritional deprivation, was more prominent among children with cyanotic CHD. This finding reflects the cumulative effect of chronic hypoxia, recurrent infections, and delayed access to corrective cardiac interventions. Previous studies have similarly reported a higher prevalence of stunting among children with cyanotic heart disease, underscoring the impact of prolonged disease burden on linear growth [10, 12].

Wasting was prevalent across all age groups, with moderate wasting being the most common pattern. The persistence of wasting, particularly in the 1–5-year age group, suggests ongoing nutritional stress and inadequate catch-up growth. While some studies have reported higher wasting among acyanotic CHD due to heart failure and feeding intolerance, the greater severity observed among cyanotic CHD in the present study may reflect prolonged hypoxia and delayed intervention in this population [10,12,13].

MUAC assessment further corroborated the high burden of malnutrition, especially among younger children. The greater proportion of severe malnutrition observed among children with cyanotic CHD highlights the utility of MUAC as a rapid screening tool in identifying high-risk children, particularly in resource-limited settings. Similar observations regarding the usefulness of MUAC in children with CHD have been reported previously [13].

Nutritional classification using the Indian Academy of Pediatrics and Wellcome Trust criteria revealed a substantial burden of protein-energy malnutrition, with higher grades predominating among children with cyanotic CHD. These findings are in agreement with earlier Indian studies and emphasize that children with CHD constitute a nutritionally high-risk group requiring proactive nutritional assessment and intervention [8,10,13].

Overall, the present study highlights that malnutrition in children with CHD is not solely the result of inadequate dietary intake but represents a complex interaction between disease severity, chronic hypoxia, increased metabolic demands, and delayed definitive treatment. Integrating routine nutritional screening and early nutritional intervention into standard CHD management protocols is essential to improve growth outcomes, optimize surgical readiness, and enhance long-term prognosis.

5. CONCLUSION

Malnutrition remains a prevalent and clinically significant comorbidity among children with congenital heart disease, particularly in those with cyanotic lesions. The study demonstrates that both acute and chronic forms of undernutrition are common and vary according to the type of cardiac defect. Early identification of growth failure through systematic anthropometric assessment, coupled with timely nutritional and medical interventions, is essential. Incorporating structured nutritional support into the comprehensive management of children with congenital heart disease can substantially improve growth outcomes and overall prognosis.

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