

Original Research Article**NUTRITIONAL STATUS OF CHILDREN WITH CONGENITAL HEART DISEASES SEEN AT THE USMANU DANFODIYO UNIVERSITY TEACHING HOSPITAL, SOKOTO, NORTH-WESTERN NIGERIA****Abstract**

Background: Congenital heart diseases (CHD) in children may be associated with varying degrees of undernutrition due to poor intake, impaired nutrient utilization and increased metabolic demands in the presence of heart failure and hypoxia.

Objective: To assess the nutritional status of children with CHD at the Paediatric Cardiology Unit, Department of Paediatrics, Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto.

Methodology: A cross-sectional descriptive study from November 2014 to April 2017. Children aged up to 15 years diagnosed with CHD were assessed using the WHO z-score tables for weight for age (underweight) for those below 10 years, weight for height (wasting) for those below 5 years, height for age (stunting) and body mass index for age (thinness) for all the subjects. Social class and echocardiographic diagnosis were noted. Data was analysed with SPSS version 22.

Results: Of 90 children with CHD, 79 (87.8%) were aged below 5 years, 62 (68.9%) had acyanotic CHD while 28 (31.1%) had cyanotic CHD. Male to female ratio was 1.5:1. Underweight was detected in 72.9% (62 of 85 below 10 years of age), while 60.8% (48 of 79 below 5 years of age) were wasted. Prevalence of stunting and thinness each was 57.8% in all the subjects. Those with acyanotic CHD had higher proportional prevalence of wasting ($p = 0.08$) and underweight ($p = 0.04$). Age < 1 year and female gender were associated with wasting ($p = 0.03$) while low social class was associated with stunting ($p = 0.02$).

Conclusion: Prevalence of undernutrition is high amongst children with CHD in UDUTH, Sokoto.

Key words: congenital heart disease, underweight, wasting, stunting, Sokoto

29 **Introduction**

30 Children with congenital heart diseases have been documented to have poor nutritional status.
 31 Factors responsible for this include genetic predisposition, pre-natal factors, increased metabolic
 32 demands in the presence of heart failure, poor oxygenation and reduced availability, intake and
 33 absorption of nutrients.¹⁻³ Malnutrition is a major burden amongst children in developing
 34 countries due to prevailing food shortages, ignorance and rampant preventable infectious
 35 diseases.⁴ These factors alone or in combination may worsen the nutritional status of children
 36 with chronic health problems like congenital heart diseases (CHD).⁵

37 It has been recognized that evaluation of children with CHD in different settings is essential as
 38 this helps with more insight into the underlying associated factors in particular locales and helps
 39 with the eventual management.¹ Optimal nutrition is also essential prior to cardiac surgery and it
 40 improves the outcome.⁵ Previous studies on the prevalence of under-nutrition amongst children
 41 with CHD have been undertaken in other centers which are mainly in Southern Nigeria with no
 42 study from the North for comparison. Hence, this study was carried out in Sokoto, Northwestern
 43 Nigeria to assess the nutritional status of children with CHD.

44 **Objective**

- 45 1. To determine the prevalence of underweight, wasting, stunting and thinness among
 46 children with congenital heart disease.
- 47 2. To assess the relationship of nutritional status with underlying cardiac diagnosis and
 48 social class

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52 **Materials and methods:**

53 **Study area:**

54 The study was carried out at the Paediatric Cardiology Unit of the Paediatrics Department of
55 Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto which is the main tertiary
56 health facility located in Sokoto State. The hospital receives referrals from within and outside the
57 state including Zamfara and Kebbi States; and the neighbouring Niger and Benin Republics in
58 the West African sub-region.⁶

59 Children aged 15 years and below who are in-patients with suspected CHD are referred to the
60 Paediatric Cardiology unit on a daily basis from other units in the Hospital, while out-patients are
61 seen in the Clinic and at the Echocardiography sessions which hold once weekly each on
62 separate days.

63 **Study design:** This was a cross-sectional descriptive study conducted over a 30-month period
64 (1st November 2014 to April 2017).

65 **Study subjects:** Children aged 15 years and below presenting for the first time to the unit either
66 in the clinic or at Echocardiography sessions were consecutively recruited throughout the study
67 period after obtaining informed consent from the parents plus assent for children above 7 years.
68 Exclusion criteria those who were very ill requiring admission, those with major congenital
69 malformations, those with history of prematurity, those with other problems including gastro-
70 intestinal anomalies, neurologic diseases like cerebral palsy, those who already had surgery or
71 palliative procedures and those without definitive diagnosis at echocardiography.

72 **Data collection**

73 Their demographic characteristics including age, gender, social status of the parents were entered
74 into a structured interviewer administered questionnaire. Other data including cardiac diagnosis

at echocardiography, weight, height, length, body mass index and nutritional status were documented.

Patient assessment procedures

Clinical assessment

The patients had general examination after relevant history taking. Clinical pallor and cyanosis were assessed. Temperature, pulse and respiratory rate were taken. Pulse oximetry (SpO₂) was measured with a Beurer GmbH pulse oximeter (Z24/002436). Precordial auscultation was with a Littmann^R Classic IIITM Stethoscope.

Nutritional assessment

The weight of infants, children less than 2 years and those > 2 years but unable to stand was taken with a Wunder beam balance table top weighing scale which measures to the nearest 0.01kg to a maximum of 13 kg, while for those above 2 years who could stand, it was taken with the Wunder beam balance floor top weighing scale.

The length was measured for those below 2 years and those above that age who could not stand with an infantometer which is locally fabricated with standard specifications, while the height was measured for those above the age of 2 years with Wunder scale stadiometer.

Their nutritional status was determined using the WHO method of classification of malnutrition with the respective z-score tables.⁷

Wasting was assessed in those aged 0 to 5 years using the z-score tables for weight for length and weight for height and was classified as follows: (i) normal/ no wasting, if weight for height was > -1sd, (ii) mild, moderate and severe wasting if weight for height was < -1sd to > - 2sd, <- 2sd to > - 3sd and < -3sd respectively.

Underweight was assessed in those aged 0 to 10 years using the z score tables for weight for age. They were classified as follows: (i) not underweight, if weight for age was $> -1\text{sd}$, (ii) mildly, moderately and severely underweight if weight for age was $< -1\text{sd}$ to $> -2\text{sd}$, $< -2\text{sd}$ to $> -3\text{sd}$ and $< -3\text{sd}$ respectively.

Stunting was assessed for all the subjects (0 to 15 years) using the length for age and height for age tables. They were classified as follows: (i) not stunted, if length/height for age was $> -1\text{sd}$, (ii) mildly, moderately and severely stunted if length/height for age was $< -1\text{sd}$ to $> -2\text{sd}$, $< -2\text{sd}$ to $> -3\text{sd}$ and $< -3\text{sd}$ respectively.

Oedematous malnutrition for those who presented with bilateral oedema of the feet.

Thinness was also assessed in subjects aged 0 to 15 years with the z-score tables for body mass index for age. They were classified as follows: (i) not thin, if the body mass index for age was $> -2\text{sd}$ and (ii) thin and very thin, if the body mass index for age was $< -2\text{sd}$ to $> -3\text{sd}$, and $< -3\text{sd}$.

Percentiles of weight, height and BMI for each subject according to age and gender was documented using the WHO centile charts for weight, height and BMI.

Echocardiography

Echocardiography was done after chest- X-ray and electrocardiogram were done and reviewed. Cardiac diagnosis was made using two-dimensional and Doppler transthoracic echocardiography (TTE). Patients were examined in the supine and left lateral positions. The few who were not cooperative were sedated lightly using intravenous or rectal diazepam at a dose of 0.05 to 0.1 mg/kg. The heart was examined through the standard parasternal, apical, subcostal, and suprasternal views using the Hewlett Packard Sonos 5500 echocardiography machine (Bloomfield CT 06002, USA) and a 8MHz transducer.

120 **Social class**

121 This was classified according to Oyedeji's method.⁸

122 **Data analysis**

123 All relevant data were entered into and analyzed using SPSS statistical software version 22.
124 Quantitative data were expressed as means and standard deviation while categorical variables
125 were expressed as proportions. Chi-square or Fisher's Exact test where necessary, was used to
126 test for statistical significance. A p-value of <0.05 was considered statistically significant.

127 **Ethical considerations**

128 Ethical approval for the study was obtained from the Ethics Committee of Usmanu Danfodiyo
129 University Teaching Hospital Sokoto. Informed consent from the parents plus assent for children
130 above 7 years was obtained. The data was treated with confidentiality.

131 **Results**

132 ***Sociodemographic characteristics***

133 Ninety cases of structural heart diseases were seen during the study period. Sixty-two (68.9%)
134 had acyanotic congenital heart disease (ACHD) while 28 (31.1%) had cyanotic congenital heart
135 disease (CCHD). Males predominated with ratio of 1.5:1. Majority were aged below 5 years and
136 were of lower social class. The age, gender and social class distribution of those with CHD are
137 shown in Table I below.

138 **Table I: Socio-demographic characteristics of children with congenital heart disease**

139 Variable	ACHD 140 (n = 62)	CCHD (n = 28)	All CHD (n = 90)
141			
142 M : F Ratio	1.5 : 1	1.5 : 1	1.5 : 1
143 Mean age (SD) yrs	1.9 (2.6)	3.5 (3.0)	2.4 (2.84)
144 Age range	1 month – 11yrs	18 month – 12yrs	1 month – 12 yrs
145			
146 Age distribution (%)			

147	< 1 year	31 (50.0)	5 (17.9)	36 (40.0)
148	1.1 – 5.0 years	26 (41.9)	17 (60.7)	43 (47.8)
149	5.1 – 10.0 years	2 (3.2)	4 (14.3)	6 (6.7)
150	10.1 – 15.0 years	3 (4.8)	2 (7.1)	5 (5.6)
151				
152	Social class			
153	Upper	7 (11.3)	4 (14.3)	11 (12.2)
154	Middle	9 (14.5)	7 (25.0)	16 (17.8)
155	Lower	46 (74.2)	17 (60.7)	63 (70.0)

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158 ***Distribution of cardiac lesions in those with CHD***

159 Ventricular septal defect was the commonest acyanotic lesion while Tetralogy of Fallot was the

160 commonest cyanotic CHD. The distribution of the cardiac diagnosis is detailed in Table II below.

161 **Table II: Showing the distribution of cardiac diagnosis in children with congenital heart**

162 **disease (n = 90)**

163	Type of Cardiac Lesion	Frequency	%tage
164	Acyanotic CHD		
165	Ventricular septal defect	38	42.2
166	VSD + ASD	7	7.8
167	Atrioventricular canal	6	6.7
168	Atrial septal defect (ASD)	5	5.6
169	Patent ductus arteriosus	5	5.6
170	Dextrocardia + VSD	1	1.1
171	Cyanotic CHD		
172	Tetralogy of Fallot	14	15.6
173	Double outlet right ventricle	6	6.7
174	Transposition of the Great Arteries	3	3.3
175	Tricuspid atresia	2	2.2
176	Common atrium	2	2.2
177	Total anomalous pulmonary venous connection	1	1.1

178

Weight and height percentiles of children with CHD

Of the 90 children with CHD, 65 (72.2%) had weight below the 5th percentile while (23.3%) had height below the 5th percentile. There was no significant difference in the proportional prevalence of those with low weight and height percentiles with respect to the type of CHD. However, females were noted to have a higher proportional prevalence of those below the 5th percentile for height (p = 0.01).

Prevalence of underweight, wasting, stunting and thinness among children with CHD

The total prevalence of wasting in under-fives was 60.7% and severe wasting (<-3sd) was higher amongst infants (p =0.1) as shown in Table III. The prevalence of underweight was also significantly higher in infants (p =0.03) as seen in Table IV, as well as stunting (p = 0.03). Although, moderate stunting was more in those aged 1 to 5 years. In Table V, the prevalence of thinness is shown which was high among all the age groups (p = 0.1)

Table III: Showing prevalence of wasting amongst the children with CHD aged 0 to 5 years (n = 79)

Variable	0-1yr	1.1-5 yrs	Total
Weight for height			
>-1sd	3 (8.3)	6 (14.0)	9 (11.4)
<-1sd - >- 2sd	6 (16.7)	16 (37.2)	31 (39.2)
< - 2sd - > - 3sd	10 (27.8)	10 (23.3)	20 (25.3)*
< - 3sd	17 (47.2)	11 (25.6)	28 (35.4)*
	36 (45.6)	43 (54.4)	79 (100)

$\chi^2 = 6.3$, $df = 3$, $p = 0.1$, * = prevalence of wasting = 60.7%

Table IV: Showing weight for age (underweight) amongst the children with CHD aged 0 to 10 years (n = 85)

Variable	0-1yr	1.1-5 yrs	5.1-10.0 yrs	Total
Weight for age				
>-1sd	1 (2.8)	4 (9.3)	2 (33.3)	7 (8.2)
<-1sd - >- 2sd	4 (11.1)	12 (27.9)	0 (0.0)	16 (18.8)
< - 2sd - > - 3sd	9 (25.0)	18 (41.9)	2 (33.3)	29 (34.1)*
< - 3sd	22 (61.1)	9 (20.9)	2 (33.3)	33 (38.8)*
	36 (42.4)	43 (50.6)	6 (7.1)	85 (100)

$X^2 = 19.9$, $df = 6$, $p = 0.03$, * = prevalence of underweight = 72.9%

Table V: Showing the prevalence of stunting amongst the children with CHD aged 0 to 15 years (n = 90)

Variable	0-1yr	1.1-5 yrs	5.1-10yrs	10.1- 15yrs	Total
Height for age					
>-1sd	4 (11.1)	5 (11.6)	4 (66.7)	1 (20.0)	14 (15.6)
<-1sd - >- 2sd	10 (27.8)	9 (20.9)	1 (16.7)	4 (80.0)	24 (26.7)
< - 2sd - > - 3sd	13 (36.1)	22 (51.2)	0 (0.0)	0 (0.0)	35 (38.9)*
< - 3sd	9 (25.0)	7 (16.3)	1 (16.7)	1 (0.0)	17 (18.9)*
	36 (40.0)	43 (47.8)	6 (6.7)	5 (5.6)	90 (100)

$X^2 = 24.9$, $df = 9$, $p = 0.03$, * = prevalence of stunting = 57.8%

Table VI: Showing the prevalence of thinness amongst the children with CHD aged 0 to 15 years (n = 90)

Variable	0-1yr	1.1-5 yrs	5.1-10yrs	10.1- 15yrs	Total
BMI for age					
>-1sd	2 (8.3)	10 (22.7)	0 (0.0)	0 (0.0)	12 (13.3)
<-1sd - >- 2sd	6 (25.0)	14 (31.8)	0 (0.0)	4 (40.0)	24 (26.7)
< - 2sd - > - 3sd	0 (0.0)	12 (27.3)	4 (33.3)	2 (20.0)	18 (19.2)*

235	< - 3sd	16 (66.7)	8 (18.2)	8 (66.7)	4 (40.0)	36 (38.6)*
236		24 (26.7)	44 (48.9)	12 (13.3)	10 (11.1)	90 (100)

237 $X^2 = 14.6, df = 9, p = 0.1, * = \text{prevalence of thinness} = 57.8\%$

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239

240 ***Prevalence of different types of under-nutrition in CHD***

241 In Table VII, it is seen that the proportional prevalence of underweight, wasting, stunting was
 242 higher in those with ACHD than those with CCHD but this was only significant for underweight
 243 ($p = 0.04$).

244 **Table VII: Prevalence of different types of under-nutrition in CHD**

245	Type of Undernutrition	ACHD	CCHD	Total	p
246		n(%)	n(%)	n(%)	
247	Underweight (WAZ< 2sd)	47 (79.7)	15 (57.7)	62 (72.9)	0.04
248	Wasting (WHZ<2sd)	38 (66.7)	10 (45.5)	48 (60.8)	0.07
249	Stunting (HAZ<2sd)	37 (59.7)	15 (53.6)	52 (57.8)	0.4
250	Thinness (BMI<2sd)	30 (55.6)	22 (61.1)	52 (57.8)	0.5

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252

253 ***Nutritional status of children with CHD according to gender and social class***

254 When analyzed according to gender, it was seen that females had a higher proportional
 255 prevalence of wasting ($p = 0.03$) and thinness ($p = 0.01$) than males, while the proportional
 256 prevalence of stunting was higher amongst those of middle and lower social class ($p = 0.02$) as
 257 seen in Table VIII.

258 **Table VIII: Showing the prevalence of different forms of undernutrition in children with**
 259 **CHD according to social class**

260	Type of Undernutrition	SCI	SCII	SCIII	p
261		n(%)	n(%)	n(%)	

262	Underweight (WAZ< 2sd)	8 (80.0)	11 (78.6)	43 (70.5)	0.7
263	Wasting (WHZ<2sd)	7 (77.8)	7 (58.3)	34 (58.6)	0.5
264	Stunting (HAZ<2sd)	2 (18.2)	10 (62.5)	40 (63.5)	0.02
265	Thinness (BMI<2sd)	12 (85.7)	12 (60.0)	28 (50.0)	0.2

266 SC = Social class

267

268 Discussion

269 Growth is an important survival strategy which determines the immediate and long term
 270 potentials in children.⁹ Children with cardiac diseases and sub-optimal weight are exposed to far
 271 reaching consequences of malnutrition in addition to post-surgical complications.¹⁰ In this study,
 272 weight parameters were more affected than height. It was found that 72.2% of children with
 273 CHD had weight below the 5th percentile which is higher than 40.3% reported by Dalili¹ from
 274 Iran but similar to 65.2% reported by Varan¹¹ from Turkey. For the height percentile, 23.3% of
 275 children with CHD in this study had height below the 5th percentile which is similar to figures of
 276 22.6% from Iran but lower than 52% reported by Varan.^{1, 11} High figures reported from different
 277 studies have been adduced to the spectrum and severity of the underlying cardiac lesions and
 278 whether the area is a lower class area with high prevalence of under-nutrition in children.¹¹ In
 279 this study over 70% of the children were from lower class families and could already be
 280 malnourished irrespective of their cardiac condition.

281 The prevalence of wasting at 60.8% was higher than figures of 31.5% and 41.1% from Kampala
 282 in Uganda¹² and Lagos⁹ in Nigeria respectively amongst children aged below 5 years with CHD.
 283 Also, the prevalence of underweight and stunting in this study was 72.9% and 57.8% compared
 284 to 44.8% and 48.3% from Uganda and 20.5% and 28.8% reported by Okoromah from Lagos.^{9, 12}
 285 The higher figures from this area probably reflect the socio-economic status of the populace

compared to the other areas which are more cosmopolitan than Sokoto. Other reasons could be the severity of the underlying cardiac lesions, late presentation and recurrent illnesses which were not assessed in the study.

Those with ACHD had higher proportional prevalence of wasting than those with CCHD but there was no difference with respect to the proportional prevalence of stunting. This is opposed to findings by Hassan¹³ in Egypt who found those with CCHD had more wasting than stunting. Okoromah,⁹ Arodiwe¹⁴ in Southern Nigeria and other authors from Turkey,¹¹ Iran,¹ Iraq¹⁵ also found acyanotic children were more wasted while cyanotic children were more stunted. In the Ugandan study,¹² they found that CCHD was not related to any form of undernutrition unlike the ACHD similar to this study. Cyanotic CHD especially when associated with pulmonary hypertension is associated with stunting because chronic hypoxia reduces cellular metabolism and cell growth, while repeated chest infections demand an increased metabolism and results to wasting in acyanotic CHD.³

More studies have found that stunting is common with cyanosis, although where the converse is found, severity of the underlying acyanotic lesions, length of the illness and prevalent pattern of malnutrition in the area are reasons that have been adduced.¹³ A study on malnourished patients presenting to the same study centre by Adamu et al¹⁶ revealed that wasting was the predominant form of malnutrition similar to this study. However, none of our patients had oedematous malnutrition which is also not mentioned in other reports on children with CHD.

Acute malnutrition occurred more in infants as they were more wasted than those aged 1 to 5 years similar to results found by Venugopalon¹⁷ and da Silva¹⁸ who found that infants were more wasted than older children, probably reflecting more age related dependence on the care-givers

for their nutritional needs compared to the older ones.¹⁹ Wasting, underweight and stunting were more severe amongst infants than in older children. Salzer²⁰ also reported a higher prevalence of wasting in infants while Okoromah reported that younger age was a significant predictor of undernutrition among their patient cohort. This suggests that infants should be targeted with better nutritional intake and effective medical management before surgical intervention becomes available or accessible. Varan reported that better nutritional indices reduced the incidence of post-surgical complications and improves their outcome.

The girls in this study were more wasted than boys similar to findings from Dalili¹ in Iran, while Da Silva¹⁸ found that boys were more underweight.²¹ Gender differences in the prevalence and severity of malnutrition have been recognized. Though, the findings are inconsistent, with some areas finding males are more affected while others report females as predominating.

In conclusion, the prevalence of undernutrition is higher in the study population compared to most previous studies. Infants and those with ACHD were more affected. It is therefore recommended that there should be early screening and timely intervention for under-nutrition in children with CHD.

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