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

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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 l5 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

Introduction

Children with congenital heart diseases (CHD) have been documented to have poor nutritional status. Factors responsible for this include genetic predisposition, pre-natal factors, increased metabolic demands in the presence of heart failure, poor oxygenation and reduced availability, intake and absorption of nutrients.[1-3] Malnutrition is a major burden amongst children in developing countries due to prevailing food insecurity, poverty, large family size, ignorance and rampant preventable infectious diseases.[4] Thus, children with CHD from resource poor countries may be at higher risk of severe malnutrition by virtue of their exposure to above factors that predispose to malnutrition.[5]

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

Objective

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

Materials and methods:

Study area:

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

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

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

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

Data collection

Their demographic characteristics including age, gender, social status of the parents were entered 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

After taking relevant history, the patients had detailed general examination including clinical pallor, cyanosis, axillary temperature, pulse and respiratory rate. Pulse oximetry (SpO_2) was measured with a Beurer GmbH pulse oximeter (Z24/002436). Detailed precordial examination was done including auscultation with a Littmann^{R} Classic III^{TM} 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 > -1sd, (ii) mildly, moderately and severely underweight if weight for age was < -1sd to >- 2sd, <- 2sd to > - 3sd and < -3sd 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 > -1sd, (ii) mildly, moderately and severely stunted if length/height for age was < -1sd to >- 2sd, <- 2sd to > - 3sd and < -3sd 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 > -2sd and (ii) thin and very thin, if the body mass index for age was <-2sd to > -3sd, and < - 3sd.

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 oral administration of chloral hydrate at a dose of 50mg/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.

Social class

This was classified according to Oyedeji's method.[8]

Data analysis

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

Ethical considerations

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

Results

Sociodemographic characteristics

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

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

Variable	ACHD (n = 62)	CCHD (n = 28)	All CHD (n = 90)
M : F Ratio	1.5 : 1	1.5 : 1	1.5 : 1
Mean age (SD) yrs	1.9 (2.6)	3.5 (3.0)	2.4 (2.84)
Age range	1 month – 11yrs	18 month – 12yrs	1 month – 12 yrs
Age distribution (%)			
< 1 year	31 (50.0)	5 (17.9)	36 (40.0)
1.1 – 5.0 years	26 (41.9)	17 (60.7)	43 (47.8)
5.1 – 10.0 years	2 (3.2)	4 (14.3)	6 (6.7)
10.1 – 15.0 years	3 (4.8)	2 (7.1)	5 (5.6)
Social class			
Upper	7 (11.3)	4 (14.3)	11 (12.2)
Middle	9 (14.5)	7 (25.0)	16 (17.8)
Lower	46 (74.2)	17 (60.7)	63 (70.0)

Distribution of cardiac lesions in those with CHD

Ventricular septal defect was the commonest acyanotic lesion while Tetralogy of Fallot was the commonest cyanotic CHD. The distribution of the cardiac diagnosis is detailed in Table II below.

Table II: Showing the distribution of cardiac diagnosis in children with congenital heart disease (n = 90)

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

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)**

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

X^2 = 14.6, df = 9, p = 0.1, * = prevalence of thinness = 57.8%

Prevalence of different types of under-nutrition in CHD

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

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

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

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

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

Table VII: Showing the prevalence of different forms of undernutrition in children with CHD according to social class

Type of Undernutrition	SCI n(%)	SCII n(%)	SCIII n(%)	p
Underweight (WAZ< 2sd)	8 (80.0)	11 (78.6)	43 (70.5)	0.7
Wasting (WHZ<2sd)	7 (77.8)	7 (58.3)	34 (58.6)	0.5
Stunting (HAZ<2sd)	2 (18.2)	10 (62.5)	40 (63.5)	0.02
Thinness (BMI<2sd)	12 (85.7)	12 (60.0)	28 (50.0)	0.2

SC = Social class

Discussion

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

The prevalence of wasting at 60.8% was higher than figures of 31.5% and 41.1% from Kampala in Uganda[12] and Lagos[9] in Nigeria respectively amongst children aged below 5 years with CHD. Also, the prevalence of underweight and stunting in this study was 72.9% and 57.8% compared to 44.8% and 48.3% from Uganda and 20.5% and 28.8% reported by Okoromah from Lagos.[9, 12] 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 Hassan[13] in Egypt who found those with CCHD had more wasting than stunting. Okoromah,[9] Arodiwe[14] in Southern Nigeria and other authors including Varan[11] in Turkey, Dalili[1] in Iran, Rabab[15] in Iraq also found the acyanotic children were more wasted while the cyanotic children were more stunted. In the Ugandan study, they also 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 cause more of 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 al[16] 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.

Acute malnutrition occurred more in infants as they were more wasted than those aged 1 to 5 years similar to results found by Venugopalon[17] and da Silva[18] 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 in this study. Salzer[20] 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. 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 Dalili[1] in Iran, while Da Silva[18] found that boys were more underweight.[21]

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