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Original Research Article

Anthropometric assessment in children with congenital heart disease

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ABSTRACT

Background: Congenital Heart Diseases (CHD) are often associated with malnutrition with prevalence of 64%. Malnutrition in CHD increases morbidity and mortality in these children and hence it is essential to assess the nutritional status of the children with CHD so that proper nutritional therapy and rehabilitation can be done.
Methods: In this case control study 126 cases of un operated CHD in the age group of >28 days to 10 years and 126 age and gender matched controls without CHD were studied during a period of 2 year. Informed consent from the parents was obtained and they were interviewed using pre-validated proforma and relevant clinical examination, detailed anthropometric assessment was done of all cases and control.
Results: Male to female ratio was 0.9:1. Maximum cases were in age group of 1 to 5 years. Acyanotic CHD was seen in 80.16% and cyanotic CHD was seen in 19.84%. Stunting was seen in 58.72% cases and in 41.26% of controls. 82.53% of cases and 24.6% of controls were underweight.
Conclusions: The prevalence of acyanotic CHD was more common than cyanotic CHD. In acyanotic CHD cases VSD was commonest and in cyanotic CHD cases TOF was the commonest lesion. The overall prevalence of underweight and stunting was high in cases than controls. In acyanotic CHD underweight and stunting was high than cyanotic CHD. In this study malnutrition correlated significantly with congestive heart failure, low hemoglobin level, poor dietary history and pulmonary hypertension and this was statistically highly significant.

Keywords: CHD, CHF, Malnutrition

INTRODUCTION

Congenital heart disease (CHD) is defined as a gross structural abnormality of the heart or intrathoracic great vessels that are present at birth and are actually or potentially of functional significance.[1] CHD are among the most frequent anomalies present at birth, with a reported incidence of 8/1000 live births, with high impact on neonatal morbidity and mortality (33%).[2] The prevalence of CHD in Asia was reported as 9.3 per 1,000 live births and its prevalence in Europe was significantly higher than in North America (8.2 per 1,000 live births versus 6.9 per 1,000 live births).[3] Congenital heart diseases are often associated with malnutrition. The prevalence of malnutrition in congenital heart disease patients is 64%.[4] There are several possible explanations for poor growth in children with CHD, they include: low caloric intake, type of cardiac lesion, chronic hypoxemia, malabsorption, hypermetabolism.

In developing countries, due to resource limitations, corrective interventions for CHD are performed late, leading to a vicious cycle of congestive heart failure (CHF) and respiratory infections.[5,6] This results in a high prevalence of pre-operative malnutrition in patients with CHD.[7] In view of this risk of increased morbidity and mortality due to malnutrition in children with CHD it is essential to assess the nutritional status of the children

with CHD so that proper nutritional therapy and rehabilitation can be done.

METHODS

This study was a cases control study conducted in the Department of Pediatrics at AVBRH, Sawangi (Meghe), Wardha for a duration of 2 years with sample size of 126 cases with un-operated CHD diagnosed by 2 D Echo and 126 age and gender matched controls in the age group of more than 28 days to 10 years.

After taking informed consent from parents of the study subjects and controls they were interviewed using prevalidated proforma and relevant clinical examination and treatment was noted. All cases and controls underwent a detailed anthropometric evaluation at admission including weight, height, head circumference, mid arm circumference and body mass index. Anthropometric parameters were plotted on the WHO growth charts for children between the age group >28 days to 10 years and they were labelled as wasted, stunted and underweight.

The data was entered, validated and analyzed using SPSS 20.0 Version software. The numerical data was represented as mean±SD. Comparisons was made between the two main study groups (controls and cases) using Chi sqare test. A p value of <0.05 was considered to be statistically significant and p value of <0.001 as highly significant.

RESULTS

In this study the data of 126 cases with CHD and 126 controls without CHD was analyzed and following are the observations and results.

Table 1: Age and gender distribution of cases (n=126).

Gender	Age groups (in years) n (%)			
	< 1	1-5	6- 10	Total
Males	11 (8.73%)	32 (25.40%)	16 (12.70%)	59 (46.83%)
Females	8 (6.35%)	40 (31.75%)	19 (15.08%)	67 (53.17%)
Total	19 (15.08%)	72 (57.15%)	35 (27.78 %)	126 (100%)

Maximum number of cases 72 (57.14%) were in age group of 1 to 5 years, followed by 35 (27.78%) cases in age group of 6 to 10 years and least number of cases 19 (15.08%) were in age group of >28 days to 1 year.

The overall male to female M:F ratio in cases, over all three age groups (n=126) was 0.9:1. In age group >28 days to 1 year M:F ratio was 1.4:1 whereas it was 0.8 in age groups of 1 to 5 years and 6 to 10 years (Table 1).

In this study out of 126 cases with CHD the prevalence of acyanotic CHD (80.16%) was more common than cyanotic CHD (19.84%) of all 126 CHD cases. In acyanotic CHD cases VSD (39.60%) was commonest followed by ASD (27.72%) and PDA (25.74%).

In cyanotic CHD cases TOF was the commonest lesion seen in 56% followed by PS (16%) and TAPVC (12%) (Table 2).

Table 2: Types of lesions and diagnosis in cases of CHD (n=126).

Type of Lesion	No. of cases	Percentage distribution
Acyanotic CHD	101	80.16
Ventricular septal defects (VSD)	40	39.60
Atrial septal defect (ASD)	28	27.72
Patent ductus arteriosus (PDA)	26	25.74
ASD + VSD	2	1.98
Severe MR with TR	2	1.98
AV canal defect	2	1.98
Coarctation of aorta (COA)	1	0.99
Cyanotic CHD	**25**	**19.84**
Tetralogy of fallot (TOF)	14	56
Pulmonary stenosis	4	16
TAPVC	3	12
Transposition of great vessels (TGA) with VSD	2	8
DORV with large VSD	1	4
Dextrocardia with cyanotic CHD	1	4

Table 3: Comparison of nutritional status in cases and control group age group of more than 28 days to 10 years on the basis of Z-score.

Variables	Cases (n=126) (%)	Control (n=126) (%)	p value
WFA Z – score (Underweight)			
Adequate (normal + mild)	22 (17.46)	95 (75.39)	68.16 P = 0.0001, Significant
Moderate underweight (<-2 Z - score)	29 (23.01)	11 (8.73)	
Severe underweight (<-3 Z- score)	75 (59.52)	20 (15.87)	
HFA Z - score (Stunting)			
Adequate (normal + mild)	52 (41.26)	74 (58.73)	7.35 P = 0.025, Significant
Moderate stunting (<-2 Z- score)	24 (19.04)	22 (17.46)	
Severe stunting (<-3 Z- score)	50 (39.68)	30 (23.80)	

The overall prevalence of underweight was high in cases 104 (82.53%) than controls 31 (24.6%) and this was highly significant statistically (p = 0.0001, S).

The overall prevalence of stunting was high in cases 74 (58.72%) than controls 52 (41.26%) and was statistically significant (p = 0.025, S) (Table 3).

Underweight and wasting was statistically significant and higher in cases with CHD than controls (p = 0.0001, S) whereas Stunting was not much higher in cases as compared to controls and this was not statistically significant (p = 0.51, NS) in the age group more than 28 days to 5 years (Table 4).

Table 4: Comparison of nutritional status of cases and controls in the age group of more than 28 days to 5 years on basis of WHO Z score (n=91).

Parameters	-1 to +1 Z - score (Normal)		-1 to -2 Z -score (Mild)		-2 to -3 Z - score (Moderate)		< -3 Z - score (Severe)		p value
	Cases n (%)	Control n (%)	Cases n (%)	Control n (%)	Cases n (%)	Control n (%)	Cases n (%)	Control n (%)	
W/A (underweight)	12 (13.18)	54 (59.43)	3 (3.29)	14 (15.38)	21 (23.07)	7 (7.69)	55 (60.43)	16 (17.58)	67.2 p = 0.0001, S
H/A (stunting)	26 (28.57)	30 (32.96)	10 (10.98)	14 (15.38)	18 (19.78)	19 (20.87)	37 (40.65)	28 (30.76)	2.28 p = 0.51, NS
W/H (wasting)	12 (13.18)	60 (65.93)	10 (10.98)	11 (12.08)	15 (16.48)	5 (5.49)	54 (59.34)	15 (16.48)	66.02 p = 0.0001, S

Underweight and stunting was higher in cases with CHD than controls in the age group more than 6 years to10 years and which was statistically significant (p = 0.0001, S) (Table 5). In the children more than 5 years to 10 years percentage of thinness was same in both cases and control groups whereas severe thinness was significantly higher in cases 05 (14.28%) than controls 01 (2.85%) (p = 0.0053, S) (Table 6).

Table 5: Comparison of nutritional status of cases and controls in the age group of more than 5 years to 10 years on basis of WHO Z score (n=35).

Parameters	-1 to +1 Z - score (Normal)		-1 to -2 Z - score (Mild)		-2 to -3 Z -score (Moderate)		< -3 Z - score (Severe)		P value
	Cases n (%)	Control n (%)	Cases n (%)	Control n (%)	Cases n (%)	Control n (%)	Cases n (%)	Control n (%)	
W/A (Under-weight)	1 (2.85)	22 (62.85)	6 (17.14)	5 (14.28)	8 (22.85)	4 (11.42)	20 (57.14)	4 (11.42)	90.19 p = 0.0001, S
H/A (Stunting)	4 (11.42)	26 (74.28)	12 (34.28)	4 (11.42)	6 (17.14)	3 (8.57)	13 (37.14)	2 (5.71)	83.26 p = 0.0001, S

Table 6: BMI interpretation of cases and control in the age groups 5 years to 10 years on basis of Z-score.

BMI	Cases	Control	χ^2-value	p-value
Normal	24 (68.57%)	28 (80%)	4.33	0.037, S
Thinness (<-2 Z-score)	06 (17.14%)	06 (17.14%)	-	-
Severe thinness (<-3 Z-score)	05 (14.28%)	01 (2.85%)	7.77	0.0053, S
Over weight (> +1 Z-score)	0	0	-	-
Obesity (> +2 Z-score)	0	0	-	-
Total	35	35		

In acyanotic CHD underweight was 84 (83.16%) which was more than underweight in cyanotic CHD 18 (72%) and this difference was statistically significant (p = 0.009, S).

In acyanotic CHD stunting was 61 (60.39%) which was more than stunting in cyanotic CHD 12 (48%) but this difference was statistically not significant (p = 0.11, NS) (Table 7).

Table 7: Comparison of nutritional status between acyanotic and cyanotic CHD cases on the basis of Z-score.

Malnutrition	Acyanotic CHD (n=101) (%)	Cyanotic CHD (n=25) (%)	p value
WFA Z-score (Underweight)			
Adequate (normal + mild)	17 (16.83)	07 (28)	9.29 p = 0.009, S
Moderate underweight (<-2 Z - score)	22 (21.78)	02 (8)	
Severe underweight (<-3 Z - score)	62 (61.38)	16 (64)	
HFA Z-score (Stunting)			
Adequate (normal + mild)	40 (39.60)	13 (52)	4.14 p = 0.11, NS
Moderate stunting (<-2 Z- score)	18 (17.82)	04 (16)	
Severe stunting (<-3 Z- score)	43 (42.57)	08 (32)	
Total	101	25	

In cases with CHF the prevalence of underweight 42 (68.85%) and stunting 40 (65.56%) was statistically high and significant than in cases without CHF in which the prevalence of underweight was 36% and stunting was 44%. In this study malnutrition correlated significantly with low hemoglobin level, poor dietary history and pulmonary hypertension and this was statistically highly significant by OR and chi square test (p = 0.0001 S).

Table 8: Nutritional status in cases with and without CHF on the basis of Z-score.

Malnutrition	Cases with CHF (n=61) (%)	Cases without CHF (n=50) (%)	p value
WFA Z-score (underweight)			
Adequate (normal + mild)	19 (31.14)	32 (64)	24.10 p = 0.0001, S
Moderate underweight (<-2 Z-score)	12 (19.67)	08 (16)	
Severe underweight (<-3 Z-score)	30 (49.18)	10 (20)	
HFA Z-score (stunting)			
Adequate (normal + mild)	21 (34.42)	28 (56)	19.85 P = 0.0001, S
Moderate Stunting (<-2 Z-score)	08 (13.11)	11 (22)	
Severe stunting (<-3 Z-score)	32 (52.45)	11 (22)	
Total	61	50	

Table 9: Correlation of anemia, poor dietary history, pulmonary hypertension with malnutrition in cases with CHD.

Variable	Total	OR	p value
Anemia	32	3.94	50.00, p = 0.0001, S
Poor dietary history	114	13.97	128, p = 0.0001, S
Pulmonary hypertension	26	66.71	67.28, p = 0.0001, S

DISCUSSION

The study was conducted with the aim to assess the nutritional status of children with un-operated CHD in the age group above 28 days to 10 years and age and gender matched controls by anthropometric assessment.

In the present study out of total 126 cases with CHD 72 (57.15%) of cases were in age group of 1-5 years, 35 (27.78%) of cases were in age group of 6 to 10 years and 19 (15.08%) of cases were in age group of > 28 days to 1 year.

Okoromah CA et al in their study had similar distribution of cases with maximum that is 64.3% cases in 0-59 months age group and 23.1% in 60-120 months of age group which is comparable with the present study.[8]

In the study by Mondal S et al also majority of the children with CHD 23 (46%) were pre-schoolers (<5 years) which is similar to this study, followed by 19 (38%) in age group of 5-10 years and 8 (16%) above the age of 10 years.[9]

In the present study out of 126 cases with CHD male to female ratio in cases over all three age groups together (n=126) was 0.9:1. In age group >28 days to 1 year M:F ratio was 1.4:1 whereas it was 0.8:1 in age groups of 1 to 5 years and 6 to 10 years.

Similar result was seen in the study conducted by Batte A et al which included 194 cases of CHD in which majority of cases were females where in M:F ratio was 0.7:1.[10] In the age group of 1 to 5 years in their study M:F ratio was 0.8:1 and it was 0.6:1 in 6-10 years age group.

In the present study out of 126 cases with CHD, acyanotic CHD was present in 101 (80.16%) cases and cyanotic CHD was present in 25 (19.84 %) cases.

Similar results were seen in the study by Mondal S et al in which out of 50 cases with CHD, 34 (68%) had acyanotic CHD while 16 (32%) had cyanotic CHD.[9]

Similar results were also seen in the study conducted by Sjarif DR et al in which out of 95 patients with CHD, 73 (76.8%) patients had acyanotic CHD and 22 (23.2%) patients had cyanotic lesions.[11]

In the present study cases in the age group more than 28 days to 10 years the overall the prevalence of underweight was 104 (82.53%) and stunting was 74 (58.72%) in cases whereas in control underweight was 31 (24.6%) and stunting was 52 (41.26%) this difference between both the group was statistically significant (p=0.0001, S) (p=0.025, S).

Okoromah CA et al study showed that out of 73 Children with CHD aged 3-192 months wasting, stunting and underweight were present in 41.1%, 28.8% and 20.5% in cases, and 2.6%, 3.9% and 14.5% of controls and this was statistically significant.[8]

Similar results were seen in the study by Batte A et al which showed that out of 194 cases with CHD, forty five of 145 (31.5%) children aged 0-5 years were wasted, 77 of 181 (42.5%) children aged 0-10 years were underweight, 88 of 194 (45.4%) children were stunted this was statistically significant.[10]

A study by Hassan BA et al in the age group less than 6 years showed that underweight was present in 14.3%, stunting in 61.9% and wasting in 23.8% in cases with CHD and in control group underweight was present in 20% of children, stunting in 70% and wasting 10%.[12] In their study the prevalence of underweight and stunting was higher in controls than in cases which showed dissimilarity to the present study in which the prevalence of underweight, stunting and wasting was much higher in cases than controls.

In the present study out of 35 cases with CHD and 35 children in control group in the age group more than 5 years to 10 years percentage of thinness 06 (17.14%) was same in cases and control group while severe thinness was statistically 05 (14.28%) high in cases than in control group 01 (2.85%) (p= 0.0053, S).

Al-Asy HM et al study also showed similarity to the present study in which out of 60 cases with CHD BMI was significantly lower in cases than control group (p=0.001).[13]

Wishel OF et al study out of 65 cases with CHD almost half of the sample 32 (49.2%) were malnourished in relation to BMI for age.[14] In the present study out of 101 cases with acyanotic CHD, the prevalence of underweight was 83.16% which was significantly higher as compared to 25 cases with cyanotic CHD in which it was 72% (p = 0.009, S).

The prevalence of stunting was also high in cases with acyanotic CHD which was 60.39% as compared to cyanotic CHD in which it was 48% but this difference between both the groups were not statistically significant (p = 0.11, NS).

Similarly, in the study by Hassan BA et al out of 100 cases with CHD the prevalence of underweight (14.47%) and stunting (57.89%) was higher in acyanotic CHD as compared to cyanotic CHD in which underweight prevalence was 4.16% and stunting was 33.33%.[12]

In the present study malnutrition correlated significantly with heart failure, low hemoglobin level, poor dietary history and pulmonary hypertension and was statistically highly significant by OR (p=0.0001/0.0002 S).

Okoromah CA et al study showed similar results to the present study in which also malnutrition correlated significantly (p<0.001) with low haemoglobin, heart failure, low arterial oxygen saturation, poor dietary fat intake.[8]

Similar result was seen in the study by Hassan BA et al in which also malnutrition correlated significantly with low hemoglobin level, low arterial oxygen saturation, heart failure, pulmonary hypertension, and poor dietary history (p <0.05).[12]

Limitations of this study were

- Exclusion of children with palliated or corrected CHD.
- The tertiary hospital setting may have led to over-representation of more severely affected children with CHD and therefore severe malnutrition.
- The control group in the study had acute illness.
- Follow up of the cases with CHD was not done after discharge for anthropometric assessment.

CONCLUSION

In the present study congenital heart disease was more prevalent under five years age, in females and in lower socioeconomic class. Acyanotic CHD (80.16%) was more prevalent than cyanotic CHD (19.84 %).

VSD (39.60%) was commonest lesion in acyanotic CHD and TOF (56%) was commonest lesion in cyanotic CHD. The overall prevalence of underweight in the age group more than 28 days to 10 years was significantly high in cases (82.53%) than in controls (24.6%) (p = 0.0001, S). The overall prevalence of stunting in the age group more than 28 days to 10 years was significantly high in cases (58.69%) than in controls (41.26%) (p = 0.025, S).

Underweight, stunting and wasting was (83.5%), (60.43%) and (75.82%) which was higher than controls in which it was (25.27%), (51.63%) and (21.97%): (p = 0.0001, S), (p = 0.51, NS), (p = 0.0001, S) respectively in age group of more than 28 days to 5 years. Underweight and stunting was (79.99%) and (54.28 %) which was statistically highly significant than in controls in which it was (22.84%) and (14.28%) respectively in the age group more than 5 years to 10 years (p = 0.0001, S).

According to BMI Z-score in the children more than 5 years to 10 years percentage of thinness was same in both

cases and control groups whereas severe thinness was significantly higher in cases 05 (14.28%) than controls 01 (2.85%) (p = 0.0053, S).

In cases with acyanotic CHD the prevalence of underweight was 83.16% whereas in cyanotic CHD it was 72% (p = 0.009, S). In cases with acyanotic CHD the prevalence of stunting was 60.39% whereas in cyanotic CHD it was 48% (p = 0.11, NS). Malnutrition correlated significantly with heart failure, low hemoglobin level, poor dietary history and pulmonary hypertension in cases with CHD (p=0.0001S).

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