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Anthropometric Profiles of Children with Congenital Heart Disease

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Abstract

Background: Congenital heart disease (CHD) is often associated with malnutrition and failure to thrive in children. Children with congenital heart diseases are frequently undernourished irrespective of cardiac defect and presence or absence of cyanosis. The aim of the study is to assess the effect of CHD on growth and nutrition and to identify the areas of growth affected with reference to different anthropometric measurements. *Materials and Method:* A case control observational study was carried out in children aged 0-14 years old with CHD in our institute. All patients underwent an anthropometric evaluation (weight, height/length, head circumference, mid-arm circumference, triceps and subscapular skin fold thickness) and standard growth charts (NCHS and WHO) were used accordingly. *Results*: We had total of 40 patients, 27 (68%) had acyanotic congenital malformation, while 13 (32%) had cyanotic cardiac malformation. Majority, 18 (82%) out of 22 cases above 5 years with CHD were underweight. Left to right shunt children with acyanotic malformation were tended to have acute malnutrition and stunting was more severe in children with cyanotic defects, with 100% of them affected. Majority of the children (42%) were undernourished with mid arm circumference below 13.5cms. *Conclusion*: A significantly higher, that is, 82% were underweight and 86% were stunted among children with congenital heart disease. In conclusion it can be stated that children with congenital heart disease have highly statistically significant growth retardation ($P<0.001$) by student t- test.

Keywords: Congenital Heart Disease; Underweight; Stunting.

Introduction

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% [1]. CHD comprise about 30% of all congenital malformation in the new born [2]. Severe malnutrion may occur in children with congenital heart defects due to an imbalance between energy intake and consumption. Heart failure and pulmonary hypertension are the most important factors for the development of the severe malnutrition. Children with cyanotic heart disease with pulmonary hypertension are the most seriously affected requiring more aggressive nutritional therapy [3].

Cyanotic patients are affected in growth, depending upon the severity of tissue hypoxemia and degree of physiological adaptation. Weight and height are affected equally in cyanotic patients. Acyanotic lesions especially in combination with septal defect, left to right shunt will affect weight only. In short, acyanotic lesions were related to acute malnutrition whereas cyanotic lesions were related to chronic malnutrition [4]. Infants and children with CHD exhibit a range of delay in weight gain and growth.

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In some cases delay can be relatively mild, whereas in other cases, the failure to thrive can result in permanent physical or developmental impairment [5]. In caring for these children, it is important to develop a nutritional strategy and takes into account all of the factors at play, both physical and psychological. Therefore, there must be an effort between parents, physicians, nurses and other health care professionals to develop a plan that will be appropriate on an individual basis [6]. The aims of this study were to determine the anthropometric profiles and prevalence of undernutrition in children with CHD by using anthropometric measurement. Those measurements are useful in early detection of CHD and assessing the prognosis of the basic cardiac defects and their complication.

Materials and Methods

A case control observational study was carried out in children aged 0-14 years old with CHD who had consultation in our outpatient clinic. This study was conducted from August 2015 to July 2016. Children who met the inclusion criteria for age, and who had no definitive or palliative treatment given, were taken up for the study.

Inclusion Criteria

1. 0-14 years both male and female with congenital heart diseases (cyanotic & acyanotic) clinically detected and confirmed by investigations and
2. Patients who have not undergone any surgical intervention.

Exclusion Criteria

1. Major congenital malformation other than CHD.
2. Neurological disability
3. Other obvious causes of malnutrition
4. Chronic infections
5. Endocrinal causes of growth retardation
6. Known chromosomal abnormality syndromes

Diagnostic criteria of congenital heart disease

1. Clinical examination,
2. Chest X-ray
3. ECG
4. Echocardiogram to determine the type of CHD.

The following anthropometric parameters were studied:

1. Weight
2. Height /length
3. Head circumference
4. Mid-arm circumference
5. Triceps and Subscapular skinfold thickness

Anthropometric measurements were performed using same equipment throughout the study. Assessment of growth in these children by anthropometric measurements was done and compared with 50 th centile for age and sex, NCHS and WHO charts [7]. Statistical analysis was done by using software SPSS version 10.

Results

40 patients with congenital cardiac malformation were registered for this study. 16 (42%) were female and 24(58%) were males. Age wise distribution of children with acyanotic and cyanotic cardiac malformation in the subject group were divided into age groups of <5years, 5-10 years and >10 years. Majority of the children with CHDs, 18(46%) were pre-schoolers (< 5 years), followed by 15(38%) in age group of 5-10 years and 7(16%) above the age of 10 years. 27 (68%) had acyanotic congenital malformation, while 13 (32%) had cyanotic cardiac malformation. Echocardiographic diagnosis of cardiac defects revealed that Ostium Secundum Atrial Septal Defect (ASD) in 11(28%) of the children as the commonest. The second most common cardiac malformation was Patent Ductus Arteriosus (PDA) in 9(22%). Thus ASD and PDA together comprised over half 20 (50%) of cardiac defects. The third commonest cardiac malformation in the present study was Ventricular Septal Defect (VSD) in 8(18%) cases. Tetralogy of Fallot (TOF) in 7(16%) cases ranked fourth and all were male children. There were 2 (6%) cases of D-Transposition of Great Artery (DTGA). There were two cases of Double Outlet Right Ventricle (DORV) in 1(4%) and there were 1 (4%) cases of Ebstein's Anomaly and there was 1 (2%) case of Pulmonary Stenosis. Assessment of the mean observed value for weight in children with congenital cardiac malformation was 14.97 kgs significantly less than 21 kgs expected value for age and sex, NCHS standards (P=0.038) as in Table 1.

According to Indian Academy of Paediatrics (IAP)

Table 1: Comparison of observed mean weight, standard deviation, t-test and P-value.

Group	Mean weight	S.D	t-Value	P-Value
Observed value (CHD)	14.97	8.60	2.0	0.038

Table 2: Assessment of nutritional status by weight for age according to IAP classification for children less than 5 years of age.

CHD	Normal >80%	GR I PEM 71-80%	GR II PEM 61- 70%	GR III PEM 51- 60%	GR IV PEM <50%
Acyanotic - 11	-	3	3	4	1
Cyanotic - 7	0	3	3	1	0
Total-18	-	6(36%)	6(36%)	5(27%)	1(3%)

Table 3: Wellcome Trust Classification – Weight for age for children above 5 years of age.

CHD	Normal >80%	Underweight 80-60%	Marasmic <60%	Total
Acyanotic	3(14%)	15(68%)	0	18
Cyanotic	1(4%)	3(14%)	0	4
Total	4(18%)	18(82%)	0	22

Wellcome Trust Classification – Weight for age for children above 5 years.

Table 4:

Group	Observed value CHD	S.D	t-value	P-value
Mean height(cm)	99.38	107.6	10.9	0.001
Mean head circumference (cm)	44.6	3.3	-1.6	0.05
Mean MAC (cm)	12.70	1.2	-7.0	0.001
Mean triceps skinfold thickness (mm)Observed value CHD	5.5	0.61	-7.0	0.001
Mean subscapular skinfold thickness (mm)	4.51	0.53	-9.9	0.001

There was a significant mean difference between observed value and expected value (p=0.001).

[8] for children less than 5 years, only 3(17%) children with CHD had normal growth in terms of weight for age in the present study. A large majority of children (83%) with cardiac disease failed to gain weight adequately, among whom 6 (36%) had Protein energy malnutrion (PEM) grade I, 6(36%) had grade II PEM and 5(27%) had grade III PEM and 1 (3%) had grade IV PEM. Growth pattern with regard to type – acyanotic and cyanotic malformations revealed that 3(17%) had grade I malnutrition and 3(21%) had grade II 1 (3%) had grade III and 1 (3%) had grade IV malnutrition with acyanotic malformation and; 3(17%) had grade I PEM and 3(14%) had grade II PEM and 4(3%) had grade III PEM in cyanotic malformation as shown in table 2. According to Wellcome Trust classification [9], majority 18 (82%) out of 22 cases above 5 years of age with CHD were underweight (80-60%) but no one was marasmic as in Table 3.

According to Waterlow's classification of stunting [10], height for age (H/A), height was similarly affected in children with cardiac defects. There was statistically significant difference of 8.22 cms between heights of the children with CHD 99.38 cms, compared to expected 107.6 cms, NCHS standards for age and sex (P<0.001) by student t-test as in Table 4. According to Waterlow's classification [8] only 6(14%) of these children had adequate height for age and sex, a large majority 34 (86%) were stunted, among whom half 20 (50%) suffered from moderate to severe stunting and only 14 (36%) suffered from marginal stunting. Stunting was more severe in children with cyanotic defects, with 100% of them affected, 5(14%) were severely stunted while 2(6%) were moderately stunted and 3(8%) had marginal stunting. Majority of children in acyanotic had marginal to moderate stunting.

Head circumference was estimated in children with congenital cardiac malformation and mean was 44.6 cms which was not significant when compared to normal expected mean 46 cms value for age and sex according to WHO standards. There was no significant mean difference between observed head circumference and expected head circumference (P>0.05) .

Mid-arm circumference was estimated in 18 children between the age of 1 to 5 years with congenital heart disease with mean MAC value 12.68 cms and which was highly significant (p<0.001) when compared to normal expected mean 15.28 cms value for age and sex according to WHO standards. There was significant mean difference between observed mid- arm circumference and expected mid-arm circumference (P<0.001) .

The mean observed value for triceps skin fold thickness recorded in children with congenital cardiac malformation was 5.5 mm, significantly less than 8.12 mm (P<0.001) expected value for age and sex, WHO standards. The mean observed value for subscapular skin fold thickness recorded in children with congenital cardiac malformation was 4.51mm, significantly less than 6.17 mm (P<0.001) expected value for age and sex, WHO standards. There was significant mean difference between observed and expected subscapular skin fold thickness (P<0.001).

Discussion

The present study revealed that a majority, 27(68%) children had acyanotic malformation and 13 (32%) cyanotic malformation. Diagnosis of type of leading cardiac defect in the present study was ASD 11 (28%), followed by PDA 9 (22%), VSD 8 (18%) and TOF 7 (16%). While study from Mumbai reported VSD in 29% as the leading defect followed by ASD 24% and TOF 17.6% [10]. A study from Delhi reported VSD (34%) as the commonest diagnosis followed by PDA (18.6%) [10].

Age was found to be an inverse factor, the older one had less chance for malnutrition and was reported by Villasis Keever MA, et al in Mexico [13]. 100% children with cyanotic malformations were stunted, compared to those with acyanotic malformation. The study also showed significant growth retardation for children with cyanotic malformations, more for height, nearly 60% compared to 45% for weight. In contrast the study by Varan B reported that cyanotic children were more malnourished for weight for age and height for age [3]. A study by Tambic-Bukovac L [10], showed statistically significant growth retardation in 222 children with cardiac disease as compared to 50 in the control group, by values of body weight and height (p<0.001). Weight retardation was more marked than retardation in body height (p<0.001). Growth retardation was more significant in the cyanotic children than in those with acyanotic heart disease (p<0.001).

Among the children with left to right intracardiac shunt, growth retardation was found to increase proportionally with size of the shunt and was most significant in patients with large left to right shunt (QP/QS>1.80) (p>0.01) [9]. In this study only 20 (40%) had income above Rupees 1000 per person. Commonest symptoms were recurrent upper respiratory infections with breathlessness in 58% of patient followed by cyanosis in 24% of patients, cyanotic spells in 10% and congestive cardiac failure in 8%. Thus growth is affected in children with congenital heart disease, being highly statistically significant when compared to expected values, in terms of weight height, mid-arm circumference and skin fold thickness for age and sex, 50 th centile, NCHS and WHO standards (p<0.001).

Around 90% of children were malnourished, indicating that children with CHD significantly suffered from growth failure. Failure to gain weight was seen in those with acyanotic malformation while stunting was seen with cyanotic CHD. Mid-arm circumference and skinfold thickness were also reduced significantly (p<0.001) in present study. Head circumference between children with acyanotic and cyanotic defect showed no difference. Severity of the cardiac lesions and malnutrition put children with CHD at risk for increased morbidity and mortality. Hence, strategies for intervening in the monitoring of growth, a more intensive nutritional rehabilitation, and early corrective surgery should be done to optimise the outcome. Some limitations in our study should be considered. Firstly, this study was conducted in hospitalized patients and hence the results in this study are not a truerepresentative of the general population. Secondly, possible risk factors such as number of family members, mid-parental height, were not analysed in this study. Thirdly, our exclusion criteria may have caused selection bias, leading to underestimation of the true prevalence of malnutrition as some excluded cases may have had more severe malnutrition.

Conclusion

Congenital heart disease in children constitutes an organic cause for failure to thrive. The child needs increase calorie intake for increased cardiac work, sympathetic over activity, recurrent respiratory infections, and hypoxia, in addition, congestive cardiac failure causes difficulty in feeding with poor intake and malabsorption. Hence growth failure is inevitable in symptomatic children with congenital heart disease, which was noted among nearly 90% of the cases with regard to weight, height, mid-arm circumference and skin fold thickness, compared to 50 th centile of NCHS and WHO standards being highly statistically significant (P<0.001) by student t-test.

The two main groups of structural heart defects, acyanotic and cyanotic heart disease show a distinct pattern of growth failure. Children with acyanotic malformations such as ASD, VSD, PDA, PS etc.

manifested with characteristic symptoms of poor feeding, fatigue, dyspnoea, tended to gain less weight and to be leaner than those with cyanotic defects such as TOF, DORV, D-TGA, who have decreased oxygen carrying capacity which affects the growing ends of the epiphyseal plates of long bones affecting growth and hence severely stunted in height. Mid arm circumference and triceps and subscapular skin fold thickness were also affected significantly in present study. PEM and growth retardation are probably the most wide spread, health and nutritional problems in developing countries. In India, 43% under-fives are underweight and 48% stunted in comparison a significantly higher 82% underweight and 86% stunted among children with congenital heart disease. The difference of 40% contributed by cardiac defect as cause for growth failure is significant. In conclusion it can be stated that children with congenital heart disease have highly statistically significant growth retardation ($P<0.001$) by student t- test.

Children with CHD are at risk for increased morbidity and mortality. Strategies for growth monitoring, nutritional rehabilitation, and early surgery should be done in these children.

References

1. Daniel Bernstein. Congenital heart disease. Kliegman, Behrman, Bonita F.S, Joseph W, Nina.F.S (eds) Nelson Textbook of Paediatrics, 19 th edition vol II, Elsevier; 2012.p.1549.
2. Hoffman JKaplan S. The incidence of congenital heart disease. Journal of the American College of Cardiology. 2002; 39(12):1890-1900.
3. Julien I.E Hoffman, Samuel Kaplan. The Incidence of Congenital Heart Disease J Am Coll Cardio. 2002; 39(12):1890-900.
4. Varan B, Tokel K, Yilmaz G. Malnutrition and growth failure in cyanotic and acyanotic congenital heart disease with and without pulmonary hypertension. Arch Dis Chil. 1999; 81(1):49-52.
5. De Staebel O et al. Malnutrition in Belgian children with congenital heart disease on admission to hospital. J Clin Nurs. 2000; 9(5):784-91.
6. Mehrizi ADrash A. Growth disturbance in congenital heart disease. J Pediatr. 1962; 61(3):418-29.
7. Menon GPoskitt E. Why does congenital heart disease cause failure to thrive?. Arch Dis Child 1985; 60(12):1134-39.
8. Growth Charts - WHO Child Growth Standards. Cdc.gov. 2016 [cited 8 August 2016]. WHO_ charts. htm#The WHO Growth Charts
9. Achars Textbook Of Pediatrics (4Th Edn) . Google Books. 2016 [cited 8 August 2016].
10. Villasís-Keever MA e. [Frequency and risk factors associated with malnutrition in children with congenital cardiopathy].