e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2023; 15(9); 635-640

Original Research Article

Evaluation of Growth and Nutritional Status Among Children with Congenital Heart Disease: An Observational Study

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Received: 19-07-2023 / Revised: 18-08-2023 / Accepted: 20-09-2023
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Conflict of interest: Nil

Abstract:

Background: Heart defects present at birth can lead to problems in child development and nutrition as a consequence of high metabolic rate, feeding problems, and cardiovascular anomalies.

Aim: To assess growth patterns and nutritional status among children with CHD and compare nutritional impairment between cyanotic and acyanotic cases.

Methodology: The study was hospital based and cross-sectional, and it involved 150 children between 6 months and 12 years old with confirmed CHD by echocardiography. Anthropometric and growth indices, according to WHO criteria, were measured.

Results: There were 70.0% and 30.0% of acyanotic CHD and cyanotic CHD cases, respectively. The rates of underweight, stunting, and thinness/wasting in these patients were 44.7%, 36.0%, and 32.0%, respectively. There was significant.

Conclusion: Children with CHD demonstrated substantial nutritional and growth impairment, particularly those with cyanotic defects, emphasizing the need for routine growth monitoring and early nutritional intervention.

Keywords: Congenital Heart Disease; Growth Pattern; Nutritional Status; Underweight; Stunting; Wasting.

Introduction

Congenital heart disease (CHD) is among the most common congenital anomalies in children and a significant cause of morbidity and mortality in childhood globally [1]. Besides being a condition that affects the heart and the circulatory system, CHD is likely to affect growth and nutrition in children because of various reasons such as metabolic stress, poor feeding, low nutrient intake, respiratory illnesses and abnormal haemodynamic status [2]. Growth and nutritional problems in children with CHD can range from poor weight gain, stunting and malnutrition among others due to various reasons that may interact to affect growth and nutrition [3]. Also, the magnitude and type of growth problems in CHD can vary depending on the form of heart lesion, with cyanotic lesions in the heart making children more vulnerable to nutritional problems [4]. Therefore, monitoring growth and nutritional status through proper anthropometric assessment is essential to identify children that require intervention [5].

Background of the Study: Nutritional deficiency has been established as one of the clinical issues for children with congenital heart disease (CHD) [6]. The relationship between cardiovascular physiological changes, high energy requirements, inadequate calorie consumption, poor appetite, and multiple infections can adversely affect the normal growth of the child and cause malnourishment, stunted growth, and wasting [7]. Nutritional compromise could vary depending on the nature of the congenital heart defect, especially when comparing cyanotic and acyanotic congenital heart disease [8]. Malnutrition can also affect the immune system of the child, physical development, medication intolerance, and overall health outcomes, thereby emphasizing the importance of proper assessment [9]. Assessment of weight, height, mid-upper arm circumference, and Z-scores based on age can provide information on the nutritional risk of the affected children [10]. Within this context, the current study evaluated growth patterns and nutritional status among children with CHD and the effect of the clinical type of CHD on nutritional compromise.

Growth and Nutritional Status in Children with Congenital Heart Disease: Growth impairment and malnutrition in children suffering from congenital heart disease (CHD) are especially challenging due to the effect that congenital heart defects can have on the equilibrium between the intake and expenditure of energy in the body [11]. Growth

impairment can manifest in insufficient weight gain, decreased linear growth, malnutrition, stunting, or the inability to thrive. It depends on the kind and the physiological effects of the heart problem on the individual child [12]. The increased burden on the cardiopulmonary system may increase the resting energy expenditure. Additionally, such conditions as difficulty feeding, tiredness during feeding, tachypnoea, lack of appetite, and frequent respiratory tract infections can decrease the intake of calories [13]. Chronic hypoxaemia in cyanotic CHD children may have an additional negative impact on growth and nutrition due to the increased risk of nutrient deprivation [14]. Thus, regular monitoring of weight, height/length, mid-upper arm circumference, and age and gender-specific Z-scores will help identify any deviation from normal growth [15]. Timely identification of nutritional problems with proper feeding and management of the heart defect will improve the child's health and growth.

Research Objectives

The objectives of the study are:

- To assess the demographic and growth characteristics of children with congenital heart disease using standardized anthropometric parameters.
- To determine the nutritional status of children with congenital heart disease in terms of underweight, stunting, and wasting/thinness.
- To evaluate the distribution of cyanotic and acyanotic congenital heart disease among the study participants.
- To compare the prevalence of underweight, stunting, and wasting/thinness between children with cyanotic and acyanotic congenital heart disease.

Methodology

The study was conducted to assess growth patterns and nutritional status among children with congenital heart disease (CHD) using standardized clinical and anthropometric parameters.

Study Design: An observation study was carried out based in a hospital setting amongst children suffering from congenital heart disease.

Study Area: The experiment was conducted at the Department of Pediatrics, Prasad Institute of Medical Sciences & Prasad Hospital, Lucknow, Uttar Pradesh, India.

Study Duration: The study was conducted over a period of one year.

Study Participants: Study subjects were children between 6 months and 12 years old with echocardiographic diagnosis of CHD. Subjects with major congenital anomalies or chromosomal abnormalities, chronic diseases affecting growth, endocrine or metabolic disease, previous corrective heart surgery, or incomplete medical history were excluded.

Sample Size: A total of 150 children fulfilling the eligibility criteria were enrolled consecutively during the study period.

Procedure: The demographic and clinical data was collected using a standardized proforma. All subjects were examined clinically and subjected to two-dimensional echocardiography with Doppler study. They were categorized into cyanotic or acyanotic CHD patients. Body anthropometry, that is, weight, height/length and mid upper arm circumference were recorded using standard methodology. The nutritional status of children was determined using WHO growth references. Weight for age, height for age and weight for height/BMI for age were calculated.

Statistical Analysis: Analysis of data was done through IBM SPSS statistics version 26.0. Results for continuous data were reported as mean ± standard deviation while those for categorical data were reported as frequencies and percentages. Independent sample T test, Chi-Square test, Fishers Exact test, and Mann-Whitney U test were used where applicable. Statistical significance was set at p-value<0.05.

Results

There were 150 children with congenital heart disease that were assessed throughout the course of this research. Results showed the existence of significant prevalence of growth retardation and poor nutritional status among the subjects studied. Variations in nutritional status existed depending on the clinical form of the CHD, which was more severe in children with cyanotic heart disease.

Table 1: Demographic Characteristics of Study Participants (N = 150)

Characteristics	Frequency (n)	Percentage (%)
Age group		
6 months–2 years	42	28.0
>2–5 years	48	32.0
>5–8 years	34	22.7
>8–12 years	26	17.3
Sex		
Male	86	57.3
Female	64	42.7

Table 1 indicated that out of the 150 participants, the biggest percentage was that of the >2-5 year age bracket at 48 (32.0%), then came 42 (28.0%) in the 6 months-2 year age bracket. The >5-8 year age bracket had 34 (22.7%) while the >8-12 year age bracket had 26 (17.3%). There were 86 (57.3%) male participants compared to 64 (42.7%).

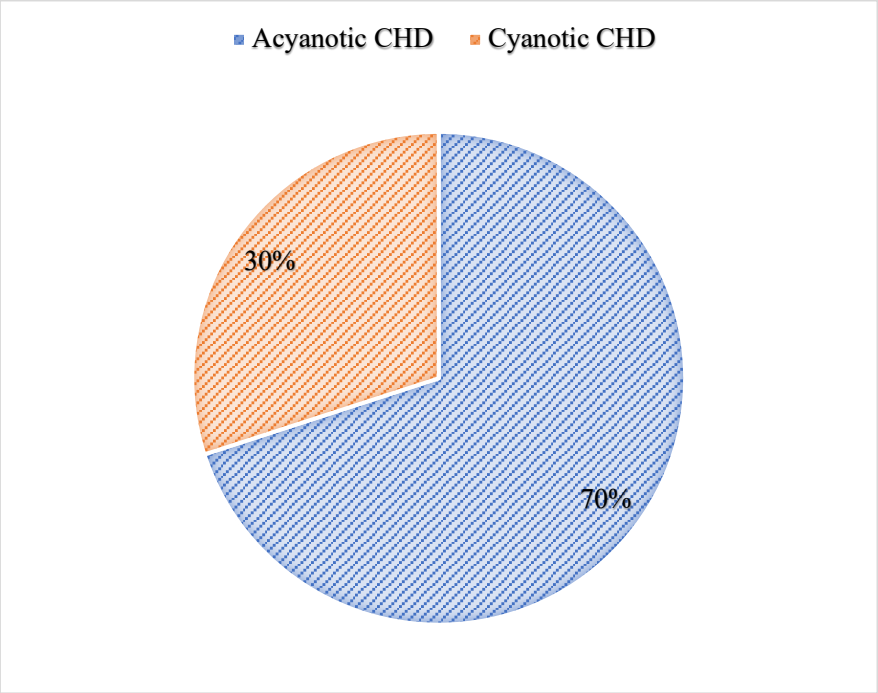

Figure 1: Distribution of Children According to Type of Congenital Heart Disease

Table 2 showed that 105 (70.0%) out of the 150 children were acyanotic CHD patients, whereas 45 (30.0%) of them were cyanotic CHD patients. Therefore, more than two-thirds of the total sample size comprised of acyanotic CHD cases. The number of acyanotic CHD children was greater than twice of the cyanotic CHD children. This implied that the prevalence of acyanotic CHD cases is higher than that of the other type.

Table 2: Anthropometric Characteristics of Study Participants

Anthropometric Parameter	Mean ± SD
Weight (kg)	16.42 ± 7.18
Height/Length (cm)	104.36 ± 25.47
Mid-upper arm circumference (cm)	14.82 ± 2.31
Weight-for-age Z-score	−1.71 ± 1.12
Height-for-age Z-score	−1.54 ± 1.18
Weight-for-height/BMI-for-age Z-score	−1.39 ± 1.09

Table 2 revealed that the mean body weight for the subjects was 16.42 ± 7.18 kg, and the mean height/length was 104.36 ± 25.47 cm. The mean mid upper arm circumference was 14.82 ± 2.31 cm. The mean weight for age, height for age and weight for height/BMI for age Z-scores were –1.71 ± 1.12, –1.54 ± 1.18, and –1.39 ± 1.09, respectively. The negative mean Z-scores indicated poor weight gain and linear growth.

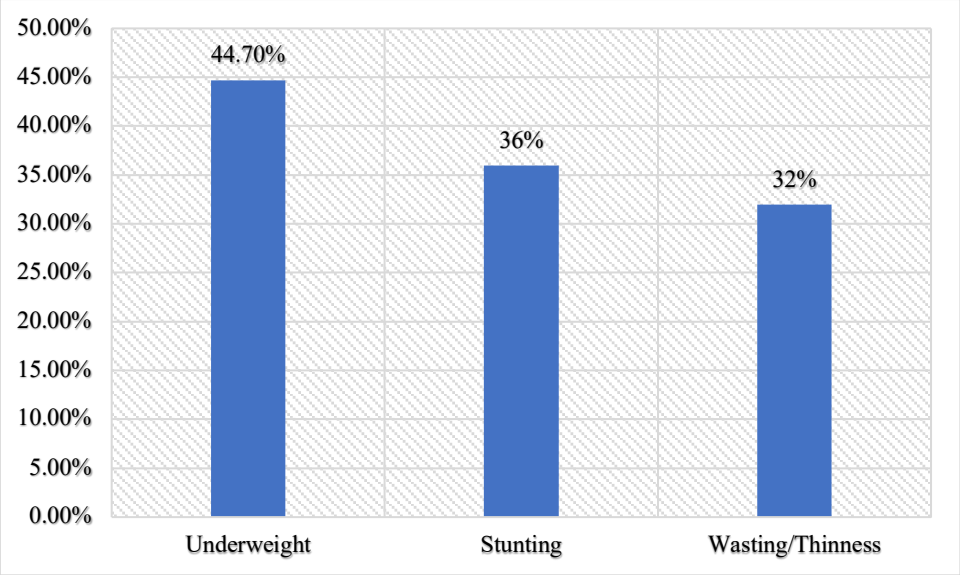

Figure 2: Nutritional Status of Children with Congenital Heart Disease

Figure 2 demonstrated substantial presence of malnutrition amongst children having CHD. Out of all the children suffering from CHD, 67 (44.7%) children were underweight, which is the most common form of nutritional anomaly. Stunting was detected in 54 (36.0%) cases and wasting/thinness in 48 (32.0%) children. Therefore, almost one-third of all the children were suffering from malnutrition.

Table 3: Nutritional Status According to Type of Congenital Heart Disease

Nutritional Indicator	Acyanotic CHD (n = 105) n (%)	Cyanotic CHD (n = 45) n (%)	p-value
Underweight	39 (37.1)	28 (62.2)	0.005*
Stunting	31 (29.5)	23 (51.1)	0.012*
Wasting/Thinness	27 (25.7)	21 (46.7)	0.011*

*Statistically significant at $p < 0.05$.

Table 5 shown that there is higher incidence of nutritional deficit in patients with cyanotic CHD. Out of 45 cases of cyanosis, 28 (62.2%) were found to be underweight whereas out of 105 cases of acyanosis, only 39 (37.1%) were found to be underweight (P = 0.005). Similar is the case for stunting where 23 (51.1%) cyanotic cases have stunted growth compared to 31 (29.5%) acyanotic cases (P = 0.012). For thinness/wasting the ratio is also the same with P value 0.011.

Discussion

The current study examined growth and nutrition of 150 children with CHD and revealed significant growth impairment. The mean weight and height/length were 16.42 ± 7.18 kg and 104.36 ± 25.47 cm, respectively, whereas the mean weight for age, height for age, and weight for height/BMI for age Z scores were -1.71 ± 1.12, -1.54 ± 1.18, and -1.39 ± 1.09, respectively. These negative Z-scores showed overall trend toward poor growth among children with CHD. Negative variation in anthropometric Z-scores was described by Monteiro et al. (2012) [16] among children with CHD despite that most values were still within normal reference range.

Also, Daymont et al. (2013) [17] demonstrated significant reduction in weight for age and length for age Z-scores among young children with CHD especially among those with CHD requiring repair. These results confirmed the present observation that CHD may negatively affect both weight gain and linear growth.

Nutritional assessment in the current study revealed underweight as the most prevalent nutritional abnormality in 67 (44.7%) patients, followed by stunting in 54 (36.0%) and wasting/thinness in 48 (32.0%). High prevalence of these abnormalties suggested that both acute and chronic types of nutritional impairment are present in children with CHD. In Okoromah et al. (2011) [18] the burden of malnutrition among children with congenital heart defects was high, with 90.4% having some form of malnutrition and 61.2% having severe malnutrition; wasting and stunting were present in 41.1% and 28.8% cases, respectively.

Nasiruzzaman et al. (2011) [19] detected significant growth impairment among children with CHD with more prevalent severe stunting than severe wasting. In addition, Blasquez et al. (2016) [20] in assessment of 125 infants with CHD revealed that malnutrition is an important clinical problem. Therefore, all these studies confirmed the present finding that nutritional

assessment should be an integral part of the clinical examination in children with congenital heart abnormalities.

The present study has also shown the clinically relevant differences depending on the type of CHD. Although the acyanotic CHD was more common [105 (70.0%)] compared with cyanotic CHD [45 (30.0%)], the nutritional impairment was significantly higher in cyanotic group. Underweight was observed in 62.2% children with cyanotic CHD compared with 37.1% in acyanotic group ($p = 0.005$). Also, stunting was found in 51.1% versus 29.5% ($p = 0.012$) and wasting/thinness was found in 46.7% versus 25.7% ($p = 0.011$). Okoromah et al. (2011) showed the same trend regarding the prevalence of malnutrition depending on CHD category though the study revealed that more frequently wasting was observed in acyanotic CHD and more frequently stunting – in cyanotic CHD.

Also, Blasquez et al. (2016) [20] have analyzed nutritional status depending on cyanosis and pulmonary hypertension which emphasized the clinical importance of cardiac characteristics during nutritional assessment. Therefore, the present results together with previous evidence show that growth impairment and malnutrition are common among children with CHD and that cyanotic defects are the subgroup with particularly nutritional vulnerability requiring regular growth monitoring and early nutritional interventions.

Conclusion

The current study found that the children suffering from congenital heart diseases were affected with significant impairment in their growth and nutritional status which was seen in form of decreased anthropometric Z-scores and high rate of malnutrition in the forms of underweight, stunting and wasting or thinness. In the 150 children analyzed, underweight was seen in 44.7%, stunting in 36.0% and wasting/thinness in 32.0% cases. While the incidence of acyanotic CHD (70.0%) was higher as compared to cyanotic CHD (30.0%), there was significant impairment in the nutritional status of children with cyanotic defects in the form of underweight in 62.2%, stunting in 51.1% and wasting/thinness in 46.7% cases.

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