

Nutritional Status in Children with Congenital Heart Disease: Prevalence and Its Associated Factors

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ABSTRACT A cross sectional study was undertaken on 58 children (age range 4 months-15 years) with congenital heart disease (CHD) and in controls of 58 subjects without CHD. The study was performed by anthropometric examination, history of acute respiratory tract infection, dietary intake, simple laboratory examination and type and severity of CHD were recorded. There were significant differences in: 1. Nutritional status between patients with CHD and without CHD ($p < 0.001$). 2. Frequency of acute respiratory tract infection between patients with CHD and without CHD ($p < 0.001$). 3. Duration of each episode of acute respiratory tract infection between patients with CHD and without CHD ($p < 0.05$). 4. Calorie and protein intakes between patients with CHD and without CHD ($p < 0.05$). Type of CHD (cyanotic and non-cyanotic) was significantly associated with nutritional status based on height for age among patients with CHD ($p < 0.01$). However, there was no significant association between the presence or absence of heart failure with nutritional status among patients with CHD. In conclusion, there were significant differences of nutritional status, frequency/duration of acute respiratory tract infection, calories and protein intake between patients with CHD and without CHD. Type of CHD (cyanotic and non-cyanotic) was significantly associated with nutritional status based on height for age. [*Paediatr Indones* 1998; 38:38-46]

Introduction

The prevalence of congenital heart disease (CHD) has been remarkably constant throughout the world over the years.¹ According to studies in Western countries the incidence of CHD is 7/1000 live births. Infants and children with CHD are generally underweight and frequently retarded in growth.²⁻⁵ CHD which frequently causes

malnutrition and growth disturbances is CHD with left to right shunt including ventricular septal defect (VSD), atrial septal defect (ASD), and patent ductus arteriosus (PDA).^{2,6,7} The severity of growth disturbance depends on the size of the shunt, the presence of congestive heart failure, and pulmonary hypertension.^{7,8} Growth retardation is more significant in cyanotic children than in those with non-cyanotic CHD.^{4,5,9}

Factors which can affect nutritional status include dietary intake, genetic, acute recurrent infection, chronic illness, long-term corticosteroid therapy and socioeconomic level.^{10,11} Malnutrition in CHD is influenced by the type and severity of CHD,⁵ dietary intake,^{5,12-15} and frequent respiratory infections.¹⁶ Anthropometry, measurement of body size and proportions, are the simplest and most quantitative measures of nutritional status^{17,18,23} and can be assessed anytime or periodically.¹⁸ The purpose of this study is to assess the nutritional status of patients with CHD and factors associated with it.

Methods

This cross sectional study was conducted in the Pediatric Cardiology Division and Pediatric Outpatient Clinic, Adam Malik Hospital, Medan, from September 1st, 1995 to February 29th, 1996. This study involved two groups of population. The first group comprised children who suffered from CHD and have not undergone operation, which have been registered in Pediatric Cardiology Division in the last two years (July 1st, 1993 to July 31st, 1995). The second group comprised children who visited Pediatric Outpatient Clinic with the same age and gender; they served as controls. The diagnosis of CHD was based on history of illness, physical examination, chest x-ray, electrocardiography and echocardiography. A letter was sent to all patients, asking them to visit the Pediatric Outpatient Clinic. Patients with cerebral palsy or hypothyroidism, those with diarrhea or vomiting, those who had been on long-term steroid treatment, and those with contact to adult tuberculosis at home were excluded from the study.

Body weight for children below 2 years of age was measured with Kubota weighing scale with the accuracy of 50 g, while for children over 2 years was measured with a minimal dress by using Seca weighing scale with the accuracy 0.5 of kg. Body length for children below 2 years of age was measured by Pedobaby scale with the accuracy of 0.1 cm; the baby was on lying position with fixed head and full extension of the leg.¹¹ For children over 2 years body height was measured by using stadiometer with the accuracy of 0.1 cm. The child stood up and the back touched the stadiometer which was fixed to the wall; the head plate formed angle of 90° from the wall.^{11,17} Hemoglobin level was determined by cyan method with the accuracy of 0.1 g/dl.

Nutritional status was defined based on the standard of WHO-NCHS^{19,20} classification as modified on "Hasil dan Rekomendasi Semiloka Anthropometri di Indonesia 1991."²¹ Dietary intake was asked in the last 24 hours. Calorie and protein intakes

were accounted based on "Komposisi Zat Gizi Pangan Indonesia",²² with house-hold measurement.²³ Recommended dietary allowances values were based on "Rekomendasi Widyakarya Nasional Pangan dan Gizi V 1993".²⁴ For acute respiratory tract infection (ARI) the frequency and duration of each episode were asked. The types of CHD were classified as cyanotic and non-cyanotic.⁹ The severity of heart defect was based on the presence of heart failure. Heart failure was diagnosed clinically when there were symptoms and signs of heart failure and/or from a medical record noted that the patients had been treated with digitalis, diuretics, or ACE inhibitors. Association between variables were analyzed with chi-square test. A p level of <0.05 was considered significant.

Results

Only 61 of the total 101 patients were available for the study. Ten patients died and the others gave no response to the letter. Three patients were excluded because of no results of echocardiography. Of the 58 patients analyzed, 44 patients were non-cyanotic CHD; e.i., VSD 30, VSD + pulmonary stenosis (PS) 1, ASD 5, ASD + pulmonary hypertension 3, ASD + VSD 1, and PDA 4 patients. The remainder 14 were cyanotic patients, i.e., tetralogy of Fallot (TF) 8, PS + VSD 2, complete AV canal 1, single atrium + VSD + double outlet left ventricle (DOLV) 1, dextrocardia + single atrium + single ventricle 1, and single atrium + VSD + PS 1 patient. The age range of the patients was 4 months to 15 years (median 3 years and 8 months), and consisted of 27 boys and 31 girls. For control group we selected 58 children without CHD with the same age and gender.

Tables 1 and 2 show that there was a significant difference of nutritional status between patients with and without CHD based on both body weight for age and body height for age ($p < 0.001$). Furthermore, Table 3 depicts that there was no significant difference of nutritional status between cyanotic and non-cyanotic CHD patients based on body weight for age. Conversely, there was a significant difference of nutritional status between patients with cyanotic CHD and non-cyanotic CHD based on body height for age ($p < 0.01$). See Table 4.

When we compared the nutritional status of patients with and without heart failure, it appeared that there was no significant difference of nutritional status between CHD with heart failure and those without heart failure based on both body weight for age and body height for age. These can be seen in Tables 5 and 6.

The frequency of acute respiratory tract infections was significantly different between patients with CHD and patients without CHD, as can be seen in Table 7. Similarly, Table 8 shows that there was a significant difference of the duration of each episode of acute respiratory tract infections between patients with CHD and those without CHD.

Table 1. Nutritional status of patients with CHD and without CHD based on body weight for age

	Nutritional status				Total
	Good n (%)	Moderate n (%)	Poor n (%)	Bad n (%)	
CHD	4 (6.9)	15 (25.9)	27 (46.6)	12 (20.7)	58 (100.0)
Non CHD	31 (53.4)	26 (44.8)	1 (1.7)	0 (0)	58 (100.0)

df=3, $\chi^2=59.92$, $p<0.001$

Table 2. Nutritional status of patients with CHD and without CHD based on body height for age

	Nutritional status				Total n
	Good n (%)	Moderate n (%)	Poor n (%)	Bad n (%)	
CHD	21 (36.2)	8 (13.8)	20 (34.5)	9 (15.5)	58
Non CHD	39 (67.2)	12 (20.7)	4 (6.9)	3 (5.2)	58

df=3, $\chi^2=19.867$, $p<0.001$

Table 3. Nutritional status of patients with cyanotic CHD and non-cyanotic CHD based on body weight for age

	Nutritional Status				Total n (%)
	Good n (%)	Moderate n (%)	Poor n (%)	Bad n (%)	
Cyanotic CHD	0 (0)	3 (21.4)	5 (35.7)	6 (42.9)	14 (100.0)
Non-cyanotic CHD	4 (9.1)	12 (27.3)	22 (0.5)	6 (13.6)	44 (100.0)

df=3, $\chi^2=6.262$, $p>0.05$

42 Nutritional status of children with congenital heart disease

Table 4. Nutritional status of patient with cyanotic CHD and non-cyanotic CHD based on body height for age

	Nutritional status				
	Good	Moderate	Poor	Bad	Total
	n (%)	n (%)	n (%)	n (%)	n (%)
Cyanotic CHD	2 (14.3)	2 (14.3)	4 (28.6)	6 (42.9)	14 (100.0)
Non-cyanotic CHD	19 (43.2)	6 (13.6)	16 (36.4)	3 (6.8)	44 (100.0)

df=3, $\chi^2=11.529$, $p<0.01$

Table 5. Nutritional status of patients with CHD accompanied with heart failure and without heart failure based on body weight for age

	Nutritional status				
	Good	Moderate	Poor	Bad	Total
	n (%)	n (%)	n (%)	n (%)	n (%)
CHD with heart failure	1 (5.3)	2 (10.5)	9 (47.4)	7 (36.8)	19 (100.0)
CHD without heart failure	3 (7.7)	13 (33.3)	18 (46.2)	5 (12.8)	39 (100.0)

df=3, $\chi^2=6.246$, $p>0.05$

Table 6. Nutritional status of patients with CHD accompanied with heart failure and without heart failure base on body height for age

	Nutritional status				
	Good	Moderate	Poor	Bad	Total
	n (%)	n (%)	n (%)	n (%)	n (%)
CHD with heart failure	7 (36.8)	3 (15.8)	6 (31.6)	3 (15.8)	19 (100.0)
CHD without heart failure	14 (35.9)	5 (12.8)	14 (35.9)	6 (15.4)	39 (100.0)

df=3, $\chi^2=0.155$, $p>0.05$

Table 7. Frequency of acute respiratory tract infection of patients with and without CHD

	Frequency of ARI		
	< 6x/year	>6x/year	Total
	n (%)	n (%)	n (%)
CHD	28 (48.3)	30 (51.7)	58 (100.0)
Non-CHD	46 (79.3)	12 (20.7)	58 (100.0)

df=1, $\chi^2=12.893$, $p<0.001$

Table 8. Duration of each episode of acute respiratory tract infection between patients with CHD and without CHD

	Duration of ARI in each episod		
	0-7 day	>7 day	Total
	n (%)	n (%)	n (%)
CHD	47 (81.8)	11 (19.0)	58 (100.0)
Non CHD	57 (98.3)	1 (1.7)	58 (100.0)

df=1, $\chi^2=9.295$, $p<0.005$

There were significantly difference calories and protein intake in the last 24 hours between patients with CHD and without CHD ($p<0.05$) Table 9 and 10.

Only 37 of 44 patients with non-cyanotic CHD could be compared with patient without CHD in the presence anemia, 7 of them refused to be performed hemoglobin examination. There were no significant difference in the presence of anemia between both group ($p>0.05$) Table 11.

Table 9. Calorie intake in the last 24 hours of patients with CHD and without CHD

	Calirie intake			
	>75%	50-75%	<50%	Total
	n (%)	n (%)	n (%)	n (%)
CHD	22 (37.9)	16 (27.6)	20 (34.5)	58 (100.0)
Non CHD	32 (55.2)	17 (29.3)	9 (15.5)	58 (100.0)

df=2, $\chi^2=6.055$, $p<0.05$

* Accounted in percent of recommended dietary allowance

Table 10. Protein intake in the last 24 hours of patient with CHD and without CHD

	Protein Intake			
	>75%	50-75%	<50%	Total
	n%	n%	n (%)	n (%)
CHD	43 (74.1)	7 (12.1)	8 (13.8)	58 (100.0)
Non CHD	53 (91.4)	3 (5.2)	2 (3.5)	58 (100.0)

df=2, $\chi^2=6.240$, $p<0.05$

* Accounted in percent of recommended dietary allowance

Table 11. Anemia in patients with non-cyanotic CHD and without CHD

	Anemia	Non anemia	Total
	n (%)	n (%)	n (%)
CHD	9 (24.3)	28(75.7)	37(100.0)
Non CHD	6(16.2)	31(83.8)	37(100.0)

df=1, $\chi^2=0.753$, $p>0.05$

Discussion

In this study 67.2% of 58 children with CHD had the nutritional status (weight for age) below the -2 SD of the percentile 50th of standard WHO-NCHS, and 20.7% were below the -3 standard deviation. Based on height for age, 50% of patients were below the -2 SD and 15.5% below the -3 SD. Weintraub found that 25-30% of patients with CHD had body weight and body height below the 3rd percentile.⁵ Unger found in 44 CHD patients with the age of 1 month to 2 years, 19 patients were underweight, 9 were borderline, and 16 patients were normal.¹⁵

Tambic on his study of 222 children with CHD consisted of 33 cyanotic CHD and 189 non-cyanotic CHD found that there was significantly different growth retardation between cyanotic and non-cyanotic CHD.⁹ This study demonstrated similar results, that the nutritional status of patients with cyanotic CHD was significantly different with that of non-cyanotic CHD, based on height for age. Growth retardation in patients with cyanotic CHD might be associated with tissue hypoxemia.⁵

Weintraub found that body weight were predominantly decreased in patients with CHD accompanied with heart failure,⁵ While Forchielli found, malnutrition in patients with CHD accompanied with heart failure was associated with increased calorie consumption due to increased respiratory rate.³ But in this study there were no

significant difference of nutritional status between patients with CHD with and without heart failure; this condition may be caused by the fact that most patients with heart failure in this study had been already treated.

Recurrent respiratory tract infections in patients with CHD increase basal metabolic rate that may cause decreased body weight.¹⁶ Acute respiratory tract infections in patients with CHD in this study were more frequent than in those subjects without CHD, and the duration in each episode was longer.

Calorie and protein intakes in the last 24 hours were found to be lower in patients with CHD than in subjects without CHD. In this study calorie and protein intakes in the last 24 hours were estimated by interview only, which might not reflect the actual daily intake. The anemia in this study was compared between patients with non-cyanotic CHD and without CHD (patient with cyanotic CHD was not included because most of them were polycythemia).

To sum up, our study indicates that there was a significant difference of nutritional status between patients with and without CHD which is related to calorie and protein intakes. The type of CHD (cyanotic and non-cyanotic) was significantly associated with nutritional status based on height for age. There was no association between the presence or absence of heart failure with nutritional status among patients with CHD. Patients with CHD experience more frequent and longer duration of acute respiratory tract infections. No difference was found on the prevalence of anemia between patients with or without CHD.

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