

Original Research Article

Burden of malnutrition and anemia among children with congenital heart disease

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ABSTRACT

Background: Congenital heart disease (CHD) is the most common birth defect and in India, the prevalence is 2.5 to 5/1000 live births. Malnutrition and anemia are common co-morbidities that determine the outcome in CHD. This study was undertaken to assess the extent of malnutrition and anemia among 1-12-year-old children with CHD.

Methods: A total 80 children with CHD, admitted for intervention under the Rashtriya Bal Swasthya Karyakram (RBSK) scheme were enrolled. Nutritional status was assessed using standardized anthropometric measurements. Anemia was estimated using hemoglobin, red cell indices, red cell distribution width and peripheral smear. IEC approval, informed consent and assent from participants were obtained prior to the study. Statistical analysis was performed using SPSS version 19.

Results: 2/3rd children were >5-years-old. Acyanotic CHD was more common (81.3%) and 35% had ventricular septal defect. Among cyanotic CHD (18.7%), 13.7% had tetralogy of fallot. In CCHD, there was only one child with normal weight and height. In ACHD, 71% were underweight, 49%, had stunting and 82% had wasting. Anemia was diagnosed in nearly 1/3rd, and iron deficiency was the most common. Even though polycythemia was noted in those with CCHD, increased RDW and reduced red cell indices unmasked iron deficiency.

Conclusions: Majority were >5-years-old, due to late referral for intervention. The burden of malnutrition and iron deficiency anemia, that modify the outcome, was very high, Hence, early identification, prompt referral and correction of co-morbidities are of utmost importance, as majority are likely to get surgical/non-surgical interventions under government sponsored schemes like RBSK in India.

Keywords: Anemia, Congenital heart disease, Iron deficiency anemia, Malnutrition, Polycythemia, Rashtriya Bal Swasthya Karyakram Scheme

INTRODUCTION

Congenital heart disease (CHD) is the most common birth defect, representing a major global health problem. Twenty-eight percent of all major congenital anomalies comprise of heart defects. CHD, both acyanotic and cyanotic (ACHD and CCHD) occurs in approximately 0.8% of live births.¹ The burden of CHD is high in developing countries like India, due to the high birth rate and critical nature of CHD requiring expensive surgical

and non-surgical interventions. Prevalence of CHD reported from India is between 2.5 to 5/1000 live births, but in recent studies by Bhat et al, and Smitha et al, prevalence as high as 8.5% to 13.65% has been noted. The etiology of CHD is multifactorial ranging from monogenic defects, chromosomal anomalies, and environmental factors like teratogens and maternal diseases like diabetes mellitus.^{2,3} In India, the Rashtriya Bal Swasthya Karyakram (RBSK) scheme, for the four Ds; defects, deficiencies, diseases, and developmental

delay/disabilities, is now addressing the burden of CHD. Accreditation of private institutions under this government scheme is a big boon.

Around 59% of children with CHD are reported to be malnourished, irrespective of the type of the cardiac defect.⁴ The risk factors for malnutrition are multifactorial and comprises of heart failure, hypoxia, cyanosis, multiple heart defects, delayed or partial corrective surgery, anemia, and pulmonary hypertension.⁵ Children with CHD are a nutritionally high-risk group. CHD is considered a real challenge because of the complex interplay between medical, surgical, dietetic, and socio-economic factors. Anemia is an important risk factor for morbidity and mortality in children with CHD. Children with malnutrition, commonly have anemia, which is attributed to multiple nutritional deficiencies; iron, vitamin B12, vitamin B6, folate and protein, and bone marrow hypoplasia.⁶ Early malnutrition and anemia can produce suboptimal growth and development with long-term sequelae. These are common co-morbidities, that affect the growth of the child, are often overlooked in day-to-day practice. As these co-morbidities modify the outcome, effort should be taken for early identification and correction before appropriate intervention for CHD.

METHODS

This was a cross sectional study of 80, 1-12-year-old-children with CHD, admitted at Sree Mookambika Institute of Medical Sciences, Kulasekharam, Kanyakumari district, Tamil Nadu, an accredited private centre under the RBSK scheme, during the period March 2017-September 2018. Purposive sampling technique was adopted. Sample size was calculated as 67, based on 59% prevalence of malnutrition.⁴

Inclusion criteria

- Children with significant CHD admitted for surgical or non-surgical intervention in the age group 1-12 years.

Exclusion criteria

- Children with growth failure due to syndromic or genetic type of CHD and those not willing to participate in the study.

Socio-demographic data, infant and young child feeding (IYCF) practices and current diet were recorded using a proforma. Nutritional status was assessed by standardized anthropometric measurements. Revised IAP growth charts, 2016 were utilized for interpreting anthropometric data.⁷ Anemia was assessed using hemoglobin, red cell indices like MCV, MCH and MCHC, red cell distribution width (RDW) and peripheral smear in a single accredited laboratory, under supervision of an experienced pathologist. Age specific WHO cut offs were used to interpret hemoglobin levels.⁸ IEC approval, informed consent, and assent from participants >7 years of age were obtained prior to the study.

Statistical analysis

Statistical analysis was performed using SPSS version 19.

RESULTS

Among the 80 children, 36.2% were 1-5-year-old. Male: female ratio was 1:1. The distribution of children according to age and gender is depicted in Table 1.

Table 1: Distribution according to age and gender (n=80).

Age group	Gender				Total
	Male		Female		
	No.	%	No.	%	No. (%)
12-59 months	14	17.5%	15	18.75%	29 (36.25%)
5-12 years	26	32.5%	25	31.25%	51 (63.75%)

Table 2: Distribution according to the type of congenital heart disease (n=80).

Type	No.	%	
Acyanotic CHD	VSD	28	35%
	ASD	24	30%
	PDA	8	10%
	Others*	5	6.3%
Total ACHD	65	81.3%	
Cyanotic CHD	TOF	11	13.7%
	Others**	4	5%
Total CCHD	15	18.7%	

*Pulmonary stenosis, aortic stenosis, coarctation of aorta, **Complex heart disease, double outlet right ventricle.

Majority had ACHD (81%) and VSD was the most common (35%). Among those with CCHD (18.7%), TOF the most common (13.7%). The distribution as per type of CHD is given in Table 2. More than 2.3rd belonged to low socio-economic status. The Infant and Young Child Feeding (IYCF) Practices and food intake were suboptimum in 80%. The anthropometric data is summarized in Table 3. There was only child in CCHD with normal weight and no stunting, wasting or chronic energy deficiency. In ACHD, 71% were underweight as

per weight for age, 49%, had stunting as per height for age, 82% had wasting as per weight for height and 83% had chronic energy deficiency as per BMI. The hematological parameters are given in Table 4. Anemia was diagnosed in 1/3rd and iron deficiency were common. Even though polycythemia was noted in those with CCHD, increased RDW and reduced red cell indices unmasked iron deficiency. Peripheral smear examination showing microcytic hypochromic anemia with increased RDW confirmed iron deficiency anemia.

Table 3: Distribution according to nutritional status (n=80).

Weight for age (WfA)	Type of congenital heart disease				Total	
	Acyanotic CHD		Cyanotic CHD			
	No.	%	No.	%	No.	%
Normal	19	23.75%	1	1.25%	20	25.00%
Underweight (mild, moderate, severe)	46	57.5%	14	17.5%	60	75.00%
Height for age (HfA)						
No stunting	33	41.25%	1	1.25%	34	42.50%
Stunting (mild, moderate, severe)	32	40.00%	14	17.5%	46	57.50%
Weight for height (WfH)						
No wasting	12	15.00%	1	1.25%	13	16.25%
Wasting (mild, moderate, severe)	53	66.25%	14	17.5%	67	83.75%
BMI (kg/m²)						
Normal	11	13.75%	1	1.25%	12	15.00%
Moderate CED*	43	53.75%	6	7.5%	49	61.25%
Severe CED*	11	13.5%	8	10%	19	23.75%

*CED: chronic energy deficiency

Table 4: Distribution according to haematological parameters (N=80).

Hemoglobin (g/dl)	No.	%
Normal	49	61.3%
Anemia	17	21.3%
Polycythaemia	14	17.5%
Red cell indices (MCV, MCH, MCHC)		
Normal	63	78.8%
Decreased	17	21.2%
RDW		
Normal	51	63.8%
Increased	29	36.2%
Peripheral smear		
Normocytic normochromic anemia	67	83.8%
Microcytic hypochromic anemia	13	16.2%

DISCUSSION

In India, the prevalence of CHD is not uniform across the globe. In India, it varies from 0.8 to 5.2/1000 live births in community-based studies, and from 3.9 to 26.4 in hospital-based studies and almost 10% of under-five mortality is accounted for by CHD.^{2,3,9,10}

Majority in the present study, referred for intervention under the government sponsored RBSK scheme were >5 years-old and this was due to late referral. There is a changing profile in the referral pattern before and after the introduction of the scheme.¹¹ Before the start of the scheme in India, majority of these children were denied any intervention due to financial constraints. Now, private institutions are also accredited under the scheme and more children are getting benefitted.¹² The male to female ratio in the study was 1:1. Begam R et al, Singh G et al, Vaidyanathan B et al and Tandon S et al had reported a ratio of 0.9:1, 1.1:1, 1:1 and 0.8:1, respectively.^{4,13-15} Thus, no significant gender bias was noted in health care approach and intervention.

ACHD was more common than CCHD. Majority had VSD (35%) followed by ASD (30%), TOF (13.7%), PDA (10%), and this proportion was in accordance with similar studies by Smitha R et al, reporting VSD (40.7%), ASD (19.06%), PDA (9.53%) and TOF (13.8%) and Kapoor R et al reporting VSD (21%), ASD (19%), PDA (14.6%) and TOF (4.6%).^{4,16}

Majority of the children in the present study, belonged to lower and middle class. This reflects the high prevalence

in this group and the health seeking behavior under the government schemes like RBSK. A high prevalence of CHD among children belonging to low socio-economic status has been already highlighted in some studies.^{15,16}

The IYCF practices and food intake were suboptimum in majority of cases, attributable to the illness, recurrent infections, lack of information and motivation. This points to the need for anticipatory nutrition and growth counselling for such vulnerable children.

Compared to NFHS 4 data with underweight (42.5%), stunting (48%), wasting (19.8%), among under-five children, children with CHD were more underweight, stunted and wasted.¹⁷ Studies had suggested that severity of cardiac lesions influence the nutritional status in children with CHD.¹⁸⁻²⁰ Etiology of malnutrition in CHD is multifactorial mainly due to elevated energy expenditure, chronic hypoxemia, malabsorption or feeding difficulties and hypermetabolism.²¹⁻²³ In those with CCHD, the extent of malnutrition was more than ACHD, attributable to the complex nature of heart disease and associated hypoxia.

Anemia is an important risk factor for morbidity and mortality in patients with CHD. Hemoglobin is not a sensitive indicator in detecting anemia in CCHD children. Anemia was more common in ACHD whereas polycythemia was common in CCHD. However, red cell indices and RDW unmasked iron deficiency anemia in children with polycythemia. Peripheral smear confirmed iron deficiency anemia. Heart failure may occur and worsen by anemia as a comorbidity.⁷ Studies by Gaiha et al and Lano MO had observed high prevalence of iron deficiency in children with CHD.^{24,25} The finding of high prevalence of nutritional anemia especially iron deficiency anemia shows the effect of poor diet and warrants corrective interventions by iron supplementation in optimum doses both for prevention and treatment. Optimizing the dose of iron is also important as majority may be on suboptimum doses of iron.

Limitations of the study: The distribution of age group and the type of CHD was non uniform in the study sub-groups.

CONCLUSION

Among 80 children with CHD, majority were >5 years-old, due to late referral for intervention. ACHD, especially VSD was more common and among CCHD, TOF was the most common defect. The burden of malnutrition and iron deficiency anemia, that modify the outcome, was very high. Hence, early identification, prompt referral and correction of co-morbidities are of utmost importance, as majority are likely to get surgical/non-surgical interventions under government sponsored schemes like RBSK in India. This, being a cross-sectional study, the improvement in nutritional status and anemia after intervention was not assessed.

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