Innovative Journal of Medical and Health Science
Received 15 Mar 2021 | Revised 30 Apr 2021 | Accepted 19 May 2021 | Published Online 18 June 2021

DOI: https://doi.org/10.15520/ijmhs.v11i06.3323
I Jour Med Health Science 11 (06), 1731–1738 (2021)
ISSN (O) 2589-9341 | (P) 2277-4939 IF:1.6

RESEARCH ARTICLE

MALNUTRITION, DEVELOPMENTAL DELAY, AND IMPAIRED SOCIAL MATURITY IN RELATION TO TYPE OF CONGENITAL HEART DISEASE AMONG 0–15-YEARS-OLD CHILDREN

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Abstract

Background: Children with congenital heart disease (CHD) have impaired growth and development with adverse outcome.

Objectives To determine nutritional status, developmental, and social quotient among 0-15-year-old children with CHD and the association with type of CHD.

Methodology: Among children enrolled under RBSK Scheme, relevant history and examination findings were recorded using a structured proforma. Nutritional status was assessed using anthropometric measurements, Developmental quotient (DQ) using developmental screening test-Bharat Raj and Social quotient (SQ) using Vineland Social Maturity scale-Malin's Indian adaptation.

Results: Out of 60, 46.7% were <5 years old, Male:Female ratio 1:1.4. 86.6% had ACHD, 13.4% CCHD. 61.7% were underweight (ACHD -59.6%, CCHD -75%). 48.3% had stunting (ACHD -44.2%, CCHD -75%); significantly more in CCHD (p <0.01). 66.7% had wasting (ACHD -63.5%, CCHD -87.5%). 48% had thinness/low BMI (ACHD -46.2%, CCHD -62.5%); significantly more in >5-yrs-old group (p<0.01). 63.3% had low DQ <85 (ACHD -59.6%, CCHD -87.5%). 86.7% had low SQ <85 (ACHD -84.6%, CCHD -100%). Mean DQ was low, 74.2 +/-17.9 (ACHD -77.23 +/-17.2, CCHD -57.87 +/-16); significantly more in CCHD (p <0.01). Mean SQ was low 63.18 +/-17.5 (ACHD -65.21 +/-17.2, CCHD -50 +/-12.8); significantly more in CCHD (p <0.01).

Conclusion: Malnutrition, developmental delay, and impaired social maturity were common; stunting and lower DQ and SQ significantly more in CCHD and low BMI in >5-yrs.-old category. More females being enrolled indicate less gender bias. As RBSK scheme, addresses birth defects, developmental delay, and nutritional deficiencies and accredits private institutions, it is a big boon to children with CHD.

Keywords: Malnutrition, Congenital Heart Disease, Developmental Delay, Impaired Social Maturity, DQ, SQ, Stunting, Underweight, Wasting, RBSK

1 | INTRODUCTION

Congenital heart disease (CHD) is the most common type of congenital anomalies. The prevalence is 8-12/1000 live births in India and global prevalence is 9/1000 live births [1,2]. Survival rates in children with CHD is increasing with advances in better diagnostic modalities and surgical/nonsurgical interventions. Children with CHD are at high-risk for malnutrition and neurodevelopment delay [3]. Currently, the attention has been redirected from heart-related morbidity to concern for nutritional, developmental, and neurological outcomes, that can persist throughout childhood and adult life. Malnutrition is common in them due to poor nutritional intake, coupled with frequent infections. Both in utero and after birth, there may be an effect on brain development due to altered cerebral blood flow with impaired cerebral oxygen delivery. The critical time for brain growth and maturation, myelination, and development of neural networks are the fetal and postnatal periods. Any alteration in brain maturity and cerebral blood flow during sensitive developmental periods and during the time of interventions under anaesthesia, may lead to increased risk of developmental delay [4]. They are often restricted from interactive play, social gatherings and have less social interaction due to cardiac debilitation, exercise intolerance, prematurity, and low birth weight issues. Parental anxiety and overprotectiveness may reduce child's exposure to peers, affecting social competence. Those with CHD are not subjected to proper screening for growth, and developmental and social maturity. Indian data on impact of CHD on developmental and social maturity among affected children is scanty. Anthropometric, developmental, and social maturity assessment and early identification of any alteration and appropriate intervention can alter long-term nutritional status, neurodevelopmental outcomes, and social maturity in these children. Early intervention is expected to create opportunities and support academic, behavioural, psychosocial, and adaptive functions and outcome. Currently, in India, these children are entitled to get treatment under the government scheme, Rashtriya Bal Swasthya Karyakram (RBSK). The scheme accredits private institutions, as government facilities are less. The present study focuses on nutritional, developmental, and social maturity status among children with CHD, enrolled under the scheme.

2 | METHODS

This was a hospital based cross sectional study on 0-15-years-old-children with CHD in the Department of Pediatrics, Sree Mookambika Institute of Medical Sciences, Kulasekaram, Kanyakumari district, Tamil Nadu, an accredited private institution, under the RBSK scheme. The period of study was January 2019 to August 2019. Consecutive sampling was adopted. Sample size was calculated as 60, based on a previous study [5]. Both pre-and-post-operative cases were included. Those with chromosomal/genetic conditions, visual/hearing deficits, microcephaly, acquired heart diseases, other co morbidities, and intraoperative/postoperative complications were excluded. Institutional Ethics Committee approval and consent from parents/caregivers were obtained prior to enrolment. Data was collected using a structured proforma, including detailed birth history, family, and socioeconomic history and dietary intake. Socio-economic status was graded according to Modified Kuppuswamy socioeconomic scale, 2019. Nutritional status was assessed by standardized anthropometric measurements. Weight was measured using electronic weighing scale and height/length using infantometer/stadiometer. Nutritional status was classified as follows, underweight as per weight for age (WFA), stunting as per height for age (HFA), wasting as per weight for height (WFH) and thinness as per low BMI, using WHO,

Supplementary information The online version of this article (https://doi.org/10.15520/ijmhs.v11i06.3323) contains supplementary material, which is available to authorized users.

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2006 charts in <5 yrs. and Revised IAP, 2016 charts in >5 years category.

DQ was assessed by Developmental Screening Test by Bharath Raj, for 0-15 years, consisting of 88 items, which represent the behavioural characteristics of respective age levels. Appraisal of a child was done by a semi-structured interview with the parent/person well acquainted with the child. Developmental Quotient (DQ) was calculated using the calculator incorporated with the test folder for ready computation from mental age and the chronological age of children. DQ <85 was considered as delay [6]. Social quotient was assessed using Vineland social maturity scale, Indian adaptation by Malin, for 0-15 years, consisting of 89 items, by interview method. Social skills were evaluated in the following areas: Daily living skills (general self- help, eating, and dressing), Communication (listening, speaking. writing), Motor skills (fine and gross, including locomotion), Socialization (interpersonal relationships, play and leisure, and coping skills), Occupational skills, and Self-direction. Raw scores were converted to an age equivalent score, expressed as social age. Social Quotient (SQ) was calculated from social age and the chronological age. SQ <85 was considered as impaired social maturity [7].

The collected data was entered into Microsoft excel sheet and was analyzed using SPSS 20.0 version. Statistical significance was assessed using independent t-test and Chi square test and p value <0.05.

3 | RESULTS

Out of the 60 children with CHD in the 0-15-years-old age group, 52 (86.6%) had ACHD and 8 (13.4%) had CCHD. 28 (46.7%) were <5 years old and 32 (53.3%) were >5 yrs. old. Male to female ratio was 1:1.4. 60% of children with CHD were LBW babies and 26.7% were preterm. Majority belonged to middle and lower class as per the Revised Kuppuswamy Socio-economic status scale; 38 (63.3%) middle class (II, III) and 21(35%) lower class (IV, V). 14 (23.3%) children had family history of CHD, 8 (13.3%) in parents, 2 (3.3%) siblings, and 4 (6.7%) other relatives. Among ACHD, 19 (36.5%) had VSD, 18 (34.6%) had ASD and among CCHD, 4 (50%) had TOF. Distribution as per type of CHD is given in table 1.

Distribution according to study parameters and type of CHD is given in table 2. 37(61.7%) were underweight; ACHD -31 (59.6%), CCHD -6 (75%). As per IAP classification, 26.7% were -grade I, 21.7% -grade II, 10% grade -III and 3.3% -grade IV. 29 (48.3%) had stunting, significantly more in CCHD (p<0.01); ACHD -23 (44.2%), CCHD -6 (75%). 35% had mild, 10% moderate and 3.3% had severe stunting indicating chronic malnutrition. 40 (66.7%) had wasting; ACHD -33 (63.5%), CCHD -7 (87.5%). 31.7% had mild, 25% had moderate and 10% had severe wasting indicating acute malnutrition. 29 (48%) had thinness/low BMI; ACHD -24 (46.2%), CCHD -5 (62.5%). Thinness was significantly more in >5 yrs. old; 21 (65.6%) in >5 years old and 8 (28%) in <5 yrs. old (p <0.01). Distribution as per CHD type and age-group is given in table 2& 3.

38 (63.3%) had DQ <85 indicating developmental delay; ACHD -31 (59.6%), CCHD -7 (87.5%); 16 (26.7%) borderline (score 68-84), 16 (26.7%) mild (score 52-67), 4 (6.7%) moderate (score 36-51) and 2 (3.3%) severe delay (score <35). Mean DQ was low, 74.2 +/-17.9; ACHD -77.23 +/-17.2, CCHD - 57.87 +/-16, significantly more in CCHD (p<0.001).

52 (86.7%) had SQ <85 indicating impaired social maturity; ACHD -44 (84.6%), CCHD -8 (100%). Mean SQ was low, 63.18 +/-17.5; ACHD -65.21 +/-17.2, CCHD – 50 +/-12.8, significantly more in CCHD (p<0.001). Among 38 (63.3%) children with developmental delay, 35 (92.1%) had impaired social maturity. Even among 22 (36.7%) children with normal development, 17 (77.3%) had impaired social maturity given in table 4&5.

4 | DISCUSSION

In India, due high birth rate and high prevalence, the burden of CHD is huge [1]. In view of the critical nature of the defect, most children require surgical/non-surgical interventions. CHD is an important cause of considerable morbidity and mortality in children.

In the present study, proportion of children in the <5 and >5 years age group was comparable. In a previous hospital-based study from India, it was found that only 18% of children belonged to >5 yrs. age group [8]. The higher number of >5 yr old children in the present study is attributable to the RBSK Scheme, which is offering free treatment among 0–18-years old. But for the scheme, many of them would not have been brought for intervention, due to financial and social reasons.

In this study, the male female ratio was 1:1.4. This is contrary to previous studies from India, that showed higher number of males; Singh et al, reported a ratio of 1.25:1 [9]. More females being enrolled under the RBSK Scheme shows a positive trend against gender bias. In a previous comparative study, the authors had reported a ratio of 1.18:1 during pre-RBSK to 0.9:1.5 in post-RBSK period [10].

We observed that 60% were LBW, and 26.7% were preterm babies. LBW is attributable to prematurity, hemodynamic disturbances during intrauterine growth, other co-morbidities, and congenital malformations associated with syndromes.

As per Modified Kuppuswamy Socio-Economic Status Scale 2019, majority belonged to middle and lower class similar to previous reports [10, 11]. This reflects the population having more congenital anomalies and those seeking cashless facility.

As observed in previous studies, ACHD was more common and among ACHD, VSD and ASD and among CCHD, TOF were more common [10,12]. 23.3% reported CHD in other family members. Blue GM et al, 2012, had reported that recurrence risks vary as per monogenic and multifactorial inheritance and can be as high as 10% [13]. The recurrence risk increase, if a parent rather than a sibling is affected, and overall recurrence of CHD may be up to 37% within family members [14].

In this study, majority were underweight, stunted and wasted with low BMI, as observed in other studies. Observed malnutrition ranging from 27%-90.4%, highlight the importance of nutritional screening and early intervention [10, 15, 16, 17, 18]. Stunting was significantly more in CCHD like previous study [19], which is attributable to chronic hypoxia, excessive calorie requirement, poor nutritional absorption from the digestive tract and differences in the levels of ghrelin [20]. As observed in this study, low BMI/thinness and wasting have been reported to be high [12, 21], due to low caloric intake, type of cardiac lesion, chronic hypoxemia, malabsorption, and hypermetabolism. Increased prevalence of thinness among >5-yrs.-old is attributable to chronic malnutrition associated with cardiac illness, lack of awareness, delay in seeking health care and lack of treating the root cause by definitive intervention for CHD.

Considerable developmental delay was noted among two third, significantly more in CCHD. It has been reported that up to 75% can have delay [3, 5, 22, 23], with a five-fold probability of getting fine and gross motor delay compared to normal children [24]. This finding highlights the need for developmental screening and appropriate interventions to maximize their potential and overall development to reduce burden of disability on the child, family, and society.

Impairment in social status as evidenced by low SQ was noted in 85% in ACHD and 100% in CCHD, significantly more in CCHD. Few studies had observed significant impairment in social maturity, social adjustments, daily living self-care skills, healthy social interactions, due to over protectiveness, pampering and anxiety arising from inadequate knowledge among parents [24]. This over-caring leads to dependent characterization of child, resulting in lesser SQ. In this study, impaired social maturity was more prevalent than developmental delay. SQ was lower in 77.3% children, who had normal DQ. Low SQ despite better DQ may be due to social restriction, school absenteeism and over protection in view of the illness. This observation by comparison between DQ and SQ was unique, which identifies a significant handicap that prevent achievement of full potential as a normal adult, resulting in impairments in living skills and communication. This calls for the need for comprehensive, holistic approach and early intervention in children with CHD, addressing growth, development, and social maturity. The children in this study were referred for further evaluation and appropriate therapy, apart from cardiac intervention.

5 | LIMITATIONS

Low sample size, variable numbers in the ACHD and CCHD subgroups, no control group, and no follow up data after nutritional, cardiac and developmental interventions. Confounding factors with negative impact like physical restriction, over protection by parents, school absenteeism, poor peer interactions not studied.

6 | CONCLUSION

Malnutrition, developmental delay, and impaired social maturity among children with CHD, and more thinness in the older age-group, warrants periodic assessment and intervention. More stunting, developmental delay, and impaired social maturity in CCHD, highlights the need for early definitive cardiac intervention. More females enrolled under the RBSK Scheme denote a positive trend against gender bias. Focus on birth defects, developmental delay, and nutritional deficiency and accreditation of private institutions under the scheme is a big boon to the society.

WHAT THIS STUDY ADDS?

- Apart from malnutrition, developmental delay, and impaired social maturity are common among children with CHD, more so in CCHD and >5-year-old category.
- More females enrolled under the RBSK Scheme denote a positive trend against gender bias.
- The RBSK scheme that focuses on birth defects, developmental delay, and nutritional deficiencies and provides accreditation to private institutions, is a big boon to children with CHD.

Contribution: SS collected and analyzed the data and drafted the paper, EKE conceived the study, modified, and approved the draft. SKM, RK and KS contributed to clinical care

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Table 1. Distribution of Children according to type of CHD

Type		No	%
Acyanotic CHD	**VSD**	19	31.6
	ASD	18	30
	PDA	9	15
	Others *	6	10
Total ACHD		52	86.6
Cyanotic CHD	**TOF**	4	6.7
	Others **	4	6.7
Total CCHD		**8**	**13.4**

Table 2. Distribution according to Nutritional, Developmental and Social Maturity Status as per type of CHD

Parameter	Type of CHD				Total	
	ACHD		CCHD			
	N	%	N	%	N	%
Weight for age (WFA)						
Normal	21	40.4	2	25	23	38.3
Underweight	31	59.6	6	75	37	61.7
Height for age (HFA)						
Normal	29	55.8	2	25	31	51.7
Stunting	23	44.2	6	75*	29	48.3
Weight for height (WFH)						
Normal	19	36.5	1	12.5	20	33.3
Wasting	33	63.5	7	87.5	40	66.7
BMI						
Normal	28	53.8	3	37.5	31	51.7
Low	24	46.2	5	62.5	29	48.3
Developmental Status- DQ						
Normal	21	40.4	1	12.5	22	36.7
Low	31	59.6	7	87.5*	38	63.3
Social Maturity- SQ						
Normal	8	15.4	0	0	8	13.3
Low	44	84.6	8	100	52	86.7

P<0.01- statistically Significant.

Table 3. Distribution according to Nutritional, Developmental and Social Maturity Status as per Age-group

Parameter	Age Group				Total children with CHD (n=60)	
	0-5 yrs. (n=28)		5-15yrs. (n=32)			
	N	%	N	%	N	%
Weight for age (WFA)						
Normal	13	46.4	10	31.3	23	38.3
Underweight	15	53.6	22	68.7	37	61.7
Height for age (HFA)						
Normal	12	42.9	19	59.4	31	51.7
Stunting	16	57.1	13	40.6	29	48.3
Weight for height (WFH)						
Normal	11	39.3	9	28.1	20	33.3
Wasting	17	60.7	23	71.9	40	66.7
BMI						
Normal	20	71.4	11	34.4	31	51.7
Thinness (<-2SD to >-3 SD)	1	3.6	7	21.9*	8	13.3
Severe Thinness (< -3 SD)	7	25	14	43.7*	21	35
Developmental Quotient (DQ)						
Normal (DQ 85 & above)	10	35.7	12	37.5	22	36.7
Developmental Delay (DQ <85)	18	64.3	20	62.5	38	63.3
Social Quotient (SQ)						
Normal (SQ 85 & above)	5	17.9	3	9.4	8	13.3
Impaired Social Maturity (SQ < 85)	23	82.1	29	90.6	52	86.7

Table 4. Comparisons of SQ with developmental delay

SQ	DQ				Total	
	Normal (DQ 85 & above)		Developmental delay (DQ < 85)			
	N	%	N	%	N	%
Normal social maturity (SQ 85 & above)	5	22.7	3	7.9	8	15.3
Impaired social maturity (SQ < 85)	17	77.3	35	92.1	52	84.7
Total	22	100	38	100	60	100

Table 5. Comparison of Mean DQ and SQ in Children with ACHD and CCHD

Mean	TYPE OF CHD		All CHD
	ACHD	CCHD	
Mean DQ	77.23(+/- 17.2)	57.87(+/-16)	74.2(+/-17.9)
P value	**<0.001**		
Mean SQ	65.21(+/-17.2)	50(+/-12.8)	63.18(+/-17.5)
P value	**<0.001**		

***P<0.01- statistically Significant.**

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How to cite this article: Shivaashankari D., Elizabeth K E., Sanjay K M., Rugmini K., Kiron S. **MALNUTRITION, DEVELOPMEN-TAL DELAY, AND IMPAIRED SOCIAL MATURITY IN RELATION TO TYPE OF CONGENITAL HEART DISEASE AMONG 0–15-YEARS-OLD CHILDREN** . Innovative Journal of Medical and Health Science. 2021;1731–1737. https://doi.org/10.15520/ijmhs.v11i06.3323