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Malnutrition and Growth Failure in Cyanotic and Acyanotic Congenital Heart Diseases with and Without Pulmonary Hypertension

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ABSTRACT

Objective: To determine the status of malnutrition and growth failure in cyanotic and acyanotic congenital heart diseases with and without pulmonary hypertension.

Study Design: Cross sectional study.

Place and Duration of Study: Department of Pediatric Cardiology, National Institute of Cardiovascular Diseases, Tando Muhammad Khan, Pakistan, from Jan 2020 to Oct 2021.

Methodology: A total of 250 children, with echocardiography confirmed congenital heart disease, of both genders and aged below 5 years were included. All cases were divided into 4 groups, these being, acyanotic congenital heart disease with PH, acyanotic congenital heart disease without pulmonary hypertension, cyanotic congenital heart disease with pulmonary hypertension and cyanotic Congenital heart disease without pulmonary hypertension. Gender, age, body weight, height, area of residence and malnutrition status were determined in all cases and compared in between study groups.

Results: There were 41(16.4%) patients with acyanotic PH, 115(46.0%) acyanotic without PH, 34(13.6%) cyanotic with pulmonary hypertension and 60(24.0%) cyanotic without pulmonary hypertension among a total of 250 cases. Significant differences were noted in terms of age, weight, and height among different study groups (p<0.001). Nutritional status as normal was noted in 51(20.4%) cases, mild malnutrition in 50(20.0%), moderate malnutrition in 65(26.0%) and 84(33.6%) with severe malnutrition. Children having cyanotic congenital heart disease and pulmonary hypertension were also found to have failure to thrive (p=0.009).

Conclusion: Malnutrition and growth failure were found to be very prevalent among children with CHDs under the age of 5 years. Malnutrition was significantly more pronounced among children having cyanotic CHDs with PH.

Keywords: Acyanotic, Congenital Heart Disease, Cyanotic, Pulmonary Hypertension.

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INTRODUCTION

Severe acute malnutrition affects around 20 million children globally,[1] with 18.5 million of these children being from developing countries.[2] Malnutrition is taken as the most frequent cause of morbidity and mortality among children around the world,[3] as lack of food and poor socioeconomic status are the major reasons behind this burden among developing countries. Local data is not available about the exact extent of malnutrition among children with congenital heart diseases (CHDs) while linkage between CHDs and malnutrition is thought to be multifactorial.[4] Chromosomal or genetic abnormalities, improper nutrition because of difficulty in feeding and suboptimal nutritional absorption from gastrointestinal tract are some of the major reasons of malnutrition among children.[5] Researchers have found growth failure to be present among 64% of CHD cases from developing countries where malnutrition is frequent even in otherwise healthy children.[6] Increased caloric assistance is often needed to maintain the increased myocardial, respiratory and neuro-humoral functions among children with CHD.[7] Malnutrition has been found to be associated with frequent hospitalizations, adverse surgical outcomes, persistent impairment of somatic growth and increased rates of mortality among children with CHD,[8] with one study reporting 62.9% of children with CHD to have some kinds of malnutrition while 43.8% were having failure to thrive.[9] To date, no study in Pakistan has been conducted to find out the extent of malnutrition and growth failure among children having CHDs with and without pulmonary hypertension (PH) so this study aimed to find out status of malnutrition and growth failure in cyanotic and acyanotic congenital heart diseases with and without PH as the findings of our study might help in estimating the types of CHDs and

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effects of the presence or absence of PH on nutritional status and growth of these children in Pakistan.

METHODOLOGY

The cross-sectional study was conducted at the Department of Pediatric Cardiology, National Institute of Cardiovascular Diseases (NICD), Tando Muhammad Khan, Pakistan, from January 2020 to October 2021. Approval from Institutional Ethical Committee was acquired (Certificate No: 2021/1007, dated 28-10-2021) after which informed and written consent was taken from parents or guardians. The sample size was taking expected proportion of children with malnutrition as 62.9%.[9]

Inclusion Criteria: Echocardiography confirmed children with CHD, of either gender, aged below 5 years, visiting Outpatient Department of Pediatric Cardiology were included.

Exclusion Criteria: Children having Down syndrome, cleft palate or neuromuscular problems, unwilling or unable to undergo echocardiography or those who were critically ill (at risk of death), were excluded.

Nonprobability convenience sampling technique was adopted. Gender, height (cm), weight (kg) and residential status (urban/rural) of enrolled participants was noted. Presence of CHDs was identified with the help of echocardiography reports. PH was labeled on echocardiographic evaluation, where mean pulmonary arterial pressure of more than 25 mmHg was labeled as PH. All the study cases were divided into 4 groups as i) acyanotic CHD with PH, ii) acyanotic CHD without PH, iii) cyanotic CHD with PH and iv) cyanotic CHD without PH. Malnutrition status of the cases was diagnosed considering their weight for age, height for age and weight for height as per World Health Organization (WHO) standards where z score below -1 to -1.9 SD was considered as mild malnutrition, -2 to -2.9 SD as moderate malnutrition and <3 SD as severe malnutrition. Normal nutritional status was labeled as z scores above -1.1. When weight and length were less than 5th centile for age, it was labeled as "failure to thrive".[10]

For data analysis, Statistical Package for the social sciences (SPSS) version 26.00 was used. Mean and standard (SD) were calculated to express quantitative variables. Qualitative variables were expressed as percentages and frequencies. In between study groups, chi-square test was used to compare qualitative data

Table-I: Distribution of Types of Congenital Heart Diseases with and Without Portal Hypertension (n=250)

Types of Congenital Heart Diseases		n (%)
Acyanotic with pulmonary hypertension (n=41)	Ventricular Septal Defect	14(34.1%)
	Patent Ductus Arteriosus	9(22.0%)
	Atrial Septal Defect	10(24.2%)
	Ventricular Septal Defect + Patent Ductus Arteriosus	5(12.2%)
	Complete Atrioventricular Septal Defect + Patent Ductus Arteriosus	3(7.3%)
Acyanotic without pulmonary hypertension (n=115)	Ventricular Septal Defect	49(42.6%)
	Atrial Septal Defect	29(25.2%)
	Ventricular Septal Defect + Atrial Septal Defect	13(11.3%)
	Aortic Valve Stenosis	9(7.8%)
	Coarctation of the Aorta	6(5.2%)
	Complete Atrioventricular Septal Defect	9(7.8%)
Cyanotic with pulmonary hypertension (n=34)	Dextro-transposition of the Great Arteries with Intact Ventricular Septum and No Pulmonary Stenosis	9(26.5%)
	Total Anomalous Pulmonary Venous Return	6(17.6%)
	Truncus Arteriosus	8(23.5%)
	Univentricular Heart with No Pulmonary Stenosis	5(14.7%)
	Complex Congenital Heart Disease	6(17.6%)
Cyanotic without pulmonary hypertension (n=60)	Tetralogy of Fallot	34(56.7%)
	Univentricular Heart with Pulmonary Stenosis	4(6.7%)
	Ebstein Anomaly	3(5.0%)
	Pulmonary Atresia	5(8.3%)
	Complex Congenital Heart Disease	5(8.3%)
	Complete Atrioventricular Septal Defect with Pulmonary Stenosis	4(6.7%)
	Tricuspid Atresia	2(3.3%)
	Pulmonary Stenosis + Total Anomalous Venous Return	2(3.3%)
	Fallot's Pentalogy	1(1.7%)

while analysis of variance (ANOVA) was employed to compared quantitative variables and the *p*-value of <0.05 was taken as significant.

RESULTS

Out of a total of 250 cases, there were 138(55.2%) male and 112(44.8%) female. Overall, mean age, weight and height were noted to be 16.2±10.8 months, 6.48±2.3 kg and 76.8±11.1 cm. There were 155(62.0%) cases that belonged to rural areas. Ventricular septal defect (VSD) was found to be the commonest type, noted in 63(25.2%) cases.. Among all study cases, there were 41(16.4%) with acyanotic CHD with PH, 115(46.0%) acyanotic CHD without PH, 34(13.6%) cyanotic CHD with PH and 60(24.0%) cyanotic CHD without PH. Table-I shows distribution of types of CHDs with and without PH.

(*p*<0.001). Likewise, the height among children having acyanotic CHD with PH and cyanotic CHD with PH were low in comparison to children having acyanotic CHD without PH and cyanotic CHD without PH and the difference was statistically significantly (*p*<0.001) (Table-II).

Normal nutritional status was noted in 51(20.4%) cases, mild malnutrition in 50(20.0%), moderate malnutrition in 65(26.0%) and 84(33.6%) with severe malnutrition while failure to thrive was noted in 158(63.2%) cases. No statistically significant difference was found in terms of nutritional status among groups (*p*=0.458) but cases of failure to thrive varied significantly among groups (*p*=0.009) Table-III shows comparison of nutritional assessment among different groups.

Table-II: Comparison of Demographic and Anthropometric Characteristics (n=250)

Characteristics/Nutritional Assessment		Acyanotic with PH (n=41)	Acyanotic without PH (n=115)	Cyanotic with PH (n=34)	Cyanotic without PH (n=60)	*p*-value
Gender	Male (n=138)	24(58.5%)	65(56.5%)	20(58.8%)	27(48.3%)	0.662
	Female (n=112)	17(41.5%)	50(43.5%)	14(41.2%)	31(51.7%)	
Residence	Rural (n=155)	23(56.1%)	68(59.1%)	24(70.6%)	40(66.7%)	0.453
	Urban (n=95)	18(43.9%)	47(40.9%)	10(29.4%)	20(38.0%)	
Age in Years (Mean±SD)		11.24±6.0	18.23±11.6	9.71±1.4	19.47±11.5	<0.001
Weight in Kg (Mean±SD)		5.39±1.8	6.89±2.5	5.12±0.8	7.20±2.4	<0.001
Height in cm (Mean±SD)		68.7±10.2	78.5±10.8	72.5±7.8	81.6±10.2	<0.001

PH: Pulmonary Hypertension; SD: Standard Deviation

Table-III: Comparison of Nutritional Assessment (n=250)

Characteristics/Nutritional Assessment		Acyanotic with PH (n=41)	Acyanotic without PH (n=115)	Cyanotic with PH (n=34)	Cyanotic without PH (n=60)	*p*-value
Nutritional Assessment	Normal (n=51)	11(26.8%)	27(23.5%)	3(8.8%)	10(16.7%)	0.458
	Mild Malnutrition (n=50)	10(24.4%)	18(15.7%)	7(20.6%)	15(25.0%)	
	Moderate Malnutrition (n=65)	9(22.0%)	33(28.7%)	9(26.5%)	14(23.3%)	
	Severe Malnutrition (n=84)	11(26.8%)	37(32.2%)	15(44.1%)	21(35.0%)	
Failure to Thrive (n=158)		20(48.8%)	69(60.0%)	29(85.3%)	40(66.7%)	0.009

PH: Pulmonary Hypertension

No statistically significant difference was noted in terms of gender (*p*=0.662) and residential status (*p*=0.453). Significant differences were noted in terms of age (*p*<0.001) as age among children having acyanotic CHD with PH (11.24±6.0 years) and cyanotic CHD with PH (9.71±1.4 years) were significantly low in comparison to children with acyanotic CHD without PH (18.23±11.6 years) and cyanotic CHD without PH (19.47±11.5 years). Weight among children having acyanotic CHD with PH (5.39±1.8 kg) and cyanotic CHD with PH (5.12±0.8 kg)) were low in comparison to children having acyanotic CHD without PH (6.89±2.5 kg) and cyanotic CHD without PH (7.20±2.4 kg) and the difference was statistically significant

DISCUSSION

In a developing country like Pakistan, where surgical intervention for cardiac diseases like CHDs is not frequently available, the proportion of malnutrition is thought to be high among these cases but not many studies have been performed to find out the exact extent. We observed 79.6% cases with some degree of malnutrition which shows that the incidence of malnutrition is remarkably high among CHD cases. A study evaluating nutritional status of children with unoperated CHDs, reported that overall presence of malnutrition was found to be 84.0% in comparison to 20.0% among controls.[10] Another study,[11] found 27% of CHD cases to have some kinds of malnutrition, but

more recently published data,[12] found malnutrition to be 85% among CHD cases, similar to a study from Iran which reported 80.2%.[13] Differences in proportion of malnutrition among CHD cases in various countries of the world might be explained as variations in cardiac lesions, presence or absence of CHD related complications and/or absence of surgical corrections for CHDs while causes of malnutrition in children with CHDs could be because of inappropriate energy intake, mal-absorption, decrease in splanchnic blood flow, delayed gastric emptying, intestinal oedema or increased nutrient excretions in conditions like fatty diarrhea, protein-losing enteropathy leading to growth retardation among these children.[12] Chronic hypoxia is also common in these CHD cases, as heart and lung are overworked, resulting in increased needs of energy, up to 50% more caloric requirement than their healthy counterparts.[12] VSD was the commonest CHD in our study, similar to a local study from Multan, which noted VSD in 28.5% cases,[14] and another study which found VSD among 42.9% cases.[13] We found that children having cyanotic CHDs with PH had distinct patterns of lower age, body weight and height while 85.3% of cyanotic CHDs cases with PH had failure to thrive, similar to another study which found cyanotic cases with PH to have significantly more association with malnutrition 9 leading to the conclusion that cyanotic children with PH have worst nutritional status,[15] with some researchers reaching the consensus that PH is one of the major causes of malnutrition in the pediatric age group.[16-18]

LIMITATIONS OF STUDY

We were unable to measure the impact of economic status of families of enrolled cases. We also could not gather data about the biochemical parameters among the studied cases.

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CONCLUSION

Malnutrition and growth failure were found to be very prevalent among children with CHDs under the age of 5 years, with malnutrition being significantly more pronounced among children having cyanotic CHDs with PH. Early identification and treatment of CHD cases, resolution of cyanosis and reduction in PH might result in improvement of nutritional status among these children.

Conflict of Interest: None.

Authors Contribution

Following authors have made substantial contributions to the manuscript as under:

SS & BH: Data acquisition, data analysis, critical review, approval of the final version to be published.

FUR & MH: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

MUR & SUS: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, et al. Maternal and child undernutrition: global and regional exposures and health consequences. Lancet 2008; 371(9608): 243-260. https://doi.org/10.1016/S0140-6736(07)61690-0
2. Mena MB, Dedefo MG, Billoro BB. Treatment outcome of severe acute malnutrition and its determinants among Pediatric patients in West Ethiopia. Int J Pediatr 2018; 2018: 8686501. https://doi.org/10.1155/2018/8686501
3. India State-Level Disease Burden Initiative Malnutrition Collaborators. The burden of child and maternal malnutrition and trends in its indicators in the states of India: the Global Burden of Disease Study 1990-2017. Lancet Child Adolesc Health 2019; 3(12): 855-870. https://doi.org/10.1016/S2352-4642(19)30273-1
4. Chinawa AT, Chinawa JM, Duru CO, Chukwu BF, Obumneme-Anyim I. Assessment of nutritional status of children with Congenital Heart Disease: A comparative study. Front Nutr 2021; 8: 644030. https://doi.org/10.3389/fnut.2021.644030
5. Okoromah CA, Ekure EN, Lesi FE, Okunowo WO, Tijani BO, Okeiyi JC, et al. Prevalence, profile, and predictors of malnutrition in children with congenital heart defects: a case-control observational study. Arch Dis Child 2011; 96(4): 354-360. https://doi.org/10.1136/adc.2009.176644
6. Thompson-Chagoyan OC, Reyes-Tsubaki N, Rabiela-Barrios OL, Buendia-Hernandez A, Miranda-Chavez I, Carrasco-Quintero R. The nutritional status of the child with congenital cardiopathy. Arch Inst Cardiol Mex 1998; 68: 119-123.
7. Okoromah CA, Ekure EN, Lesi FE, Okunowo WO, Tijani BO, Okeiyi JC. Prevalence, profile, and predictors of malnutrition in children with congenital heart defects: a case-control observational study. Arch Dis Child 2011; 96(4): 354-360. https://doi.org/10.1136/adc.2009.176644
8. Arodiwe I, Chinawa J, Ujunwa F, Adiele D, Ukoha M, Obidike E. Nutritional status of congenital heart disease (CHD) patients: Burden and determinant of malnutrition at university of Nigeria teaching hospital Ituku - Ozalla, Enugu. Pak J Med Sci 2015; 31(5): 1140-1145. https://doi.org/10.12669/pjms.315.6837
9. Varan B, Tokel K, Yilmaz G. Malnutrition, and growth failure in cyanotic and acyanotic congenital heart disease with and without pulmonary hypertension. Arch Dis Child 1999; 81(1): 49-52. https://doi.org/10.1136/adc.81.1.49
10. Hassan BA, Albanna EA, Morsy SM, Siam AG, Al Shafie MM, Elsaadany HF, et al. Nutritional status in children with un-operated congenital heart disease: an Egyptian center experience. Front Pediatr 2015; 3: 53. https://doi.org/10.3389/fped.2015.00053

11. Mehrizi A, Drash A. Growth disturbance in congenital heart disease. J Pediatr. 1962; 61: 418-429. https://doi.org/10.1016/S0022-3476(62)80373-4
12. Tokel K, Azak E, Ayabakan C, Varan B, Aslamaci SA, Mercan S, et al. Somatic growth after corrective surgery for congenital heart disease. Turk J Pediatr 2010; 52(1): 58-67. https://doi.org/10.1542/peds.2009-0141
13. Tabib A, Aryafar M, Ghadrdoost B. Prevalence of malnutrition in children with congenital heart disease. J Compr Ped 2019; 10(4): e84274. https://doi.org/10.5812/compreped.84274
14. Arshad MS, Anwar-ul-Haq HM, Adnan M, Zulqarnain A. Frequency, and pattern of Paediatric Heart Diseases: Five years' experience at The Children's Hospital, Multan. Pak J Med Sci 2020; 36(6): 1308-1312. https://doi.org/10.12669/pjms.36.6.2312
15. Villasis-Keever MA, Aquiles Pineda-Cruz R, Halley-Castillo E, Alva-Espinosa C. Frequency, and risk factors associated with malnutrition in children with congenital cardiopathy. Salud Publica Mex 2001; 43(4): 313-323.
16. Costello CL, Gellatly M, Daniel J, Justo RN, Weir K. Growth Restriction in infants and young children with congenital heart disease. Congenit Heart Dis. 2015; 10(5): 447-456. https://doi.org/10.1111/chd.12231
17. Toole BJ, Toole LE, Kyle UG, Cabrera AG, Orellana RA, Coss-Bu JA. Perioperative nutritional support and malnutrition in infants and children with congenital heart disease. Congenit Heart Dis 2014; 9(1): 15-25. https://doi.org/10.1111/chd.12064
18. Assefa B, Tadele H. Severe acute malnutrition among unoperated Ethiopian children with congenital heart disease: A wake-up call to reverse the situation, A retrospective cross-sectional study. Ethiop J Health Sci 2020; 30(5): 707-714. https://doi.org/10.4314/ejhs.v30i5.9