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NUTRITIONAL PROFILE OF CHILDREN WITH CONGENITAL HEART DISEASE.

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ABSTRACT

Introduction: Cardiac malformations are undoubtedly responsible for malnutrition, which may range from mild under nutrition to severe failure to thrive (FTT). Inadequate weight at the time of surgery delays the surgical intervention. The present study was planned to assess the nutritional status of children with congenital heart diseases and the factors contributing to under nutrition among them. This will help in counselling parents regarding nutrition, child's diet and feeding habits modification enabling them to make their child fit for an early surgical intervention.

Aims and objectives: To assess the nutritional status of children with congenital heart disease (CHD) admitted to a tertiary care teaching hospital.

Materials and methods: This was a single center observational study conducted over 1 year on 160 patients of Echocardiography confirmed CHD, admitted to pediatric unit of an urban tertiary care teaching hospital. Three anthropometric, seven biochemical and haematological markers along with daily dietary calculations, developmental history (gross motor, fine motor, language and social adaptive milestones) and radiological parameters were measured in all patients and the Data analysis was performed for the whole group and for subgroups to determine the influence of cyanosis and different types of congenital heart diseases on the state of nutrition, using appropriate statistical tests (mean, SD, minimum, maximum and 95% of confidence interval).

Results & Conclusions: The children with CHD were markedly undernourished with both weight (87 %) and height (83%) affected in the cyanotic group, while in the acyanotic patients the weight (72%) was more affected than height (58%). Mid upper arm circumference was below the fifth centile in 20% of children. Four of the 7 biochemical and haematological measurements were abnormal in 64% patients. Recurrent infections and undernutrition lead to development of anaemia (30%) in children with acyanotic heart disease.

KEYWORDS : Nutrition, Congenital heart disease.

Congenital heart disease accounts for more infant deaths than all other congenital defects put together. About half of those who survive, require surgery within the first year of life, equivalent to an "infant surgery rate" of approximately 1400 per million live births1. Despite this significant workload and recent advance in medical and surgical management, the pre- existing state of nutrition is one aspect of congenital heart disease (CHD) that comes to our mind for better quality of life and a better outcome for further surgical treatment. In India, due to paucity of cardiac surgery centers that can operate on children at an early age, these patients are put on medical management, awaiting the patient to reach a proper age for surgery which makes the patient prone for recurrent infections and poor weight gain which further delays the surgical intervention. Inspite of this, there is no published Indian data on the subject of malnutrition in children with CHD,so the present study was planned to assess their nutritional status as accurately as possible by making multiple measurements of anthropometry, biochemical, and hematological factors and the factors contributing to under nutrition in them. This information would enable us to stress on the improvement of feeding habits, counseling parents regarding the importance of nutrition and in making them fit for an early surgical intervention.

MATERIALAND METHODS: This was a Single center observation al study conducted over 1 year on 160 patients of CHD (confirmed on Echocardiography) admitted to pediatric unit of tertiary health care center (B.J.Medical College, Pune). Operated cases of CHD, any other pathological abnormality or a chronic illness, children with chromosomal abnormality/syndromic features and neonates with CHD were excluded from the study. Anthropometric measurements (weight, height, Mid upper arm circumference (MUAC)), Biochemical markers (blood sugar , blood urea , creatinine, serum electrolytes) Haematological markers (haemoglobin, total leukocyte count) along with dietary calculations, developmental history (gross motor, fine motor, language and social adaptive milestones) and radiological parameters (X-ray chest, ECG and 2D ECHO) were assessed to construct a nutritional profile.

The Indian academy of pediatrics (IAP) charts provide information on growth from birth to 18 years and data has been obtained from all the strata of Indian society. Thus, in present circumstances, these charts remain the best option for growth monitoring in Indian children and are recommended for use by the Growth Monitoring Guidelines Consensus Meeting of the IAP. The Data analysis was performed on the Microsoft excel sheet both for the whole group and for subgroups to determine the influence of cyanosis and different types of congenital heart diseases on the state of nutrition, using appropriate statistical tests (mean, SD, minimum, maximum and 95% of confidence interval).

RESULTS: Out of the total 160 patients enrolled, 100(62.5%) patients had acyanotic disease. Majority of patients (68.75%) were in the age group of 1 month to 5 years with mean age of 1.67 (range ; 2months – 3.8years). The male to female ratio was 1.75:1. The distribution of various types of heart diseases is shown in table no. 1

Table 1: Distribution of various congenital heart diseases

Acyanotic heart disease	No of pts (% of total)	Cyanotic CHD	No of pts (% of total)
VSD	39 (24.4)	TOF	17 (10.6)
ASD	21 (13.13)	TAPVC	14 (8.75)
CoA	2 (1.25)	TGA	11 (6.8)
PDA	11 (6.9)	DORV	10 (6.25)
DCM,Fups myocarditis	4,2 (3.75)	Others	8 (5)
Combined	17 (10.6)		
PS, SVP	3, 1 (2.5)		

Many patients required recurrent admissions to the hospital due to illness and the most common cause for that was encountered was recurrent chest infections (34%) and recurrent congestive cardiac failure (21%). When the developmental history was assessed, it was found that 11 patients had global developmental delay.

Nutritional profile Analysis:

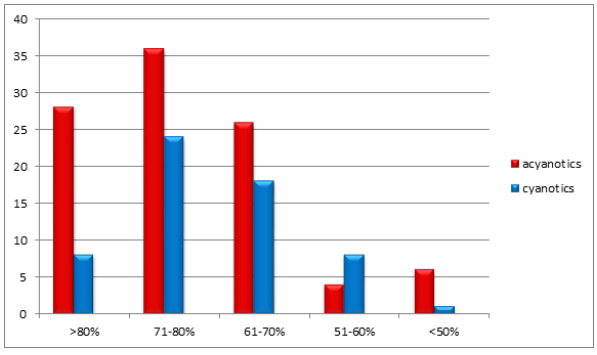
Anthropometry:

In present study, 34.5% were severely underweight. On subgroup

analysis, it was found that there was no significant difference in weight for age between those children with cyanotic heart disease and those with acyanotic heart disease. (P > 0.05). As we can see in the graph 1, maximum patients fall in the wasted group. Majority of patients had weight for age in the range of 61 to 80 percent. Similarly, 78% patients had stunting (as per Waterlow's criteria), of this, 17.5% were severely stunted and as depicted in the graph 2, the proportion of cyanotics in moderate and severe stunting is high. On subgroup analysis (table no. 2), it was found that, cyanotic patients were significantly more stunted as compared to acyanotic group (p<0.05).

After assessing the mid arm circumference in one to five year age group, only 21% of the patients had normal MUAC (>12.5), 46% had moderate malnutrition(MUAC 11.5-12.5cm) and 33 % had severe malnutrition(MUAC<11.5).

Graph 1:Anthropometric evaluation (weight for age)



Graph 2: Anthropometric evaluation (height for age) Categorisation as per Waterlow's classification

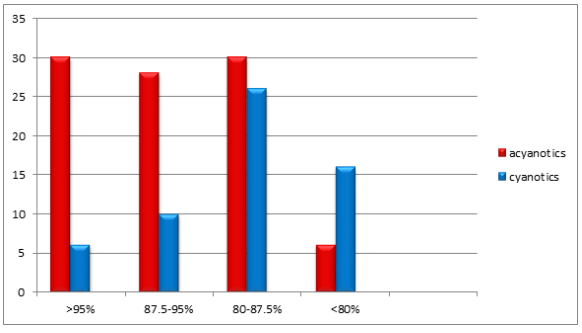


Table 2: Height for age (H/A). (subgroup analysis)

Type of CHD	>3rd percentile (≥90%H/A)	<3rd percentile (<90%H/A)
Cyn	10	50
acyn	42	58

p value- 0.019

Dietary assessment

44 patients had approximately no dietary lag out of which 30(37.5%) had wasting. After analysing this statistically it was revealed that there was no significant difference between weight of those children with dietary deficit of less than 50 percent of expected and those with more than 50% calorie deficit. (P > 0.05). 91 patients had no dietary protein deficit out of them, 39% had wasting. 14 patients had protein deficit of more than 6 gms out of them only 1 patient did not have wasting and it was revealed that there was significant difference between weight of those children with dietary lag of proteins and those without any protein lag. (P < 0.05).

Malnutrition and educational status of mother

47.5 % of mothers of the children suffering from CHD were illiterate out of which 89% had babies who were malnourished(45% of total). The effect of education could be easily judged as out of the 52.5 % of mothers who were educated had 1/3rd (33%) normally grown children and similar results were seen statistically as there was significant difference in growth of children between those children who had educated mothers as compared to those with illiterate mothers.(p < 0.05).

Table 3: Comparison of weight for age of patient with maternal education status:-

Weight for age	≥80%W/A	<80%W/A
Illiterate	8	68
Literate	28	56

P value0.02

Relation of malnutrition with the status at birth:-

When the birth history of the patients was taken into consideration, it was found that there was statistically significant difference (P value-0.01 Odds10.74 RR7.73≈8) in weight for age for those who were born preterm than those who were born full term. The high relative risk also suggests that the risk of malnutrition was 8 times higher in those patients who were born preterm.

Lab parameters

Haemoglobin variation in children with acyanotic CHD:

Out of the total acyanotic cases, 30% developed severe anaemia (haemoglobin <7 gm/dl), 38% had moderate anaemia (haemoglobin 7-10 gm/dl), 40% had mild anaemia (Hb10-12mg/dl) and 13.3% had normal haemoglobin (>12mg/dl).

In the cyanotic group, 53% of patients had haemoglobin higher than 12 mg/dl.

Other lab parameters :

Table no 4: Lab parameters.

Parameter	Cyanotic group(mean±S.D)	Acyanotic group(mean±S.D)
Haemoglobin [Mean ± SD]	11.8±3.3	8.7±2.5
Total leukocyte count	8616.3±4293.85	9526±4874.7
Serum creatinine	0.79±0.32	0.80±0.27
Blood urea level	48.4±30.0	46.4±17.9
Serum bilirubin	0.75±0.23	0.78±0.23
Serum sodium	133.6±7.07	132.6±5.90
Serum potassium	3.41±0.43	3.63±0.0.59

The haemoglobin was in the range of moderate anaemia in acyanotic group. In cyanotic group it was in the normal range when the mean was considered. The total leukocyte count was in the normal range in both the groups. Serum creatinine was also normal in both the groups. Total serum bilirubin was in the range of 0.75±0.23 in cyanotic group and 0.78±0.23 in the acyanotic group. Serum sodium and potassium were in the normal range in both the groups. On subgroup analysis, none of the parameters had statistically significant difference between cyanotic and acyanotic patients.

Other investigations:

The chest X-ray when examined was normal in only 12 patients (7 of them had ASD and 5 had TOF). The most common X-ray finding was cardiomegaly. Bilateral hilar lung infiltrates were also seen in many X-rays. The X-ray findings were specific to the type of cardiac lesion.

ECG (Electrocardiography) was normal in 14 patients. Other patients had ECG findings in concordance with the type of cardiac lesion.

DISCUSSION: It is well known that malnutrition accompanies and contributes to morbidity in CHD. Controversy exists regarding the relative roles of low caloric intake, type of cardiac lesion, malabsorption, and hypermetabolism. Patients with CHD and cyanosis, pulmonary hypertension, and congestive heart failure appear to have an increased prevalence of growth failure and malnutrition[2,3,4]. Optimising nutritional status may improve surgical outcome and contributes to reduced morbidity.

Age: In the present study, 43.75% patients were diagnosed in their first year of life. This was also the case in most recent studies as Sonali Tank et al[5] and Shah et al[6] which could be due to increased awareness and better facilities available now. Certain diseases like ventricular septal defects, patent ductus arteriosus, pulmonary stenosis, are known to present early in life and hence diagnosed early.

Sex: The present study showed male to female ratio of 1.75:1 which was contrary to that observed by Anshula et al[7], which had male to female ratio of 0.8:1. Congenital heart disease as a whole occurs with equal frequency in male and females but some lesions such as aortic stenosis, coarctation of aorta, transposition of great vessels and tetralogy of Fallot are more common in males whereas atrial septal defects are more common in females[8]. Another reason why males were more common in this study could be that, in Indian society, even today, males get more attention and privilege than females and they are brought to the hospitals more frequently.

Types of CHD: Acyanotic heart disease were more than cyanotic ones in studies conducted by Anshula et al[7], Shah et`al[6], Shamim et al[9], Kapoor and gupta et al[10]. In our study Ventricular septal defect was the most common lesion followed by ASD, which was also the case in these other studies except Anshula et al[7], which had ASD as the most common lesion. TOF was the commonest cyanotic lesion.

Developmental history: Developmental lag was also found in five patients, two of them were cyanotic. This was secondary to severe wasting and hypotonia. In a study conducted by Sonali Tank et al[5] on children with CHD, 33% children had a delay in both physical and mental milestones with a higher percentagein children with cyanotic congenital heart disease. Proportionately higher incidence of developmental lag was because this study included cases of CHD with certain syndromes like downs, turners and other associated somatic anomalies. Similar study conducted by Shah et al[6] observed 87 % of patients to have developmental delay. They have attributed it to the severe failure to thrive.

Anthropometric analysis: As per the recent estimate from the National Family Health Survey-3[11] (NFHS-3), an unique source for tracking the status of child malnutrition in India, about 46 percent of the children under 5 years of age are moderately to severely underweight (thin for age) and 38 percent are moderately to severely stunted (short for age). If we compare the proportion of malnourished patient in under five group of present study to this data, 81 percent of the total under five patients were moderately to severely underweight (thin for age), and 72 percent were moderately to severely stunted. This itself indicates that children suffering from CHD are more malnourished when compared to the general pediatric population. In present study, 34.5% were severely underweight. On subgroup analysis, it was found that there was no significant difference in weight for age between those children with cyanotic heart disease and those with acyanotic heart disease. ($P > 0.05$). Similarly, 78% patients had stunting (as per Waterlow's criteria), of this, 17.5% were severely stunted and on subgroup analysis, it was found that, cyanotic patients were significantly more stunted as compared to acyanotic group ($p<0.05$).

To summarize, although both groups were undernourished, cyanotic patients were more stunted as compared to acyanotic ones. Nutrition history gave the impression that cyanotic patients consumed lesser nutrients and all these patients had difficulty in respiration and tachypnoea which further decreased the nutrient intake. In addition, these patients are particularly prone for metabolic acidosis caused by hypoxia which itself is an important factor in inefficient processing of nutrients at the cellular level. Assessment of the mid arm circumfere nce revealed that 33 % had values less that 3 standard deviations. Similar finding were also observed by Shah et al[6], this study had failure to thrive in 42% of cases.

The subgroup analysis observed in our study was in concordance with that observed by Oya Yucel et al[12] and Birgül varan et al[13]. Mitchell et al[1] also observed significant undernutrition and wasting in patients of CHD but they did not find any difference in cyanotic and acyanotic group. Malnutrition in our study was seen in more number of patients as compared to other studies. Some of the reasons being, most of the patients referred to our hospital had severe cardiac lesions and were from families of a low socioeconomic level.

Dietary analysis: After comparing wasting and calorie deficit, it was revealed that there was no significant difference between weight of those children with calorie deficit of less than 50% calories of exspected intake and those with more than 50% calorie dietary deficit($p>0.05$) which itself suggests that patients were malnourished irrespective of their dietary status This itself proves that dietary calorie and protein inadequacy is not the only cause for malnutrition. The other causes could be micronutrient deficiencies, high basal metabolic rate and chronic hypoxia and acidosis.

In comparison to our study, Viera et al[14] found that the intake of calories per kilogram of body weight, of daily proteins, sodium and vitamin A was within the recommended levels in malnourished children with CHD. However, the intake of daily calories, fats, fiber, potassium and iron was below the recommended levels.($p < 0.05$).

Education of mother: There is a famous saying, 'Where there is an educated mother in the home, matters go well.' To check for the effect of mothers education on wellbeing of the baby in terms of weight of the baby we compared both the parameters and it revealed, that there was significant difference in growth of children between those children who had educated mothers as compared to those with illiterate mothers ($p < 0.05$). This was also observed by a case control study done by Anshula et al[7] who observed that socioeconomic status of the family was found to be significantly associated with the causation of malnutrition in CHD.

Birth history: When statistical analysis of preterm and fullterm babies was done it was found that, the risk of malnutrition was 8 times higher in those patients who were born preterm which was also proved by Anshula tendon et al[7]. Khalil et al[15] observed that the incidence was about 10 times higher in low birth weight and preterms in comparison to full term infants and the incidence was highest in those preterms where the birth weight was less than 1500 g.

Biochemistry and Haematology parameters: In the present study, average haemoglobin in acyanotic patients was 8.7±2.5 gm/dl and in cyanotic patients was 11.8±3.3 gm/dl. Similarly we compared dietary habits with the development of anemia or fall in haemoglobin, and it was revealed that the difference was not statistically significant. Hence it could be said that, fall in haemoglobin had many other reasons including poor diet habits.

On analysis of the other lab parameters, the averages of total leucocyte count, serum creatine, blood urea level, serum bilirubin, serum sodium and potassium were within normal range. When assessed individually, the total leucocyte count was abnormal in 33 patients and serum sodium was low in only one patient, BUL (blood urea level) was abnormal in 70 (43.75%) patients, 62 (38.75%) patients had abnormal serum creatinine, 51.25% patients had serum potassium in the lower range. 10% patients had serum bilirubin in the higher ranges. This was similar to findings observed by Mitchell et al[1] who demonstrated that many biochemical and haematological variables were abnormal in children with congenital heart disease. The interpretation, however, is difficult, as it is impossible to ascertain the importance of individual variables to the overall wellbeing of each child.

The present study was limited to patients admitted to tertiary care centre, which comprised of patients with severe lesions and complications. Patients with small and simple cardiac defects could not be included. Only three parameters for anthropometric analysis were used as there are no available criterias and uniform recommend ation charts to be followed for Indian children which included all types of socio economic groups.

To conclude, the current status of nutrition in children with CHD in India leaves a lot to be desired. The magnitude of problem is enormous and resources are very limited. It is time to take stock of the situation and formulate guidelines to improve nutrition and breach the gap to make the patient available for surgery early and also to improve the surgical outcome. Early diagnosis of CHD, early treatment of complications and vigorous counselling regarding ways to improve the nutritional intake at the grassroot level would definitely improve the outcome.

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