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Original Research Article

"Assessment of Nutritional Status in children with Congenital Heart disease -A Cross-sectional Study"

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ABSTRACT

Congenital heart defects (CHDs) children are malnourished and also had increased morbidity and mortality due to persistent impairment of somatic growth, frequent hospitalisation and increased death rate. All major congenital anomalies comprise of heart defects is Twenty-eight percent **Methods**– 52 children are taken who are having CHD; detailed clinical examination and Nutritional status examination for Weight for Age, Weight for Height, Body Mass Index, MUAC were taken. **Results -** In this study on 52 children, 67.3% were in the age group 5-12 years whereas 32.7% belonged to age group 12mon-59mon.The male to female ratio were 1:0.9. 80.8% had ACHD; out of which VSD was the most common (36,5%).19.2% had CCHD, out of which TOF was the most common (13.5%) of ACHD. In children with ACHD, 76.5% had mild, 57.1% had moderate,50% had severe stunting according to height for age whereas in children with CCHD ,23.5% hadmild,42.9% had moderate,50% had severe stunting, statistically significant with p-value - 0.0464.

Key words– Congenital Heart Defect, Cyanotic congenital heart disease, Acyanotic congenital heart disease.

INTRODUCTION:

In India, the prevalence of CHD is not uniform across the country and varies from 0.8 to 5.2/1000 patients in community-based studies. All major congenital anomalies comprise of heart defects[1]. Twenty-eight percent have heart failure in first week of life,18%between the first and fourth week, and 20% between 1and 12 months. Failure to thrive and Malnutrition are often associated with congenital heart defects. It has been shown that heart injuries associated with congestive heart failure, cyanosis, multiple heart defects, delayed corrective surgery, anemia and pulmonary hypertension lead to impairment of growth velocity, weight gain, and height development. Children born with congenital heart disease are considered part of a nutritional high-risk group. Elevated energy expenditure caused by the possible causes are: poor socioeconomic status and lack of knowledge of nutritional requirements required for a particular age and sex.[2]Chronic hypoxemia is an important factor in anorexia and

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 06, 2022

inefficient processing of nutrients.[3] Malabsorption or feeding difficulties.[4] Hyper metabolism probably due to increased catecholamine production and abnormal demands of various organs, in particular the muscles of respiration, the myocardium and hematopoietic system. The severity of malnutrition ranges from mild under nutrition to failure to thrive. There is clear evidence of an association between malnutrition and poor wound healing, impaired immunity, reduced muscle function, and an increased risk of postoperative pneumonia. In the long term, malnutrition in infancy can produce suboptimal growth and physical and cognitive development later in childhood and adolescence. Prevalence of CHD in India is reported to be between 2.5 to 5/1000 live births but recent studies by Bhat et al[5] and Smitha et al[6].have suggested the prevalence to be between 8.5 and 13.6. The present study is therefore aimed at determining the nutritional status of children with congenital heart disease and to determine different degrees of malnutrition.

Methods: This is a hospital based observational cross-sectional study conducted in Katuri Medical college and Hospital, Guntur, Andhra Pradesh between November 2021 to April 2022. Data collection was done by convenient sampling. During that period 60 children were admitted, 08 patients were excluded as 03 children had not given consent and another 04 patient was having chromosomal/genetic disorders/congenital syndromes,02 cases post-operative cases of congenital heart disease and trivial heart diseases. Data was collected from 52 children aged between 1-12 years. 1-12 years of age children admitted in the paediatric ward with various complaints were evaluated for congenital heart disease.

Inclusion criteria:

• Preoperative cases of congenital heart disease within the age group 1-12years who consult as Outpatients as well as Inpatient for surgical and non-surgical interventions in Paediatrics Department, Katuri Medical college and Hospital, Guntur, Andhra Pradesh.

Exclusion criteria:

• Patients with chromosomal/genetic disorders/congenital syndromes
• Post-operative cases of congenital heart disease and trivial heart diseases
• Patients with acquired heart diseases
• Patients not given consent

Socio demographic data regarding age, gender and socio-economic status was collected using pre tested questionnaire. Data regarding birth order, mother age at the time of conception, gestational age at the time of delivery and consanguinity of marriage was also collected. General examination and systemic examination were done.

Nutritional status was classified according to Weight for Age (IAP Classification of Malnutrition, IAP and WHO growth charts), Height for Age (Waterlows Classification of Stunting, IAP and WHO growth Charts), Weight for Height (Water lows Classification of Wasting, IAP and WHO growth Charts) and Mid Upper Arm Circumference, Body Mass Index (IAP and WHO Charts).MUAC was measured by using non-stretchable, flexible tape. IAP (5-18 years) & WHO (0-5yrs) Growth Charts for Weight for Age, Height for Age, Weight for Height and BMI was utilized for plotting the measurements.

Echocardiography: Standard 2D echocardiogram was done for all patients enrolled in the study using phased array transducers of different frequencies tailored according to each patient's age, body built, and weight.

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 06, 2022

The collected data was spread on Microsoft excel and analyzed using SPSS version 20.0.1. data was summarized as mean and standard deviation for numerical variables and count and percentages for categorical data. Chi square test was applied Z test was used to test the significant difference.

Results: Among the 60-pediatrics admitted in Katuri Medical college during the study period October 2021 to march 2022. Data was collected from 52 children aged between 1-12 years.

Table -1 Distribution according to Age and Sex

Age	Sex				Total	
	Male		Female			
	Numbers	Percentage	Numbers	Percentage	Numbers	Percentage
12-59 Months	10	58.8 %	07	41.2 %	17	100 %
5-12 Years	17	51 %	18	49 %	35	100%
Total	27		25		52	100%

Comparing the distribution of age group and sex, out of the 17 children in the age group 12-59 moths, 58.8% are male and 41.2% are female, whereas out of 35children in the age group 5-12yrs, 51% are male and 49% are female.

In the present study, 32.7% belonged to 12mon-59mon and 67.3% belonged to 5-12years**.**In this study, 52% were male and 48% were female.

Table -2 Distribution According to type of Congenital Heart Disease (n=52)

Type		Numbers	Percentage (%)
Acyanotic	VSD	19	36.5 %
	ASD	15	28.8%
	PDA	05	9.6%
	OTHERS*	03	5.7%
Total ACHD		41	80.8 %
Cyanotic	TOF	07	13.5 %
	OTHERS**	03	5.7 %
Total CCHD		10	19.2 %

OTHERS*□Pulmonary stenosis, Aortic Stenosis, Coarctation of Aorta

OTHERS**□Complex Heart Disease, Double outlet right Ventricle,

Out of the 52 children enrolled with congenital heart disease, 80.8% had Acyanotic congenital heart disease and 19.2% had cyanotic congenital heart disease In ACHD(80.8%) group, VSD(36.5%) was more predominant followed by ASD(28.8%) and PDA(9.6%) and Others(5.7%) In CCHD(19.2%) group, TOF(13.5%) was more predominant and others(5.7%).

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 06, 2022

Table 03: Distribution according to Socio Economic Status

Socio Economic status	Numbers	Percentage (%)
Upper Class (I)	Nil	Nil
Upper Class (II)	02	3.8 %
Lower Middle Class (III)	05	9.6 %
Upper Middle Class (IV)	33	63.5%
Lower Class (V)	12	23.1 %
Total	52	100 %

In this present study, majority of the children with congenital heart disease belonged to upper lower class (63.5%) class with Lower class (23.1%) and Lower middle class(9.6%).

In this present study, only 1.9% of the family member (Maternal uncle) had a history of congenital heart disease (Acyanotic-VSD) corresponding to the lesion in the affected child for which surgical correction was not done.

In this study, 5.8% of the mothers were below 19 years, 92.3% belonged to 19-35years and 1.9% was above 35 years at the time of conception.

Majority of children with congenital heart disease had parents who were second degree (76.9%) consanguinity and only 22.5% were third degree consanguinity.

In this study, majority of the children with the congenital heart disease belonged to second birth order (55.76%) whereas 30.76% belonged to first and 13.46% third birth order.

In this study only 5.8% were preterm (<37weeks) and 94.2% were term (>37weeks).

In this stduy17.3%of total children were low birth weight (< 2.5kg) and 82.7% had normal birth weight (2.5 – 3 kg).

Majority of the children (82.7%) were exclusively breast fed till 6 months. Only 32.7% were continued breast feeding up to 2 years whereas 67.3% were not. Majority of the children (75%) were started on complementary feeding in the form of mashed rice, mashed idly by end of 6 months Most of the children (92.3%) were started on family pot feeding by end of 1 year of age.

In this study, 5.8% of the children took <50% of the required calories and 3.8% of the children took <50% required proteins,93.8% took 50-70% of the required calories and 94.3% took 50-70% of the required proteins and only 1.2% took 76-90%ofthe required calories and 1.9% took 76-90%of the required proteins.

Table 04: Comparison between ACHD and CCHD according to Weight for Age

Weight for Age (WfA)	Type of Congenital Heart Disease				Total	
	Acyanotic		Cyanotic			
	Numbers	Percentage (%)	Numbers	Percentage (%)	Numbers	Percentage (%)
Normal	12	92.3%	01	7.7%	13	100%
Mild Under weight	12	85.7%	02	14.3%	14	100%

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 06, 2022

Moderate Under weight	**11**	**73.3%**	**04**	**26.7%**	**15**	**100%**
Sever under weight	**07**	**70%**	**03**	**30%**	**10**	**100%**
Very sever under weight	**0**	**0**	**0**	**0**	**0**	**0**
Total					**52**	**100%**

$\chi 2$: 2.615 ; p-value : 0.454; Statistically not significant

In children with ACHD, 85.7% had had mild, 73.3% had moderate,70% had severe underweight according to weight for age whereas in children with CCHD, 14.3% had mild,26.7% had moderate and 3% had severe underweight. Statistically not significant with p value - 0.454.

In this present study, according to WfA,25% were normal and 75% were underweight.26.9% had mild, 28.8% had moderate,19.2% had severe and 1.2% had very severe underweight.

Table 05: Comparison between ACHD and CCHD according to Height for Age

Height for Age (HfA)	**Type of Congenital Heart Disease**				**Total**	
	Acyanotic		**Cyanotic**			
	Numbers	**Percentage (%)**	**Numbers**	**Percentage (%)**	**Numbers**	**Percentage (%)**
Normal	**23**	**95.8%**	**01**	**4.2%**	**24**	**100%**
Mild Stunting	**13**	**76.5%**	**04**	**23.5%**	**17**	**100%**
Moderate Stunting	**04**	**57.1%**	**03**	**42.9%**	**07**	**100%**
Sever Stunting	**02**	**50%**	**02**	**50%**	**04**	**100%**
Total					**52**	**100%**

$\chi 2$: 7.97; p-value : 0.0464; Statistically significant

In children with ACHD, 76.5% had mild,57.1% had moderate,50% had severestunting according to height for age whereas in children with CCHD ,23.5% had mild,42.9% had moderate,50% had severe stunting, statistically significant with p-value - 0.0464.

In this present study, 46.2% were normal and 53.8% were stunted accordingto height for age.32.7% had mild, 13.5% had moderate, 7.7% had severe stunting.

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 06, 2022

Table 06: Comparison between ACHD and CCHD according to Weight for Height

Weight for Height (WfH)	Type of Congenital Heart Disease				Total	
	Acyanotic		Cyanotic			
	Numbers	Percentage (%)	Numbers	Percentage (%)	Numbers	Percentage (%)
Normal	07	87.5%	01	12.5%	08	100%
Mild wasting	21	87.1%	03	12.5%	24	100%
Moderate wasting	08	61.5%	05	38.5%	13	100%
Sever wasting	06	85.7%	01	15.3%	07	100%
Total					52	100%

$\chi 2$: 4.136; p-value : 0.246; Statistically not significant

In children with ACHD, 87.1% had mild, 61.5% had moderate, 85.7% had severe wasting according to weight for height whereas in children with CCHD, 12.5% had mild, 38.5%had moderate, 15.3% had severe wasting. Statistically not significant.

In this study, 15.4% were normal and 84.6% were wasted according to weight for height, 46.2% had mild, 25% had moderate and 13.4% had severe wasting.

Wasting was more common in children aged 5-12 years (mild –70.8%, moderate – 69.3%, severe –57.2%) compared to children between 12-59 months (mild-29,2%, moderate – 30.7%, severe – 42.5%).

Table 07: Comparison between ACHD and CCHD according to BMI

BMI	Type of Congenital Heart Disease				Total	
	Acyanotic		Cyanotic			
	Numbers	Percentage (%)	Numbers	Percentage (%)	Numbers	Percentage (%)
Normal	11	87.5%	01	22.5%	08	100%
Moderate Chronic Energy Deficiency	28	90.3%	03	09.7%	31	100%
Sever Chronic Energy Deficiency	07	53.8%	06	16.2%	13	100%
Total					52	100%

$\chi 2$:8.1215; p-value : 0.017; Statistically not significant

In children with ACHD, 90.3% had moderate and 53.8% had severe CEDaccording to BMI, whereas in children with CCHD, 09.7% h ad moderate and 16.2%had severe CED. Statistically not significant.

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 06, 2022

In this study, 84.6% had chronic energy deficiency (CED). Majority (59.6%) had moderate chronic energy deficiency and 25% hadsevere chronic energy deficiency.

Chronic energy deficiency based on BMI was more common in children aged5-12 years (moderate – 67.7 %, severe - 69.3%) compared to children between 12-59months (moderate– 32.3%, severe - 30.7%).

Table 08: Distribution According to MUAC (6-59 Months)

MUAC	NUMBER	PERCENTAGE%
Normal (>13.5cm)	**08**	**47%**
Malnutrition (<13.5cm)	**09**	**53%**
Mild-Moderate (12.5cm – 13.5cm)	**06**	**35.4**
Sever (<12.5cm)	**03**	**17.6%**
Total	**23**	**100**

Only 23 children were in the age group of 6-59 months, According to MUAC,47% were normal(>13.5cm) and 53% were malnourished (35.4% had mildto moderate malnutrition and 17.6% had severe malnutrition).

DISCUSSION:

In developing countries like India, the burden of Congenital Heart Defect is high because of high birth rate and critical nature of Congenital Heart Defect requires Expensive treatment. The most common congenital malformation among all birth defects causing morbidity and mortality among children is Congenital Heart Defect.

Different types of cardiac malformation can affect nutrition and growth to varying degrees. The severity of malnutrition can range from mild under-nutrition to failure to thrive.

In India, the prevalence of CHD is not uniform across the country and varies from 0.8 to 5.2/1000 patients in community-based studies while the prevalence ranges between 3.9 and 26.4/1000 live births in hospital-based studies in India, which is not uniform across the country [5, 6].Ten percent of the present under 5 infant deaths may be accounted for by CHD.

Congenital heart disease (Cyanotic and Acyanotic) occurs in approximately 0.8% of live births worldwide.

AGE DISTRIBUTION:

In the present study, 32.7% belonged to 12mon-59mon and 67.3% belonged to 5-12years.This gives an outlook on the lack of parental education and information regarding their attitude for health care.

SEX DISTRIBUTION:

In this study, 25 (48%) were female and 27 (52%) were male children. In a study by Rubia et al,[7]Singh G et al,[8]observed male to female ration 0.9:1 and 1.1:1 respectively and study by Vaidyanathan B et al[2] observed male to female ratio as 1:1 and 0.8:1. This study shows male to female ratio as 1:0.9

DISTRIBUTION OF SEX ACCORDING TO AGE:

Comparing the distribution of age group and sex, out of the 17 children in the age group 12-59 moths, 58.8% are male and 41.2% are female whereas out of children in the age group

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 06, 2022

5-12yrs, 51% are female and 49% are male.

DISTRIBUTION ACCORDING TO TYPE OF CONGENITAL HEARTDISEASE:

Out of the 52 children enrolled with congenital heart disease, majority (80.8%) had Acyanotic congenital heart disease and 19.2% had cyanotic congenital heart disease.

Majority had VSD-36.5% followed by ASD 28.8%, TOF-13.5%, PDA-9.6% which was again correlating with similar studies by Smitha R et al (VSD-40.7%; ASD-19.06%; PDA-9.53%; TOF13.8%),[6]Kapoor R et al (VSD-21%; ASD-19%; PDA-14.6%; TOF-4.6%),[3]Mishra et al (VSD-28%; ASD-6%; PDA-8%; TOF-6%),[4].

DISTRIBUTION ACCORDING TO SOCIO ECONOMIC STATUS:

In this present study, majority of the children with congenital heart disease belonged to lower (86.6%) class with Upper lower class (63.5%) and lower class (23.1%) according to Modified Kuppusamy Socio Economic Scale. A study by Agha MM et al,[9]Tanden Set al[10] also reported a high prevalence of CHD in children belonging to low socio-economic status.

DISTRIBUTION ACCORDING TO FAMILY MEMBERS AFFECTED:

In our study, only one patient had a family member (paternal uncle) who had a history of congenital heart disease (Acyanotic) for which surgical correction was done. According to Nelson, the risk of occurrence increases if a 1st degree relative (parent/sibling) is affected (2-6%) whereas when two first degree relatives are affected with CHD, the risk of subsequent child may reach to 20-30%.[11] Oyen N.et al reported that strong familial clustering was present in first-degree relatives, ranging from 3-fold to 80-fold compared with the population prevalence. Ellesoe GS et al, also reported similar correlation between familial cocurrence and congenital heart disease[12]

DISTRIBUTION ACCORDING TO MATERNAL AGE AT TIME OF CONCEPTION:

In this study, 5.8% of the mothers were below 19 years, 92.3% belonged to 19-35years and 1.9% was above 35 years at the time of conception. Best K.E et al reported that that advanced maternal age is not a risk factor for CHD, however there was marginal risk of infants developing certain types of CHD, among mothers aged more than 35years[13] which was also supported by Miller et al who also observed that infants born to mothers older than 35 years of age seemed to be at 20% increased risk of CHDs, whereas Luo YL et al observed in his study that the occurrence of CHD was seen in younger mothers.[14]

DISTRIBUTION ACCORDING TO DEGREE OF CONSANGUINITY:

In the study, majority of children with congenital heart disease had parents who were second degree (76.9%) consanguinity and 22.5% were third degree consanguinity and no first-degree consanguinity noted. Gnanalingam MG et al also observed that parental consanguinity was noted in 12.5% of the control group compared to 31.1% of the CHD group.[15]

DISTRIBUTION ACCORDING TO BIRTH ORDER:

In this study, majority of the children with the congenital heart disease belonged to second birth order (76.9%) and 22.5% third birth order. A study by Howell EM concluded that birth order is significantly related to mortality and nutritional status in large African families, with later born children having poorer outcomes.[16]

A possible explanation for this association could be that higher order births are more likely to be unwanted which results in less attention and care from parents: antenatal and postnatal care and child check-up decreases with the higher birth order. Another explanation could be

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 06, 2022

that intra-household allocation of food and resources decreases with an increasing number of births in the household.

DISTRIBUTION ACCORDING TO GESTATIONAL AGE AND BIRTH WEIGHT:

In this study 94.2% were term (>37 weeks) and only 6.2% were preterm (<37weeks) and 82.7% had normal birth weight (2.5-3kg) and only 17.3% out of the total children were low birth weight(<2.5kg). Miller et al reported there was no correlation between the incidence of low birth weight and preterm and congenital heart disease[17]whereas Steurer AM et al, stated that incidence of CCHD was highest at 29 to 31 weeks' GA (0.9%) and lowest at 39 to 42 weeks (0.2%) and that morbidity remains increased across all gestational groups in comparison with infants born at 39 to 42 weeks.[18]

In this study shows that the changing attitude towards periodic antenatal care and care of fetal wellbeing by the mothers as well as the approach by health care workers and health care system in ensuring proper maternal nutrition, antenatal care and safe delivery.

DISTRIBUTION ACCORDING TO IYCF PRACTICES:

According to NFHS DATA 5 (2019-2022),[19]64% were exclusively breast fed till 6 months, breast feeding was continued in 39% up to 2 years, complementary food started at 6 months in 94% and family pot feeding was started at 1 year by 16%. whereas in our study 82.7% were exclusively breast fed till 6 months but only 32.7% were continued breast feeding up to 2 years.

DISTRUBITION ACCORDING TO NUTRITIONAL STATUS (WfA, HfA, WfH, BMI, MUAC):

Studies have suggested that severity of cardiac lesions influence the nutritional status in children with congenital heart disease. Dietary inadequacy, recurrent infections, complications such as heart failure and severe pulmonary hypertension also contribute to malnutrition. As per Swagata M et al from Karnataka observed that 82% were underweight and 86% were stunted among children with congenital heart disease.[20]Habeeb NM et al, observed that that malnutrition, stunting and wasting were detected in 65.8%, 66.4% and 62.5% of patients respectively and prevalence rates were significantly higher among cyanotic (62.8%, 74.4% and 25.6%) when compared to acyanotic (49.5%, 63.3% and 18.3%)[21] whereas Varan B et al reported mild or borderline malnutrition was more common in group acyanotic CHD with pulmonary hypertension patients whereas both moderate to severe malnutrition and failure to thrive were more common in group cyanotic with pulmonary hypertension patients.

WEIGHT FOR AGE/ WfA

In this present study, according to Weight for Age, 25% were normal and 75% had varying grades of underweight (26.9% had mild, 28.8% had moderate, 19.2% had severe), indicating acute malnutrition.

- In children with ACHD, 85.7% had had mild, 73.3% had moderate, 70% had severe underweight according to weight for age whereas in children with CCHD, 14.3% had mild, 26.7% had moderate and 3% had severe underweight.
- Underweight was more common in children aged 5-12 years (mild- 64.3%, moderate- 73.3%, severe- 80%) compared to children between 12-59 months (mild- 35.7%, moderate- 26.7%, severe- 20%).

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 06, 2022

HEIGHT FOR AGE/ HfA

 In this present study, 46.2% were normal and 53.8% had varying grades of stunting (32.7% had mild, 13.5% had moderate, 7.7% had severe stunting) according to height for age, indicating chronic malnutrition.

 In children with ACHD, 76.5% had mild, 57.1% had moderate, 50% had severe stunting according to height for age whereas in children with CCHD, 23.5% had mild, 42.9% had moderate, and 50% had severe stunting. This was found to be statistically significant with a p value 0.0464.

 Mild and Moderate stunting was more common in children aged 5-12 years –58.8% and 57.1% respectively compared to children with 12-59months- 41.2% and 42.9% respectively but severe stunting was common in age group 12-59 months compared to 5-12years. This was found to be statistically significant with a p value 0.004.

WEIGHT FOR HEIGHT/ WfH:

 In this study, 15.4% were normal and 84.6% had varying grades of wasting (46.2% had mild, 25% had moderate and 13.4% had severe wasting) according to weight for height

 In children with ACHD, 87.1% had mild, 61.5% had moderate, 85.7% had severe wasting according to weight for height whereas in children with CCHD, 25% had mild, 38.5% had moderate, 15.3% had severe wasting There was no statistical significance.

Wasting was more common in children aged 5-12 years (mild- 70.8%, moderate- 69.3%, severe- 57.2%) compared to children between 12-59 months (mild- 29.2%, moderate-30.7%, severe- 42.5%).

CHRONIC ENERGY DENSITY ACCORDING TO BMI:

 In this study, 15.3% were normal, 84.6% had CED. Majority 59.6% had moderate CED and 25% had severe CED.

 In children with ACHD, 90.3% had moderate and 53.8% had severe CED according to BMI, whereas in children with CCHD, 9.7% had moderate and 46.2% had severe CED. This was not statistically.

 Chronic Energy deficiency based on BMI was more common in children aged 5-12 years (moderate – 67.7 %, severe -69.3%) compared to children between 12-59 months (moderate-37.3%, severe –30.7%).

MID UPPER ARM CIRCUMFERENCE/MUAC:

 Only 33 children were in the age group of 6-59 months, according to MUAC,47% were normal (>13.5cm) and 53% were malnourished (35.4% had mild to moderate malnutrition and 17.6% had severe malnutrition).

Children with Congenital heart disease had both acute and chronic malnutrition and chronic energy deficiency based on their anthropometric indicators. Children with Acyanotic congenital heart disease were more underweight, and wasted and children with cyanotic congenital heart disease were more stunted. Children in age group 5-12 years were more underweight, stunted, wasted compared to children in age group 12-59 months as most of the infants of age group were breast fed and close attention was paid by mothers.

CONCLUSION:

Malnutrition is a very common complicating problem in children with symptomatic CHD, predicted by the presence of anemia, low arterial oxygen saturation, heart failure, poor dietary history, and pulmonary hypertension.

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 06, 2022

In this study on 52 children, 667.3 % were in the age group 5-12 years whereas32.7% belonged to age group 12mon-59mon.The male to female ratio was 1:0.9. 80.8%had ACHD; out of which VSD was the most common (36.5%).19.2% had CCHD, out of which the most common (13.5%) was TOF.

70% of ACHD were underweight in comparison to 30% in CCHD.,50%of ACHD were stunted in comparison to 50% in CCHD,85.7% of ACHD were wasted in comparison to 15.3% wasted in CCHD.

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ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 06, 2022

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