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NUTRITIONAL STATUS IN CHILDREN WITH OPERATED CONGENITAL HEART DISEASES IN ZAGAZIG UNIVERSITY HOSPITALS

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ORIGINAL ARTICLE

Nutritional Status in Children with Operated Congenital Heart Diseases in Zagazig University Hospitals

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ABSTRACT

Background: Congenital heart disease is the most common congenital problem in children accounting for nearly 25% of all congenital malformations. **Objectives**: were performed to assess the nutritional status in children with operated CHD, evaluate the malnutrition status in children with operated CHD and to evaluate the daily caloric intake standards among acyanotic and cyanotic CHD children. **Patients & Methods:** included 68 children with acyanotic and cyanotic operated CHD at least 3 months post operatively. Mean age of children in this study was 2.33 months, ranged from 5 month to 5.8 years and most 52.9% were male. That disagreed was conducted a study on CHD children aged 3 months to 16 years on some of growth parameters. **Results**: our results we found, all CHD children underwent an anthropometric evaluation (weight, length and head circumference) at presentation, the mean weight was 10.67kg, the mean head circumference was 45.55cm, the mean length was 84.29cm and the mean of mid arm circumference was 13.43cm . Regarding the body mass index (BMI) for age of CHD children > 2years, the mean of BMI was 14.6 kg/m^2. **Conclusion:** the malnutrition in children with operated congenital heart disease is a major problem in pediatric hospital of Zagazig university as the prevalence of malnutrition among those children was high.

Keywords: Nutritional Status , Operated Congenital Heart Diseases, cardiac surgery

INTRODUCTION

Congenital Heart Disease (CHD) is often associated with malnutrition and failure to thrive[1]. Growth delay in children with CHD is a common complication [2]. Failure to thrive can be mild or severe that ends in permanent physical or developmental deterioration [3].

Malnutrition and failure to thrive have long been recognized as common systemic consequences of congenital heart defects. Infants with cyanotic CHD and complex univentricular lesions are particularly susceptible to acute and chronic malnutrition. Mechanism of growth for growth deficiency in CHD are multifactorial including associated chromosomal anomalies/genetic syndromes, inadequate nutrition due to feeding difficulties, and poor nutritional absorption from the digestive tract in chronic congestive heart failure [4].

Cyanotic, complicated and non-operated patients with CHD are more vulnerable to nutritional complications. Structured feeding program including micronutrient supplementation as well as parental education strategy should be established for those children [5].

Cardiac surgery has improved patient survival and nutritional status. [6]. Improved nutrition status not only allows infants and children with CHD to reach growth and development potentials but also optimizes surgical outcomes [7]. The increase in knowledge about corrective cardiac surgery and concerning the care of patients with CHD has led to increase in life expectancy [8].

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Success in managing those children is no longer solely dependent on the post-surgical survival alone; as nowadays operative interventions have a higher success rate, hence the focus of management has turned to minimizing malnutrition, approaching age-appropriate growth parameters and improving quality of life for patient and family [4].

Ratanachu and Pongdara [9] concluded that, malnutrition was found in 40% of pediatric patients with CHD and cardiac surgery has a significant positive effect on weight gain and nutritional status

AIM OF THE WORK

The aim of this study is to evaluate the nutritional status of operated CHD in the Pediatric Cardiology Unit, Childrens Hospital and Cardiothoracic Surgery Clinic, Zagazig University

PATIENTS AND METHODS

This study was a cross sectional observational study of 68 children, with different symptomatic operated CHD presented to Cardiology Unit and Cardiothoracic Clinic in Zagazig University Hospitals, throughout the period from May 2018 to the end of November 2018. A written informed consent was taken from parents of each case, the study was approved by our ethical committee. The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

This study was classified according to: Cardiac surgery was classified as follows: total corrective without major anatomical defect after surgery and palliative surgery to improve hemodynamic problem but remained anatomical defects.

Inclusion criteria : Both sex including in this study and the age ranged from 3 months to 6 years at least 3 months post operatively.

Exclusion criteria :We exclude patients with congenital anomalies and patients with other diseases (including genetic disorders) affecting the growth or the nutritional status of the children.

Anthropometric measurements:

Weight gain has traditional been the favored means of assessing the adequacy of nutritional support. It fluctuates markedly in health and disease. However, it is highly beneficial during infancy. Length is an excellent maker of child hood growth, since it is not subject to daily variation as weight. Serial measurements over a 3-6 month interval are recommended and declaration in growth percentiles may be an early, or occasionally the only, indicator of nutrition chronic disease or sub optimal intake .

Statistical analysis

Data were collected, tabulated and analyzed by SPSS 20, software for Windows. According to the type of data qualitative represent as number and percentage , quantitative continues group represent by mean ± SD. P value was set at <0.05 for significant results &<0.001 for high significant result.

RESULTS

Table (1), showed that 47.1% were female, mean of age were 2.33 with range from 5month to 5.8 years and 75% were the birth weight between 2.500 - 4kg. **Table (2),** showed that 79.4% were Acyanotic CHD and 20.6% were Cyanotic CHD. **Table (3) and Fig. (1),** showed that the mean age of operations time was 6.7 with range from 3 to 18 months and 89.7% were corrective operations. **Table (4),** showed that mean of weight were 10.76 with range from 4.7 to 18.5kg, mean of length were 84.29 with range from 59 to 112 and mean of BMI were 14.6 with range from 11.6 to 16.9 (BMI measured in patients > 2years). **Table (5),** showed the anthropometric measures (percentile) of studied patients. **Table (6),** showed that the mean of weight for age z score were -0.90 with range from -3 to 2, mean of mid arm circumference z score were -1.01 with range from -3 to 1. 51.5% of patients were average BMI and 13.2% were pathologic malnutrition.

Fig. 2, 3, 4 ,5 showed that there was statistically significant difference in patient with cyanotic in comparison to patient a cyanotic CHD as regards weight, length, BMI for age ,(mid arm circumference and weight) Z .

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Table (1): Demographic data of studied patients (N=68)

		No.	%
Sex	**Female**	**32**	**47.1%**
	Male	**36**	**52.9%**
Age	**Mean ±SD**	**2.33**	**1.65**
	Range	**0.5**	**5.8**
Birth weight (Kg)	**< 2.500 gm**	**14**	**20.6%**
	2.500 –- 4	**51**	**75.0%**
	>4000	**3**	**4.4%**

Table (2): Classification of CHD (Acyanotic and Cyanotic) of studied patients

		No.	**%**
Acyanotic CHD	Yes	54	79.4%
Cyanotic CHD	Yes	14	20.6%

Table (3): Operations time and type

	Min	**Max**	**Mean**	**SD**
operation time (month)	**3**	**18**	**6.70**	**3.55**
Type of operations				
Corrective	**61**		**89.7%**	
Palliative	**7**		**10.3%**	

Table (4): Anthropometric measures of studied patients

	Min	**Max**	**Mean**	**SD**
Weight (Kg)	**4.7**	**18.5**	**10.76**	**2.6**
Head circumference (Cm)	**39**	**51.50**	**45.55**	**3.17**
Length (Cm)	**59**	**112**	**84.29**	**15.31**
Mid arm circumference (Cm)	**11**	**16**	**13.43**	**0.99**
BMI for age (Kg / m2)	**11.6**	**16.9**	**14.6**	**3.7**

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Table (5): Anthropometric measures (percentile) of studied patients

		No.	%
Weight percentile	**3rd**	**16**	**23.5 %**
	5th	**9**	**13.3 %**
	10th	**19**	**27.9 %**
	25th	**7**	**10.3 %**
	50th	**9**	**13.2 %**
	75th	**7**	**10.3 %**
	95th	**1**	**1.5 %**
Length percentile	**3rd**	**1**	**1.5 %**
	5th	**8**	**11.8 %**
	10th	**11**	**16.2 %**
	15th	**1**	**1.5 %**
	25th	**20**	**29.3 %**
	50th	**14**	**20.6 %**
	75th	**9**	**13.2 %**
	90th	**3**	**4.4 %**
	95th	**1**	**1.5 %**
Mid arm circumference	**3rd**	**17**	**25 %**
	15th	**35**	**51.5%**
	50th	**16**	**23.5%**
BMI for age percentile	**3rd**	**8**	**11.8 %**
	15th	**17**	**25 %**
	50th	**36**	**52.9%**
	85th	**7**	**10.3%**

Table (6): Anthropometric measures (Z score) of studied patients

	Min	Max	Mean	SD
Height for age Z-scor	**-3**	**1**	**-0.37**	**0.96**
Weight for age Z-scor	**-3**	**2**	**-0.90**	**1.14**
Weight for Height Z-scor	**-3**	**2**	**-0.62**	**1.32**
Mid arm circumference Z- Score	**-3**	**1**	**-1.01**	**0.91**
BMI Z-score				
Ideal	**7**		**10.3 %**	
Average	**35**		**51.5 %**	
Below average	**17**		**25 %**	
Pathologic malnutrition	**9**		**13.2 %**	

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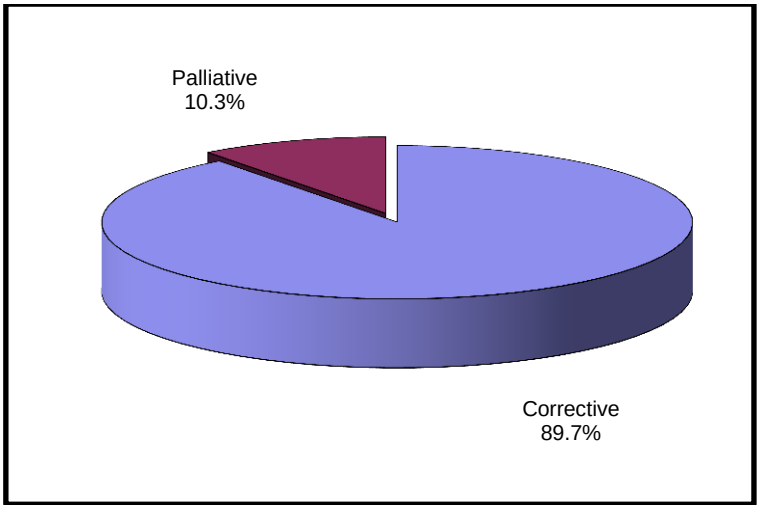

Figure (1): Type of operations

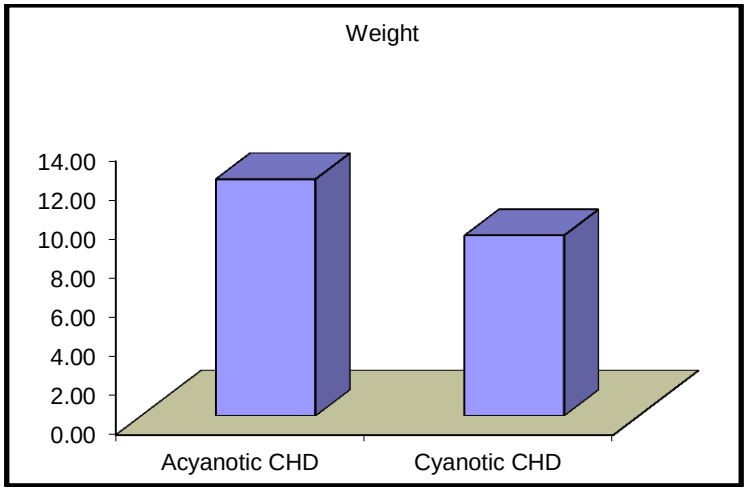

Figure (2): Weight as regards Acyanotic CHD: Cyanotic CHD

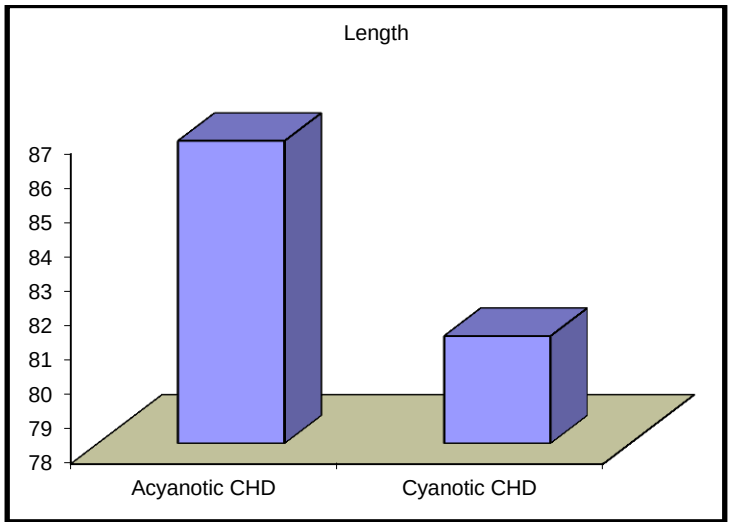

Figure (3): Length as regards Acyanotic CHD: Cyanotic CHD

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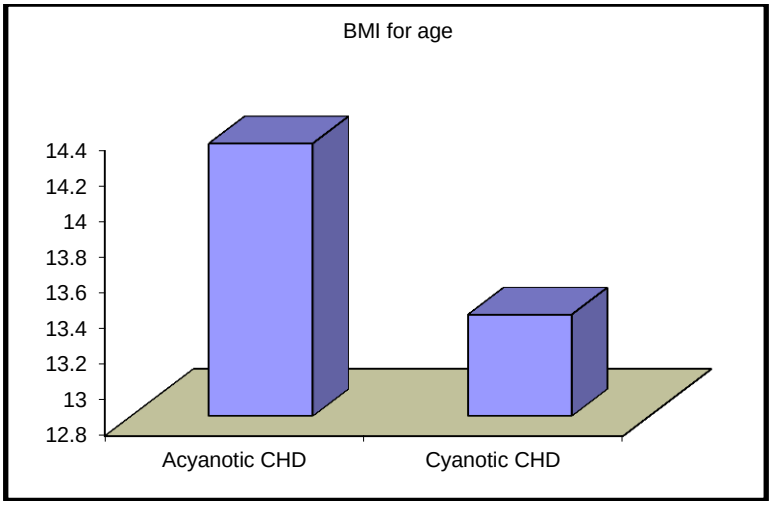

Figure (4): BMI as regards Acyanotic CHD : Cyanotic CHD

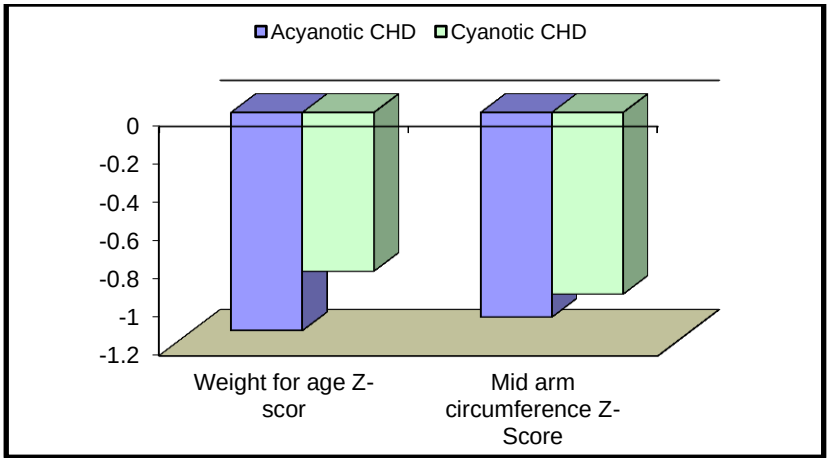

Figure (5): Weight for age and mid arm circumference Z scores

DISCUSSION

Congenital heart disease is the most common congenital problem in children accounting for nearly 25% of all congenital malformations [10]. Children with congenital heart disease (CHD) have been documented to have poor nutritional status. Factors responsible for this include genetic predisposition, pre-natal factors, increased metabolic demands in the presence of heart failure , poor oxygenation and reduced availability, intake and absorption of nutrients [11].

Malnutrition is common in infants and children with CHD. Cardiac surgery has improved patient survival and nutritional status [9].

Growth delay in children with CHD is a common complication [2]. Success in managing those children is no longer solely dependent on the post-surgical survival alone; as nowadays operative interventions have a higher success rate, hence the focus of management has turned to minimizing malnutrition, approaching age-appropriate growth parameters and improving quality of life for patient and family [4]. Therefore, this study was designed across sectional study , to evaluate the nutritional status of children with operated CHD including 68 children aged between 3 months and 6 years, at least 3 months post operatively. Throughout the period from May 2018 to the end of November 2018 in the Pediatric cardiology Unit, Children Hospital and Cardiothoracic Surgery Clinic, Zagazig University. Also, the objectives were performed to assess the nutritional status in children with operated CHD, evaluate the malnutrition status in children with operated CHD and to evaluate the daily caloric intake standards among acyanotic and cyanotic CHD children. This

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study included 68 children with acyanotic and cyanotic operated CHD. Mean age of children in this study was 2.33 months, ranged from 5 month to 5.8 years and most 52.9% were male. That disagreed with [12] was conducted a study on CHD children aged 3 months to 16 years on some of growth parameters. and resulted that a high percentage of patients were under the 5th percentile regardless of age classifications and type of CHD. In our results we found, all CHD children underwent an anthropometric evaluation (weight, length and head circumference) at presentation, the mean weight was 10.67kg, the mean head circumference was 45.55cm, the mean length was 84.29cm and the mean of mid arm circumference was 13.43cm . Regarding the body mass index (BMI) for age of CHD children > 2years, the mean of BMI was 14.6 kg/m2 . These findings were agreement with the studies of **Sjarif et al.,** [13] and **Brosig et al.,** [14]**.** Also, In our results we found, weight parameters were more affected than lenght. It was found that 27.9% of children with CHD had weight below the 10th percentile was disagreed to the results 40.3% was reported by **Dalili et al.,** [11] from Iran and 65.2% reported by **Varan et al.,** [15] from Turkey. For length percentile, 29.3% of children with CHD in this study had length below the 25th percentile which disagreed to 22.6% was reported by **Varan et al.,** [15] from Turkey and 52% reported by **Dalili et al.,** [12] from Iran. Regarding the mid arm circumference were in the 3rd ,5th and 50th percentiles were 25%, 51.5% and 23.5% for CHD children respectively. However, the subjects who's BMI was in the 15th ,50th percentiles were 25% and 52.9% for CHD children respectively. This results agreed with the results reported by **Dalili et al.,** [12] from Iran**, Mondal** and **D'Souza ,** [16] and **Isezuo et al.,** [17]**.** According to our study we found the Z score anthropometric measurements for age of CHD children, the present study showed that a mean of Z score weight for age was -0.9, that a mean Z score height for age was -0.37. Regarding , the mean Z score weight for height were -0.62. However, the mean mid arm circumference was -1.01. Additionally, the average of BMI was 35 (51.5%) and 9 (13.2%) were pathologic malnutrition which in agreement with the study by **Hassan et al.,** [18]. Our study was classified based on the presence or absence of cyanosis, that revealed a majority 54 (79.6%) of them had a cyanotic type and 14 (20.6%) CHD children had cyanotic type. That disagreed to **Isezuo et al.,** [17] was 62 (68.9%) of CHD had a cyanotic type, while 28 (31.1%) had cyanotic CHD, also the predominance of a cyanotic type 82% with **Mondal and D'Souza,** [16] in Mumbai, 74.2% with **Villasis- Keever et al.,** [19] in Mexico, 87.2% **Chen et al.,** [20] in Croatia. In contrast study by **Varan et al.,** [21] from Turkey reported predominance of cyanotic CHD 65.2% that also disagreed with our study.

Statistically, there were significant differences in weight, length and BMI for age among cyanotic CHD children as compared by a cyanotic CHD children (p value= 0.02, p value=0.039 and p value= 0.036). As regard, there were statistically significant differences between cyanotic and a cyanotic score (p value= 0.027 and p value=0.026). Nutritional defects were more evident in the case of the weight for age Z score. These findings were agreement with the study of **Sjarif et al.,** [13]**.** Our results found the pattern of malnutrition that diagnosed as (Under weight WAZ$\leq$ -2)was 27(39.7%), (stunting (chronic)HAZ $\leq$ -2) was 8(11.8%) and (wasting (acute) WHZ $\geq$-2)was 12(17.6%), that commonest malnutrition was underweight was 27 (39.7%). This results agreed with results of **Habeeb** [5] that use the Z score in defining malnutrition and reported 65.8% of patients was under weight also reported the malnutrition 66% was in a population of 460 Indians with CHD. Our results were disagreed with the study reported by **Hassan et al.,** [18] who reported stunting in 61.9% of patients, **Okoromah et al.,** [4] also reported underweight 20.5%, stunting in 28.8% cyanotic CHD and wasting in 41.1% in a cyanotic CHD while, **Ratanachu and Pongdara** [9] reported underweight 28%, stunting in 16% and wasting in 22% of 161 Thailand children with CHD, reported the most common type of malnutrition in the general Egyptian pediatric population was

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stunting, reported malnutrition prevalence of 27% of Turkish children with CHD who were below the 3rd percentile for both weight and height but they used a different method to define malnutrition reported that both wasting and stunting were more common in cyanotic CHD than in a cyanotic CHD. Also, disagreed with our results study of observed higher prevalence of wasting in acyanotic CHD associated with left to right shunts and heart failure compared with cyanotic CHD.

Our study results in comparesion between cyanotic and a cyanotic CHD children among nutritional status and oxygen saturation showed 49/54 (90.7%) had normal nutritional status and 6/14 (42.8%) of cyanotic CHD children had severe nutritional status (p value<0.001). On other hand, the mean of the oxygen saturation for acyanotic CHD children and compared with cyanotic CHD children were (92.89 vs 84.62) respectively (p value<0.001). Statistically, there were highly significant differences between cyanotic and a cyanotic CHD children among nutritional status and oxygen saturation. that in agreement with **Hassan et al., [18]** who reported that malnutrition is a very common proplem in children with CHD and predicted by the presence of low arterial oxygen saturation, and poorly dietary history. Also in agreement with our results the study of **Okoromah et al., [4]** found that the predictors of malnutrition included low arterial oxygen saturation. Regarding the clinical presentation for CHD children in our study that demonstrate signs was 26 (38.2%) were teeth caries and clinical examinations revealed under weight 27(39.7%).These findings were agreement with the studies of **Sjarif et al., [13].** Our study has been performed according to severity and modified Ross score grades for heart failure among CHD children, our study showed (79.4%) of patients had no heart failure with Ross score grades (0-2 points), (13.2%)of patients had mild heart failure(3-6points), (4.4%) of patients had moderate heart failure (7-9points) and (2.9%) of patients had severe heart failure (10-12points) was agreement with **Hassan et al., [18]** who reported that malnutrition is a very common proplem in children with symptomatic CHD and heart failure. Our results found that biochemical and hematological investigations for CHD children, was hemoglobin with a mean 11.6g/dl. That was disagreed with **Hassan et al., [18]** who reported that malnutrition is a very common proplem in children with CHD and the presence of low hemoglobin level. Morever, **Okoromah et al., [4]** found that the presence of anemia that also disagreed with our results. The total protein with a mean value 6.44g/dl, the mean of serum albumin was 3.96**,** that disagreed with study was found patients whose postoperative level were <3g/dl. Also, our results we found the mean value of iron was 99.19 micg/dl, the mean value of ferritin`was 63.45ng/ml measured in both a cyanotic and cyanotic CHD. the result of investigations, found 11.1%of children with cyanotic CHD demonstrated true iron deficiency anemia, even higher than a cyanotic CHD group which showed 3% of true iron deficiency anemia(p=0.19). No patient in their study who had serum ferritin above 300ng/ml which considered to be the upper normal range. The serum concentration of pre albumin reflects the synthesis capacity of the liver and is markedly diminished in malnutrition and other conditions. However, in our study the mean value was 18.67mg/dl in postoperatively children ,that disagreed the study performed preoperatively that reported patients undergoing cardiac surgery with preoperative pre albumin levels $\leq$ 20mg/dl have an increased risk for postoperative infections and the need for longer mechanical ventilation.

In our study serum electrolytes disorders following cardiac surgery for cyanotic and acyanotic CHD children. The mean value of serum sodium was 138.5mmol/l, the mean value of serum potassium was 4.09 mmol/l, the mean value of serum magnesium was 1.97mg/dl, the mean value of serum phosphorus was 3.39mg/dl and the mean value of serum calcium was 8.99mg/dl. The study who showed that postoperative level of serum (magnesium, sodium and calcium) varied within normal ranges, while only potassium

was significantly associated with postoperative cardiac surgery was 3.44mmol/l. Also our results disagreed with the study of that showed postoperative serum (magnesium, sodium, calcium and potassium) varied within normal ranges and insignificantly associated with postoperative cardiac surgery (magnesium was 1.5mmol/dl and calcium was 4.75mmol/dl. Also study evaluated that pre and postoperative mean levels of electrolytes, were in normal ranges and significant relationship was found with postoperative cardiac surgery as serum (sodium 144mEq/l, potassium 3.78mEq/l and ionized calcium 1.15mmol/l).

In our study pre- and postoperative for CHD children, according to echocardiography results was the most CHD was PDA(32.4%), the TOF was (5.9%), the VSD was (20.6%), the COA and PS was (11.8%), and the last one was AVC (5.9%). However, the ejection fraction EF% of cardiac function documented in 49(72.1%) of patients as normal EF. the study disagreed with our results was who found VSD the predominant (36%), followed by ASD(14%) and PDA (0.4%) regarding acyanotic CHD. TOF was found in (26%) regarding cyanotic CHD. study, they found the most common acyanotic CHD was VSD(21.5%) and common cyanotic CHD was TOF(19.8%).

Our study was performed the type of operation and operating time. According to the type of operation, there were 89.7% of CHD children undergoing corrective operation and 10.3% of them undergoing palliative operation. Regarding, the operating time was ranged from 3-18months, with a mean value 6.7months.

Including postoperatively echocardiography follow up in our study found 16.2% of patients were pulmonary hypertension and EF of cardiac function improvement in 13(19.1%)of patients were corrective operated and4(5.9%) of patients were palliative operated. The **Varan et al.,** [21] study were disagreed to our study who's found cyanosis and pulmonary hypertension were important predictors of nutrition and growth in cyanotic CHD.

Our study presented comparesion between preoperative and postoperative as regard to the mean values of daily dietary intake of calories, the mean value of ideal daily dietary intake of calories (24h) was 1175 calori/day. The result of our study found in preoperative as regard to daily dietary intake of calories(24h) with a mean value 1020 calori/day and postoperative with a mean value 1096 calori/ day.

The study of **Litch et al.,** [22] and **Varan et al.,** [15] disagreed with our study that cyanotic infants had a lower daily caloric intake when compared to the age matched cyanotic CHD children. This study was conducted in the only tertiary teaching hospital and the severe CHD are likely referred for evaluation and management.

Some centres have established home monitoring programs with the aim of nutritional surveillance and management after discharge [23].

Conclusion: The malnutrition in children with operated congenital heart disease is a major problem in pediatric hospital of Zagazig university as the prevalence of malnutrition among those children was high.

Conflict of interest The authors declare that they have no conflict of interest.

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