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Assessment of Nutrition State in Children with Heart Diseases

Hanan M.Abdelmoneim, Bahaa Elamir Hawary, Alaa Magdi Eldoctour Soliman*
Department of Pediatrics, Faculty of Medicine Aswan University
*** Corresponding author:** Alaa Magdi Eldoctour Soliman, **Mobile:** (+20)01009118747, **E-mail:** alaa.kroosh@gmail.com

ABSTRACT

Background: It is well- known that children with congenital heart diseases (CHD) are at high risk for nutrition and growth restrictions. **Objective:** The purpose of this study was to assess growth restriction in infants and young children with heart disease and investigate the relationship between poor growth, feeding difficulties, cardiac classification, and nutrition intervention on outcomes. **Materials and Methods:** This study was performed on 100 children, 50 of them with symptomatic CHD (patient group). They were recruited from the Pediatric Cardiology Outpatient Clinic at Aswan Heart Center from March to August, 2016. A group of 50 apparently healthy children matched in age and sex represented our control group. CHD was diagnosed or excluded by clinical findings and echocardiographic and other routine tests. **Results:** We found there was some growth restriction in children with CHD compared to normal children in same age group. The growth deficiency was wasting rather than stunting and it was found to be the most common type of malnutrition in our study. No relationship between cardiac complexity, classification (cyanotic vs. acyanotic) and variables including growth parameters. Close nutritional monitoring should be included routinely for all children with CHD regardless of cardiac classification. Age at time of corrective surgery affects the potential for nutritional recovery and catch-up growth. **Conclusion**: Children with CHD require unique nutritional challenges. It is important to start dealing with nutrition status in congenital heart diseases as a preventable association rather than common consequence. Nutritional screening for diagnosed CHD cases will help in early detection of growth faltering, consequently it will provide access to early nutrition intervention and improve patient outcomes.

Keywords: Congenital Heart Disease, Malnutrition, Immunonutrition, Nutrition in CHD.

INTRODUCTION

Congenital heart disease (CHD) is a significant health problem. It affects between 0.3% and 1.5% of all pregnancies. Children with CHD are known to show marked decreases in their growth patterns compared to healthy children in same age group**.** It is also known that surgery and the load of chronic disease and cardiac failure result in significant metabolic and nutritional stress. Moreover, insufficient nutritional intake in the post-operative period results in further challenges to restor normal growth parameters [(1)].

Understanding the degree of growth restriction, type of feeding difficulty, cardiac classification/diagnoses and pre-surgery nutrition intervention in children with CHD have a beneficial to restructure proper clinical interventions. Wavering growth preadmission and low growth parameters are usually allied with the increased hospital length stay and recurrent admissions. Nutritional screening and follow up may detect growth wavering, enable access to early nutrition intervention and improve patient consequences [(2)]**.** Cautious assessment and awareness of the nutritional needs in the hospitalized critically ill child is significant. Insure appropriate nutrition in those patients by the two main methods (enteral and parenteral) help in better outcome [(3)].

The ability to enhance and modulate the immune system activity by interventions with particular nutrients is termed immuno-nutrition. When we prescribe a specific diet, it is important to consider that nutrients are not only elements to influence body growth. They also have a crucial powerful force improving the whole body health through their ability for regulation of immune system [(4)]**.**

Nutrition restrictions and malnutrition in the child with congenital heart disease could be avoidable. The main line of prevention are nutrition interferences (oral intake or nutrition support) and close follow up. Delivering well tolerated nutrition intervention help in promoting weight gain [(5)].

AIM OF THE WORK

The purpose of this study was to assess growth restriction in infants and young children with heart disease and investigate the relationship between poor growth, feeding difficulties, cardiac classification and nutrition intervention on outcomes.

PATIENTS AND METHODS

Study Design:

This was a case–control observational study of 50 children in age group (0-60 months) with symptomatic congenital heart disease. They were enrolled from Pediatric Cardiology Outpatient Clinic at Aswan Heart Center between March to August, 2016. A group of 50 apparently healthy children matched in age and sex represented our control group. Informed consent was obtained from parents and other caregivers before enrolment.

Ethical approval:

In addition, the study was approved by the Ethical Committee of Faculty of Medicine, Aswan University.

Data Collection:

(1) The 50 children with symptomatic CHD were enrolled for:

- Medical history as well as clinical examination.
- They were classified according to clinical presentation and echocardiography finding into two subgroups (cyanotic, acyanotic).

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- Initial nutrition assessment prior to admission for correction of the congenital heart defect either by cath. or surgically. The assessment included the three main modalities of assessment (subjective, objective and biochemical).
- On discharge time, family counselling regarding the child special need and nutrients requirement was done.
- Three months' duration follow-up assessment in outpatient clinics including the 3 main modalities was done.

(2) A group of 50 apparently healthy children Selected from normal cases in other screening studies (in Aswan Heart Center) or Normal cases miss-diagnosed as CHD (ex. PFO /ASD) were enrolled for:

- Full medical history as well as a clinical examination. Nutrition assessment including subjective, objective and biochemical modalities was done. Family counseling regarding healthy diet for the general population in this age group was done.
- Echocardiography study to exclude any abnormal echocardiographic findings.

(3) Data analysis and comparisons between the two main groups (cases, control) and the two subgroups (cyanotic, acyanotic) were done in both initial assessment and follow-up.

(4) Results about the pattern and degrees of nutrition in the study population discussed for possible applicable recommendations.

Interventions: None. Analysis of patient data only

Inclusion Criteria include:

- AGE: (0-60 months)
- Both sexes.
- Diagnosed as cardiac patient
- ***Exclusion Criteria:***
- Any serious ongoing acute illness requiring hospitalization.
- Chronic illnesses other than CHD associated with demonstrable edema.
- Dysmorphic features, other diseases including genetic disorders affecting the growth or the nutritional status of the children.

There was no apparently significant social level difference between participants

Methodology: All the children were subjected to:

1. History and clinical examination:

- Personal history: Name, Age, Sex, Mode of delivery**,** NICU admission and recurrent hospital admission.
- Present history: Symptoms of feeding difficulties.
- Socioeconomic history.
- Dietary History: Frequency of feeding, allergy to special formula/food, multivitamins intake**,** difficulty in feeding and the relative proportions of protein, carbohydrate and fat consumed was reviewed with the mother. we did a family counselling and health /dietitian education to the family.
- Clinical signs of malnutrition, such as symmetrical edema, skin lesions and dry, thin and depigmented hair were assessed.

2. Methods of Assessment of Nutrition:

A) Subjective: Subjective Global Assessment (SGA).

B) Objective: Anthropometric measures, WHO Z-score.

C) Biochemical markers: Hemoglobin (g/dl) and serum albumin (g/dl).

The study population (diseased part) were all enrolled to the same post-operative nutrition protocol: *(Aswan Heart Center protocol)*

Baseline caloric requirements

1. For patients with a body mass index (BMI) < 30 kg/m^2:

Administer 25-35 kcal/kg/day based on actual body weight.

(BMI = (wt. in kg)/ (height in meters)^2)

2. If BMI ≥ 30 $kg/m^{2:}$

Administer 22-25 kcal/kg based on ABW

ABYV = [(actual weight - IBW) x 0.25] + IBW.
IBW = 22 x height in meters^2-

For patients with renal dysfunction or on regular hemodialysis:

Daily protein requirements = 1.5-2.5 gm/ Kg/ Day.

For diabetic patients or stress induced ulcer:

Start with 150-200 gm dextrose/ day or increase the lipid content to 50% instead of 30%.

a) Lipids are infused separately and in a rate = 0 .1 gm/Kg/hour not exceeding 12 hours.

b) Lipid infusion tubing should be discarded after administration (after 12 hours).

c) A daily amount of vitamins, trace elements & electrolytes:

Na	60 - 150 mEq/day.
K	40 - 80 mEq/day.
PO4	10 - 40 moll/day.
Ca	10 - 15 mEq/day.
Mg	8 - 2 0 mEq/day

(ACCP Updates in Therapeutics 2013).

Statistical Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) release 16. Data with a normal distribution are presented as mean and SD. The mean of two groups was compared by t-test. Non-parametric values were represented as median and range, and the medians of two groups were compared by Mann–Whitney U test. Qualitative data were represented by their frequency and relative percentage, and chi-square test was used for testing association of qualitative data. Correlations were performed using the Pearson bivariate correlation. A p-value of <0.05 was considered statistically significant.

Comparisons were made between the two main study groups (controls and cases) and the three subgroups (controls, a cyanotic group and cyanotic group).

Continuous variables were expressed as means and SDs if they were normally distributed and as median and range if skewed. Differences were considered significant at $p<0.05$.

RESULTS

Study Population:

A total 50 children with symptomatic CHD were recruited in this study from the Pediatric Cardiology Outpatient Clinic at Aswan Heart Center. A group of 50 healthy children matched in age and sex represented our control group. Demographic characteristics are given in table (1).

Table (1): Demographic criteria in patients and control

	Cases	***Control***	***p-value***
Age (0-60 months***)***	12 (0-56)	10 (2-58)	> 0.05[a]
Gender(male/female)	(42.6 /57.4	(47/53)	> 0.05[b]
Gestational age(weeks)	39.5 ± 0.85	39.4 ± 0.88	> 0.05[c]
Birth weight (kg)	2.3 ± 0.6	3.0 ± 0.5	<0.05[c]
Poor nutritional history	69%	22%	<0.05[b]

[a] Mann–Whitney U test. [b] Chi-square test. [c] t-test.

No significant differences were detected between patients and controls in demographic data excluding birth weight, which was higher in the control group. Additional, the poor nutritional history was significantly different in the patient group.

Subjective Global Assessment (Questionnaire):

Anthropometric and laboratory data are shown in table (2). According to SGA, 20 % (n = 10) of patients were not at risk of undernutrition and 70% of patients were diagnosed as well nourished by SGA.

The reliability indicators including (accuracy, positive power and negative power) of the SGA method were 66.428%, 56.074% and 41.25%, respectively. Likelihood ratio positive (LR+), likelihood ratio negative(LR-) and odds ratio (OR) of the SGA method were 1.628, 0.256 and 6.359, respectively.

Table (2): Anthropometric measures and biochemical markers (initial assessment in the two main groups)

Anthropometric measures	*Cases (no.=50)*	*Control(no.=50)*	*p-value*
Weight (kg), mean ± SD			
Height/ length (cm), mean ± SD	6.5 ± 3.4	10 ± 4.3	<0.05[b]
Head circumference (cm), mean ± SD	66.3 ± 4.3	73.2 ± 4.2	<0.05[c]
Mid-upper arm circumference (cm), mean ± SD	42 ± 4.1	43.3 ± 2.8	<0.05[c]
Triceps skin fold thickness (mm), median (range)	11.7 ± 2.3	13.2 ± 1.4	<0.05[c]
Subscapular skin fold thickness(mm), median (range)	5.5 (4–10)	8 (5.3–13.1)	<0.05[b]
Biochemical markers levels	4 (3.2–7.4)	7 (5.5–10.2)	<0.05[a]
Hemoglobin (g/dl), mean ± SD	10.2 ± 1.2	12.3 ± 1.0	<0.05[c]
Serum albumin (g/dl), mean ± SD	3.7 ± 0.8	4.31 ± 0.8	<0.05[c]

[a] Mann–Whitney U test. [b] Chi-square test. [c] t-test.

Both anthropometric measures and biochemical markers showed that there was significant malnutrition and some growth restriction in children with CHD compared to normal children in same age group.

Table (3): Nutritional status in patients and control group "initial assessment".

	Cases (no.=50)	***Control (no.=50)***	***P-value***
Nutrition status, n (%)			
Normal	7 (14%)	44 (88%)	<0.05
Malnutrition	43 (86%)	6 (12%)	<0.05
Pattern of malnutrition n (%)			
Underweight (WAZ ≤ -2 SD)	5 (11.6%)	1 (16.6%) 1	>0.05
Wasting (WHZ ≤-2 SD)	26 (60.4%)	(16.6%)	<0.05
Stunting (HAZ ≤ -2 SD)	12 (27.9%)	4 (66.6%)	<0.05
Degree of malnutrition, n (%)			
Moderate	16 (37.2%)	8(95%)	<0.05
Sever	27 (62.7%)	2(5%)	<0.05

The nutritional status for the case and control group.

- The overall prevalence of malnutrition reached 86.0% in cases compared to 20% in the control group.
- In children with CHD, prevalence of wasting (low WHZ) and stunting (low HAZ) were significantly higher compared to the control group.
- Also, the relative proportion of children with severe malnutrition was significantly higher in patients with CHD.

Table (4): Nutritional status in patients with acyanotic and cyanotic CHD the two subgroups

	Acyanotic CHD (no=29)	***Cyanotic CHD (no=21)***	***p-Value***
Nutrition status, n (%)			
Normal	4 (13.8%)	3 (14.2%)	> 0.05
Malnutrition	25 (86.2%)	18 (85.7%)	> 0.05
Pattern of malnutrition n (%),			
Underweight (WAZ < -2 SD)	4 (16%)	1 (5.5%)	> 0.05
Wasting (WHZ < -2 SD)	10 (40%)	16 (88.8%) 1	<0.05
Stunting (HAZ < -2 SD)	11 (44%)	(5.5%)	<0.05
Degree of malnutrition, n (%)			
Moderate	15 (60%)	7 (38.8%)	<0.05
Sever	10 (40%)	12 (61.2%)	< 0.05

In patients with CHD, no significant difference in nutrition status between acyanotic (86.2%) and cyanotic (85.7%). Additionally, stunting was proportionately higher (44%) in acyanotic subgroup, while wasting was predominant (76 %) in the cyanotic subpopulation. Moreover, the degree of malnutrition was significantly high in cyanotic group (61.2%) as shown in table (4).

Subjective Global Assessment "follow-up":

The study sample population comprised follow-up of total 50 children with congenital heart disease. Patients' anthropometric and laboratory follow up data are shown in table (5). According to SGA, 46 % (n = 23) of patients were not at risk of under-nutrition and 54 % (n = 27) were at risk of under-nutrition. Based on objective assessment of nutritional status, 36 % (n =18) of patients were well nourished and 64% (n = 32) were undernourished and according to SGA were really undernourished. Also, 78 % of patients who were diagnosed as well nourished by SGA were really well nourished. The reliability indicators including (accuracy, positive power and negative power) of the SGA method were 66.428%, 56.074% and 41.25%, respectively. Likelihood ratio positive (LR+), likelihood ratio negative (LR-) and odds ratio (OR) of the SGA method were 1.628, 0.256 and 6.359, respectively (Table 5).

Table (5): Anthropometric Measurements, Biochemical markers "Follow-up"

	Follow-up	***Control***	***p-value***
Anthropometric Measurements			
Weight (kg), mean ± SD	9 ±3.7	10± 4.3	>0.05[b]
Height or length (cm), mean ± SD	68 ± 5.2	73.2 ± 4.2	<0.05[c]
Head circumference (cm), mean ± SD	43 ± 4.1	43.3 ± 2.8	>0.05[c]
Mid-upper arm circumference (cm), mean ± SD	12 ± 2.3	13.2 ± 1.4	<0.05[c]
Triceps skin fold thickness (mm), median (range)	5.8 (4-10)	8 (5.3-13.1)	<0.05[b]
Subscapular skin fold thickness(mm), median (range)	4.3 (3.2-7.4)	7 (5.5-10.2)	<0.05[a]
Biochemical markers levels			
Hemoglobin (g/dl), mean ± SD	11 ± 1.2	12.3 ± 1.0	>0.05[c]
Serum albumin (g/dl), mean ± SD	3.9 ± 0.50	4.31 ± 0.8	>0.05[c]

[a] *Mann–Whitney U test.* [b] *Chi-square test.* [c] *t-test.*

Anthropometric measures showed that there was significant malnutrition and some growth restriction in follow up group compared to normal children in same age group. There were no significant differences between follow up group and controls regarding biochemical markers level.

Table (6): The Nutrition status in follow-up and control group

	"Follow –up" (no.=50)	***Control (no.=50)***	***P-value***
Nutrition status, n (%)			
Normal	18 (36%)	44 (88%)	<0.05
Malnutrition	32 (64%)	6 (12%)	<0.05
Pattern of malnutrition n (%),			
Underweight (WAZ ≤ -2 SD)	11 (34%)	1(16.6%)	> 0.05
Wasting (WHZ ≤-2 SD)	12 (37.5%) 9 (21.8%)	1(16.6%) 4 (66.6%)	>0.05
Stunting (HAZ ≤ -2 SD)	22 (68.7%)		<0.05
Degree of malnutrition, n (%)	10 (31.3%)	9 (95%)	
Moderate		1 (5%)	<0.05
Sever			<0.05

Regarding nutritional status for the case **"follow-up"** and control group, there was significant malnutrition, the overall prevalence of malnutrition reached (64%) in cases compared to 12% in the control group. Malnutrition patterns showed significant stunting (HAZ) compared to the control group. Also, the relative proportion of children with severe malnutrition was significantly higher in patients with CHD compared to control group (Table 6).

Table (7): The Nutrition status in follow-up in the cyanotic and acyanotic subgroups

	Acyanotic CHD (no=29)	***Cyanotic CHD (no=21)***	***p-Value***
Nutrition status, n (%)			
Normal	10 (34.4%)	8 (38 %)	> 0.05
Malnutrition	19 (65.5%)	13 (61.9%)	> 0.05
Pattern of malnutrition n (%),			
Underweight (WAZ < -2 SD)	7 (36.8%)	6 (46.2)	> 0.05
Wasting (WHZ < -2 SD)	6 (31.5%)	6 (46.2%)	> 0.05
Stunting (HAZ < -2 SD)	6 (31.5%)	1 (7.6%)	> 0.05
Degree of malnutrition, n (%)			
Moderate	16 (84.2%)	6 (46.2%)	<0.05
Severe	3 (15.7%)	7 (53.8%)	< 0.05

In patients with CHD "follow-up", no significant difference in nutrition status between acyanotic (65.5%) and cyanotic (61.9%). No significantly difference in pattern of malnutrition between the two subgroups. The degree of malnutrition was significantly higher in cyanotic group (35.8%)

DISCUSSION

Our study has been performed to evaluate nutritional status and growth of children with CHD, extend the evidence-base about the effects of growth restriction/poor growth, cardiac diagnosis, feeding difficulty in infants and young children with CHD. The high prevalence of 86% in our CHD group demonstrates the importance of malnutrition in patients with CHD. Moreover, 62.7% of cases had severe malnutrition. Previous reports showed that CHD-related malnutrition is particularly common in developing countries, but prevalence varies widely from 27% up to 90.4%.

This current study was conducted in Aswan Heart Center. It is a tertiary cardiothoracic center to which cases with severe CHD and its complications are likely to be referred to for evaluation, management and early surgical correction. In the present study, double-outlet right ventricle, Tetralogy of Fallout, transposition of great vessels, aortic abnormalities, pulmonary artery abnormalities and left to right shunt lesions association with predominantly pulmonary hypertension, moderate to severe CHF were the most common cardiac lesions.

In our study, in relation to complexity of cardiac diagnosis, the majority of participants had more than congenital heart defect, but none of these subgroups were significantly associated with growth restriction. We did not find any significant difference between cyanotic & acyanotic CHD where both of them had similar nutrition status. The overall malnutrition in a cyanotic (86.2%) and cyanotic (85. 7%). We are concordant with **Costello *et al.*** [(2)] who reported no relationship between cardiac classification (cyanotic vs. acyanotic) and variables including nutrition growth parameters and growth history. There was no relationship between common cardiac diagnoses (e.g., TGA, TOF, and VSD) and nutrition or growth variables. These findings are in contrast to the majority of the literature [(6)].

Despite earlier diagnosis and major advances in medical and surgical management, growth restriction remains an ongoing problem prior to cardiac surgery in this population. Most recent studies indicate that weight was more affected than height in this population, which supports international research [(2)]. This is in agreement with our study where relative proportions of underweight,

wasting and stunting in our study patient group were 11.6, 60.4, and 27.9%, respectively. This is in agreement with **Okoromah *et al.*** [7] who reported that the relative proportions of underweight, wasting and stunting were 20.5, 41.1and 28.8 %, respectively. As in the study of **Okoromah *et al.*** [7] the high prevalence of malnutrition in our study may be explained by several factors including the distribution pattern of cardiac lesions and the presence of severe complications of CHD such as CHF. This is also in concordance with **Owens *et al.*** [8] study, which indicated significantly that the child's age at time of corrective surgery affects the potential for nutritional recovery and catch-up growth.

In the present study, stunting was proportionately higher (44%) in acyanotic subgroup, while wasting was predominant (76 %) in the cyanotic subpopulation. Several studies of the patterns of malnutrition in CHD vary widely [9]**.** In contrast to our results, **Okoromah *et al.*** [7] reported that children with acyanotic CHD were more likely to be wasted, while those with cyanotic CHD were more prone to stunting. Also, **Salzer *et al.*** [10] observed a higher prevalence of wasting in acyanotic CHD associated with left to right shunts and heart failure compared to cyanotic CHD.

In the present study, the significant contributing factors of malnutrition were poor dietary history, anemia, heart failure and pulmonary hypertension. In agreement with these findings, **Okoromah *et al.*** [7] found that the predictors of malnutrition included CHF, type of CHD, duration of symptoms, age under 5 years, anemia, low arterial oxygen saturation and poor dietary fat intake. In south India, **Vaidyanthan *et al.*** [6] reported that older age at corrective intervention and lower growth potential as predictors of malnutrition in children with CHD, whereas factors like cardiac diagnosis, dietary intake and socioeconomic scale had no significant impact on nutritional status. However, in Mexico, **Villasís-Keever *et al.*** [11] found that the risk factors associated with malnutrition were the presence of a cyanotic CHD, the lack of nutritional supplementation and a greater number of family members.

In our current study, we used the Subjective Global Nutrition Assessment as a subjective clinical modality for nutrition status assessment in children with congenital heart disease. Whereas objective measures of nutritional status cannot take into account all of the variables that a clinician should consider to identify malnutrition.

In agreement with **Secker and Khursheed** [12], we found that subjective global nutrition assessment (SGNA) help us to make a complete nutrition assessment. It has strong clinical judgement to know if this child short or thin? Is it by nature or because of inadequate intake? If intake is inadequate, what is the cause? Is there physical evidence of wasting to support the historical findings? Are losses of body mass affecting the child's ability to perform? Is the child's nutritional status and functioning worsening or beginning to improve? Is the child likely to continue to have problems? What needs to be treated?

In Concordance to Our study, a lot of families reported that their babies/ children had a feeding difficulty and this was associated with lower growth parameters especially preoperative. We also found a significant relationship between faltering growth preadmission and presence of a feeding difficulty. We used this questionnaire also for clinical judgment & follow–up. That questionnaire was also a good tool for family counselling regarding main nutritional facts, the special needs and specific feeding difficulties of the CHD baby that highly correlates to the daily caloric intake. We had discussed with the mother how to feed her baby properly & different ways to boost calories intake.

In agreement with **Venugopalan *et al.*** [6] another predictor of malnutrition among children with congenital heart disease in this study is weight for height using z-score. Currently, the WHO recommended the use of Z-Score or SD system to grade under nutrition. This method measures all the three indices and expresses the results in terms of Z scores or standard deviation units which other methods don't. This is in concordance with our study result as the children with pre-operative malnutrition pattern low weight for age (WAZ), low weight for height (WHZ), low height for age (HAZ) score ($\leq$ -2) and showed slow rate of weight gain post-operative. However, since WAZ did not differ significantly across different RACHS-1 score severities of surgery, it would appear that surgery for severe lesions was undertaken regardless of nutritional status and a long-term study on nutrition and outcomes is needed to examine whether increasing nutrient supply, particularly protein, preoperatively may be of benefit to counteract the adverse effects of low WAZ in neonates undergoing surgery for CHD [13]**.**

A study in 2011, identified increases in IGF-1 and its carrier protein insulin-like growth factor binding protein-3 after surgical repair in children with acyanotic CHD. Authors postulated that these increases are related to improved postoperative nutrition. As, the increase in growth factors may be more directly related to the repair, which often results in resolution of congestive heart failure with improved cardiovascular physiology [14]**.**

In our current study follow-up, however there was proportional improvement in the nutrition status as malnutrition was 64% in comparison with 86% in the initial readings. The anthropometric measures showed that there was significant malnutrition and some growth restriction in "follow-up" group 64% compared to normal children 12% in same age group. There were no significant differences between "follow-up" group and controls regarding biochemical markers level.

The malnutrition pattern showed significant stunting (low HAZ) in comparison with the control group. Also, the severity of malnutrition was relatively increased in CHD patient's follow-up. This is in agreement with the regional variations in the distribution of malnutrition that may also contribute to these differences. According to Egypt Demographic and Health Survey 2006 & 2008, stunting was the most common type of malnutrition in the general Egyptian pediatric population [15]**.**

As a conclusion, close nutritional monitoring should be included routinely for all children with CHD regardless of cardiac classification. Nutrition guidelines

should be added to both surgical and medical guidelines in management of children with congenital heart disease as it has a significant contributing relation to the overall outcome. This recommendation is in agreement with almost all nutrition studies done for pediatrics population. For example, recommended routine nutritional rehabilitation as standard practice in the management protocol of these children and early surgical repair / interventional procedure. **Arodiwe *et al.*** [16] reported that in order to improve the nutritional status and decrease the risk of late mortality, more needs to be done to determine novel ways of delivering sufficient nutrition support [13]**.** Having a dedicated multidisciplinary care team of dietitians, nurses, physicians, nurse practitioners, physician assistants, speech and occupational therapists is fundamental in the success of nutrition care in these patients [5]**.**

CONCLUSION

Congenital heart defects (CHD) are commonly associated with malnutrition in pediatrics population. A complicated management approaches is needed. A combined balanced surgical, medical and nutritional management is decided according to the cardiac lesion category and severity.

Children with CHD require unique nutritional challenges. It is important to start dealing with nutrition status in congenital heart diseases as a preventable association rather than common consequence. Nutritional screening for diagnosed CHD cases will help in early detection of growth faltering. Consequently, it will provide access to early nutrition intervention and improve patient outcomes.

RECOMMENDATIONS

- Medical practices in CHD outline protocols should give high consideration to the concept of "migrate poor growth in children with CHD".
- We recommend routine nutritional assessment as "standard practice" in the management protocol of CHD children in both medical and surgical (early surgical repair / interventional procedure) stages. Subjective global nutrition assessment could be used as a simple and reliable bed side method of assessment.
- Interventions with specific nutrients in the term of immunonutrition (glutamine, omega-3 fatty acids, antioxidants such as vitamin E, vitamin C, selenium, copper, iron and zinc) are highly recommended.
- Approaches to Application of dietary advices are required for good communication practice between patients and health care providers. Health care providers should be aware about these strategies. Awareness could be incorporated through educational sessions for (physicians, nurses and dietitians).
- More comparative researches between different protocols including our suggested protocol is highly recommended.
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