

# Nutritional Disorders and Nutritional Management of Pediatric Cardiac Patients

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## Abstract

**Background:** Malnutrition is common in children with congenital heart disease (CHD) due to increased energy needs from a hypermetabolic state and decreased intake from factors like fluid limitations and poor intestinal blood flow. This can lead to stunting, wasting, and underweight. Nutrition for pediatric cardiac patients focuses on providing adequate calories and protein for growth while managing fluid, sodium, and fat intake, often requiring tailored approaches to support healing, manage heart failure, and prevent malnutrition.

**Objective:** To review nutritional disorders in children with heart diseases and nutritional management of pediatric cardiac patients.

**Conclusion:** Early nutritional assessment and intervention, including tailored feeding strategies and optimizing preoperative nutrition, are crucial to improve surgical outcomes, growth, and overall health in these vulnerable children. Providing adequate nutrition before surgery significantly improves post-operative outcomes.

**Keywords:** pediatric cardiac patients; congenital heart disease; malnutrition; nutritional management; growth; enteral nutrition.

## Introduction

Malnutrition is common in children with congenital heart disease (CHD) due to increased energy needs from a hypermetabolic state and decreased intake from factors like fluid limitations and poor intestinal blood flow. This can lead to stunting, wasting, and underweight. Early nutritional assessment and intervention, including tailored feeding strategies and optimizing preoperative nutrition, are crucial to improve surgical outcomes, growth, and overall health in these vulnerable children [1].

The heart condition can create a hypermetabolic state, meaning the body burns more calories than usual. Reduced nutritional intake represents the major problem. Some treatments require restricting fluids, which can also limit the volume of food a child can consume. Decreased blood flow to the intestines can reduce nutrient absorption [2].

For pediatric cardiac patients managed medically, nutrition is focused on supporting chronic growth and managing heart failure symptoms. These children are often in a state of "compensated failure," where their bodies work harder just to maintain basic functions. This hypermetabolic state necessitates a proactive approach to prevent "cardiac cachexia" (severe wasting) and to ensure the child remains a viable candidate for future interventions [3].

Nutrition is a positive epigenetic factor: an adequate nutritional intervention in a developmental critical period can change the outcome in adulthood. This concept has a revolutionary power and supports the idea that nutritional treatment should be considered comparable to drug therapy [4].

## Nutritional Treatment and Feeding During Childhood

Human milk is universally recognized as the "gold standard" for infant nutrition, so every other nutritional strategy must be compared to it [5]. Breast milk contains an elevated amount of saturated fat and cholesterol but

a low amount of sodium. Infants who are breastfed have higher blood cholesterol levels at one year of age if compared to formula-fed infants, but when they become adults, these data are often inverted and adults who have been breastfed tend to have lower blood cholesterol values [6].

Furthermore, breast-feeding is associated with at least two behavioral benefits on cardiovascular risk: a better self-regulation on intake amounts, and a taste evolution that may improve acceptance and preference of healthy foods after weaning and later in life. Evidence suggests that infants who were breastfed tend to have lower blood pressure values [7].

Breastfeeding seems to have a protective effect towards the development of future obesity. The period from complementary feeding to the achievement of a mature diet, from 4–6 months to 2–3 years of age, represents a radical shift in pattern of food consumption. The introduction of solid food as a complement of breastmilk or formula milk should start at about 6 months of age to grant a sufficient amount of micronutrients, but the optimal methods to fulfill this goal are not clearly defined [4].

Current feeding practices are influenced by small scale studies of infant feeding behavior, parental behavior, popular opinions and folk customs. New healthy foods may need to be introduced repeatedly to establish taste preferences. Moreover, it is recognized that children ranging from 2 to 5 years of age are selective in their food choices [1].

After 2 years of age, the amount of calories derived from fat should be gradually reduced to less than 30% of total daily calories. Calories no more introduced as fat should be replaced with grain products, fruits, vegetables, low fat milk products, legumes, lean meat, fish or other protein rich foods [2].

In the age from 2 to 6 years, challenges are related to providing quality nutrient intake and avoiding excessive caloric intake. A significant amount of saturated fat and cholesterol derives from milk and dairy products in this age group, therefore a transition to low-fat milk and other dairy products is important [8]. In clinical practice, some parents and their children may over-interpret the need to restrict their fat intakes. For this reason, it is important to give a higher accepted limit of fat intake; these recommendations are for average intake over several days, so that if fat-rich foods are consumed, compensation can be obtained by eating healthier food in the other weekly meals [9].

Since no single food item provides all the essential nutrients in the amounts needed, food variety seems to be a key stone in building an adequate diet. As children grow up, sources of food and influences on eating behavior increase; many meals and snacks are usually consumed away from home and often without supervision [1].

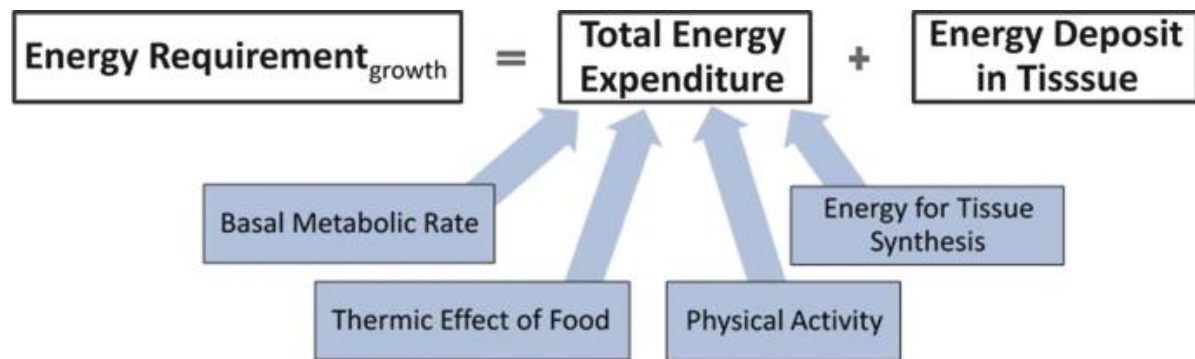
Significant adverse changes occur in older children's food consumption: they usually reduce or skip breakfast and increase intake of snacks, fried and nutrient-poor foods, sweetened beverages, as well as portion size at each meal [6]. In addition, at this age dairy product consumption decreases and there is a shift away from fruit and vegetable consumption. This shift in dietary patterns in adolescence results in calcium, potassium, iron, zinc and vitamins intake below recommended levels, whereas sodium intake is far above recommended intake [5]. Adolescence is a nutritionally vulnerable developmental stage, as growth rate accelerates; therefore, counselling in late childhood and adolescence should be individualized for better dealing with contemporary lifestyles [8].

### **Nutritional Management of Pediatric Cardiac Patients**

Nutrition for pediatric cardiac patients focuses on providing adequate calories and protein for growth while managing fluid, sodium, and fat intake, often requiring tailored approaches like high-protein diets (1.2–1.5 g/kg/day), specific macronutrient ratios, and supplements (omega-3, Vitamin D, iron) to support healing, manage heart failure, and prevent malnutrition, with feeding methods evolving from enteral (tube) to oral based on stability [10].

### Key Nutritional Goals

Energy and protein: Ensure sufficient calories for increased metabolic demands due to heart stress and adequate protein (1.2–1.5 g/kg/day) for growth, often challenging due to poor intake or fluid restrictions.



**Figure 1: Energy requirement for growth (Vichayavilas et al., 2021).**

Sodium and fluid: Limit sodium and control fluid intake to prevent volume overload, especially with heart failure. Fats: Focus on healthy fats (olive oil, nuts, fish) and limit saturated/trans fats to manage cholesterol. Micronutrients: Address deficiencies in zinc and iron, especially with diuretics, and consider Omega-3s and high-sodium items [12].

### Dietary Recommendations

Emphasize fruits, vegetables, whole grains, lean proteins (fish, poultry, beans, and nuts), low-fat dairy, and healthy oils. Limit or avoid processed foods, sugary drinks, sweets, and fatty meats.

### Nutritional Follow-up and Support

Nutritional follow-up for pediatric cardiac patients, like those with congenital heart disease or heart failure, targets growth failure and high metabolic demands. It requires careful monitoring of caloric intake, fluid restriction, and nutrient optimization to support cardiac function and improve surgical outcomes.

Growth tracking: Weight, length/height, head circumference, and Body Mass Index (BMI) should be closely tracked and plotted on World Health Organization (WHO) or specific cardiac growth charts. Standard follow-up is typically recommended every 1–2 weeks for acutely malnourished patients to adjust interventions, and at 1, 3, and 6-month intervals post-surgery to monitor long-term recovery.

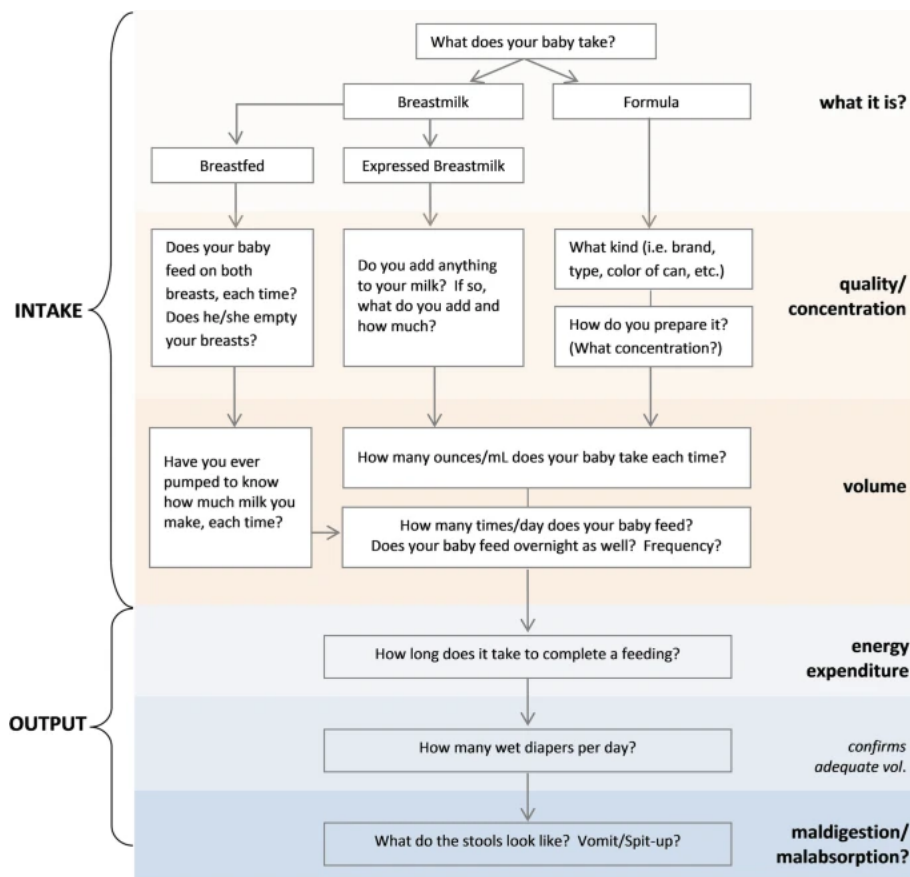
Nasogastric (NG) tube feeding may be necessary if the infant cannot consume enough calories orally due to fatigue [13].

Specific micronutrients play a vital role in pediatric heart failure medical management. Iron is optimized to prevent anemia, which places an unnecessary burden on cardiac output. Vitamin D is essential for bone health and general cardiovascular function. Selenium is often supplemented to support myocardial metabolic function [14].

### Management of Malnutrition in Children with Congenital Heart Disease

In pathologies associated with tachycardia, a rapid heart rate requires more energy and can make it harder for children to eat adequately. Frequent interruptions in feeding due to procedures, fluid restrictions, and the risk of swallowing problems, like vocal cord paralysis, can exacerbate malnutrition after surgery [4].

Regarding consequences of malnutrition, failure to thrive is a common issue where a child does not grow at the expected rate. Children may experience growth retardation in the form of stunting (short stature) and wasting (low weight for their height) [7].



**Figure 2: Evaluation of nutrient intake and utilization (Vichayavilas et al., 2021).**

On the other hand, malnutrition is a major problem that increases the risk of hospitalization, poor surgical outcomes, and even death. Providing adequate nutrition before surgery significantly improves post-operative outcomes. A comprehensive nutritional assessment is essential, using growth charts and sometimes specialized measurements like bioelectrical impedance to account for fluid overload [8].

## Conclusion

Early nutritional assessment and intervention, including tailored feeding strategies and optimizing preoperative nutrition, are crucial to improve surgical outcomes, growth, and overall health in these vulnerable children [1]. Providing adequate nutrition before surgery significantly improves post-operative outcomes. A comprehensive nutritional assessment is essential, using growth charts and sometimes specialized measurements like bioelectrical impedance to account for fluid overload [8]. Nutrition is a positive epigenetic factor: an adequate nutritional intervention in a developmental critical period can change the outcome in adulthood, and nutritional treatment should be considered comparable to drug therapy [4].

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