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Literature Review

Pediatric Nutritional Assessment

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Abstract:

Background: Pediatric nutrition plays a vital role in the growth and development of children. It not only meets the daily nutritional needs of healthy children but also supports their normal growth. In contrast, for unhealthy children, it aims to prevent growth delays and developmental issues, especially in cognitive functions. The situation in Indonesia presents a unique challenge with the coexistence of undernutrition and overnutrition, both having significant short-term and long-term health impacts.

Discussion: In the realm of pediatric nutrition, malnutrition manifests in various forms. Nutritional deficiencies such as wasting, stunting, and being underweight arise from inadequate dietary intake. Additionally, there are concerns about micronutrient malnutrition, which includes both deficiencies and excesses of vital nutrients. Overnutrition, leading to obesity and associated chronic diseases, is also a significant problem. The approach to pediatric nutritional care is multi-faceted, involving the assessment of nutritional status, determination of individual caloric needs, and selecting the appropriate method for nutrition delivery, whether it be oral, enteral, or parenteral. Monitoring and evaluating the effectiveness of these interventions is a critical ongoing process. An important aspect of preventive care includes educating parents about proper feeding techniques, such as establishing regular meal times and understanding the child's hunger and satiety signals, to avoid feeding difficulties. For cases like Failure to Thrive (FTT), where children do not meet standard growth metrics, careful management is necessary to ensure adequate nutrition and to prevent complications like refeeding syndrome.

Conclusion: Effective pediatric nutrition requires a holistic and personalized approach. It is crucial in addressing the dual burden of undernutrition and overnutrition in Indonesia. By implementing proper nutritional care and structured feeding practices, children's health outcomes can be significantly improved, supporting their growth and developmental processes.

Keywords: Assessment, Nutrition, Pediatric

Introduction

Pediatric nutrition is essential for both healthy and sick children. In healthy children, the primary goal of nutrition is to optimize growth and development and to provide appropriate daily needs.[1] Conversely, in unhealthy children, nutrition serves not only daily needs but also to prevent delayed growth and irreversible effects on development, particularly cognitive function.[1] Nutrition plays a significant role in a child's growth and development.[2] Proper nutrition, initiated early, supports normal growth and development by meeting nutritional needs and preventing nutrient deficiencies.[1] In infants, good nutrition aids in preventing diseases such as infections by boosting immunity and optimizing neurological and cognitive development.[2] During the school-age and teenage years, nutrition plays a further role in preventing non-communicable diseases like obesity, diabetes, and cardiovascular diseases, thereby enabling better health in adulthood.[2]

In Indonesia, nutritional disorders or malnutrition represent a dual burden, where the prevalence of undernutrition or malnutrition remains high, while the prevalence of obesity or overnutrition is simultaneously increasing. Both have negative short-term and long-term impacts, necessitating attention for the resolution of these nutritional issues. According to the Riskesdas (Health Research and Development Survey) results from 2007, 2010, and 2013, there has been no improvement in addressing undernutrition.[3] The province with the lowest percentage of severely malnourished toddlers is Bali at 13.2%, while the highest is NTT (East Nusa Tenggara) at 33%. Moreover, the percentage of stunted toddlers in Indonesia is high at 37.2% according to Riskesdas 2013, showing no improvement from the 2007 and 2010 surveys.[3] Riau province has the lowest percentage of stunted toddlers, with NTT having the highest.

Definition and Classification of Malnutrition

Malnutrition refers to a deficiency, excess, or imbalance in a person's intake of energy and/or nutrients. Such nutritional deficiencies make children particularly vulnerable to diseases and death. The term "malnutrition" covers three major groups of conditions[4]:

- Nutritional deficiencies, which include wasting (low weight-for-height), stunting (low height-for-age), and underweight (low weight-for-age).
- Micronutrient-related malnutrition, which includes micronutrient deficiencies (lack of essential vitamins and minerals) or excess micronutrients.
- Overweight, obesity, and diet-related non-communicable diseases (such as heart disease, stroke, diabetes, and certain types of cancer).

Low weight-for-height, known as wasting, typically indicates acute and severe weight loss, often due to insufficient food intake and/or infectious diseases like diarrhea causing weight loss. A moderately or severely wasted child has an increased risk of mortality but can be managed effectively. Low height-for-age, known as stunting, results from chronic or repeated nutritional deficiency, often related to poor socio-economic conditions, inadequate maternal health and nutrition, frequent illnesses, and/or improper infant and child feeding and care practices in early life. Stunting hinders children from reaching their full physical and cognitive potential. Children with low weight-for-age are known as underweight. An underweight child may be stunted, wasted, or both.[4]

Micronutrient-related malnutrition can be a deficiency or excess of vitamins and minerals. Micronutrients are needed by the body to produce enzymes, hormones, and other substances, so a lack of micronutrient intake can hinder optimal growth and development. The most common micronutrient malnutrition includes deficiencies of iodine, vitamin A, and iron. Iodine, vitamin A, and iron are globally significant for public health; their deficiencies are a major threat to the health and development of populations worldwide, especially children and pregnant women in low-income countries.[4]

Overweight and obesity occur when an individual's weight is too high for their height. Abnormal or excessive fat accumulation can impair health. Body Mass Index (BMI) is a common weight-for-height index used to classify overweight and obesity. BMI is defined as an individual's weight in kilograms divided by the square of their height in meters (kg/m^2).

In adults, overweight is defined as a BMI of 25 or more, while obesity is a BMI of 30 or more. Overweight and obesity result from an imbalance between consumed (excess) and expended (insufficient) energy. Globally, this often occurs with the consumption of energy-dense foods (high in sugar and fat) and engagement in less physical activity.[4]

Pediatric Nutritional Care

To evaluate and provide adequate and appropriate nutrition to children, several steps known as pediatric nutritional care should be undertaken, encompassing assessment and diagnosis, determination of needs, method of administration, monitoring, and evaluation.[5]

Assessment

The assessment is conducted to determine nutritional status and clinical diagnosis, whether the patient suffers from malnutrition or has adequate nutritional supply. Nutritional status can be assessed through anthropometry and physical examination.

Anamnesis should include dietary intake, eating patterns, food tolerance, oromotor, fine motor, and gross motor development, weight change, social, cultural, and religious factors, and clinical conditions affecting intake.[5]

After physical examination, nutritional status is determined based on weight relative to the patient's length or height. The WHO 2006 charts are used as a reference for children under 5 years of age, and the CDC 2000 charts are used for patients over 5 years. The WHO 2006 charts are preferred for ages 0-5 due to superior methodology compared to CDC 2000. The subjects in the WHO 2006 study were from five continents and had environments conducive to optimal growth. For ages 5-18, the CDC 2000 charts are used, considering that the WHO 2007 charts (5-18 years) do not include weight-for-height data and the WHO 2007 data is a smoothing of the NCHS 1981 data. Nutritional status is determined using the WHO 2006 Z score cut off for ages 0-5 and the Waterlow criteria for ideal body weight percentage for children over 5 years.[5]

Table 1. Interpretation of nutritional status according to Waterlow, WHO 2006, and CDC 2000[6]

WfH CDC 2000	WfH WHO 2006	Interpretation
< 70%	Z < -3 SD	Severely Wasted
70 – 90%	-3 SD < Z < -2 SD	Wasted
90 – 110%	-2 SD < Z < +2 SD	Normal
110 – 120%	+2 SD < Z < +3 SD	*Overweight*
> 120%	Z > +3 SD	Obese

WfH = Weight for Height

In assessing children at risk of overweight, marked by a weight-for-height above +1 SD on the WHO 2006 curve or >110% on the CDC curve, plotting against the respective BMI curve is necessary. A patient is considered overweight if the plotting falls between +2 SD < Z < +3 SD on the WHO 2006 curve or between the 85th and 95th percentiles on the CDC 2000 curve, and is considered obese if it falls at Z > +3 SD on the WHO 2006 curve or above the 95th percentile on the CDC 2000 curve. For 1-5 year olds, the upper-arm circumference (UAC) can be interpreted according to Table 2 below.[5]

Table 2. Upper arm circumference interpretation

UAC (cm)	Interpretation
< 11,5	Severely wasted
11,5-13,5	Wasted
> 13,5	Normal

If a patient is found to be overweight or obese, the measurement is shifted to using the Body Mass Index (BMI), which compares weight to total body surface area and then plots against an age line. For children under 2 years, the WHO 2006 charts, which have a Z value > 2 for overweight and > 3 for obesity, can be used.[5] (**Figure 1**)

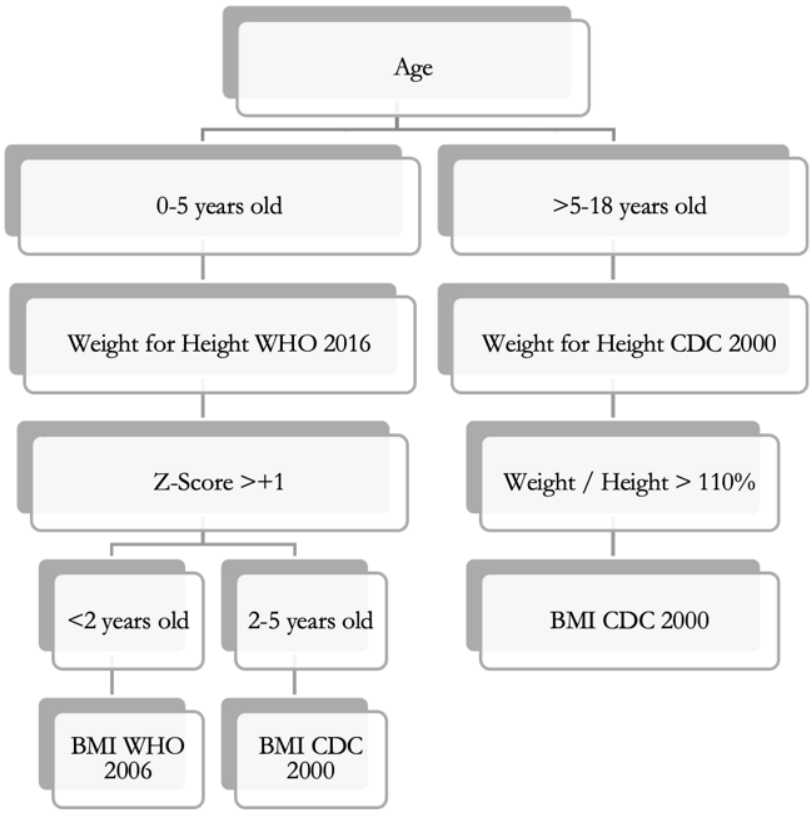

Figure 1. Algorithm for children at risk of overweight and obesity

Determining nutritional need

After determining the nutritional status of a patient, the next step is to obtain their caloric needs. These needs include three different areas: replacement of deficient nutrients, maintenance requirements, and additional needs due to loss or for the repair of diseased tissue. Ideally, caloric needs should be determined using indirect

calorimetry; however, this method is impractical and expensive. The calculation of caloric needs is adjusted according to the illness condition of the child.[5]

In non-critically ill patients, caloric needs are calculated by multiplying the ideal body weight by the recommended dietary allowance (RDA) according to height age. This calculation is applicable for good nutrition, malnutrition, and obesity. However, the portion of calories provided differs between malnutrition and obesity. Patients with poor nutrition are initially given 50-75% of the target calorie requirement to avoid refeeding syndrome. In contrast, for obesity, calorie provision does not immediately meet the target requirement but is gradually reduced until the target is achieved.[5]

Formula for calculating the caloric need is as following:

Ideal weight x RDA based on height age

With height age being the child's age on p50 of height the growth chart

Table 3. Caloric requirements based on age group

Age (years)	Caloric need (kkal/BW/day)
0 – 1	100 – 120
1 – 3	100
4 – 6	90
7 – 9	80
10 – 12	Male: 60 – 70
	Female: 50 – 60
12 – 18	Male: 50 – 60
	Female: 40 – 50

Refeeding syndrome is a metabolic complication of nutritional support in severely malnourished patients, characterized by hypophosphatemia, hypokalemia, and hypomagnesemia. This occurs due to a shift in the body's primary metabolic source, from fats during starvation to carbohydrates provided as part of nutritional support, leading to increased insulin levels and the shift of electrolytes needed for intracellular metabolism. Clinically, patients may experience arrhythmias, heart failure, acute respiratory failure, coma, paralysis, nephropathy, and liver dysfunction. Therefore,

nutritional support in malnourished patients must be provided gradually, with intake increased over 4-7 days until the target calorie intake is reached.[7]

Choosing route of administration

In providing nutrition, oral nutrition is the ideal and preferred route. If there are certain conditions that still allow the patient to receive oral nutrition but they cannot, are not advised to, or are not permitted to consume solid food, oral nutrition can be provided in a semi-solid or liquid consistency. If oral administration is not possible, there are two alternatives: enteral nutrition or parenteral nutrition.[5] (**Figure 2**)

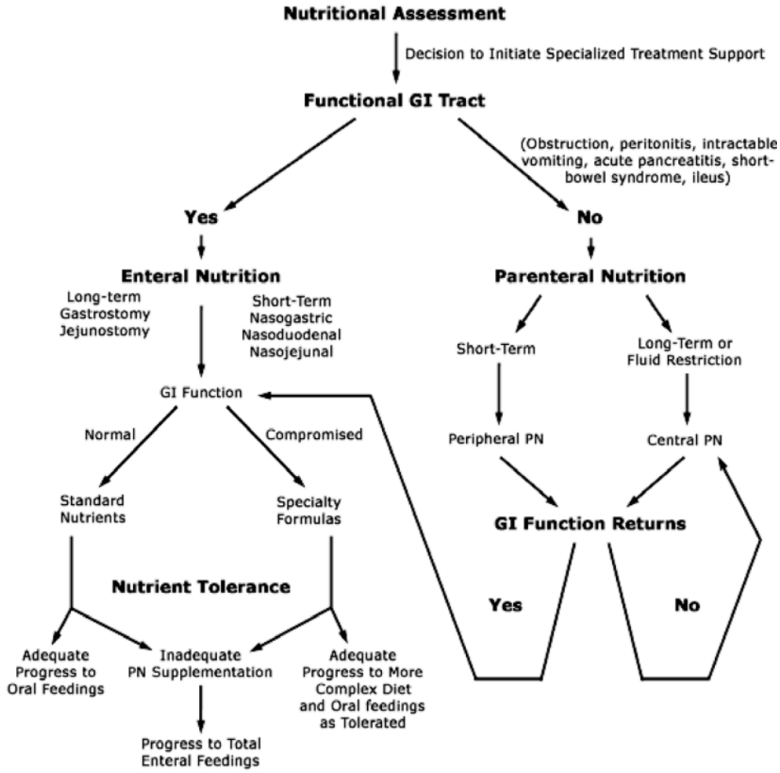

Figure 2. Algorithm to choose between parenteral and enteral route[1]

Enteral nutrition is given when oral feeding is not possible, but the intestinal function is still good. Compared to the parenteral route, enteral feeding has advantages such as lower cost, safer use, a physiological form with a complete nutrient composition, and the ability to maintain intestinal function.[5]

Choosing food type

The determination of food type is influenced by two factors: patient factors (age, medical diagnosis, medical conditions requiring special nutrition, and gastrointestinal function) and formula factors (osmolality, renal solute load, calorie concentration and thickness, nutrient composition, and product availability). In the administration of

enteral formulas, the child's age is classified into infants (<1 year), 1-10 years, and over 10 years. The differences between these three preparations are that in the enteral formula for 1-10 years, the calorie composition is denser compared to the enteral formula for children under 1 year. The composition of protein, sodium, potassium, chloride, and magnesium is higher compared to the adult enteral formula (>10 years). The composition of iron, zinc, calcium, phosphorus, and vitamin D is higher compared to the adult enteral formula.[5] (**Figure 3**)

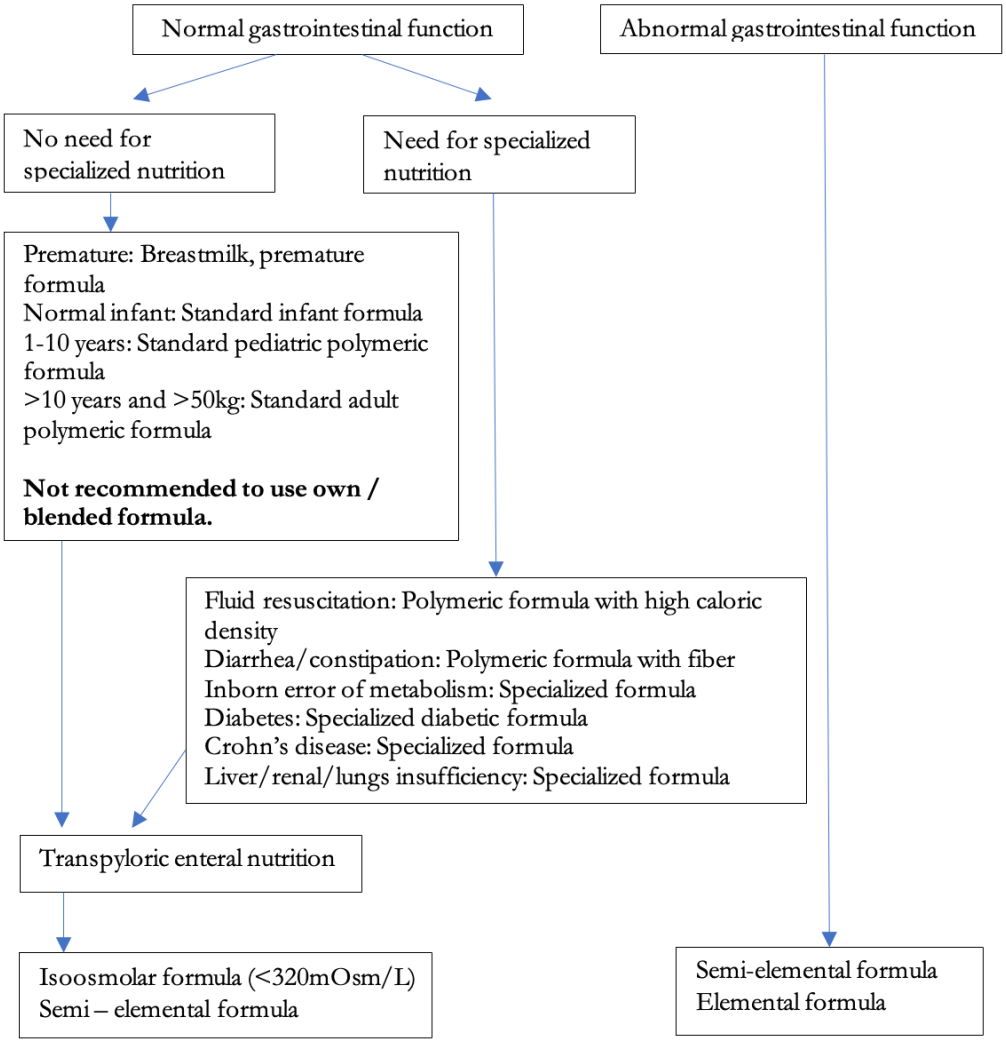

Figure 3. Algorithm for choosing enteral formula

Monitoring and Evaluation

The monitoring and evaluation of nutritional therapy provision is conducted in two phases: short-term and long-term. Short-term monitoring assesses the acceptance of food, tolerance to food, and the impact of food on the gastrointestinal tract. Long-term monitoring evaluates disease recovery and child growth.[5]

Basic Feeding Rules

The Indonesian Pediatric Society (IDAI) has adapted the Basic Feeding Rules from Bernard-Bonnin's "Feeding problems of infants and toddlers".[8] It is crucial that parents are first informed about the basic feeding rules applicable to all young children. Parents should control what, when, and where their children eat. Children should be allowed to regulate how much they eat to learn internal meal regulation, based on physiological hunger and satiety signals. In case of feeding difficulties, several steps recommended by Bonnin[8] should be followed:

Scheduling

- Regular scheduling of main meals and snacks.
- Mealtime should not exceed 30 minutes.
- Avoid offering other snacks during meals except for drinks.

Environment

- Ensure a pleasant environment without coercion to eat.
- Use a napkin as a base for dining to maintain cleanliness.
- Eliminate distractions (toys, television, electronic devices) during meals.
- Refrain from using food as a reward.

Procedure

- Serve food in small portions.
- Begin with the main meal, followed by drinks.
- Encourage self-feeding.
- If the child shows signs of not wanting to eat (clenching mouth, turning head, crying), offer food again neutrally, without coaxing or forcing.
- End the meal if the child refuses to eat after 10-15 minutes.
- Clean the child's mouth only after the meal is complete.

In Indonesia, many parents struggle with these aspects due to inadequate understanding. Parents/caregivers often resort to coaxing and comforting the child in various ways to encourage eating, which can interfere with the child's concentration on eating. If the child refuses to eat, parents frequently substitute the meal with an excessive amount of formula, leading to the child being constantly full and further complicating the development of correct eating behavior.[8]

Early prevention of feeding difficulties involves the proper implementation of feeding behaviour rules. The introduction to food must also fulfil four criteria:[5]

- Timely introduction when breast milk is insufficient for the baby's nutritional needs.
- Adequacy in nutritional content suitable for the baby's age.
- Safety in food preparation and storage.
- Proper feeding, mindful of the child's hunger and satiety signals.

Implementing these feeding rules is expected to address feeding difficulties in infants, enhancing their growth and development. If a child persistently has difficulty eating, consulting a nutritionist or pediatric specialist is recommended.[5]

Failure to Thrive

The term "failure to thrive" (FTT) is used to describe infants or children who do not achieve weight gain in accordance with normal growth curves or experience weight loss. However, this terminology is somewhat inaccurate since growth encompasses several parameters such as weight, length/height, and head circumference. The term failure to thrive is more accurately used in anthropometric measurements to denote a hindrance in achieving appropriate weight gain, more aptly referred to as weight faltering. Prolonged failure to achieve adequate weight gain can impact a child's length and ultimately head circumference. Failure to thrive is more a sign or symptom of an underlying issue in a patient, rather than a diagnosis or a degree of illness. It indicates an anthropometric observation, hence does not necessarily mean malnutrition or poor nutrition, which are conditions determined at a single observation point.[9]

To diagnose a patient with failure to thrive, at least two points of observation on the weight-for-age and gender curve are required. Using the WHO 2006 charts, the criteria for failure to thrive are if the line connecting these two points diverges from the curve above it (indicating weight faltering). When using the CDC 2006 curves, the criteria are if the line connecting the two observation points crosses two major percentile lines (75th, 50th, 25th, 10th, 5th, 3rd) for weight according to age. Causes of failure to thrive can be classified into inadequate calorie intake, inadequate calorie absorption, and increased calorie needs.[9]

In managing a child with failure to thrive, it is necessary to evaluate the history of food intake, previous medical history, family medical history, and socio-economic background. Physical and supportive examinations are required to rule out medical conditions as per the complaints presented by the child's guardian. The management of failure to thrive involves the provision of adequate nutrition with calories as per the Recommended Dietary Allowance (RDA) multiplied by the ideal body weight, accompanied by regular evaluations. Management should be mindful to avoid refeeding syndrome, particularly in cases of acute malnutrition.[9]

Conclusion

Pediatric nutrition is a crucial aspect of child health care, particularly important in both healthy and unhealthy children. It serves to optimize growth and development in healthy children by meeting daily nutritional needs and plays a vital role in preventing growth delays and cognitive development issues in unhealthy children. In Indonesia, the challenge is intensified due to the dual burden of undernutrition and obesity, each carrying significant health implications. Addressing these nutritional disorders requires a comprehensive approach, encompassing assessment, diagnosis, determination of nutritional needs, appropriate administration methods, and continuous monitoring and evaluation. This approach tailors interventions to individual needs, whether for managing malnutrition, obesity, or other health conditions.

Furthermore, the implementation of basic feeding rules, adapted by the Indonesian Pediatric Society, is essential in establishing healthy eating habits and preventing feeding difficulties from an early age. These guidelines emphasize regular meal scheduling, creating a positive eating environment, and understanding children's hunger and satiety cues. Managing conditions like Failure to Thrive necessitates careful evaluation and tailored nutritional intervention to ensure adequate growth and development. Overall, effective pediatric nutrition management requires a multifaceted approach, combining direct nutritional interventions with education and preventive care, crucial for improving the health and well-being of children, especially in diverse nutritional landscapes like Indonesia.

Conflict of Interest

None declared.

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