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Nutritional Management in Children with Acute Respiratory Distress Syndrome, Decompensatio Cordis Sinistra et Dextra, Community-Acquired Pneumonia, and Marasmus: A Case Study

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ABSTRACT
Children with heart failure complicated by comorbid conditions are at increased risk of growth failure and developmental delay, contributing to malnutrition such as stunting and marasmus. This study aims to explore the effects of nutritional management on a pediatric patient diagnosed with acute respiratory distress syndrome (ARDS), decompensatio cordis (left and right), community-acquired pneumonia (CAP), and marasmus using the Standardized Nutrition Care Process (NCP).
This case study applied an individualized approach for a pediatric patient in the PICU of Dr. Wahidin Sudirohusodo Hospital, Makassar. The research focused on nutrition screening, assessment, diagnosis, intervention, monitoring, and evaluation over a 10-day period.
Nutrition screening results indicated severe malnutrition with a score of 5 and comorbidities. The nutritional diagnosis was established under the domains of Nutrition Intake and Behavior. Anthropometric measurement of mid-upper arm circumference (MUAC) increased from 10 cm to 11 cm. Biochemical monitoring still indicated anemia. Nutrition-focused physical examination (NFPE) identified prominent ribs, loss of fat in the cheeks and triceps, and thinning hair. The child's intake of F100 formula via enteral feeding gradually increased during the transition phase, then progressed to the rehabilitation phase with soft oral foods, increasing from 70% to 100% of requirements. Continuous nutrition education and counseling led to improvements in feeding practices.
Individualized nutritional management was effective in increasing both enteral and oral intake and improving MUAC by 1 cm, thus preventing further muscle mass loss

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Key Messages:
- This study underscores the importance of comprehensive nutritional management in children with ARDS, decompensated heart failure, CAP, and marasmus through the Standardized Nutrition Care Process.
- The goals of nutritional intervention in NCP include: allowing the body to adapt to increasing energy and protein intake in preparation for rehabilitation; preventing further weight loss and improving nutritional status through Nutrition-Focused Physical Exam (NFPE); and enhancing nutritional knowledge and quality of life for patients and their families through education and counseling

INTRODUCTION

Heart failure (Decompensatio Cordis) is a progressive clinical syndrome characterized by the heart's inability to maintain adequate cardiac output to meet the metabolic demands of bodily tissues. In pediatric populations, the clinical course of heart failure becomes more complex when accompanied by comorbidities such as iron deficiency anemia, Acute Respiratory Distress Syndrome (ARDS), Community-Acquired Pneumonia (CAP), nutritional marasmus, electrolyte imbalances, and pericardial complications such as minimal effusion [1]. Children with heart failure are at risk of growth disturbances, developmental delays, and premature death if not managed optimally [2].

Acute Respiratory Distress Syndrome (ARDS) is a clinical condition involving acute lung injury due to diffuse inflammation and increased pulmonary vascular permeability, leading to fluid accumulation in the alveoli and severe gas exchange impairment. This condition frequently occurs in Intensive Care Units (ICUs) and is a major cause of morbidity and mortality in critically ill patients [3]. ARDS affects 10–15% of pediatric ICU patients and is often triggered by severe infections such as community-acquired pneumonia. CAP remains a leading cause of pediatric hospitalization and is associated with higher mortality in children with poor nutritional status [4]. Nutritional marasmus exacerbates immune dysfunction, prolongs infection recovery time, and impairs tissue healing. In patients with heart failure, marasmus further disrupts fluid volume balance and reduces tolerance to tissue hypoxia, increasing the risk of death [5]. Electrolyte imbalances, such as hyponatremia and hypokalemia, exacerbate myocardial dysfunction and increase the risk of severe arrhythmias. Even minimal pericardial effusion, although appearing minor, is an important indicator of systemic inflammation or intrapericardial pressure, which can lead to cardiac tamponade [5].

According to the European Society for Clinical Nutrition and Metabolism (ESPEN), nutritional therapy in patients with critical inflammatory conditions such as ARDS, heart failure, and severe infections must be tailored to the individual's energy-protein requirements and include correction of micronutrient deficiencies. Enteral nutrition is the preferred approach if gastrointestinal function is intact, with supplementation of zinc, selenium, and vitamin D to support the immune system [4]. The complexity of this clinical case demands a multidisciplinary approach. Diagnosis of heart failure requires clinical criteria and echocardiographic assessment; anemia must be evaluated using serum iron laboratory tests; and ARDS should be diagnosed according to the Berlin Criteria and chest imaging. Additionally, comprehensive nutritional assessment is crucial to determine the degree of malnutrition and to tailor appropriate Medical Nutrition Therapy (MNT) [1]. The prevalence of malnutrition in Indonesia is 11%, with a slightly higher rate of 12.4% in South Sulawesi. Nutritional marasmus is a major risk factor for clinical deterioration in children with infections and heart failure [4].

This study aims to examine the effects of nutritional management in a pediatric patient diagnosed with "acute respiratory distress syndrome, decompensasio cordis sinistra et dextra, community acquired pneumonia and marasmus" through the Standardized Nutrition Care Process (NCP).

CASE DESCRIPTION

An 11-year-old female child (referred to as An.Q) was admitted to the Pediatric Intensive Care Unit (PICU) at Dr. Wahidin Sudirohusodo Hospital, Makassar, on April 5, 2025. The patient had previously been hospitalized for one day at Masamba Hospital before being referred to Dr. Wahidin Sudirohusodo Hospital with a medical diagnosis of acute respiratory distress syndrome (ARDS), decompensatio cordis sinistra et dextra, community-acquired pneumonia (CAP), and marasmus. Her medical history revealed treatment for pulmonary tuberculosis at the age of four and a birth history of low birth weight (2,200 grams). At the time of initial data collection (April 8, 2025), the medical diagnoses included ARDS, decompensated left and right heart failure, CAP, iron deficiency anemia, and severe malnutrition of the marasmus type. The patient is the eldest of two siblings, of Javanese ethnicity, and resides with her parents and sibling.

Upon nutritional assessment, the patient was in complete bed rest. Initial anthropometric measurements revealed a weight of 18 kg (noting facial and pedal edema), with a corrected weight of 14.4 kg, height of 121 cm, and mid-upper arm circumference (MUAC) of 15 cm. Nutritional status interpretation indicated underweight based on weight-for-age (W/A), stunted growth based on height-for-age (H/A), and severe malnutrition based on weight-for-height (W/H). A re-measurement during nutritional screening reported a MUAC of 10 cm. According to the mother, the child had been losing weight over the past six months, although no exact data was available due to the lack of regular monitoring. Based on a MUAC percentage of 42.5%, the child was classified as severely malnourished. Laboratory tests on April 5 and April 8, 2025, showed reduced hemoglobin, hematocrit, and erythrocyte levels, indicating anemia. Leukocyte count and liver transaminase enzymes were elevated, while serum albumin was decreased (see Table 2).

The patient's general condition was weak, with symptoms of shortness of breath and coughing. She had not defecated since admission. Urination was regular. Vital signs included blood pressure of 90/60 mmHg, temperature 36.5°C, respiratory rate 34 breaths/min, pulse 89 beats/min, and SpO_2 of 96%. Nutrition-focused physical examination revealed loss of buccal, triceps, and clavicular fat, prominent ribs, and signs of hair thinning and hair loss (see Table 3). Prior to illness, dietary habits included four daily meals of rice (2 scoops per meal), one piece of fish per meal, avoidance of poultry and beef, and preference for tofu over tempeh. Vegetable intake was limited to kangkung (water spinach), cabbage, and carrots, prepared infrequently. The child rarely ate fruits except for bananas and frequently consumed salty snacks (2–3 times/day). She had also previously consumed sweetened condensed milk but had since stopped. Over the past year, her appetite and intake decreased significantly, with frequent but minimal meals (3–4 spoonfuls at a time). The mother had little prior exposure to nutritional information, either from healthcare professionals or online sources.

At the time of assessment, the dietary regimen prescribed included severe malnutrition management using enteral nutrition (EN) via F75 formula (8 × 100 mL through a nasogastric tube) and parenteral nutrition (PN) with 5% dextrose (880 mL/day). The total intake from EN and PN was adjusted to the patient's tolerance and achieved 100% of the indicated requirements. The patient was in the transitional phase of nutritional rehabilitation. Prescribed medications included IV dextrose 5% at 40 mL/hour, furosemide 12.5 mg IV every 12 hours, spironolactone 25 mg orally every 24 hours, captopril 12.5 mg orally every 12 hours, sildenafil 10 mg orally every 8 hours, ceftriaxone 1.5 g IV daily, gentamicin 30 mg IV every 12 hours, and oral albuforce 8.4 mL daily.

RESULTS

The initial nutritional screening indicated that the patient was suffering from severe malnutrition with complicating conditions, namely ARDS and community-acquired pneumonia (CAP). The Nutrition Care Process (NCP) was implemented over a period of 10 days at Dr. Wahidin Sudirohusodo Hospital, with the first 5 days conducted in the PICU and the following 5 days after the patient was transferred to the Integrated Cardiac Center (PJT). Anthropometric assessments were conducted at baseline, on Day 5, and on Day 10 of the intervention. The results showed an increase of 1 cm in MUAC by Day 10; however, the nutritional status remained classified as severe malnutrition. Anthropometric monitoring and evaluation data collected during the intervention are presented in Table 1.

Table 1. Anthropometric Monitoring and Evaluation

Pre-Intervention	Day 3 of Intervention	Day 10 of Intervention	Normal Range
08/04/2025 MUAC = 10 cm $= \frac{10}{23,5} x\ 100\% = 42,5\%$ (Severe malnutrition)	12/04/2025 • MUAC = 10 cm • % MUAC = $\frac{10}{23,5} x$ 100 = 42,5% (Severe malnutrition)	17/04/2025 BB = 14,5 kg • MUAC = 11 cm • % MUAC = $\frac{11}{23,5} x$ 100 = 46,8% (Severe malnutrition)	Nutritional Status *WHO-NCHS classification for %MUAC*: • 85-110% Normal • 70,1 – 84,9% Moderate malnutrition • <70% Severe malnutrition

Biochemical monitoring was performed on Days 2, 6, and 10, in addition to the initial assessment. Results are shown in Table 2

Table 2. Biochemical Monitoring and Evaluation

Pre-Intervention			During the intervention period			Reference Range	Interpretation
Parameter	05/04/2025	08/04/2025	09/04/2025 (Follow-up examination)	13/04/2025 (Monitoring)	17/04/2025 (Monitoring)		
BD-1.10.1 HGB	-	7,6	8,2	11,3	11,7	12-16 g/dl	Anemia
BD-1.10.2 HCT	-	29	31	38	39	37-48%	Improving
BD-1.10.5 RBC	-	3,97	4,21	5,07	5	4 – 6 x10^6/UL	Improving
BD-1.10 WBC	-	12,78	14,48	14,53	14,25	4-10 x10^3/UL	Leukocytosis
BD-1.2.5 Sodium	-	129	129	139	138	136-145 mmol/L	Risk of hyponatremia
BD-1.2.7 Potassium	-	3	3,4	3,0	5,3	3,5-5,1 mmol/L	Hypokalemia risk
BD-1.4.2 SGPT	291	-	107	78	156	< 41 U/L	Elevated
BD-1.4.3 SGOT	334	-	54	43	98	< 38 U/L	Elevated
BD-1.11.1 Albumin	2,8	-	2,8	3,5	4,3	3,5-5,0 gr/dl	Risk of Hipoalbuminemia

Physical findings from nutrition-focused physical exams were recorded daily and are presented in Table 3 :

Table 3. Monitoring of Nutrition-Focused Physical Findings

Pre-Intervention		**During the intervention period**		**Reference Range**	**Interpretation**
Parameter	08/04/2025	09-12/04/2025 (intervention phase)	17/04/2025 (Day 9 of intervention phase)		
PD-1.1.21 Vital signs					
Blood Pressure	90/60	80/50*	100/62	90-110/55-75 mmHg	Improving
Temperature	36,5	36,8-36,5	36,5	36,5-37,5 °C	
SpO2	96	98-100	93	95-100%	
Respiratory	34	26-30	38	20-30x/min	Takipnea
Pulse rate	89	94-100	112	80-120x/min	
PD-1 Fisik Fokus Gizi					
PD.1.1.1 General conditon	Weakness	Weakness	Weakness	Health	Weakness
Pre-Intervention		**During the intervention period**		**Reference Range**	**Interpretation**
PD-1.1.4.5 Dyspneu	present	Present	Reduced	Normal	Improving
PD-1.1.5 GI Symptoms	No nausea/vomiting	Same	Same	Normal	Normal
PD-1.1.5.9 Constipation	Present	present	Normal	Normal	Resolved

PD-1.1.2.3 Subcutaneous Fat Loss (Buccal, Triceps, clavicula)	Present	Present	Present	Normal	*Wasting*
PD-1.1.2 Adipose	Iga gambang	Iga gambang	Iga gambang	Normal	Marasmus
PD-1.1.6 Edema	Swelling of face/hands at admission	None	None	Normal	Resolved
PD-1.1.10 Hair	Thin and falling	Thin and falling	Thin, no loss	Healthy	Marasmus
PD-1.1.13.11 Chapped Lips	Present	Present	Present	Normal	Marasmus
PD-1.1.16.18 Seizures	4x	None	None	Normal	Normal
PD-1.1.17.8 Dry Skin	Present	Present	Present	Normal	Marasmus
PD-1.1.19.2 Cough	Present	Present	Present	Normal	Sick

** Assessed on the 1st day of intervention*

The nutrition diagnoses established were *Nutrition Intake* (NI-2.11) Limited food acceptance related to physiological factors, characterized by malnutrition and failure to meet 100% of medical nutritional requirements.; dan domain *Nutrition Behavior* (NB-1.7) Undesirable food choices related to lack of social support for change and parental disinterest in learning about nutrition, evidenced by inconsistent dietary intake on Food Frequency Questionnaire (FFQ), patient only eats vegetables when prepared, resulting in inconsistent daily vegetable consumption.

Nutritional Intervention: The patient underwent nutritional therapy for severe malnutrition, progressing from the transition phase to the rehabilitation phase. Intervention goals included, facilitating metabolic adaptation to increasing energy and protein intake to *prepare for rehabilitation; Preventing further weight loss, particularly based on NFPE findings, with the aim of gradually improving MUAC; and Enhancing nutritional knowledge among the patient's mother and family to improve quality of life through education and counseling. The principle of the diet provided is the management of malnutrition in the transition phase and rehabilitation phase: Transition Phase: F100 formula providing 100 kcal/kg body weight/day (1,400 kcal), protein 29 g, fat 46.7 g, carbohydrates 217 g, fluid 1,220 mL/day, mineral mix 20 mL/1,000 mL formula; and when entering Rehabilitation Phase: Started at 70% of total requirements, progressing to 100% intake, combining F100 and soft foods (total energy 1,540 kcal, protein 40.6 g, fat 51 g, carbs 229 g); mineral mix 20 ml/1000 ml formula; Fiber according to RDA 27 gr/day; sodium according to RDA 1400 mg/day; and potassium according to RDA 4400 mg/day. The form of nutrition provided was in the transition phase, administered as a liquid diet via Nasogastric Tube (NGT) with 8 feedings (06.00, 09.00, 12.00, 15.00, 18.00, 21.00, 00.00 dan 03.00 WITA).*

Nutrition Education and Counseling: Focused on the management of malnutrition during the transition and rehabilitation phases. Conducted as bedside teaching (~15 minutes) with the patient's mother in the PICU. The nutrition care team collaborated with the attending physician, nurses, clinical nutritionists, pharmacists, and kitchen staff. Nutrition monitoring and evaluation (M&E) is conducted on several indicators, including Dietary Intake: 24-hour recall for 10 days; Anthropometry: MUAC measured at baseline, Day 5, and Day 10; Biochemical Parameters: Evaluated on Days 2, 6, and 10; and Physical Examination: Daily NFPE observations.

The results of the nutrition monitoring and evaluation of the patient's energy intake during the 10-day intervention period, based on the 24-hour recall method, can be seen in Figure 1. The comparison of the patient's intake was adjusted to meet the patient's needs gradually, starting from the transition phase in the PICU (days 1-4) where enteral F100 was administered every 3 hours, and the needs were adjusted according to the patient's tolerance. Subsequently, 70% of the needs were met during the rehabilitation phase (days 5-7) when the patient was transferred to the PJT room, with a combination of enteral and oral nutrition, consisting of F100 5 times and soft food. Finally, 100% of the needs were met during the rehabilitation phase from day 8 to day 10, with a combination of enteral and oral nutrition, consisting of F100 3 times and soft food.

The results showed that the patient's intake after the intervention underwent a positive change on average compared to before the intervention (sufficient category). The data indicated a significant increase in intake across all nutrient components from pre-intervention to day 10 of the intervention. The average percentage of intake showed results >80% of the total requirements. This was supported by the prepared formula and oral food intake, which enabled the patient's needs to be met. The patient's stable condition also became one of the factors contributing to the increased intake.

*Besides food and nutrient intake, the interaction of medications such as furosemide can lower potassium levels, necessitating caution when used concurrently with other medications that affect electrolytes. The results of nutrition education and counseling monitoring and evaluation for the patient's mother showed improvements in feeding practices, particularly in parental support for increasing the volume of enteral nutrition (NE) and gradual introduction of oral feeding. Therefore, recommendations were made for a gradual continuation of the diet, starting with 70% of nutritional needs during the rehabilitation phase a*nd progressing to 100%.

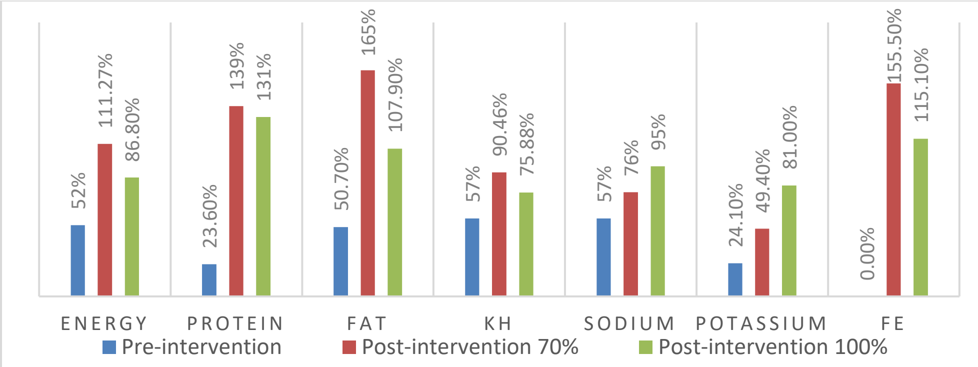

Figure 1. Results Monev Percentage of Intake Before and After Intervention

DISCUSSION

Anthropometric monitoring using Mid-Upper Arm Circumference (MUAC) was employed to objectively assess the patient's nutritional status. MUAC was chosen due to the patient's complete bed rest condition. The intervention showed a 1 cm increase in *MUAC over the 10-day period. MUAC is a relatively stable indicator in the context of acute fluid shifts compared to body weight, making it a suitable measure for ICU or non-mobile patients [6]. Despite the observed improvement, the MUAC percentage remained at 46.8%, still within the range of severe malnutrition. This indicates a substantial depletion of muscle mass, consistent with the patient's complex clinical condition. Pediatric patients with ARDS and heart failure often exhibit hypermetabolism and hypercatabolism, which accelerate skeletal muscle loss [6]. Therefore, a 10-day intervention is insufficient to restore nutritional status, and extended intervention is necessary.*

All nutrient intake parameters improved during the 10-day period, correlating with the 1 cm MUAC gain. According to Misirlioglu et al., measurable changes in anthropometry such as MUAC may require a minimum of 2–4 weeks of adequate energy-protein intervention to become evident [7].

Biochemical monitoring showed improvements as well. Hemoglobin (Hb) levels increased from 7.6 g/dL to 11.7 g/dL, and red blood cell (RBC) counts rose from 3.97 to 5.00 million/µL, indicating effective nutritional support in addressing anemia. This is crucial, as anemia in critically ill patients worsens tissue hypoxia, delays healing, and increases mortality risk. Hematocrit (HCT) also increased from 29% to 39%, suggesting improved oxygen transport capacity [8]. Albumin levels improved from 2.8 g/dL to 4.3 g/dL, reflecting protein repletion. It is important to note that patients with ARDS or CAP experience heightened metabolic demand and protein catabolism, thus requiring significantly more protein than stable individuals [9].

The patient's general condition improved gradually, shifting from a weak to a moderately stable state. Blood pressure rose from 90/60 mmHg to a more stable 100/62 mmHg, indicating positive hemodynamic adaptation. Although not yet within normal limits, the trend supports metabolic stabilization. According to Personalized Nutrition in the Pediatric ICU, stabilizing vital signs such as blood pressure is a key indicator of transition from acute to recovery phase. A normal body temperature range further suggests absence of worsening infection or metabolic dysfunction [10].

Nutrition-Focused Physical Examination (NFPE) findings such as prominent ribs, fat loss in cheeks and triceps, and hair thinning are hallmark signs of marasmus. According to the GLIM Criteria, diagnosing malnutrition requires at least one phenotypic criterion (e.g., muscle or fat loss) and one etiologic criterion (e.g., disease or inflammation). Protruding ribs suggest intercostal muscle wasting due to prolonged energy deficiency, while buccal and triceps fat loss confirms severe depletion of energy reserves [11].

The dietary strategy followed the protocol for treating severe malnutrition during the metabolic recovery phase. Days 1–4 represented the transition phase, followed by the rehabilitation phase (Days 5–10), starting at 70% of energy needs and progressing to 100% as the patient's intake improved. During the transition, all nutrition was delivered via nasogastric tube (NGT). In the rehabilitation phase, the child gradually adapted to oral feeding, while still receiving supplemental enteral nutrition via F100. The gradual transition to oral intake with soft-textured foods helped retrain gastrointestinal function [8].

Incremental energy provision is essential given the patient's limited intake capacity during acute illness. According to Briassoulis et al. (2024), full energy provision in the early critical phase is not recommended due to the risk of forced catabolism. A stepwise increase in intake, as applied in this case, aligns with the principles of personalized nutrition for critically ill patients [10]. During rehabilitation, more aggressive energy support is permissible to support catch-up growth. The Practice of Enteral Nutrition emphasizes that progressive energy administration accelerates recovery and organ function restoration [12].

Dietary management of severe malnutrition also requires caregiver understanding of nutritional components and feeding frequency. Nutrition counseling was aimed at enhancing the mother's knowledge and supporting long-term improvements in the child's quality of life. Counseling also emphasized the importance of careful transition from enteral to oral intake, with regular assessment of swallowing ability [13]. While maternal knowledge improved significantly following the nutrition education, further monitoring is needed to assess whether this translates into measurable improvements in the nutritional status of the children.

Overall, the 10-day intervention strategy proved effective in addressing the patient's dual nutritional challenges. High-protein, high-energy liquid diets administered via NGT, combined with soft oral foods during rehabilitation, significantly improved dietary intake and contributed to the recovery of nutritional status.

CONCLUSION

Based on the case description, an individualized approach to nutritional management was proven effective in improving both enteral and oral intake in the patient, leading to a 1 cm increase in Mid-Upper Arm Circumference (MUAC). This improvement is significant in preventing further loss of muscle mass and demonstrates the potential impact of structured nutrition interventions in pediatric patients with severe comorbid conditions.

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