Paediatrica Indonesiana

p-ISSN 0030-9311; e-ISSN 2338-476X; Vol.63, No.6(2023). p.450-5; DOI: https://doi.org/10.14238/pi63.6.2023.450-5

Original Article

Disease-related malnutrition in children and role of oral nutrition supplement

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Abstract

Background Disease-related malnutrition (DRM) is a common complication in chronic diseases. An oral nutrition supplement (ONS) is a formula with high energy density which is commonly used to treat malnutrition.

Objective To identify the prevalence of DRM in children with chronic disease and evaluate the benefits of ONS.

Methods A retrospective study was conducted at Prof. IGNG Ngoerah Hospital, Denpasar, Bali. Data were collected from medical records of patients who were admitted from January to December 2021. Inclusion criteria were patients aged 1-18 years with chronic diseases. Patients with organomegaly, edema, and incomplete medical record data were excluded. Disease-related malnutrition was defined as weight-for-height (for < 5 years of age) or BMI-for-age < -2SD (for > 5 years of age), according to the *WHO* growth charts. Subjects who received ONS for more than 80% of total energy during hospitalization were classified as part of the ONS group and the rest as standard group. Several variables between ONS and standard group were analyzed and considered significant if P value < 0.05.

Results Of 313 subjects with chronic disease, 139 (44.4%) were diagnosed with DRM. Among of 139 subjects with DRM, a total of 64 subjects were analyzed in the ONS and standard feeding groups. No significant difference was found between groups with regards to age, gender, weight, height, white blood cell count, and lymphocyte cell count. Subjects with severe malnutrition significantly more classified as an ONS group than subjects with moderate malnutrition (P=0.001). Mean length of hospital stay was significantly shorter in the ONS group [11.8 (SD 6.7) days] than in the standard group [16.1 (SD 6.6) days]; (P=0.012].

Conclusion Malnutrition related to chronic disease in children is prevalent. Use of ONS is associated with a shorter length of hospital stay. Thus, routine nutritional status assessment to identify malnutrition in children with chronic disease is needed to treat with ONS in order to improve prognoses. **[Paediatr Indones. 2023;63:450-5; DOI: https://doi.org/10.14238/pi63.4.2023.450-5**].

Keywords: *zinc; preterm infant; growth indicators*

Disease-related malnutrition (DRM) is a common complication, particularly in children with chronic diseases. The prevalence of DRM varied between 20 to 50% according to patients' underlying disease and the criteria used to define malnutrition.[1] A study in Latin America reported a DRM prevalence of 40-60%.[2] Most DRM occurs in children with malignancy.[3] In our hospital, the prevalence of malnutrition associated with acute and chronic diseases remains high. Our 2020 study noted a prevalence of 24.5%.[4]

Malnutrition in children with chronic disease is associated with poor prognoses, such as higher complications of infection, longer length of hospital stay, higher treatment expenses, and a higher mortality rate.[2,3] Early identification and management of malnutrition have been performed in many hospitals, such as implementing risk screening tools for malnutrition and giving oral nutrition supplements (ONS). ONS can be used to treat DRM and improve

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Submitted October 11, 2022. Accepted November 20, 2023.

the prognosis of chronic disease, such as by decreasing length of stay, complications, as well as mortality rates.[5]

An ONS is a formula for special medical purposes, with high energy density commonly of 1 kcal per mL or more and used to treat moderate and severe acute malnutrition. A study in Nicaragua reported ONS use to improve and maintain good nutritional status in children with cancer, at approximately 35-55% improving the nutritional status depending on the cancer type.[6] A previous study reported the benefit of ONS combined with diet counseling on improved nutritional status of children who were at risk for malnutrition (Z-score between -2 and -1) or children with weight faltering.[7]

Given the importance of screening for the risk of malnutrition in hospitalized children to improve prognoses and the need for adequate nutrient intake, we aimed to assess the prevalence and associated factors of DRM, particularly in children with chronic disease, and assess the effectiveness of ONS on improving prognosis.

Methods

A retrospective study with a cross-sectional and cohort approach was conducted in Prof. IGNG Ngoerah Hospital, Denpasar, Bali, Indonesia. Data were collected from medical records of patients who were admitted from January to December 2021. Inclusion criteria were patients aged 1-18 years with chronic diseases, who were admitted in the Pediatric Ward of Prof. IGNG Ngoerah Hospital, Denpasar, Bali, during the study period. Patients with organomegaly, edema, and incomplete medical record data were excluded. In a cross-sectional approach, subjects with chronic disease who met the study criteria and had their data collected on their first day of admission. For subjects with multiple hospitalizations, we used only data from the first admission. In the cohort approach, subjects who were classified as DRM on admission were followed until hospital discharge and classified into two groups: the ONS group and the standard group. On follow-up, subjects with DRM were classified into the ONS group if they had received ONS to provide at least 80% of total calories during hospitalization. On the other hand, they were classified into the standard group if they received usual food and/or ONS less than 20% during hospitalization. ONS were defined as a formula with the calorie's density more than 0.9 kcal/mL.[8]

Subjects' characteristics consisted of age, gender, disease diagnosis, nutritional status, type of nutritional support, length of hospital stay, and laboratory data including white blood cell (WBC) and lymphocyte counts. Malnutrition was defined according to weight-for-height z-score <-2SD for children under five, and BMI for age z-score <-2SD for children aged 5 years or more.[9,10] Chronic disease was defined as a disease lasting at least 3 months.[11] We included chronic infections such as HIV and tuberculosis, as well as non-infections, such as diabetes, cardiovascular disease, kidney disease, liver disease, respiratory disease, gastrointestinal disease, allergy, and cancer.

Sample size for the first step of the study (using a cross-sectional approach) was based on α=0.05, precision of 10%, and malnutrition prevalence established in a previous study of 37%,12 was calculated to be a minimum of 262 subjects. Sample size for the second step (cohort approach) was based on α=0.05, 80% power, length of stay in a previous study of 6.8 (SD 1) days,[12] and a clinical difference of 0.7 day. We calculated a minimum required sample size of 32 subjects per group.

Data analysis was performed using *SPSS version 20.0 software*. Categorical data are presented as frequencies and percentages. Numerical data are presented as mean and standard deviation (SD), if data distribution was normal, or as median and minimum-maximum if data distribution was not normal. Kolmogorov-Smirnov test was used to analyze data normality. Chi-square test was used to analyze categorical variables and independent-T test was used for numerical variables. Results with P values <0.05 were considered to be statistically significant. The study protocol was approved by the Research Ethics Committee, Faculty of Medicine, Universitas Udayana.

Results

In the first step, 340 patients were diagnosed to have chronic diseases; of these, 313 patients had complete data. Their median age was 67 (range 6-214) months

and most were male (167; 53.4%). The highest percentage of subjects had cancer (23.6%), followed by cardiovascular disease (19.8%), and respiratory disease (15.3%). Subjects' characteristics are shown in **Table 1**.

Malnutrition was found in 139 (44.4%) subjects and classified as moderate (35.1% of all subjects studied) or severe (9.3%). Significantly more subjects with malnutrition had lower body weight, longer length of hospital stay, and received ONS than subjects who were not malnourished. The characteristics of subjects with malnutrition are shown in **Table 2**.

In the second step, 64 subjects were randomly chosen from the 139 malnutrition subjects and divided into either the ONS group or the standard feeding group. The characteristics of the groups were comparable for the variables of age, gender, body weight on admission and discharge, and body height (**Table 3**). However, the ONS group had significantly more subjects with severe malnutrition compared to the standard group. White blood cell and lymphocyte counts were not significantly different between groups. The ONS group had significantly shorter length of stay than the standard group (**Figure 1**).

Discussion

The prevalence of DRM in our study was 44.4%, with most subjects classified as having moderate malnutrition. Other studies had similar results, although different diagnostic criteria and populations were studied.[1,2] This result supports the hypothesis that children with chronic diseases are at risk of malnutrition. Our subjects had various chronic diseases, such as cancer, as well as cardiovascular, respiratory, neurologic, gastrointestinal, renal, allergic, and endocrinologic diseases. The greatest percentage of subjects with DRM had cancer, similar to a previous study.[3] Cancer and chemotherapy often cause anorexia, feeding difficulties, impairment in

Table 1. Subjects' characteristics

Characteristics	(N=313)
Median age (range), months	67 (6-214)
Gender, n (%)	
Male	167 (53.4)
Female	146 (46.6)
Disease diagnosis, n (%)	
Cancer	74 (23.6)
Cardiovascular disease	62 (19.8)
Respiratory disease	48 (15.3)
Neurologic disease	45 (14.4)
Gastro-intestinal disease	35 (11.2)
Kidney disease	21 (6.7)
Allergic disease	19 (6.1)
Endocrinologic disease	9 (2.9)
Median BW on admission (range), kg	15 (3-80)
Median BW on discharge (range), kg	15 (3-80)
Median BH (range), cm	101 (47-170)

BH=body height; BW=body weight

Table 2. Characteristics of subjects with and without malnutrition

Characteristics	Subjects with malnutrition (n=139)	Subjects without malnutrition (n=174)	P value
Mean age, months (SD)	89.5 (66.5)	84.9 (66.1)	0.543#
Gender, n (%)			
Male	76 (45.5)	91 (54.5)	0.675*
Female	63 (43.2)	83 (56.8)	
Nutritional support, n (%)			
ONS	42 (61.8)	26 (38.2)	0.001*
Standard	97 (39.6)	148 (60.4)	
Mean length of stay (SD), days	10.8 (10.6)	8.5 (8.1)	0.039#
Mean BW on admission (SD), kg	17.5 (11.1)	22.9 (16.7)	0.001#
Mean BW on discharge (SD), kg	17.6 (11.2)	22.9 (16.7)	0.002#
Mean BH (SD), cm	108.1 (33.4)	107.8 (34.5)	0.951#
Mean WBC count (SE), cell/uL	23.1 (5.7)	17.4 (3.4)	0.380#
Mean lymphocyte cell count (SE), cell/uL	4.9 (1.0)	6.0 (0.9)	0.441#

Notes: ONS=oral nutrition supplement; SD=standard deviation; SE=standard error; *Independent T-test; #Chi-square test.

Table 3. Analysis of variables between ONS and standard feeding groups

Variables	ONS (n=32)	Standard (n=32)	P value
Mean age (SD), months	113.4 (63.3)	95.7 (68.9)	0.290*
Gender, n (%)			
Male	19 (48.7)	20 (51.3)	0.798#
Female	13 (52.0)	12 (48.0)	
Mean BW on admission (SD), kg	18.0 (10.9)	21.1 (13.6)	0.314*
Mean BW on discharge (SD), kg	18.3 (10.9)	21.2 (13.6)	0.355*
Mean BH (SD), kg	115.0 (34.6)	113.8 (35.4)	0.897*
Grade of malnutrition, n (%)			
Moderate	16 (35.6)	29 (64.4)	0.001#
Severe	16 (84.2)	3 (15.8)	
Mean length of stay (SD), days	11.8 (6.7)	16.1 (6.6)	0.012*
Mean WBC count (SE), cell/uL	37.7 (20.3)	22.2 (8.0)	0.483*
Mean lymphocyte count (SE), cell/uL	5.3 (2.5)	7.1 (3.3)	0.679*

Notes: BH=body height; BW=body weight; SD=standard deviation; SE=standard error; WBC=white blood cell; *independent T-test; #Chi-square test

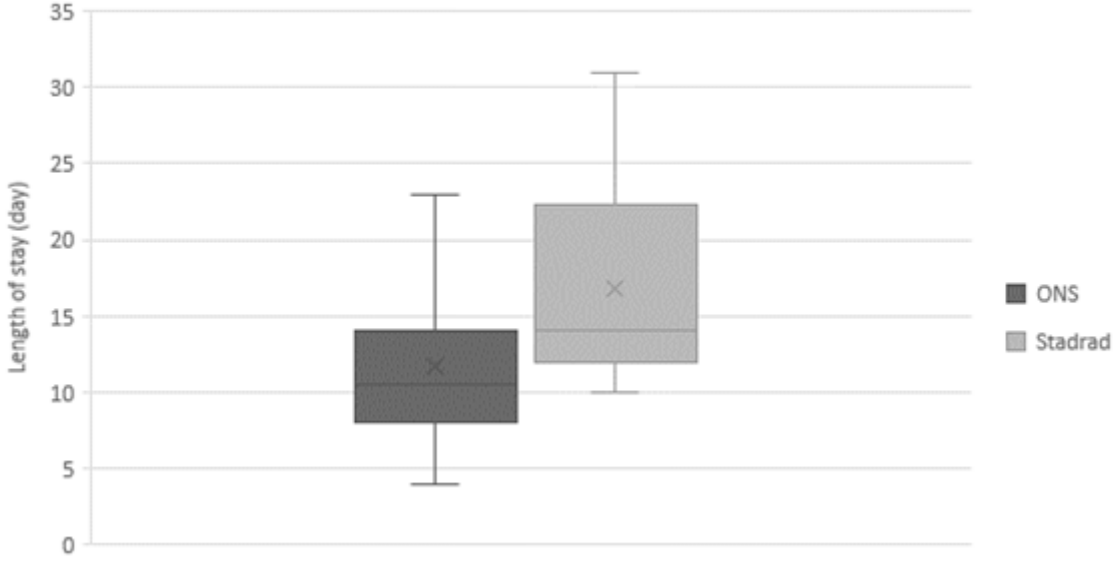

Figure 1. Box plot of nutritional support and length of stay [mean difference -4.3 days (95%CI -7.6 to -1.0); (P=0.012)]

food swallowing, and increased metabolic rates, which are related to energy imbalance resulting in disease-related malnutrition.[13] Thus, doctors should pay serious attention to early identification and management of malnutrition in children with chronic diseases.[14]

Malnutrition in children with chronic diseases is associated with poor prognoses, such as higher rates of morbidity and mortality.[2,3] Optimal nutritional support is needed to prevent and treat malnutrition in hospital settings. One modality is ONS, a liquid formula with an energy density of 1 kcal per mL or more. ONS has been widely used in children with acute or chronic diseases to ensure their growth and development. The benefits of ONS are increased energy, protein, and micronutrient intake, maintained appetite, prevention of body weight loss in acute illness or increased body weight in chronic illness, and improved prognosis.[5,15-17]

In our study, a total of 64 subjects with DRM

were randomly chosen and grouped into ONS and standard feeding groups, based on their nutritional intake during hospitalization. Age, gender, body weight, body height, as well as WBC and lymphocyte counts were not significantly different between groups. Subjects with moderate malnutrition receive ONS lower than subjects with severe malnutrition. More subjects with severe malnutrition received ONS than standard feeding. By the indication, subjects with severe malnutrition are in greater need of ONS to accelerate the improvement of their nutritional status. Many studies have reported on the benefits of ONS in improving nutritional status.[7,17,18]

Finally, we found that subjects with DRM who received ONS had a shorter length of hospital stay by approximately 4 days. ONS ensures that hospitalized patients receive the energy, protein, and micronutrient requirements in order to accelerate healing of diseases. Some studies have reported on the benefits of nutritional support in improving prognosis, including fewer complications, shorter length of hospital stay, lower hospital cost, as well as lower mortality rates.[1,17,19]

A limitation of our study was not distinguishing the types of ONS used. Several different brands of ONS were used, such as *Infatrini®*, *SGM Gain-100®*, *PediaComplete®*, *Nutrinidrink®*, *Ensure®*, and also *WHO Formula-100*. The use of various formula types may have influenced the results. We also did not calculate the daily caloric intake between the ONS and standard groups. Differences in daily caloric intake may have influenced the achievement of energy and other nutrient requirements.

In conclusion, pediatric patients with chronic diseases are common in our hospital and the prevalence of malnutrition related to chronic disease is 44.4%. Malnutrition is high in hospitalized children and needs early identification and nutritional support to improve their prognosis. Malnutrition is significantly associated with a longer length of hospital stay. Such patients require optimal nutritional support, such as in the form of ONS. Our findings suggest that ONS might shorten the length of hospital stays of DRM patients. We recommend routine evaluation of nutritional status in patients with chronic disease to identify malnutrition, in order to provide timely treatment with oral nutrition supplements.

Conflict of interest

None declared.

Acknowledgements

The authors would like to thank the research team, residents, nurses, and the nutritionist for their participation and contributions to this study.

Funding acknowledgement

This study was supported by Lembaga Penelitian dan Pengabdian Kepada Masyarakat, Universitas Udayana with grant number: 363/UN14/HK/2022.

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