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Comparison of Macronutrients Calculation in Sick Children According to Recommended Dietary Allowance and *Angka Kecukupan Gizi* in Sanglah General Hospital, Denpasar

Perbandingan Kalkulasi Gizi Makro Anak Sakit Berdasarkan Recommended Dietary Allowance dan Angka Kecukupan Gizi di RSUP Sanglah Denpasar

I Made Samitha Wijaya[1], I Gusti Lanang Sidiartha[1]*, I Gusti Ayu Putu Eka Pratiwi[1], Ida Ayu Surya Agustini[2]

[1]Departemen Ilmu Kesehatan Anak, Fakultas Kedokteran, Universitas Udayana, Denpasar, Indonesia
[2]Instalasi Gizi RSUP Sanglah Denpasar, Denpasar, Indonesia

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Correspondent:
I Gusti Lanang Sidiartha
lanang_sidiartha@unud.ac.id

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ABSTRACT

Background: Optimal nutrition care in hospitalized children is essential to improve the prognosis of diseases. One strategy is the implementation of Pediatric Nutrition care (PNC) in all hospitalized children.
Objectives: to compare the macronutrient calculation in PNC with *Angka Kecukupan Gizi* (AKG).
Methods: A cross-sectional study was conducted in hospitalized children aged six months to 18 at the Pediatric Ward Sanglah General Hospital, Denpasar, Bali, from January to December 2020. Macronutrient calculation in PNC using Recommended Daily Allowance (RDA) was compared with AKG in all subjects during hospitalization. The difference was analyzed using a paired-t test with significance if p-value < 0.05.
Results: A total of 97 subjects were included, 52 male (53.6%) and 45 female (46.4%). Most of the subjects were aged above five years old (58.8%), well nourished (49.5%), had acute diseases (60.8%), and length of stay of fewer than seven days (66%). The mean calculation of carbohydrates, lipids, and protein according to RDA and AKG were 162.3 g vs. 250 g (p<0.001), 56.2 g vs. 65.9 g (p<0.001), and 60.9 g vs. 40 g (p<0.001), respectively.
Conclusions: Protein calculation using RDA is significantly higher, conversely to carbohydrate and lipids is lower. Sick children commonly need more protein against their diseases, so using RDA to calculate the macronutrient requirement is recommended.

INTRODUCTION

Optimum nutritional management in hospitalized children is essential because it is associated with a poor disease prognosis. Several studies stated that malnutrition is associated with more extended hospital stays, higher care costs, medical complications, and higher mortality rates[1-3]. Therefore, optimal nutritional management is needed in sick children during treatment to improve the prognosis of the disease.

Every sick child, especially those requiring hospitalization, is at risk of malnutrition. The incidence of malnutrition at Sanglah Central General Hospital (RSUP) Denpasar, Bali, Indonesia, varies between 17% and 30%[4,5]. The incidence is still high, requiring optimal nutritional management. Hospital malnutrition is caused by various mechanisms, such as decreased nutritional intake due to anorexia, increased nutritional requirements due to inflammation, and impaired nutrient absorption due to gastrointestinal dysfunction. The combination of these various mechanisms is related to the underlying disease (disease-related malnutrition), which requires optimal nutritional management[6].

Nutrition management to prevent and treat malnutrition in sick children while in treatment often encounters obstacles. This condition causes nutritional intake to be not optimal. There are several reasons, including diagnostic procedures that require children to fast and tolerance to the food given is not good[7]; for example, children experience nausea, vomiting, or diarrhea after being given nutritional management.

In Sanglah General Hospital Denpasar, Bali, Indonesia, nutritional calculations for managing sick children follow the Indonesian Pediatrician Association (IDAI) recommendations listed in Pediatric Nutrition Care (ANP)[8]. There are five steps in ANP: assessing nutritional status, determining nutritional needs, determining how to provide nutrition, determining the type of food, and monitoring and evaluation[8] and determining nutritional

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needs, including macro nutrients (carbohydrates, fats, proteins) in ANP according to the Recommended Dietary Allowance (RDA). In addition, in Indonesia, there is also a way to determine macro nutrient needs according to the Nutrition Adequacy Rate (RDA) as stated in the Regulation of the Minister of Health of the Republic of Indonesia, number 28 of 2019. This study aims to compare the calculation of macro nutrients.

METHODS

The research design was retrospective observational with a cross-sectional approach. This study used secondary data collected from the medical records of inpatients in the pediatric ward, Sanglah General Hospital Denpasar, Bali, Indonesia, from January to December 2020. This research has received approval and permission from the Research Ethics Committee of the Faculty of Medicine, Udayana University/Sanglah Hospital Denpasar, Bali Number 516/UN14.2.2.VII.14/LT/2021.

The inclusion criteria were pediatric patients aged six months to 18 years who were treated in the pediatric ward of Sanglah General Hospital Denpasar, Bali, from January to December 2020. Patients were treated more than once using data for the first time during the study period. Exclusion criteria were patients treated in the intensive care unit and/or incomplete data on the patient's medical record. Data collected from the patient's medical records were age, sex, weight, length or height, disease diagnosis, length of stay, and calculation of carbohydrate, fat, and protein needs in the first 24 hours of hospital admission.

The process of weighing body weight and measuring length or height at Sanglah Hospital in Denpasar, Bali, follows the World Health Organization (WHO) guidelines[9]. Nutritional status is determined based on WHO classification using the body mass index (BMI) indicator according to age: BMI-for-age < -2SD as malnutrition, BMI-for-age > 2SD as overweight/obese, and BMI-for-age + 2SD as good nutrition[10]. The BMI formula is body weight in kilograms divided by height in meters squared (kg/m^2). The results of BMI calculations are then plotted on the WHO BMI chart according to the child's age and sex. The use of WHO standards because Indonesia has adopted them following the Regulation of the Minister of Health of the Republic of Indonesia number 2 of 2020 (PMK 2/2020). The BMI indicator according to age to determine nutritional status can be used for children aged 0-18 years, according to PMK 2/2020. Based on the diagnosis, the disease grouping becomes acute if it lasts less than three months while chronic if it lasts more than three months[11].

The carbohydrate, fat, and protein calculated in the patient's medical record are based on the Indonesian Recommended Dietary Allowance (RDA) with a composition of 45-50% carbohydrates, 35-40% fat, and 11-15% protein of total calories[12,13]. The calculation data for carbohydrate, fat, and protein needs are then compared to the RDA according to the age group and sex of the patient as stated in the Regulation of the Minister of Health of the Republic of Indonesia number 28 of 2019.

The sample size was calculated using a single sample formula with a hypothesis test. The researcher wants to prove the difference in calculating macro nutrient intake in hospitals that use the Indonesian RDA with the 2019 RDA standard. with $n = \left\{\frac{(Z\alpha+Z\beta)s}{(Xa-Xo)}\right\}^2$ α 0.05, power 80%, standard deviation of protein intake 13.7 g from previous publications[14] and a difference in mean protein intake of 5 g, the minimum sample size is 59 subjects. Statistical analysis was done using the SPSS 20.0 program. Differences in macro nutrient calculations based on the RDA and 2019 RDA were tested with the Wilcoxon test, the paired mean difference test with an abnormal distribution with a significance level if the p-value <0.05.

RESULTS AND DISCUSSION

During the study period, 97 subjects met the research criteria, consisting of 52 male subjects (53.6%) and 45 female subjects (46.4%). Since our studies from 2008 to 2019, more male patients have been treated than female patients[4,5,14-15]. This may be because males are more susceptible to disease than females due to the effect of reproductive hormones on the balance between T-cells helper-1 and T-helper-2[16].

The most age group is six years and over, namely 58.8%, while the group of children under five (under five years) is 41.2%, and 50% is in the group of children under two years (under two years). Our previous research obtained the opposite results, namely that more subjects were younger. Some are up to 12 years old[4,5,13]. Since the last few years, what is meant by children is before 18 years, so pediatricians treat patients until they are before 18 years of age. This is what causes the subjects in this study to be more in the older age group. Complete subject characteristics are shown in Table 1 below.

Table 1. Characteristics of the 97 respondents

Characteristics	n (%)
Age group	
0-2 years	20 (20.6)
3-5 years	20 (20.6)
6-18 years	57 (58.8)
Gender	
Male	52 (53.6)
Female	45 (46.4)
Nutritional status	
Malnutrition	42 (43.3)
Good nutrition	48 (49.5)
Obesity	7 (7.2)

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Characteristics	n (%)
The basis of the disease	
Acute	59 (60.8)
Chronic	38 (39.2)
Length of stay	
< 7 days	64 (66.0)
>7 days	33 (34.0)
Total	97

In this study, subjects received macro nutrient management according to the RDA calculations. The average results of macro nutrient calculations in this study were 162.3 g of carbohydrates (46.4% of total energy), 56.2 g of fat (36.2% of total energy), and 60.9 g of protein (17.4% of total energy). When compared with the calculation of macro nutrients according to the RDA, the result is 250 g of carbohydrates (57% of total energy), 65.9 g of fat (33.8% of total energy), and 40 g of protein (9.1% of total energy). If you pay attention, the protein administration to inpatients is significantly higher (Table 2). Likewise, the protein count was significantly higher if the male and female patients were differentiated.

Table 2. Calculation of macro nutrients based on RDA and RDA according to gender

Macro nutrition	RDAs	AKG	Average difference (95%IK)	p.s
Whole				
Carbohydrate (g), median (min-max)	162.3 (26.8-271.0)	250.0 (105.0-400.0)	-99.7 (-112.3; -87.2)	<0.001
Fat (g), median (min-mak)	56.2 (8.0-159.0)	65.9 (39.9-102.6)	-11.6 (-15.8; -7.4)	<0.001
Protein (g), median (min-max)	60.9 (4.0-87.0)	40.0 (15.0-75.0)	16.9 (13.1-20.7)	<0.001
Man				
Carbohydrate (g), median (min-max)	154.0 (26.8-240.2)	250.0 (105.0-400.0)	-103.7 (-118.8; -88.6)	<0.001
Fat (g), median (min-max)	56.2 (8.2-159.0)	65.9 (39.9-102.6)	-10.1 (-16.2; -4.1)	<0.001
Protein (g), median (min-max)	60.9 (4.0-87.0)	40.0 (15.0-75.0)	19.6 (15.2-24.1)	<0.001
Woman				
Carbohydrate (g), median (min-max)	174.9 (40.0-271.0)	250.0 (105.0-400.0)	-95.1 (-116.4; -73.8)	<0.001
Fat (g), median (min-max)	56.7 (8.0-83.5)	65.9 (39.9-102.6)	-13.3 (-19.3; -7.2)	<0.001
Protein (g), median (min-max)	57.9 (9.6-87.0)	40.0 (15.0-75.0)	13.7 (7.2-20.3)	<0.001

RDA, nutritional adequacy rate; CI, confidence interval; RDA, recommended dietary allowance.

Pediatric patients aged 0.5 to 13 years use protein intake for around 58%, while those aged 14-18 years use protein intake for around 43%[16]. If protein intake is insufficient, catabolism will occur, closely related to increased morbidity and patient mortality, especially in patients treated in the intensive care unit[17]. Therefore, hospitalized patients require optimal protein intake with a higher protein-energy ratio (PER). In this study, patients received protein intake with a PER of 17.4%, whereas according to the RDA calculation, protein intake was around 9.1%. Based on the age group, it is also proven that protein intake is significantly higher (Table 3). In sick children, protein synthesis and degradation occur very quickly, decreasing lean body mass, so they risk experiencing malnutrition and worsening the disease prognosis[17,18]. Optimal protein intake can prevent this decrease in lean body mass and improve the disease's prognosis. A multicenter cohort study reported a protein intake of more than 60% of the target was associated with a lower mortality rate[19]. Another study reported that a protein intake of more than 1.1 g/kg body weight was associated with a positive nitrogen balance and a lower mortality rate[20].

The weakness of this study is that it did not evaluate in more detail the achievement of protein intake during hospitalization and the possibility of excess protein intake through monitoring of uremia and acidosis. This is the first study to compare the macro nutrient needs of inpatient children using the RDA and compare it with the calculation of macro nutrients using the RDA. The advantage of this study is to calculate macro nutrient needs individually according to the patient's current condition, so using the RDA to calculate macro nutrient needs in hospitalized patients is recommended.

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Table 3. Calculation of macronutrients based on RDA and RDA according to age group

Age group	RDAs	AKG	Average difference (95%IK)	p.s
0-2 years				
Carbohydrate (g), median (min-max)	122.4 (26.8-220.0)	215.0 (105.0-215.0)	62.5 (31.6-93.4)	<0.001
Fat (g), median (min-mak)	44.6 (8.2-80.3)	52.7 (39.9-52.7)	6.7 (-15.9-2.5)	0.144
Protein (g), median (min-max)	36.2 (7.0-87.0)	20.0 (15.0-20.0)	20.5 (9.6-31.5)	0.001
3-5 years				
Carbohydrate (g), median (min-max)	132.0 (28.0-240.2)	215.0 (215.0220.0)	75.9 (49.9-101.9)	<0.001
Fat (g), median (min-mak)	48.2 (8.0-79.6)	52.7 (52.7-60.9)	4.6 (-11.9-2.7)	0.200
Protein (g), median (min-max)	50.2 (4.0-76.3)	20.0 (20.0-25.0)	25.6 (17.2-33.9)	<0.001
6-18 years				
Carbohydrate (g), median (min-max)	198.0 (64.9-271.0)	300.0 (220.0-400.0)	121.2 (106.7-135.6)	<0.001
Fat (g), median (min-mak)	64.2 (18.8-159.0)	78.2 (60.9-102.6)	15.7 (9.8-21.7)	<0.001
Protein (g), median (min-max)	60.9 (14.5-87.0)	50.0 (25.0-75.0)	12.6 (8.1-17.1)	<0.001

RDA, nutritional adequacy rate; CI, confidence interval; RDA, recommended dietary allowance.

CONCLUSION

The calculation of protein needs is significantly higher using the RDA than the RDA. On the other hand, the calculation of carbohydrate and fat needs is lower. The protein energy ratio given is more than 10% to support the increased protein needs of sick children. Macro nutrients are 46.6% carbohydrates, 36.2% fat, and 17.4% protein. The use of RDA in calculating macro nutrient needs in inpatients is more recommended because the calculation is individual according to the child's current condition, and protein is higher to support the needs of children who are sick. Suggestions for further research on its impact on disease prognosis.

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All authors have no conflict of interest in this article. This research is independent research from researchers.

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