Public Health of Indonesia
E-ISSN: 2477-1570 | P-ISSN: 2528-1542

Original Research

Serum total protein and albumin levels among malnourished elementary-aged children East Nusa Tenggara, Indonesia

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Doi: https://dx.doi.org/10.36685/phi.v8i4.643
Received: 18 October 2022 | Revised: 7 November 2022 | Accepted: 2 December 2022

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Abstract

Background: School-aged children between 6-12 years are a vulnerable group that could be affected by malnutrition, which may cause growth failure and affect their school achievement. East Nusa Tenggara, Indonesia, is known as the province with the highest cases of malnutrition.

Objective: This study aimed to determine serum total protein and albumin levels among malnourished elementary-aged children. Serum total protein and albumin are biochemical parameters that give valuable data due to malnutrition.

Methods: This study employed a case-control design. Purposive sampling was used to select the samples with a total of 90 children aged 6 – 12 years, of which 45 were assigned to a case group and a control group. The children's blood was collected and analyzed using Riele Photometer 5010. The Biuret method was applied for total protein and bromocresol green for albumin serum. Independent sample *t*-test with a significant value <0.05 was used to determine the difference between mean total protein and albumin levels.

Results: The percentage of low total protein levels in malnourished children was 36%, and the percentage of low albumin levels was 27%. The mean level of total protein and albumin was found to be lower in malnourished than in well-nourished children, 6.324±1.1748 g/dL vs. 7.047±0.6330 g/dL (p = <0.001), and 3.927 g/dL±0.7779 g/dL vs. 4.242 g/dL±0.5272 (p = 0.016), respectively.

Conclusion: There were significant differences in total protein and albumin serum among malnourished and well-nourished children. The results may serve as basic information for further studies or to create an intervention to reduce malnutrition.

Keywords: serum total protein; serum albumin; school-aged children; malnutrition

Background

Malnutrition is defined as a deficiency or imbalance of a person's energy and nutrient intake; it can be formed as wasting, stunting, and being underweight (Mayangsari & Rasmiati, 2020; World Health Organization, 2020). School-aged children are vulnerable to malnutrition (Effendy, Wirjatmadi, Adriani, & Tosepu, 2015; Murhima Alika et al., 2022). Malnutrition has a considerable impact on school-age children, such as less enrollment in school on time and less achieving age-appropriate

grades. In addition, there is a significant association between malnutrition and children's scholastic performance in school (Khanam, Nghiem, & Rahman, 2011; Shree & Murthy, 2021).

Global Nutrition Report of 2020 recorded malnutrition prevalence in children and adolescents aged 5 – 19 years were 11.6% for boys and 8.1% for girls globally, whereas for Asia region was 16.5% for boys and 12.3% for girls (Micha et al., 2020). Furthermore, Christian and Smith (2018) reported that micronutrient deficiency (malnutrition), including iron deficiency anemia and iodine anemia, tend to occur more in girl than in boys (25% vs. 22,5%; 5% vs. 2.5%), while vitamin a deficiency has high percentage occurs in boys than in girls (23% vs. 20%). This study also reported percentage of boys and girl who were underweight are higher in the south Asia region than in any region in the world, with almost 60%; southeast Asia also recorded the highest percentage of stunting in adolescent (5-19 years old) with 12% (Christian & Smith, 2018).

National Basic Health Research in 2018 reported proportion of children aged 5-12 years classified by BMI for age were very thin 2.4; thin 6.8, while among gender, were 2.8 very thin; 7.3 thin for boys and 2.0 very thin; 6.2 thin for girls. East Nusa Tenggara was the province with the highest proportion of undernutrition children aged 5-12 years, 4.6 very thin and 13.9 thin (Kementerian Kesehatan Republik Indonesia, 2018). Rick factor of malnutrition concluded by the study on school adolescents in northwest Ethiopia was male gender, illness last two weeks, and more than five family members (Demilew & Emiru, 2018).

East Nusa Tenggara is known as a province that has become the Indonesian "barn" of children with stunting (a form of malnutrition), and even the Indonesian President is giving special attention to this province to lower case numbers (Herin, 2022). Unlike children under five years who accepted special attention for malnutrition, especially in Indonesia, unfortunately, there are fewer data and programs implemented for elementary school-aged children. Malnutrition among children aged 5-19 years was associated with a higher potential of infectious diseases, delayed maturation, low muscular strength, reduced work capacity, and a higher risk of osteoporosis (Aiga et al., 2019).

In addition to the anthropometric measurement for classifying the children's nutritional status, laboratory examinations were also valuable for monitoring child development, especially regarding nutrient intake and adequacy. The nutritional status of children's parameters is serum total protein and albumin (Keller, 2019). Low levels of these two parameters, also known as hypoproteinemia and hypo albuminemia more likely found in malnourished children (Mishra, Bastola, & Jha, 2009).

A study conducted in Zaria among malnourished children aged 6-59 months in 2018 found the serum total protein and albumin were significantly lower in malnourished than in well-nourished children (Abdullahi, Yakubu, Bugaje, & Akuyam, 2018). Another study confirmed that total protein and serum albumin are recommended as useful indicators of the nutritional status of malnourished children. Those two parameters are good markers of protein energy malnutrition (Kumar & Singh, 2013).

Serum total protein and albumin assay are promising for the early detection of malnutrition and better prognosis. This will help all stakeholders involved in the malnutrition prevention program could take one step forward in battling malnutrition (Chowdhury, Akhter, Haque, Aziz, & Nahar, 2008). Therefore, this study aimed to determine the level of serum total protein and albumin among malnourished elementary-aged children in Oelomin, Nekamese Subdistrict, Kupang District, Indonesia.

Methods

Study Design

This was an analytical descriptive study using a case-control design to determine the difference in mean serum total protein and serum albumin between malnourished and well-nourished children. This study was conducted from April to July 2022 at Tunfeu 2 Public Elementary School in Oelomin Village, Nekamese Subdistrict, Kupang District, East Nusa Tenggara.

Samples

Purposive sampling was used to select 90 children between the ages 6 – 12 years who were divided into two groups: 45 children as the case group and 45 children as the control group, while the criteria of case group were children age 6 -12 years who have

z score between -3s - < -2 s (thinness), otherwise, the control group consist of children age 6-12 years who have z score between -2s - +1s (normal), the z score was count using the Body Mass Index (BMI) for age 5-19 years indicator according to Children Anthropometry Standard on Indonesian Minister of Health Regulation (Ministry of Health Indonesia, 2020).

Data Collection

This study also collected some data such as children's names, date of birth, gender, also parents' income, and educational level that were classified based on the Central Statistical Bureau classification (Badan Pusat Statistik, 2017) using questionnaires.

Furthermore, children also underwent the anthropometric measurement consisting of body weight using a body scale and body height using a stature meter for BMI utilizing a body weight formula in kilograms divided by the square of body height in meters to obtain the malnutrition status. 3 cc of venous blood from children were collected using butterfly needle to plain vacuum tube and sit to clot before the serum separated using a centrifuge.

The samples were analyzed for total protein with biuret method and albumin with bromocresol green method (Diasys Diagnostic Systems GmbH Reagent) while the reference values for serum total protein and albumin in children were 6-8.3 g/dL; 4-5.8 g/dL, respectively. The samples were measured with Riele Photometer 5010 in the chemical chemistry laboratory Medical Laboratory Technology Health Polytechnic Kupang.

Data Analysis

Data were compiled and analyzed using an independent sample *t*-test with a significant *p*-value <0.05 to determine the difference of mean total protein and albumin levels in case and control groups using SPSS Version 26 Software.

Ethical Consideration

Ethical clearance of this study was obtained from the Health Research ethics commission of Health Polytechnic Kupang Number LB.02.03/1/0116/2022, Date 18th April 2022. In addition, informed consent was obtained from the children's parents or guardians before the children were enrolled in this study.

Results

A total of 90 children enrolled in this study out of 230 total population that matched the inclusion criteria. **Table 1** shows that based on gender number of males and females was slightly equal, although, in the control group, females were more than males (25 vs. 20). Variables that similar highest percentage between cases and the control group was father's occupation: Farmers (60% and 58%); mother's education: Elementary (33% and 40%); mother's occupation: no job (88% and 83%); and family income: medium (62% and 58%). While the father's education with the highest percentage was different: elementary (38%) for the cases group and senior high (47%) for the control group. Variables that have significantly different were age between the case and control group (p = 0.006), while other variables had no significant difference between the two groups.

Table 1 Distribution of children's gender, age, parent's education, and parent's income

Variables	Case *n* (%)	Control *n* (%)	*p*-value
Gender			0.527
Male	23 (51)	20 (44)	
Female	22 (49)	25 (56)	
Age			0.006
6-9 years	18 (40)	31 (69)	
10-11 years	27(60)	14 (31)	
Father's Education			0.082
None	4 (9)	3 (7)	
Elementary	17 (38)	11(23)	
Junior High	12 (27)	7 (16)	
Senior High	9 (21)	21 (47)	
University/College	3 (7)	3 (7)	

Table 1 Cont.

Father's Occupation			1.000
No Job	2 (4)	2 (4)	
Farmers	27 (60)	26 (58)	
Private employee	0 (0)	4 (9)	
Entrepreneur	14 (32)	11 (25)	
Government employee	2 (4)	2 (4)	
Mother's Education			1.000
None	7 (16)	5 (11)	
Elementary	15 (33)	17 (40)	
Junior High	7 (16)	9 (20)	
Senior High	12 (26)	10 (22)	
University/College	4 (9)	3 (7)	
Mother's Occupation			1.000
No Job	39 (88)	37 (83)	
Farmers	1 (2)	2 (4)	
Private employee	2 (4)	0 (0)	
Entrepreneur	2 (4)	6 (13)	
Government employee	1(2)	0 (0)	
Family Income			1.000
Low	13 (29)	13 (29)	
Medium	28 (62)	26 (58)	
High	4 (9)	6 (13)	

Table 2 shows low levels of serum total protein and serum albumin were higher percentages found in the case group than in the control group, with 36% vs. 11 % and 27% vs. 7%, respectively. The total protein level is considered low if the level is < 6 g/dL, and < 3.5 g/dL for albumin is regarded as low.

Table 2 Distribution of serum total protein and albumin

Variables	**Case** ***n (%)***	**Control** ***n (%)***
Serum Total Protein		
Low	16 (36)	5 (11)
Normal	29 (64)	40 (89)
Serum Albumin		
Low	12 (27)	3 (7)
Normal	33 (73)	42 (93)

Table 3 Serum total protein levels among malnutrition and normal children

Serum Total Protein (g/dL)	**Case (*n* = 45)**	**Control (*n* = 45)**	***p***	**95% CI**	
				Lower	**Upper**
Mean	6.324 g/dL	7.047 g/dL	<0.001	0.3269	1.1176
Std Deviation	1.1748	0.6330			

Table 4 serum albumin levels among malnutrition and normal children

Serum Albumin (g/dL)	**Case (*n* = 45)**	**Control (*n* = 45)**	***p***	**95% CI**	
				Lower	**Upper**
Mean	3.927 g/dL	4.242 g/dL	0.016	0.0372	0.5940
Std Deviation	0.7779	0.5272			

Table 3 shows that mean serum total protein levels were lower in the case group than in the control group: 6.324±1.1748 g/dL vs. 7.047±0.6330 g/dL. There was a significant difference in serum total protein between malnutrition and normal children (p = 0.000). **Table 4** shows a significant difference in serum albumin between malnutrition and normal children (p = 0.016).

Discussion

Adequacy of protein intake was critical in school-aged children, considering this population needed a large amount of protein to support their growth. Malnutrition in children can be caused by low intake of nutritious food, the presence of infection, and the problem with absorbing nutrients from food (Effendy, Prangthip, Soonthornworasiri, Winichagoon, & Kwanbunjan, 2020; Fadilah & Romadona, 2022; Taki, 2018).

This study found a significant difference in serum total protein and albumin between malnourished children and well-nourished children. This study was in line with other studies with the same conclusion (Abdullahi et al., 2018; Kumar & Singh, 2013). If the need for protein is not met for a long period, this will lead to protein synthesis disturbance that results in the total protein and albumin being found to be lower than the reference values (Costarelli & Emery, 2009; Neli, Latif, Rompas, & Putri, 2021). Therefore, low levels of total protein and albumin in serum can cause many alterations and harmful effects on children's growth and have a destructive impact on the future of a nation because children are the future generation. This study also described that among malnourished children, there are factors including low education of both father and mother that may affect their knowledge of nutritious food for their children, occupation as a farmer who did not earn stable income per month for providing the nutritious food, this result was similar to other studies that stated that there is a correlation between parent's knowledge and income to the malnutrition status on children (Khattak, Iqbal, & Ghazanfar, 2017; Syafar, Arsin, & Bahar, 2016; Tangkelangi, 2019).

Conclusion

The serum total protein and albumin levels were significantly lower in malnourished children than in well-nourished children (p < 0.05). It is recommended that future studies to estimate the protein intake also detect infection or any disease that could affect protein absorption in malnourished children. A prediction study of malnutrition in school-aged children is also needed, so the stakeholder can take preventive or controlling action to tackle the problem in the field.

Declaration of Conflicting Interest

The authors declare that there is no conflict of interest.

Funding

This study was fully funded by Health Polytechnic of Kupang via 2022 Lecturer Research Funding.

Acknowledgment

We would like to express our highest appreciation to the Director of Health Polytechnic of Kupang for giving us a chance to conduct our research. We acknowledge the government of Kupang District, Nekamese Subdistrict, and the Headmaster of SD Inpres 2 Tunfeu for their valuable cooperation during data collection. We would like to express our gratitude to all enumerators, parents, and students at SD Inpres 2 Tunfeu who participated in this study. We are also grateful to the Medical Laboratory Technology Department, Health Polytechnic of Kupang, for the facilitation and support for the study. Special thanks to Novelia G. B. So'o, AMd.AK and Yuan A. Tassi, Amd.AK, who gave their valuable time and energy in helping us through the blood sample collection.

Author Contribution

MT contributed to the planning, searching of the literature, data collection, and writing the manuscript; SWD contributed in supervised the conduct of the study; MBB contributed to reviewing the draft and supervision; and AA contributed to revising the manuscript and supervising the conduct of the study. All authors agreed to the final version to be published.

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Cite this article as: Tangkelangi, M., Djami, S. W., Bia, M. B., & Astuti, A. (2022). Serum total protein and albumin levels among malnourished elementary-aged children East Nusa Tenggara, Indonesia. *Public Health of Indonesia, 8*(4), 110-115. https://dx.doi.org/10.36685/phi.v8i4.643