The Influence Of Lemuru Nugget Giving Against Protein, Calcium, Zinc And Z-Score HG / U Intake Of Class 1 Elementary School Children Stunting In The Work Area Of Pantai Labu Health Center, Deli Serdang Regency

Oslida Martony[1], Dini Lestrina[2], Novriani Tarigan[3], Ginta Siahaan[4]

[1,2,3,4]*Department of Nutrition, Poltekkes Ministry of Health Medan, Indonesia*
Email: oslida64@gmail.com

Abstract

Background: Failure of Height Growth (HG) results in human resources being unable to compete in the era of globalization, affecting work productivity, increasing the risk of obesity and triggering the metabolic syndrome. The incidence of stunting in school children is quite high, including North Sumatra with a prevalence of 42.3%. During the growth period of very high bone mineralization, low intake of protein, calcium and zinc influences linear growth. Growth failure is caused by inadequate intake of one or more nutrients. Aged 5-12 years is an opportunity to catch up and improve height. **Objective:** To determine the effect of lemuru fish nuggets on protein, calcium, zinc and Z-Score HG / U intake for grade 1 elementary school children who are stunted**. Research Methods**: the study was conducted in April-June 2018, quasi-experimental with a pre and post-test design, a sample of 31 people treated and 36 controls. The treatment group was given lemuru fish nuggets for 30 days for 75 gr—data collection using 2x24 hour Food Recall method, five-day food recording and HG measurement. The data collected was processed using T dependent test data analysis with $\alpha = 0.05$. **Results:** There were significant differences in the average values of protein, calcium and zinc intake before and after administration of lemuru fish nuggets, these differences in intake affected the average Z-Score HG / U values, the treatment group was higher than the control. Suggestion: to the sample mother to continue giving food made from fish containing high protein, calcium and zinc in the daily menu, so that the lagging of HG growth can be pursued.

Keywords: Lemuru Nugget, Intake, Protein, Calcium, Zinc, Z-Score HG / U, Stunting

A. INTRODUCTION

Inadequate and unbalanced nutritional intake can affect the growth, development and nutritional status of children. (Baranowski et al., 2000). School-age children are a group of children who are prone to getting unbalanced nutrition so that there is a high risk of growth failure in children. (Zlotkin et al., 1985). Failure of height growth (HG) produces less competitive human resources because stunting will affect work productivity, increase the risk of obesity and obesity, and trigger metabolic syndrome disease. (Kaufman et al., 1997).

Stunting is a short body state that exceeds 2 SD (Standard Deviation) deficits below the median height of the population for international reference. (Akombi et al., 2017). Short prevalence in children based on the results of the 2007 Basic Health Research was 36.8%, the

2010 Basic Health Research was 35.6%, the 2013 Basic Health Research was 37.2%, and the Basic Health Research 2018 was 30.8%. In contrast, the health problems in society are considered severe if the short prevalence is 30-39% and acute if the short prevalence is ≥40% (WHO, 2010 in RI, K. 2013).

The factors that cause a child to experience stunting are very complex; lack of food intake and infectious diseases are direct factors. (Reyes et al., 2004). At the household level, the nutritional situation is influenced by the ability of the household to provide adequate quantities and types of food, nutritional care of mothers and children which is controlled by educational and behavioural factors, and the health condition of household members. (Strobel et al., 1979).

The quantity and quality of protein intake has an effect on plasma insulin growth factor I (IGF-I) levels and also on bone matrix proteins and growth factors that play an essential role in bone formation. (Renehan et al., 2004). Besides, fulfilling the intake of several high-quality micronutrients has a significant role in preventing the occurrence of stunting such as zinc, iron, vitamin A, iodine, even calcium and phosphorus is also crucial in the linear growth of children (Mikhail et al., 2013).

Zinc (Zn) is an essential substance for the body; zinc is involved in a variety of acid-base balance, amino acid metabolism, the formation of immune system proteins, reproduction and development of the nervous system (O'Dell, 1992 in Rahayu et al., 2017). Also, a high intake of zinc will reduce calcium uptake from bones. From a study conducted by Trisnawati (2014) in Central Java, as many as 94.2% of research subjects had zinc intake <70% of the Nutrition Adequacy Rate (NAR). Following the results of research Rahmawati et al., (2017) which shows the relationship between the level of zinc adequacy with stunting. Hidayati et al., (2010) also stated that a lack of zinc intake had a 2.67 times greater risk of stunting in children.

During growth, demands for bone mineralization are very high; low calcium intake can result in low mineralization of new bone deposit matrix and osteoblast dysfunction (Ebina et al., 1991). Calcium deficiency will affect linear growth if the calcium content in bone is less than 50% of regular content (Prentice, 1993 in Endah et al., 2019).

A study proves that the low HG / U is due to low protein intake which is supported by moderate consumption of iodine and zinc, consequently affecting the height of primary school children (Setijowati, 2013). Research Endah et al., (2016) also showed that micronutrient intake was significantly lower in stunting children compared to non-stunting children. Growth failure can be caused by inadequate intake of one or more nutrients such as micronutrient intake, namely calcium and zinc (Kartini et al., 2016).

Elementary school-age children are vulnerable to growth disorders, while rapid height growth in addition to toddlers also occurs at elementary school age. (Baranowski et al., 2000). This means that when a toddler experiencing short nutritional status still has the opportunity to catch up (catch up) and improve it at the age before puberty. This is consistent with the results of research by Mitra, (2015), which states that the provision of intervention in stunting children through highly nutritious foods can accelerate the growth of stunting children height.

To overcome these nutritional problems, one way that can be done is by providing interventions in the form of additional food that will help meet the nutritional needs of children with stunting. (Voth-Gaeddert et al., 2018). Optimizing the handling of nutritional problems in children can be done through diversification of the development of supplementary food formulas by considering aspects of nutrition, health benefits, acceptability, and excellence of local food resources (Widodo et al., 2015).

In terms of countermeasures to overcome the lack of intake of protein, calcium and zinc as well as spurring the growth of schoolchildren will be done by administering the Lemuru

(Sardinella sp) fish nuggets. Fish nugget processing is a simple processing method and has a long shelf life, with storage in the freezer can reach two weeks. (Khoddami et al., 2009).

The results of observations in the field, Labu Beach is one of the producers of fish. The types of fish in question are Lemuru (Tamban) fish. It is known that Tamban fish is relatively cheap and easily obtained by the community, but the use of fish is only sold in fresh form and managed on a household scale to be used as side dishes.

B. METHODOLOGY

Research Design: This study is a Quasi-Experimental study with a pre and post-test design control group design. This design, allows researchers to measure the effect of treatment (intervention) in the experimental group, by comparing between the treatment group (before and after the intervention) and also between the treatment group with the control group.

Location and Time of Research: This study was conducted on elementary school students in grade I who were stunted at 104258 Pematang Biara Public Elementary School, 105336 Rantau Panjang Public Elementary School, 105344 Public Elementary School Denai Lama and 105337 Public School Labu Pekan Beach in the Labu Pantai Public Health Center. The reason for choosing the location of the research is the results of the selection of first-grade elementary school children who are in the working area of Labu Pantai Puskesmas, which is confirmed by HG measurement obtained data on these three SDNs, the prevalence of elementary school children I experienced stunting> 25%, meaning the short number prevalence is quite high. Labu Beach is also a fish-producing area (coastal area), where cheap fish production can be utilized by the community to overcome existing nutritional problems.

Population and Sample: The population is 162 first grade students from 104258 Pematang Monastery (68 people), 105356 Rantau Panjang Elementary School (44 people), 105344 Public Elementary School Denai Lama (50 people) Labu Beach and 105337 Public Elementary Beach Pumpkin Week (66 people). The sample is determined by screening according to the Z-score HG / U> -2 SD criteria, not experiencing chronic infectious disease, not allergic to fish and eggs. After the sample was obtained, a group was formed, namely the treatment group of 31 people (SDN 104258 Pematang Monastery and SDN 105356 Rantau Panjang). The control group was 36 people (SDN 105344 Denai Lama and SDN 105337 Labu Pekan Beach). This study has obtained the approval of a research code of ethics from the health research ethics commission with the number: 0179 / KEPK / POLTEKKES KEMENKES MEDAN / 2018.

Types and Methods of Data Collection: Data on Protein, Calcium and Zinc intake were obtained by conducting a 24-hour food recall for 2 (two) consecutive days (before and after the intervention). A 24-hour food recall was carried out by interviewing the research sample accompanied by the sample mother. The interview was carried out using a 24-hour food recall form and a food picture book. In addition to 24 hours Food Recall, food recording is also carried out for 5 days to fulfil the day of data obtained with 24 hour Food Recal. The record of sample food for 5 days was carried out by the respondent (mother). Height data (HG) is obtained by measuring HG using a 200 cm scale microtoise with an accuracy of 0.1 cm. HG measurements were carried out two times, the first measurement was done before giving the intervention, and the second measurement was done a day after responding.

Provision of Lemuru Fish Nugget: given every day for 30 days (except weeks), given every hour at 09.00 WIB at the school of each study sample. The researcher, assisted by an enumerator, will ensure that the food is eaten right away (not allowed to take it home).

The processing of Lemuru fish nuggets is done in the laboratory of the Nutrition Department of the Poltekkes Medan. Food ingredients and amounts are regulated following what has been determined and are given the same every day. Proximate tests are carried out at the

Industrial Research and Development Agency of the Indonesian Industrial Research and Standardization Center. From the test results, it is known that the composition of nutrients in 100 gr lemuru fish nuggets;

Table 1. Lemuru Fish Nugget Test Results in 100 gr

No	Parameter	Unit	Result	Metode
1	Water content	% (w/w)	60.0	SNI 01-2891-1992
2	Ash Content	% (w/w)	14.9	SNI 01-2891-1992
3	Protein	% (w/w)	9.33	SNI 01-2891-1992
4	Carbohydrate	% (w/w)	10.7	SNI 01-2891-1992
5	Total Fat	% (w/w)	3.88	SNI 01-2891-1992
6	Phosphor	% (w/w)	0.39	Spectrophotometry
7	Zinc (Zn)	mg/gr	2.09	A A S
8	Calcium (Ca)	mg/gr	121.76	A A S
9	Magnesium (Mg)	mg/gr	12.07	A A S
10	Iron (Fe)	mg/gr	1.31	A A S

Data Processing and Analysis: Data processing as a whole is done using computer aids. Bivariate analysis to see differences in the average value of intake of protein, calcium, zinc and Z-score HG / U between treatment and control, before and after administration of the intervention. The initial step taken is to test the normality of data between the control group and the treatment group by using the Crosstabs test with a value of $p > \alpha$ so that it is concluded that there is no difference between the control group and the treatment group. For research data, prior to statistical tests using different tests namely paired t test and Independent samples test, normality test data was conducted using the Kolmogorov-Smirnov One-Sample Test, from the test results it was known that the value of $p > \alpha$ for all variables studied, both the control group and the treatment group, so that the conclusion that the research data is usually distributed. Therefore, statistical tests can be continued using different tests, where the conclusion of the test results is determined if the value of $p < \alpha$ (0.05), then there are differences in the average value of the variables studied before and after the intervention. There are differences in the average value the variables studied were between the control group and the treatment group.

C. RESULT AND DISCUSSION

Characteristics of the sample

Age is the life span that starts from birth then is determined by the measurement scale using years. From table 2 it can be seen that most of the samples in this study in the treatment and control groups at the age of 7 years were 58.0% and 58.3%. In comparison, the sex of the sample was mostly male, namely 61.3% in the treatment group and 69.4% in the control group.

Table 2. Distribution of Primary School 1 Class Children by Age and Gender

Characteristics	Treatment group		Control Group	
	n	%	n	%
1. Age				
7 years	18	58.0	21	58.3
8 years	11	35.5	15	1.7
9 years	2	6.5	0	0
2. Gender				
Man	19	61.3	25	69.4

Woman	12	38.7	11	30.6
Total	31	100.0	36	100.0

Characteristics of the respondent:

Table 3. Distribution of Mothers by Age, Education and Occupation

Age	Treatment group		Control Group	
	n	%	n	%
1. Age				
20 – 29 years	9	29.0	10	27.8
30 – 39 years	14	45.2	19	52.8
40 – 49 years	7	226.	6	16.7
>49 years	1	3.2	1	2.8
2. Level of Education				
Elementary School	11	35.5	14	38.9
Yunior High School	10	32.3	4	11.1
Senior High School	10	32.3	18	50.0
3. Job				
Housewife	28	90.3	34	94.4
Entrepreneur	2	6.4	2	5.6
Teacher	1	3.2	0	0
Total	31	100.0	36	100.0

Intake of Protein, Calcium, Zinc and Zscore HG / U Before and After Intervention

a. Protein intake

The average value of Protein intake in both sample groups before and after the intervention can be seen in table 4.

Table 4. Average Value of Protein Intake

Protein Intake (gr)	Treatment Group		Control Group	
	Before	After	Before	After
Average	36.62	51.17	32.66	43.44
Standard Deviation	5.97	5.62	6.09	5.86
Minimum Value	27.00	37.15	20.15	30.25
Maximum Value	50.80	64.35	49.05	55.67
n	31		36	
p-Value	0.0001		0.0001	
Mean Difference	14.22		10.78	

b. Calcium Intake (Ca)

The average value of Calcium intake in both sample groups before and after the intervention can be seen in table 5.

Table 5. Average Calcium (Ca) Value

Calcium Intake (mg)	Treatment Group		Control Group	
	Before	After	Before	After
Average	188.5	236.53	156.76	164.87
Standard Deviation	82.2	49.07	40.57	41.75

Minimum Value	71.75	168.6	96.07	105.30
Maximum Value	416.92	340.80	265.80	288.50
N	31		36	
p-Value	0.010		0.209	
Mean Difference	48.03		8.14	

c. Zink (Zn) Intake

The average value of zinc intake in the two sample groups before and after the intervention can be seen in table 6.

Table 6. Average Value of Zinc Intake (Zn)

Zink Intake (gr)	Treatment Group		Control Group	
	Before	After	Before	After
Average	3.61	5.32	3.13	3.46
Standard Deviation	1.14	0.65	0.78	0.65
Minimum value	2.05	3.90	1.60	2.56
Maximum value	6.65	6.80	4.70	5.60
n	31		36	
p-Value	0.0001		0.015	
Mean Difference	1.74		0.34	

d. Z-Score HG/U

The average HG / U Z-Score values in the two sample groups can be seen in table 7.

Table 7. Average Z-Score HG / U

Z Score HG/U	Treatment Group		Control Group	
	Before	After	Before	After
Average	-2.57	-2.49	-2.64	-2.64
Standard Deviation	0.43	0.44	0.42	0.42
Minimum Value	-3.69	-3.65	-3.42	-3.39
Maximum value	-2.00	-1.88	-2.05	-1.86
n	31		36	
p-Value	0.0001		0.689	
Mean Difference	0.08		0.01	

Bivariate Analysis of Protein, Calcium, Zinc and Z-Score HG / U Intake between Treatment and Control Groups

The difference between the treatment group and the control group can be seen in table 8.

Table 8. Differences in the Average Value of Protein, Calcium, Zinc and Z-Score HG / U Intake between the treatment and control groups

Variable	Treatment	Control	p-value
Protein (gr)	14.22	10.78	0.031
Calcium (mg)	48.00	8.14	0.038
Zink (mg)	1.74	0.34	0.0001
Z Score HG/U	0.08	0.01	0.0001
n	31	36	

Characteristics

In both groups, it was found that the most age at age 7 years, because the age of 7 years and above is the average age of children more easily affected by the risk of stunting compared to children aged <6 years, where at the age of 7 years there was a decrease in height increase higher than the age under 6 years.

Whereas in the sexes, grade 1 elementary school children with male sex are more easily stunted than girls. The results of this study are in line with research by Rosha et al. (2012) that girls have a protective effect or a lower risk of stunting than boys. This is due to factors of mother's anxiety or concern and the closeness of the mother to a daughter; girls are considered weak children so that they get extra attention compared to boys who are deemed more reliable. Also, boys tend to have more active play activities compared to girls so that a lot of energy comes out if not balanced with adequate nutrition and food can trigger stunting (Rosha et al., 2012).

Whereas the mother of a stunted 1st-grade elementary school child is known to have an age in the 30-39 year age group, where that age signifies the age at which the mother has more than one child so that the mother's attention is more preoccupied with smaller children. This is in line with research conducted by Agustiningrum (2016), where the average age of mothers who have stunting children is 31 years with a marriage age of 22 years.

The level of education of mothers also has differences between the two groups. In the treatment group, there is an almost equal distribution between the levels of education in elementary, junior and senior high schools. Still, in the control group, the broadest distribution is in respondents with high school and elementary education levels. The results of this study indicate that mothers already have an education level classified as secondary education, namely high school graduate. Mothers with secondary education are expected to have more positive attitudes towards food nutrition so that they can help fulfil adequate nutritional needs for the family. Senior high school level is also considered to have the ability to receive information about nutrition and health of children (Rosha et al., 2012).

The work of the two groups has a pretty close similarity of> 90% with a job as a housewife. According to Sulastri (2012), stunting is more common in mothers with work as housewives because this is related to inadequate family income or low economic levels to meet the primary and secondary needs of children.

Difference Between Protein, Calcium, Zinc and Zscore HG / U Intake Before and After Giving Lemuru Nugget

1) Protein intake

The result of the research data shows the value of $p < \alpha$ so it can be concluded that there is a difference in the average value of protein intake before and after the intervention of lemuru fish nuggets, where the difference in the average increase in the amount of protein intake is 14.55 gr/hr, and from the average value of even after administering the nugget, it has fulfilled the nutritional adequacy rate of children aged 7-9 years. In the control group, there were also differences between the protein intake before and after, but if seen the average value of protein intake was less than in the treatment group who were given additional food lemuru fish nuggets. This study is in line with Juhartini's research (2016) which also shows the results that there are differences in the level of protein consumption before and after the administration of BMC Moringa PMT.

Adequate protein intake will provide the amino acids the body needs to build bone matrix and influence bone growth because the protein functions to modify the secretion and action of osteotropic hormone IGF-1 so that protein intake can modulate the genetic potential of achieving

peak bone mass (Endah et al., 2016). Low protein intake has been shown to damage bone mass mineral acquisition by impairing IGF-1 production and effects. In the body, proteins are used for growth and repair of cells. Enough protein will be able to perform its function for the growth process. Giving foods that are high in protein, calcium, Vitamin A, and zinc can spur children's height (Koesharisupeni in Mitra, 2015). The provision of adequate nutritional intake affects the standard growth patterns so that it can catch up. The prevalence of stunting in the group of children with low protein intake is greater than 1.87 times than the group of children with adequate protein intake (Endah et al., 2019).

In this study, the highest protein contribution from lemuru fish, which is known as the lemuru fish nugget, contributes to the protein intake of 6.99 gr/hr, in addition to considering quantity, it must also be found in terms of the quality of protein intake. Food sources of animal protein provide the amino acids needed to build the bone matrix. Besides, meeting the needs of quality micronutrients is closely related to protein consumption, especially animal protein about addressing micronutrient problems, especially iron minerals, zinc, selenium, calcium, and vitamin B12 which are related to stunting problems (Hardinsyah & Tambunan, 2014).

2) Calcium intake

Calcium intake in the treatment group before intervention with an average value of 188.5 mg/day, after interventions giving lemuru nuggets to 236.53 mg/day, with a difference in intake increases of 48.03 mg/day. Statistical test results give $p < \alpha$ value so it can be concluded that there are differences in the average value of calcium intake before and after administration of lemuru fish nuggets in the treatment group, whereas in the control group no difference was found between calcium intake before and after. However, the average value of calcium intake even the maximum value of calcium intake of 340.80 mg/day does not meet the recommended nutritional adequacy rate for children aged 7-9 years which is equal to 1000 mg/day.

The low calcium intake is due to the donation of the lemuru fish nugget of only 91.22 mg/day. In this case, an effort to increase the composition of the amount of calcium in lemuru fish nuggets has been done by utilizing bone and spines from fish as a source of calcium and adding another source of calcium, milk and tofu, to this product so that based on proximate test results it is known that in 100 gr Lemuru fish nuggets contain 121.76 mg.

According to Souganidis (2013), micronutrient deficiencies can be a cause of growth retardation, one of the reduced micronutrients is very important to prevent stunting, namely calcium and zinc, which have a role in the linear growth of children. During growth, the demands on bone mineralization are very high. Low calcium intake can cause low mineralization of the new bone deposit matrix, which affects the work of osteoblasts if the child experiences a lack of weight, it can cause stunting. Low calcium intake can cause a stunting prevalence of 3,625 times when compared to groups with adequate calcium intake (Endah et al., 2019).

In line with research conducted by Chairunisa et al. (2018) found a low calcium intake in stunting children with an average of 303.3 mg/day. Analyzing the low calcium intake, it is essential to do nutrition education to mothers who provide family food to be able to choose foods that contain high calcium, not necessarily sourced from milk but can be obtained from fish and green vegetables, so that the calcium intake of children can meet the recommended nutritional adequacy rate.

3) Zinc intake

The average zinc intake in the treatment group before the intervention was 3.61 mg/day and after the intervention, it was 5.32 mg/day with an increase of 1.71 mg/day, this average value did not meet the nutritional adequacy levels that were recommended that is 11 mg/day. Statistical test results provide $p < \alpha$ values, so it can be concluded that there are significant differences in the average value of zinc intake before and after administration of the intervention. Likewise, in the

control group, there were differences in the average zinc intake before and after, but the treatment group had a higher average compared to the control group.

This is in line with the study of Oktiva & Adriani, (2017) who found a low intake of zinc in stunting children, where the level of zinc intake is less than the nutritional adequacy rate of 72.22%. Likewise, Sulistianingtias research (2017), where 64.3% with a lack of zinc intake in adolescents experience stunting. Therefore it is necessary to make efforts to provide food containing zinc which can meet the nutritional adequacy of children. In this lemuru fish nugget, one donation contributed 1.57 mg of zinc and needed support from the leading daily food that could meet those needs.

Low intake of zinc can cause zinc levels in the body to below and have an impact on the incidence of stunting because zinc plays a role in the linear growth of children. However, zinc intake is influenced by the amount and form of zinc consumed, a diet that increases absorption (protein). Zinc is also associated with essential hormones involved in bone growth such as samatomedin-c, osteocalcin, testosterone, thyroid hormone and insulin. Zinc also smooths the effect of vitamin D on bone metabolism by stimulating DNA synthesis in bone cells. Therefore, zinc is closely related to bone metabolism, so it is essential in the stages of growth and development (Anindita, 2012).

4) Z-Score HG / U

This study provides results that before the intervention of lemuru fish nugget given an average Z-Score HG / U value of -2.57 with a minimum value of -3.69 and a maximum of -2.00. When seen from the results of HG measurements it is known that the average value of HG samples is 107.6 cm with a minimum value of 102.7 cm and a maximum value of 115 cm. after the administration of lemuru fish nuggets for 30 days, an average Z-Score HG / U value of -2.49 was obtained, with a minimum value of -3.65 and a maximum value of -1.88. When viewed from the results of HG measurements, it is known that the average value of 108.7 cm, with a minimum value of 104 cm and a maximum value of 116.2 cm. After statistical tests, the value of $p < \alpha$ was obtained so that it can be concluded that there were differences in the average value of the Z-Score HG / U before and after the administration of lemuru fish nuggets in grade 1 elementary school children who were stunted.

In this case, it can be seen that an increase in HG increases by 1.1 cm (increase in Z-Score HG / U by 0.08). According to Almatsier (2010), that children aged 1-7 years will experience an increase in HG of 7.6 cm in a year and to 5.1 cm a year until the beginning of rapid growth during adolescence. This study is in line with the results of Oktaviana's study (2015) which shows that there is an effect of supplementary feeding on the increase in HG of undernourished children under five, where HG before and after administration of PMT biscuits and tempeh flour sponge gives a rise of 1 cm for 60 days of administration.

This study is also in line with Juhartini's research (2015) on the provision of supplementary biscuit food and Moringa mixed food ingredients for BW and HG underweight malnourished children in the Working Area of the Kalumpang Community Health Center in Ternate for 30 days with meaningful results where toddlers experienced an average increase HG of 1.04 cm, an increase of HG 0-0.5 cm in 9 children under five and an increase in HG> 1 cm in 2 children under five. Likewise, with the research of Supadmi, Saidin and Samsudin (2008) which resulted in a 1.5 cm increase in HG in infants who were given additional food in the form of a mixture of rice flour, Tempe flour and catfish flour for 90 days. Likewise, the study of Syarfaini, Satrianegara and Astari (2016) in which elementary school children experienced an average HG increase of 0.54 cm when given tempeh nuggets with cork fish substitution for one month.

From some of the studies mentioned above, proving that supplementary feeding will increase HG in stunted children, accelerating the increase in HG in this study is possible because the PMT given is made from fish which contain high protein, calcium and zinc. However, this study is a pre-post test, so that the increase in HG achieved may not only be caused by supplementation of food but also by other factors such as consumption of children's primary food. Feeding can improve HG grade 1 stunted elementary school children, but to shift the Z-Score HG / U from the stunting group to normal takes longer with a more substantial portion of administration. Therefore, the "catch up" period must be a concern so that stunting children can achieve optimal HG (according to age group).

D. CONCLUSION

The average value of protein intake, calcium and zinc of elementary school students in grade 1 who experienced stunting (treatment group) before giving lemuru fish nuggets was 36.62 gr/day, after administration it was 51.17 gr/day. The value of the protein intake of the treatment group is higher than the control group. The average value of the Z-Score HG / U of elementary school children grades 1 who experienced stunting (treatment group) before giving lemuru fish nugget of -2.57, after giving increased to -2.49, while in the control group did not change.

There is a significant difference in the average value of protein, calcium, and zinc intake in elementary school students who experience stunting before and after the administration of lemuru nuggets. There is a significant difference in the average value of Z-Score HG / U of elementary school children in grade 1 who experience stunting before and after the administration of lemuru nuggets. There were significant differences in protein, calcium and zinc intake between the treatment group and the control group. There was a significant difference in the HG / U Z-score between the treatment group and the control group.

For the mother or the closest person who prepared the child's food to continue providing fish-based food, to pursue optimal height growth. Counselling activities need to be done to the mother or the closest people who prepare children's food about the use of local food that can be used to improve the nutritional status of children.

For public health centre Officers who carry out the screening activities of new children to enter elementary school to follow up the data until the nutritional status of the children in the data is known, so that those who experience growth retardation can do nutrition education to the child's family. This research can be continued by making one fish product that has a longer shelf life, and giving is done with a longer time when the child is stunting at puberty.

REFERENCES

Adriani, M., & Wirjatmadi, B. (2014). Gizi dan kesehatan balita. *Jakarta: kencana*.

Akombi, B. J., Agho, K. E., Hall, J. J., Merom, D., Astell-Burt, T., & Renzaho, A. M. (2017). Stunting and severe stunting among children under-5 years in Nigeria: A multilevel analysis. *BMC pediatrics*, *17*(1), 15.

Almatsier, S. (2010). Prinsip dasar ilmu gizi, PT. *Gramedia Pustaka Utama, Jakarta*.

Anindita, P. (2012). Hubungan Tingkat Pendidikan Ibu, Pendapatan Keluarga, Kecukupan Protein & Zinc dengan Stunting (Pendek) pada Balita Usia 6 35 Bulan di Kecamatan Tembalang Kota Semarang. *Jurnal Kesehatan Masyarakat Universitas Diponegoro*, *1*(2), 18764.

Aridiyah, F. O., Rohmawati, N., & Ririanty, M. (2015). Faktor-faktor yang Mempengaruhi Kejadian Stunting pada Anak Balita di Wilayah Pedesaan dan Perkotaan (The Factors Affecting Stunting on Toddlers in Rural and Urban Areas). *Pustaka Kesehatan*, *3*(1), 163-170.

Baranowski, T., Mendlein, J., Resnicow, K., Frank, E., Cullen, K. W., & Baranowski, J. (2000). Physical activity and nutrition in children and youth: an overview of obesity prevention.

Chairunnisa, E., Kusumastuti, A. C., & Panunggal, B. (2018). *Asupan Vitamin D, Kalsium dan Fosfor pada Anak Stunting dan Tidak Stunting Usia 12-24 Bulan di Kota Semarang* (Doctoral dissertation, Diponegoro University).

Damayanti, R. A., Muniroh, L., & Farapti, F. (2016). Perbedaan tingkat kecukupan zat gizi dan riwayat Pemberian ASI Eksklusif pada Balita Stunting dan Non Stunting. *Media Gizi Indonesia*, *11*(1), 61-69.

Dewi, M., & Aminah, M. (2016). Pengaruh Edukasi Gizi terhadap Feeding Practice Ibu Balita Stunting Usia 6-24 Bulan (The Effect of Nutritional Knowledge on Feeding Practice of Mothers Having Stunting Toddler Aged 6-24 Months). *Indonesian Journal of Human Nutrition*, *3*(1), 1-8.

Ebina, Y., Okada, S., Hamazaki, S., Toda, Y., & Midorikawa, O. (1991). Impairment of bone formation with aluminum and ferric nitrilotriacetate complexes. *Calcified tissue international*, *48*(1), 28-36.

Endah, M. S., Mohammad, J., Neti, N., & Mei Neni, S. (2019). Asupan protein, kalsium dan fosfor pada anak stuntingdan tidak stuntingusia 24-59 bulan. *Jurnal Gizi Klinik Indonesia*.

Fitri, (2012). *Berat Lahir Sebagai Faktor Dominan Terjadinya Stunting pada Balita (12-59 Bulan) di Sumatera (Analisis Data Riset Kesehatan Dasar 2010)*.Tesis. Program Studi Ilmu Kesehatan Masyarakat Fakultas Kesehatan Masyarakat. Jakarta: Universitas Indonesia, Depok

Hardinsyah, R. H., & Tambunan, V. (2014). Kecukupan energi, protein, lemak dan karbohidrat dalam angka kecukupan gizi yang dianjurkan bagi bangsa Indonesia. *Jakarta: Direktorat Jenderal Bina Gizi dan Kesehatan Ibu dan Anak Kemenkes*.

Hariyadi, D., & Ekayanti, I. (2012). Analisis pengaruh perilaku keluarga sadar gizi terhadap stunting di Propinsi Kalimantan Barat. *Teknologi dan kejuruan*, *34*(1).

Hastono, S. P. (2001). Analisis data. *Depok: Fakultas Kesehatan Masyarakat Universitas Indonesia*.

Hidayati, L., Hadi, H., & Kumara, A. (2010). Kekurangan energi dan zat gizi merupakan faktor risiko kejadian stunted pada anak usia 1-3 tahun yang tinggal di wilayah kumuh perkotaan Surakarta.

Indonesia, T. K. P. (2009). PT Elex Media Komputindo. *PT Gramedia*.

Juhartini, J. (2016). Pengaruh Pemberian Makanan Tambahan Biskuit Dan Bahan Makanan Campuran Kelor Terhadap Berat Badan Dan Hemoglobin Studi Pada Balita Dengan Status Gizi Kurus Di Wilayah Kerja Puskesmas Kalumpang Kota Ternate Tahun 2015. *Hospital Majapahit (JURNAL ILMIAH KESEHATAN POLITEKNIK KESEHATAN MAJAPAHIT MOJOKERTO)*, *8*(2).

Kartini, A., Suhartono, S., Subagio, H. W., Budiyono, B., & Emman, I. M. (2016). Kejadian stunting dan kematangan usia tulang pada anak usia sekolah dasar di daerah pertanian Kabupaten Brebes. *Jurnal Kesehatan Masyarakat*, *11*(2), 96-103.

Kaufman, S. S., Loseke, C. A., Lupo, J. V., Young, R. J., Murray, N. D., Pinch, L. W., & Vanderhoof, J. A. (1997). Influence of bacterial overgrowth and intestinal inflammation on duration of parenteral nutrition in children with short bowel syndrome. *The Journal of pediatrics*, *131*(3), 356-361.

Khoddami, A., Ariffin, A. A., Bakar, J., & Ghazali, H. M. (2009). Fatty acid profile of the oil extracted from fish waste (head, intestine and liver)(Sardinella lemuru). *World Applied Sciences Journal*, *7*(1), 127-131.

Kusuma, K. E., & Nuryanto, N. (2013). *Faktor risiko kejadian stunting pada anak usia 2-3 tahun (Studi di Kecamatan Semarang Timur)* (Doctoral dissertation, Diponegoro)

Meilyasari, F., & Isnawati, M. (2014). *Faktor risiko kejadian stunting pada balita usia 12 bulan di Desa Purwokerto Kecamatan Patebon, Kabupaten Kendal* (Doctoral dissertation, Diponegoro University).

Mikhail, W. Z. A., Sabhy, H. M., El-Sayed, H. H., Khairy, S.A., Salem, H.Y.H.A., Samy, M. A., (2013). Effect of Nutritional Status on Growth Pattern of Stunted Preschool Children in Egypt. Acad J Nutrition 2013; 2 (1).

Mitra, M. (2015). Permasalahan Anak Pendek (Stunting) dan Intervensi untuk Mencegah Terjadinya Stunting (Suatu Kajian Kepustakaan). *Jurnal Kesehatan Komunitas*, *2*(6), 254-261.

Nadiyah, N., Briawan, D., & Martianto, D. (2014). Faktor Risiko Stunting Pada Anak Usia 0—23 Bulan Di Provinsi Bali, Jawa Barat, Dan Nusa Tenggara Timur. *Jurnal gizi dan pangan*, *9*(2).

Oktarina, N. H., & Kartasurya, M. I. (2013). *Pengaruh Pemberian Micronutrient Sprinkle Terhadap Status Antropometri Bb/U, Tb/U dan Bb/Tb Anak Stunting Usia 12-36 Bulan* (Doctoral dissertation, Diponegoro University).

Oktarina, Z., & Sudiarti, T. (2012). Faktor risiko stunting pada balita (24—59 bulan) di sumatera. *Jurnal gizi dan pangan*, *8*(3), 177-180.

Oktiva, B. R., & Adriani, M. (2017). Perbedaan Kadar Zinc Rambut pada Anak Stunting dan Non Stunting Usia 12-24 Bulan di Kelurahan Tambak Wedi Kenjeran, Surabaya. *Amerta Nutrition*, *1*(2), 133-142.

Oktovina, R., Bambang, W., & Merryana, A. (2015). Pengaruh Pemberian Makanan Tambahan Biskuit Dan Bolu Tepung Tempe Terhadap Peningkatan Berat Badan Dan Tinggi Badan Pada Balita Gizi Kurang Tahun 2015. *Jurnal Ilmiah Kedokteran*, *4*(1), 16-24.

Rahayu, S., Subagio, H. W., & Rahfiludin, M. Z. (2017). Hubungan Tingkat Kecukupan Gizi, Asupan Tembaga, Serat dan Fitat Dengan Kadar Seng Serum Anak Sekolah Dasar Bertubuh Pendek di Karangawen Demak. *JURNAL KESEHATAN MASYARAKAT INDONESIA*, *2*(1).

Rahman, S. N., Saifuddin, S., & Sri'ah, A. (2014). Hubungan Pola Konsumsi Pangan Sumber Zink Dengan Status Zink Anak Sekolah Dasar. *Fakultas Kesehatan Masyarakat. Universitas Hasanudin*.

Rahmawati, D. P., Daru, A. S. A., Zulaekah, S., & Hidayati, L. (2017). Tingkat Kecukupan Asupan Protein, Zinc, Kalsium, Vitamin D, Zat Besi (Fe), dan Kadar Hb Pada Remaja Putri Stunting dan Non Stunting di SMP N 1 Nguter Kabupaten Sukoharjo.

Rahmayana, R. (2014). *Hubungan pola asuh ibu dengan kejadian stunting anak usia 24-59 bulan di posyandu asoka II wilayah pesisir kelurahan Barombong kecamatan Tamalate kota Makassar Tahun 2014* (Doctoral dissertation, Universitas Islam Negeri Alauddin Makassar).

Renehan, A. G., Zwahlen, M., Minder, C., T O'Dwyer, S., Shalet, S. M., & Egger, M. (2004). Insulin-like growth factor (IGF)-I, IGF binding protein-3, and cancer risk: systematic review and meta-regression analysis. *The Lancet*, *363*(9418), 1346-1353.

Reyes, H., Pérez-Cuevas, R., Sandoval, A., Castillo, R., Santos, J. I., Doubova, S. V., & Gutiérrez, G. (2004). The family as a determinant of stunting in children living in conditions of extreme poverty: a case-control study. *BMC Public Health*, *4*(1), 57.

RI, K. (2013). Laporan hasil riset kesehatan dasar 2013. *Jakarta: Badan Litbangkes RI*.

Rosha, B. C., Hardinsyah, H., & Baliwati, Y. F. Analisis Determinan Stunting Anak 0-23 Bulan Pada Daerah Miskin Di Jawa Tengah Dan Jawa Timur (Determinant Analysis of Stunting

Children Aged 0-23 Months in Poor Areas in Central and East Java). *Nutrition and Food Research*, *35*(1), 34-41.

Setijowati, N. (2013). Hubungan Kadar Seng Serum dengan Tinggi Badan Anak Sekolah Dasar Penderita GAKY. *Jurnal Kedokteran Brawijaya*, *21*(1), 22-28.

Souganidis, E. (2012). The relevance of micronutrients to the prevention of stunting. *Sight and Life Magazine*, *26*(2), 10-18.

Strobel, C. T., Byrne, W. J., & Ament, M. E. (1979). Home parenteral nutrition in children with Crohn's disease: an effective management alternative. *Gastroenterology*, *77*(2), 272-279.

Sulastri, D. (2012). Faktor determinan kejadian stunting pada anak usia sekolah di Kecamatan Lubuk Kilangan Kota Padang. *Majalah Kedokteran Andalas*, *36*(1), 39-50.

Sulistianingtias, E. L., & Dasuki, M. S. (2017). *Hubungan antara Asupan Zink dengan Kejadian Stunting pada remaja di Sukoharjo Jawa Tengah* (Doctoral dissertation, Universitas Muhammadiyah Surakarta).

Supadmi, S., Saidin, S., & Samsudin, M. (2008). Pengaruh pemberian makanan tambahan pada balita kurang energi protein (KEP) pengunjung balai penelitian dan pengembangan gangguan akibat kekurangan iodium (BPP GAKI) Magelang. *Nutrition and Food Research*, *31*(2), 157966.

Supariasa, I. D. N., Bakri, B., & Fajar, I. (2002). Penilaian status gizi. *Jakarta: Egc*, *5*.

Syarfaini, S., Satrianegara, M. F., & Astari, A. R. A. (2016). Pengaruh Pemberian Nugget Tempe Dengan Subtitusi Ikan Gabus Terhadap Status Gizi Anak Sekolah Dasar di MIS DDI Ainus Syamsi Kelurahan Lette Kota Makassar 2014. *Al-sihah: The Public Health Science Journal*, *8*(2).

Trisnawati, I. (2014). *Hubungan Asupan Fe, Zinc, Vitamin C dan Status Gizi dengan Kejadian Anemia pada Remaja Putri di SMP Negeri 4 Batang* (Doctoral dissertation, Universitas Muhammadiyah Surakarta).

Voth-Gaeddert, L. E., Stoker, M., Cornell, D., & Oerther, D. B. (2018). What causes childhood stunting among children of San Vicente, Guatemala: Employing complimentary, system-analysis approaches. *International journal of hygiene and environmental health*, *221*(3), 391-399.

Widanti, Y. A. (2017). Prevalensi, faktor risiko, dan dampak stunting pada anak usia sekolah. *JITIPARI (Jurnal Ilmiah Teknologi dan Industri Pangan UNISRI)*, *1*(1).

Widodo, S., Riyadi, H., Tanziha, I., & Astawan, M. (2015). Perbaikan Status Gizi Anak Balita dengan Intervensi Biskuit Berbasis Blondo, Ikan Gabus (Channa striata), dan Beras Merah (Oryza nivara). *Jurnal Gizi dan Pangan*, *10*(2).

Zlotkin, S. H., Stallings, V. A., & Pencharz, P. B. (1985). Total parenteral nutrition in children. *Pediatric Clinics of North America*, *32*(2), 381-400.