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Research Article
Effectiveness of Red Bean Cookies Increases Z-Score and Albumin in Stunting Children 13-36 Months at Pantai Labu Health Center

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Abstract

Background and Objective: Stunting is a growing problem that happens to children caused by lacking some certain nutrients. Stunting based on TB/U index using WHO standard with Z-Score <-2 SD. This study determine the effect of cookies with and without red beans on TB/U Z-Score and albumin levels of stunted children aged 13-36 months in Durian and Kuba Sentang Village. **Materials and Methods:** Quasi experiment is a type of research that is used with pre and post test design, the population is all children aged 13-36 months who experience stunting, then the sample was divided into two groups of stunting toddlers who were given cookies with and without red beans, each group consists of 26 people. Provision of cookies with and without red beans given every day as much as 5 pieces (20 g/chip) weighing 100 g for 12 weeks. Data were collected with TB data and albumin levels before and after giving the cookies. The albumin content was examined in the North Sumatra Regional Health Laboratory. **Results:** Cookies with red beans affect the body's height and albumin levels while the group of cookies without red beans only affects albumin levels. As for the difference in Z-Score and blood albumin using the T-independent test, there were differences in the treatment group compared to the control group with $p<0.05$. **Conclusion:** Red bean cookies which are rich in protein, zinc, calcium and Fe were able to increase Z-Score (TB/U) and blood albumin levels.

INTRODUCTION

Chronic nutritional problems due to insufficient intake of nutrients over a long period, such as protein, zinc and calcium will cause stunting. Stunting can occur since the fetus is still in the womb of a mother until the child is 2 years old, which is called the first 1000 days of life[1]. Around the world, around 25% of children under 5 years of age are stunted[2]. Identification of stunting is usually measured based on TB/U and then categorized according to WHO Anthropus 2005, where if the Z-Score TB/U<-2 SD then a toddler is said to be stunting. A stunning state in addition to being considered a disorder due to nutrient deficiency is also suspected to increase the prevalence of metabolic disorders at the time of entering adulthood[3].

Based on the Global Nutrition Report in 2014, Indonesia ranked 17th among 117 countries that have the highest prevalence of wasting, overweight and stunting in toddlers, respectively 12.1, 11.9 and 37.2%. In 2010, Indonesia was ranked 5th with the largest number of stunting toddlers in the world with a prevalence of 35.6% and then increased in 2013 to 37.2%[4]. While in 2018 there was a decrease to 30.8% but still above the WHO standard value[5]. The prevalence of stunting in North Sumatra in 2010 was 42.3% and became 43.5% in 2013. The stunting rate in 2016 was 18.1% and increased to 20.3% in 2017 with one of the causes of low zinc intake. While in 2019 there was an increase to 30.11%. This incident happened in 15 districts or cities of North Sumatra. One of them is Deli Serdang District.

The incidence of stunting in children under 3 years (toddlers), can occur when the fetus receives less supply of nutrients while in the womb. Due to low maternal consumption, especially the nutrients needed for fetal growth are insufficient. In addition, the intake of nutrients after breastfeeding a baby is also less noticed by the mother so it has an impact on the intake of toddlers for a long time[6].

Calcium is a bone formation mineral that works complementary to the process of matrix formation, deposits in the formation of bone tissue so that if calcium deficiency occurs it will inhibit cell division, growth and tissue repair that will affect body weight and height[7]. Zinc is one of the micronutrients that play a very important role in the growth and development of toddlers, where zinc plays a role in the enzyme system, hormones, immunity and reproductive function. Zinc affects growth hormones such as Insulin Growth Factor 1 (IGF-1) which is needed for growth and development. The presence of blood serum calcium must be within the normal range concentration because it is needed for the bone mineralization process while hair zinc levels are biomarkers to determine zinc deposits over a long period[8,9].

In meeting the needs of nutrients that are important in the growth and development of a toddler child, it is necessary to add food ingredients that contain essential nutrients to snack foods, food additives and food consumed daily. Cookies are one type of biscuit that is popular with the public because it tastes crispy, savoury and suitable for snacks to meet daily nutritional needs[10].

Cookies with the addition of red bean flour are useful to overcome the problem of stunting, osteoporosis and people with infectious diseases because they contain nutrients such as protein, calcium, zinc, phosphorus and iron. About 100 g of red beans, it contains 22.1 g of protein, 502 mg of calcium, 429 mg of phosphorus, 10.3 mg of iron and 2.6 g of zinc or zinc[11]. Red beans can be used as flour to make a variety of food products including cookies that are popular in all circles ranging from children to adults[12]. Research that is conducted by Siahaan *et al.*[13] stated that giving cookies for 30 days with the substitution of tempe formula was found to increase the albumin and haemoglobin levels of pregnant women's blood which are needed for fetal growth and development.

Pantai Labu is located in Deli Serdang District and became one of the government's focuses in the reduction of the stunting program. Based on that information and there is still a high incidence of stunting in North Sumatra, particularly in Pantai Labu, the authors are interested in examining the effect of red bean cookies in reducing stunting incidence in Pantai Labu Health Center. The object of this study particularly was to determine the effect of cookies with and without red beans on TB/U Z-Score and albumin levels of stunted children aged 13-36 months in Durian and Kuba Sentang Village.

MATERIALS AND METHODS

Study area: This study was carried out in the working area of Pantai Labu Health Center by taking two villages, namely Durian Village and Kuba Sentang Village. The experiment was started from the beginning of July 1 to September 30, 2018.

Ethical approval: This research has obtained ethical approval from the Ethics Committee, No: 036/KEPK/POLTEKKES KEMENKES MEDAN/2017.

Experimental design: The design of this study is a quasi-experimental design with pre and post-test-only control group design. The sample was divided into two groups based on the village after a statistical calculation, namely, the treatment group gave red bean cookies to as many as 26 people in the Durian Village and the control group was given cookies without red beans to as many as 26 people in the village of Kuba Sentang. This type of design can determine the

difference in body height (TB), Z-Score (TB/U) and blood albumin levels before and after the intervention of cookies with and without red beans. The sample size was determined by the formula[14]:

$$n1 = n2 \left(\frac{\left(Z\alpha^2 + Z\beta \right)s}{X1 - X2} \right)^2$$

Where:

n = Sample size per group
Zα = Standard normal z-value for a significance level α = 0.05
Zβ = Standard normal z-value for the power of 80
X1 and X2 = Different samples

As for the provision of cookies given to stunting children as many as 5 pieces (100 g/day) are done for 12 weeks starting the beginning of July 1 to September 30, 2018. Snack consumption is controlled by researchers and supervised by health cadres who have been briefed first by researchers called treatment consumption supervision.

Data screening: The data of stunting toddlers were first screened by measuring their height using microtoise measuring instruments with an accuracy of 0.1 cm and then compared with the age to obtain stunting toddlers (<-2 SD) of as many as 26 people in each village. The data collected included data on average age, TB and blood albumin levels. The data that has been collected is then processed manually through the stages of the process starting with editing, coding, cleaning and tabulating data. Then all those data were put in the entry and processed with the help of the SPSS program.

Nutrient intake data was also taken to see the homogeneity between the treatment and control groups and this data was taken to avoid bias due to daily nutrient consumption. This decision was done by the method of food recall for 24 hrs. Nutrient intake to determine consumption before giving cookies with and without red beans for 2 consecutive days, as well as after treatment, nutrient intake was taken by doing a 24 hrs recall for 2 consecutive days.

Blood sampling: Blood sampling for albumin examination was done twice during the study, namely before and after treatment. Blood was taken using a 2.5 cc syringe from the child's left arm, the process was carried out by laboratory personnel and then examined in the Path Lab laboratory. Blood albumin levels were examined by BCG (Bromocresol Green) using Shimadzu spectrophotometer UV-100-02.

Data analysis: Data analysis was univariate and bivariate, normality test data was performed using Kolmogorov Smirnov. In this study, all the data were normally distributed and the test used was a t-dependent test to see the changes in each group then continued with an independent t-test to see the difference between the groups.

RESULTS

Sample characteristic: Table 1 explain that most samples in the treatment and control groups were male, 61.5 and 65.4%, respectively. Meanwhile, based on age, the highest number of samples in the treatment group was those aged 13-24 months (53.8%) and in the control group was those aged 25-36 months.

Nutrient content of cookies with and without red beans in 100 g of ingredients: Table 2, results showed that cookies with and without red beans have a fairly high protein content, but red bean substitution causes the protein to increase 3-4 times. While, the energy produced does not make too much difference. In cookies with variations of red bean substitution, there was an increase in nutrients, especially in the minerals zinc and calcium.

Mean and Standard Deviation (SD) of nutrient intake before and after giving red bean cookies: Table 3 showed that the recall results obtained for 2 consecutive days before and after giving cookies with and without red beans showed no difference with the t-dependent test method with p>0.05. The description of food recall results shows that the homogeneity in terms of the nutrients consumed is not significantly different so the provision of cookies can be used as an indicator to see changes in blood albumin levels in stunted children.

Average Z-Score and albumin: The average value of Z-Score and albumin before and after in the treatment group (giving cookies with red beans) and the average value of Z-Score and albumin levels before and after in the control group (giving cookies without red beans) were in Table 4.

Table 4, shows that from 26 samples for the treatment group, there was an increase in the average body height from 80.05-81.30 cm, while for albumin levels, there was an increase in the average albumin level from 4.09-4.64 g dL^{-1}. Based on the results of the t-dependent statistical test, there was a significant difference before and after giving cookies with red beans p<0.05.

Table 1: Frequency distribution of sample characteristics

Sample characteristics	Treatments		Control	
	N	Percentage	N	Percentage
Gender				
Man	16	61.5	17	65.4
Woman	10	38.5	9	34.6
Age (month)				
13-24	14	53.8	9	34.6
25-36	12	46.2	17	65.4

Table 2: Nutrient content of cookies with and without red beans in 100 g of ingredients

Nutrient contents	Cookies without red beans	Cookies with red beans
Carbohydrate (g)	20	28
Fat (g)	7.25	24.15
Protein (g)	2.1	10.3
Zinc (mg)	7.12	69.24
Calcium (mg)	15.07	39.15
Energy (kcal)	160	172

Source: Chemistry Laboratories FMIPA Brawijaya University 2019

Table 3: Distribution of mean and standard deviation (SD) of nutrient intake before and after giving red bean cookies

	Treatments					Control					
	Before		After			Before		After			
Indicators	Mean	SD	Mean	SD	p-value	Mean	SD	Mean	SD	p-value	RDA 2019
Energy (kcal)	1128	2.19	1185	2.04	0.085	1197	4.7	1231	5.02	0.072	1350
Carbohydrate (g)	201	10.7	210	9.63	0.124	195	7.34	204	6.58	0.059	215
Protein (g)	11.7	3.52	12.3	3.3	0.067	10.2	26.1	10,9	2.73	0.078	20
Fat (g)	42	4.19	43.2	4.57	0.124	41	3.87	41.7	4.20	0.153	45
Zinc (mg)	0.91	0.15	1.05	0.37	0.078	0.89	0.07	0.92	0.37	0.092	3
Vit C (mg)	26	2.15	27.1	3.09	0.192	25.07	2.37	25.43	2.41	0.210	40
Fe (mg)	3	1.08	4	2.16	0.075	2.7	1.5	3.1	2.13	0.081	7

Table 4: Average, minimum and maximum values of body height, weight, Z-Score and albumin

Groups	Indicators		Maximum	Minimum	Average	SD	p-value
Treatments	Body height (cm)	Before	88.5	66.0	80.05	5.7	0.001
		After	89.5	67.3	81.30	5.5	
		Difference	1.00	1.30	1.25	0.2	
	Z-Score (TB/U)	Before	-2.03	-4.95	-2.77	6.82	0.001
		After	-0.77	-4.47	-1.98	7.84	
		Difference	-1.26	-0.48	-0.79	1.02	
	Albumin level (g dL^{-1})	Before	5.10	2.10	4.09	4.25	0.009
		After	5.60	2.70	4.64	5.06	
		Difference	0.50	0.60	0.55	0.81	
Control	Body height (cm)	Before	86.8	71.5	77.6	4.09	0.051
		After	87.0	71.6	77.9	4.01	
		Difference	0.20	0.10	0.30	0.08	
	Z-Score (TB/U)	Before	-2.01	-4.94	-2.88	8.13	0.057
		After	-1.69	-4.72	-2.53	8.82	
		Difference	-0.32	-0.22	-0.35	0.69	
	Albumin level (g dL^{-1})	Before	4.08	1.89	3.18	25.80	0.025
		After	4.22	2.31	3.57	14.60	
		Difference	0.14	0.42	0.39	11.20	

In the control group, it was shown that from 26 samples for the control group, there was an increase in the average body height from 77.6-77.9 cm, while for albumin levels, there was an increase in the average albumin from 3.18-3.57 g dL^{-1}. Based on the results of the t-dependent statistical test, there was a significant difference before and after giving cookies with red beans $p < 0.05$ on the albumin variable indicator, while on the height indicator and Z-Score there was no significant difference $p > 0.05$.

Table 5: Differences in Z-Score and blood albumin levels before and after giving cookies

	Mean±SD		
Variables	Treatment	Control	p-value
Z-Score before	-2.77±6.82	-2.88±8.13	0.030
Z-Score after	-1.98±7.84	-2.53±8.82	0.017
Difference Z-Score	-0.79±1.02	-0.35±0.69	0.025
Blood albumin before	4.09±4.25	3.18±25.80	0.320
Blood albumin after	4.64±5.06	3.57±14.60	0.014
Difference in blood albumin level	0.55±0.81	0.39±11.20	0.001

Table 6: Distribution of TB status and blood albumin levels

	Treatment groups				Control groups			
	Before		After		Before		After	
Indicators	N	Percentage	N	Percentage	N	Percentage	N	Percentage
Stunting	17	69	11	38	20	77	13	50
Normal	9	31	15	62	6	23	13	50
Blood albumin level stunting	17	65	6	23	16	62	14	54
Blood albumin level normal	9	35	20	77	10	38	12	46

The difference in Z-Score before and after being given cookies in the treatment group was 1.36 mg dL^{-1}, while in the control group there was a difference of 1.02 mg dL^{-1} as shown in Table 5. Based on the independent t-test, there were differences in Z-Score between the treatment groups and control group with p = 0.025. The results of the independent t-statistical test showed that there were differences in blood albumin levels between the treatment group and the control group with p = 0.001.

Status distribution of calcium levels in blood and zinc levels in hair: The distribution of short and normal status and the status of blood albumin levels with treatment and control can be seen in Table 6. Giving cookies with red beans (treatment group) for 12 weeks make short toddlers change from 69-38% while normal toddlers increased from 31-62%. For the examination of blood albumin levels, it became low from 65-23% while normal albumin levels increased from 35-77%. Given cookies without red beans (control group), there was also a change in the status of short toddlers from 77-50%. Meanwhile, on examination of normal blood albumin levels, there was also a change from 38-46%.

DISCUSSION

Based on the result of this study, shows that red bean cookies can increase the Z-Score (TB/U) and blood albumin levels that can reduce the incidence of stunting. This was in line with a study conducted by Darawati *et al.*[15] which found that using red beans as one of the materials in making food bars can reduce the incidence of stunting toddlers. This

finding was also in line with a study conducted by Kusumah *et al.*[16] which found that red bean cookies contain a high level of protein and essential amino acid that is needed by the body for reducing the incidence of stunting. A study that was conducted by Oppusunggu and Masthalina[17] also stated that using red beans as one of the ingredients in additional food for toddlers can increase their nutritional status also even increase their appetite.

This study was obtained based on the age of the sample spread in the age range of 13-36 months in the working area of Pantai Labu Health Center, namely Durian Village and Kuba Sentang Village. The age of 13-36 months is the age when it begins to appear that a toddler will experience stunting or not and when it occurs in the age of toddlers stunting will appear when in the mother's womb[18].

The stunting toddlers in the treatment and control groups were dominated by the male sex, for the treatment group it was 61.5% while for the control group it was 65.4%. This was in line with a study conducted by Bork and Diallo[19] in rural Senegal, which found that boys were more likely to experience delayed body height growth than girls.

Cookies are a type of pastry with a sweet or savoury taste, crunchy texture and small shape, made from basic ingredients of wheat flour, butter, eggs and a little milk to give a savoury taste that is finalized by roasting[10]. Cookies are also called other names biscuits, so they are popular with children and adults and can be used as snacks as additional food[13]. At the time of making cookies, it can also be added or substituted with other ingredients such as red beans, tempeh and green beans which are used as flour to be added or substituted for wheat flour[12]. In this study, cookies were added with red

beans, which were given to stunting children as much as 5 pieces (100 g/day) for 12 weeks. Cookies with the addition of red beans turned out to be able to increase nutrient intake such as protein, calcium, zinc and Fe, which are needed for the growth and development of children under five. Snack consumption is controlled by researchers and supervised by health cadres who have been appointed and briefed in advance by researchers called Treatment Consumption Supervision.

Body height is one of the anthropometric measurements to determine a person's growth and development which is called nutritional status. Height is a parameter of growth and development of a child under five in the long term[3]. Parameters of height increase rapidly in the period of growth and development, namely during the toddler and adolescent period[20].

Anthropometric measurements with height should be compared with other parameters including age (Z-Score), so that growth and development can be used as a benchmark for the success of the program, including the provision of additional food such as MODISCO, porridge, cookies and other snacks[21]. Red beans are rich in protein and amino acid which functions as development substances, besides that protein also regulates the body in the formation of new DNA the body[22]. Protein also functions to secrete and act on the osteotropic hormone IGF-1 so that it can dominate the genetic potential in achieving pick bone mass (peak bone mass). The IGF-1 hormone works by stimulating the proliferation and differentiation process of chondrocytes in the epiphyseal growth plate and as result, it will activate osteoblasts and will also affect a person's height[16]. Amino acids that are contained in protein can also build bone matrix and affect the maturity of the formation of bone cells[23,24]. Cookies which are made with added butter and milk also contain casein-type protein where this protein can increase calcium absorption and mineral retention[25].

In the process of making cookies, it used milk, butter and eggs which are a source of calcium then collaborates with vitamin D to become a homeostatic calcium serum to maintain extracellular calcium ion levels in the normal range and flow calcium to and from the reservoir in the bones. Calcium helps mineralization of the matrix of new bone deposits and osteoblast function so that in the presence of calcium, the process of increasing height will occur[9]. Calcium deficiency will cause metabolic disorders including the inflammatory cytokine regulation system that can affect chondrocytes directly so it will have an impact on the process of bone formation[26].

Zinc in red bean cookies is needed for osteoblastic, collagen synthesis and alkaline phosphatase activity. As a component of the enzyme system, zinc takes part in the turnover of the bone matrix. Zinc is also known to help regulate cellular activity that acts as a cofactor in stimulating protein synthesis. Adequacy of zinc will result in bone growth being more maximal than will be seen in the increasing height of a stunting toddler[27,28].

Red bean cookies turned out to be rich in Fe, where Fe is the basis for the formation of haemoglobin that is rich in oxygen which is needed for the activation process of cells throughout the body including cells for growth hormone[29]. This was in line with the study conducted by Ufot *et al.*[30] which stated that using red beans as supplemental material in biscuits could produce a high amount of Fe that is needed by the body. Children who suffer from Fe deficiency will be susceptible to disease and synergism with zinc helps children in the process of defence mechanisms of the body, so to achieve that, eating red bean cookies is expected to increase toddler's immune response and make the process of growth and development can run optimally[31].

The provision of cookies is given every day in as many as 5 pieces, where each chip weighs 20 g. Cookies were given for 12 weeks (3 months) in the control and treatment groups. Cookies have an impact on increasing albumin levels. Albumin is the main protein in human plasma. It encompasses about 60% of the total plasma protein in the human body. Albumin is present in plasma as much as 40% and also in the extracellular space in as much as 60%[32]. Albumin is one of the parameters that can determine nutritional status disorders[3]. Red bean cookies are rich in protein content which is obtained from red beans, wheat flour, eggs, milk and butter. These materials can contribute to the formation of total blood proteins including albumin, this blood protein is very important because it acts as a nutrient transport facility in the formation of cells needed for growth and development[33]. In addition to being a means of transporting tools, blood albumin is also useful in helping metabolic processes and the formation of new tissues in the body such as connective tissue and bone growth[34].

Red bean cookies are rich in zinc which is obtained from red beans and wheat flour. In addition to acting as a cofactor, zinc also plays a role in the synthesis of blood proteins (blood albumin). If the albumin concentration is normal, the transport of zinc in the body will run well so that the work of zinc in the blood obtained from red beans will help maximize the osteoblast process and collagen synthesis[29]. If the levels of albumin and zinc in the blood are in the normal range, the growth of toddlers will be well maintained, including increasing height growth[35].

CONCLUSION

Red bean cookies turn out can be used in reducing the incidence of stunting. This can happen because red bean cookies are rich in protein, zinc, calcium and Fe. These important materials were able to increase the Z-Score (TB/U) and blood albumin levels. If the level of blood albumin is in the normal range, it will maintain the stable process of forming new tissues and cells, including increasing height and maintaining immunity so that toddlers can avoid stunting. Besides that, giving red bean cookies can be an option for parents because their shape is preferred by children.

SIGNIFICANCE STATEMENT

This article reviews the effectiveness of red bean cookies in reducing the incidence of stunting by examining Z-Score and albumin in stunting children. The result shows that red beans can increase Z-Score and albumin. This result can be used by the public as useful information for choosing and making healthy and tasty food for their children.

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