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THE EFFECT OF LOCAL FOOD-BASED CRACKERS READY TO USE THERAPEUTIC FOOD (RUTF) ON NUTRITIONAL STATUS IN MALNOURISHED TODDLERS

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ABSTRACT— Local food-based Ready to Use Therapeutic Food (RUTF) is a therapeutic food with local food sources of tempeh flour and pumpkin flour to improve the nutritional status of malnourished and deficient toddlers who have a composition of energy, protein, fat, vitamin A and iron. This study aims to determine the effect of local food-based RUTF crackers on the nutritional status of malnourished toddlers. Quasi Experiment research design with controlled pre-posttest design. The study population was all toddlers aged 13-60 months with malnutrition status. The sample was selected according to the criteria for each treatment and control group as many as 18 people (total 36 people). The intervention in the treatment group was giving RUTF crackers based on local food 50 grams per day and nutrition education. The control group was given 50 grams of PMT biscuits per day from the Puskesmas and nutrition education. Analysis using independent t-test and using the Mann-Whitney test'. There was an effect of giving RUTF crackers on the increase in z score of weight / height between the treatment group and the control group (p = 0.010). Giving RUTF crackers can increase body weight, so it is recommended that toddlers continue to consume balanced nutritional foods as needed because PMT is complementary not a substitute.

KEYWORDS: Local food sources of tempeh and pumpkin flour, Ready to Use Therapeutic Food (RUTF), Malnourished toddlers.

1. INTRODUCTION

Lack of Energy and Protein (KEP) in children is still a problem of nutrition and public health in Indonesia. Based on the Basic Health Research (Riskesdas) in 2018, the prevalence of malnutrition was 3.9% and under-nutrition children was 13.8%. Nationally, from 2013 to 2018 the prevalence of malnutrition and malnutrition under five has decreased by 1.9%, but there are still 17 provinces in Indonesia that have high prevalence rates of malnutrition and malnutrition. [1] This situation affects the high infant mortality rate. According to WHO, more than 50% of infant and child deaths are related to malnutrition and malnutrition. Therefore, nutritional problems need to be handled quickly and precisely. One of the ways to overcome the problem of malnutrition and malnutrition is to use malnutrition management as an effort to deal with every case found. [2] The Ministry of Health has established a comprehensive policy covering prevention, promotion / education and overcoming malnutrition under five. Provision of Supplementary Food (PMT) for toddlers is an effort to improve consumption patterns at the age of five to prevent the incidence of KEP in Indonesia. 100 grams and given in the form of local food in the form of snack food. [2,3]. In the management of malnutrition, efforts are made to provide PMT in the form of biscuits, while the management of malnutrition in the rehabilitation phase requires proper feeding so that chasing growth can be achieved. Currently, feeding at the rehabilitation stage still uses F-100 or F-100 plus nutrient-dense weaning food with an energy of 150-220 kcal / kg / day and protein of 4-6 g / Kg body weight / day [4]. Research conducted by Lamid et al. Stated that the administration of F-100 was not optimal in improving the nutritional status of toddlers who attended outpatient care at

puskesmas. This is due to the low level of compliance, due to impractical formula preparation. On the other hand, giving F-100 to malnourished toddlers in the community still has problems, especially in manufacturing, hygiene and sanitation for the people who make and the equipment used. The results of a comprehensive evaluation of the handling program in Semarang City for malnourished toddlers in 2014 showed that 11 (31.4%) toddlers could not finish an F-100 per serving [5,6]. It is necessary to develop therapeutic foods with local food sources that are available, cheap, practical, acceptable and can be served in small portions. Types of food that can meet these needs with Ready to Use Therapeutic Food (RUTF). RUTF can be made on an industrial or household scale, RUTF can be made into solid form (flour, biscuits, candy) or semi-solid. The use of RUTF is proven to be able to improve the nutritional status of malnourished toddlers better than the F-100 therapy diet, where with RUTF the increase in the growth of malnourished children is 78% while at F-100 it is only 46%. The use of RUTF in solid form is very suitable in contaminated environments, natural disaster areas, home treatment or malnutrition rehabilitation centers. [7,8]

[9] develop local RUTF products made from peanuts, green beans and tempeh which have a nutritional composition of energy, protein, fat, vitamin A and iron according to the standard RUTF issued by UNICEF 2012. Calories in local RUTF products high enough, namely more than 520 kcal / 100 g of material with protein between 14-16 g / 100 g of material. Local RUTF from peanuts, green beans and tempeh is safe for consumption based on safety parameters such as microbial contamination and heavy metals. The most preferred RUTF formula for malnourished children under five is made from green beans followed by peanuts and tempeh. [9] In toddlers with malnutrition or malnutrition, the body's defense system decreases so that they are prone to infection. Protein deficiency can also interfere with the production of antibodies for humoral immunity. Protein deficiency will be accompanied by a deficiency of vitamin A (Beta Carotene) due to inhibition of the absorption, transportation, and conversion of vitamin A. [10,11] For this reason, it is necessary to substitute local food sources of protein and vitamin A. One of the local food ingredients that are rich in Vitamin A is yellow squash (Curcubita maxima) which has the potential as a source of vegetable Provitamin A in the form of beta carotene. Every 100 grams of pumpkin contains 1569 Ug of beta-carotene. Beta carotene has stable properties in food processing [12]. Given the several advantages of pumpkin, pumpkin can be used as a substitute for flour. According to research conducted by Lestario et al which proved that the addition of pumpkin flour of 12.5% in the manufacture of yellow noodles can produce beta carotene levels of 15.51 mg / 100 gr [13]. The protein contained in pumpkin flour has a digestibility of 99%, making it suitable for consumption by infants [14]. Tempe is a local food source of protein, and has protein with a higher digestibility value, which is 83% when compared to soybean which is only 75% [15]. Processing of tempeh into flour has many benefits, namely that it is easy to mix with carbohydrate sources to enrich its nutritional value, is easy to store, or is processed into fast food [16]. Tempe contains high quality protein so it can be used to complement the KEP diet [17]. Iskandar's research (2017) provides a modified formula based on green beans and pumpkin, the results of the increase in z score for toddlers before giving are -2.71 SD and the final z score is -2.49 SD, with an average weight gain of 0, 4 kg for 4 weeks. Giving modified PMT affects the nutritional status of children under five in the District of Darul Imarah Aceh [18]. This study aims to determine the effect of providing Ready to Use Therapeutic Food (RUTF) crackers based on local food on the nutritional status of malnourished children in Cibeureum Village, South Cimahi District.

2. Method

The research design was a Quasi Experiment with controlled pre-posttest design. The treatment group was given RUTF crackers for 1 month and nutrition education and the control group were given PMT Manufacturing and nutrition education. The manufacture of crackers was carried out at the Food Technology Science Laboratory of the Nutrition Department of the Health Polytechnic of the Ministry of Health, Bandung and a proximate analysis (product quality) was carried out at Sibaweh Laboratories Indonesia. The research

location is in the Cibeureum Health Center Work Area, Cimahi Selatan Subdistrict in August - December 2019. The population is all malnourished toddlers living in the area. Samples are malnourished toddlers who are allowed by the biological mother / guardian of toddlers to be treated and their nutritional status is measured. The minimum sample size was calculated using the hypothesis testing formula on a mean of 2 as many as 38 people [19]. The data collected includes age, gender, mother's age, mother's education, and mother's occupation. The data collected by interview using a questionnaire to mothers under five. The sample eating habits data were collected by interview using the Semi-Quantitative Food Frequency Questionnaire (SFFQ). Nutritional status data was done by measuring anthropomy (weighing body weight using a digital scale with an accuracy of 0.1 kg and measuring body height using a microtoise with an accuracy of 0.1 cm). Data on the quality of Ready to Use Theraupetic Food (RUTF) crackers including energy, carbohydrates, protein, fat, water content, beta carotene were examined for proximate analysis and beta carotene levels test at Sibaweh Laboratories. Analysis of the difference in the average z score between before and after treatment in each group with the Dependent t test for normally distributed data, or the Wilcoxon test for data not normally distributed. Analysis of the mean difference in z scores between the treatment group and the control group used the Independent t test for normally distributed data, and the Mann-Whitney test for data not normally distributed. The limit of significance used a 95% degree of confidence with a p value ≤ 0.05 [20,21].

3. Result

3.1 Characteristics of research subjects

The total number of research subjects at the beginning of the study was 39 people consisting of 19 treatment groups and 20 control groups. The following table presents the distribution of samples based on characteristics.

Table 1 Distribution of Treatment and Control Groups based on Gender, Age of Under-five, Mother's Age, Education and Mother's Occupation

Characteristics	Category	Intervention (n=19)		Control (n =20)	
		n	%	n	%
Gender	Man	7	36.8	11	55
	Woman	12	63.2	9	45
Toddler's Age	13-36 month	9	47.4	8	40
	37-60 month	10	52.6	12	60
Mother's Age	< 35 years	16	84.2	12	60
	≥ 35 years	3	15.8	8	40
Mother's Education	Basic Education	10	52.6	13	65
	Further Education	9	47.4	7	35
Mother's Work	Have A Job	4	21.1	4	20
	Unemployment	15	78.9	16	80

The research sample in the treatment group consisted of 7 (36.8%) men and 12 (63.2%) women, while in the control group most (55%) were men. The sample ages ranged from 18 to 60 months with a mean age of 37 months. In the 12-36 months' age group, both in the treatment group and the control group were almost comparable, while the distribution of samples based on age, in the treatment group there was less proportion of the sample aged 37-59 months (52.6%) than in the control group (60%). Maternal age ranged from 22-41 years with a mean age of 29 years. Maternal age less than 35 years was found to have a greater proportion in the treatment group (84.2%) than in the control group (60%), while in the group over 35 years of age, the proportion was greater in the control group (40%) than in the treatment group (15.8%). Most of the final education of mothers under five is junior high school (SMP). The proportion of mothers from basic education,

in the treatment group was less (55%) than the control group (65%). Most of the mothers did not work or housewives in both the treatment group and the control group. The status of working mothers found the same proportion between the treatment group and the control group, namely 20%. Most of the sample mothers work as factory workers.

3.2 Nutritional Value of RUTF Crackers

The nutritional value of Crakers RUTF was analyzed at PT Sibaweh Laboratorium Indonesia. Table 2 presents the results of a proximate analysis of local food-based RUTF crakers.

Table 2 Results of Analysis of Nutritional Content of Crackers RUTF

No	Parameter	Nutritional Value per 100 grams
1	Energy	503,20 Kcal
2	Protein	7,28 gram
3	Total Fat	17,64 gram
4	Total Carohydrate	78,83 gram
5	B-carotene	1,86 ppm
6	Water	5,04 gram

The energy of the RUTF crakers from the proximate analysis was 503.20 kcal and protein 7.28 grams per 100 grams. According to the additional food requirements for toddlers and SNI 01-7111.2-2005, the minimum energy content in biscuits per 100 grams is 400 kcal, protein 8-12 grams, carbohydrates 30 grams and a maximum water content of 5%. If you refer to these requirements, the RUTF crakers' product has met the nutritional value requirements for additional foods for toddlers.

Table 3 Nutritional Adequacy Rate (RDA) for ages 1-6 years [23]

No	Nutrients	AKG 2019 1-3 years old	AKG 2019 4-6 years old
1	Energy	1350 kcal	1400 kcal
2	Protein	20 gram	25 gram
3	Total Fat	45 gram	50 gram
4	Total Carohydrate	215 gram	220 gram

The RUTF crackers given to the treatment group were 50 grams per day with 251.15 kcal of energy, 3.64 grams of protein, 8.82grams of fat and 39.4 grams of carbohydrates for 1 month. For the 1-3 years' age group, it can add 18.6% of energy sufficiency and 18.2% protein adequacy, while for the 4-6-year age group it can add 17.9% of energy sufficiency and 14.5% of protein adequacy. RUTF is a ready-to-eat therapeutic food that has high energy in each small portion with a size of 33-35 grams containing 175-200 kcal. Calorie gain is about 200-500 calories a day with a target weight gain of 0.2 - 0.5 kilograms within a week [22].

3.3 The distribution of energy and nutrient intake data before and after the intervention for toddlers aged 13-47 months and 48-60 months

The energy and protein intake of the samples were compared against the 2019 Nutritional Adequacy Rate for ages 13-60 months. Intake data can be seen in the table below.

Table 4 Data Distribution of Energy Adequacy Percentage, Protein Before and After Intervention

Intake	Group	Pretest **Mean**±SD	Posttest **Mean**±SD

	Intervention		
	13-47 month	77.68±34.46	88.70±34.46
	48-60 month	79.32±11.46	95.49±12.75
Energy (%Adequacy)	**Control**		
	13-47 month	72.21±33.46	64.27±19.20
	48-60 month	79.60±19.61	55.64±19,04
	Intervention		
	13-47 month	149.7±87.45	237.15±125.6
	48-60 month	192.64±77.04	184.24±24.36
Protein (%Adequacy)	**Control**		
	13-47 month	211.40±95.75	179.4±57.6
	48-60 month	198.04±78.32	147.88±59.52

Based on table 4, it can be seen that the sample energy intake in both the treatment and control groups before and after the intervention is still below the Recommended Recommended Nutritional Adequacy Rate (RDA), meaning that the sample food intake is still insufficient. The increase in the percentage of sample energy intake after the intervention was found in the treatment group, namely the 13-47 months' age group, an increase of 11.02% and the highest was at the age of 48-60 months, namely 16.17%, meaning that the provision of RUTF crakcers can increase the energy intake of the sample treatment group. Whereas in the control group, both at the age of 13-47 months and 48-60 months, there was a decrease in energy intake, respectively, 7.94% and 23.96% after the intervention. The sample protein intake in the treatment and control groups before and after the intervention was above the Recommended Nutritional Adequacy Rate (RDA), meaning that the sample protein intake was more than adequate. The highest increase in protein intake after the intervention was in the treatment group aged 13-47 months, namely 87.45%, while at the age of 48-60 months there was a decrease in protein intake by 8.4%. In the control group, both at the age of 13-47 months and 48-60 months, there was a decrease in protein intake by 32% and 50.16% after the intervention.

3.4 Nutritional status before and after intervention in the treatment and control groups

The nutritional status before and after the intervention in the treatment and control groups can be seen in Table 5.

Table 5 Mean Z Score (Nutritional Status) Initial (Before Intervention) and Final (After Intervention) in the Treatment and Control Groups

Z score	Group	Pretest (Mean±SD)	Posttest (Mean±SD)
weight / height	**Intervention**	-1.35±0.58	-1.38±0.78
	Control	-1.25±0.77	-0.94±0.76

The mean z score (weight / height) of the sample before the intervention in the treatment group was -1.35 and in the control group was -1.25. Samples with nutritional status of wasting / wasting in the treatment group were 3 people (15.79%), as well as in the control group 3 people (15%). The mean z score (weight / height) of the sample after the intervention in the treatment group was -1.38 and in the control group was -0.94.

3.5 The difference in z scores before and after the intervention between the treatment group and the control group

Based on table 6, the mean change in z initial and final sample scores in the treatment group is 0.35. Whereas in the control group the mean change in z score at the beginning and end of the sample was -0.74. The

administration of RUTF crakers increased the weight of children under five with an average increase of 0.39 kg in the treatment group and an average increase of 0.26 kg in the control group. The results of statistical tests showed that based on the z score parameters weight / height there was a difference in the mean z scores before and after the intervention in the treatment group, while in the control group there was no difference in the mean z scores before and after the intervention.

Table 6 Differences in the mean of Z scores (weight / height) at the beginning and at the end of the treatment group and the control group

Parameter	Group	Z score (pre)	Z score (post)	Mean (delta)	p-Value
weight / height	Intervention	-1.25±0.77	-0.94±0.76	0.35±0.45	0.004
	Control	-1.35±0.58	-1.38±0.78	-0.74±0.43	0.510

3.6 Effect of giving RUTF Crackers on nutritional status (z score weight / Age, weight / height)

The effect of giving RUTF crackers on nutritional status (z score weight / age, weight / height) can be explained in Table 7.

Table 7 Effect of Intervention on Nutritional Status (Z Score weight / height)

Parameter	Group	Mean	SD	p*) Value
weight / height **	Intervention	0.07	0.43	0.010
	Control	-0.34	0.45	

*) Independent T test

Based on table 7, the parameters of weight / height were analyzed using the independent t test showing that there was a significant difference between the treatment group and the control group where the p value was 0.010, so it can be concluded that there was an effect of giving RUTF crackers on the increase in z score of weight / height.

Discussion

The energy intake of samples in both the treatment and control groups before and after the intervention was still below the Recommended Nutritional Adequacy Rate (RDA), meaning that the sample food intake was still insufficient. The increase in the percentage of sample energy intake after the intervention was found in the treatment group, namely the 13- 47 months' age group, an increase of 11.02% and the highest was at the age of 48-60 months, namely 16.17%, meaning that the provision of RUTF crakcers can increase the energy intake of the sample treatment group. Whereas in the control group, both at the age of 13-47 months and 48-60 months, there was a decrease in energy intake, respectively, 7.94% and 23.96% after the intervention. The sample protein intake in the treatment and control groups before and after the intervention was above the Recommended Nutritional Adequacy Rate (RDA), meaning that the sample protein intake was more than adequate. The highest increase in protein intake after the intervention was in the treatment group aged 13-47 months, namely 87.45%, while at the age of 48-60 months there was a decrease in protein intake by 8.4%. In the control group, both at the age of 13-47 months and 48-60 months, there was a decrease in protein intake by 32% and 50.16% after the intervention. The results of the food intake interview using SFFQ showed that the eating habits of the sample on average were less diverse, the variety of food ingredients consumed was limited and the portion of food was still less than the portion for the age it should be and toddlers often did not finish their meal portions. The types of carbohydrates that are often consumed are rice, while the animal side dishes are chicken, eggs, sausage and meatballs. Meanwhile, for vegetable side dishes, only tofu, tempeh and green beans. Likewise, vegetables and fruits are less diverse because toddlers do not like them. The most commonly consumed vegetables are carrots, beans, kale, while the fruits that are often consumed are bananas

and papaya. Most toddlers have a habit of snacking so that their appetite for main meals is reduced because they are full of junk food or those that do not contain calories, thereby reducing consumption of main foods. In addition, the socio-economic factors of the sample in the treatment and control groups were almost uniform, namely most of them were housewives and worked as laborers so that the purchasing power / access to balanced food was lacking even though nutrition education was given. The cause of malnutrition is caused by many factors that are directly influenced by infectious diseases and insufficient nutritional intake in both quantity and quality. Meanwhile, it is indirectly affected by the reach and quality of health services, inadequate parenting styles, poor environmental sanitation conditions and low food security at the household level [24]. Inadequate food intake is caused by the unavailability of adequate food, inadequate or wrong children getting a balanced nutritious diet, and the wrong diet. Most of the children under five with malnutrition have a diet that is less diverse, namely consuming dishes with a composition that does not meet the balanced nutrition [25].

In addition, the level of education and knowledge of mothers can affect the availability of food in the family, which in turn affects the quantity and quality of food consumption which is a direct cause of malnutrition in children under five. Furthermore, the implication affects the development of children [26]. An adequate level of family income supports children's growth and development, because parents can provide all the children's needs, both primary, such as food and secondary ones [26]. Families with more income are likely to be good and even excessive in meeting food needs, on the other hand, families with limited income are likely to be less likely to meet food needs, especially to meet nutritional needs [27]. This is because with a lack of family income, the purchasing power of diverse and nutritious foods to meet the nutritional adequacy of toddlers is reduced so that toddlers with family income are more or less vulnerable to malnutrition. [28]. The mean initial body weight of the treatment group sample was 9.83 kg and the final body weight after the intervention was 10.22 kg, there was an increase in body weight of 0.39 kg. Whereas in the control group the mean initial body weight was 10.22 kg and the final body weight after the intervention was 10.48, meaning that there was an increase in body weight of 0.26 kg. Oktovina's (2015) study conducted a study on the effect of giving additional biscuits and tempeh cake on weight gain for under-nutrition children, which resulted in an increase in body weight after the intervention was 1.2 kg in the treatment group, while the increase in body weight after intervention in the control group was 0.3 kg. [29]. Muslimah's research (2018) is in line with this study, namely intervening by giving mocaf soy cookies to malnourished toddlers for 14 days to obtain a weight gain of 0.33 kg in the treatment group and 0.22 kg in the control group [30]. The mean z score (weight / age) of the sample in the treatment group was -2.40 and in the control group was -2.51. The mean z score (weight / age) after intervention, in the treatment group was -2.31 while in the control group it was -2.26. The mean z score (weight / height) of the sample before the intervention in the treatment group was -1.35 and in the control group was -1.25. Samples with nutritional status of wasting / wasting in the treatment group were 3 people (15.79%), as well as in the control group 3 people (15%). The mean z score (weight / height) of the sample after the intervention in the treatment group was -1.38 and in the control group was -0.94. There is an increase in the z score of 0.25. The administration of RUTF crakers increased the weight of children under five with an average increase of 0.39 kg in the treatment group and an average increase of 0.26 kg in the control group. The results of statistical tests showed that there was no difference in the mean z score of weight / age before and after the intervention in the treatment group and the control group. Whereas with the z parameter score weight / height, the statistical test results showed no difference in the mean z scores before and after the intervention in the treatment group, while in the control group there was a difference in the mean z scores before and after the intervention.

The results of this study are in line with the research of Muslimah (2018) where the provision of mocaf soy cookies to malnourished toddlers did not have a significant effect on changes in the mean z score before and after the intervention in both the treatment group and the control group with p = 0.068 in the treatment group and p = 0.062 in the control group [30]. The increase in body weight that occurred in this study was not too significant so that it did not affect the increase in z score. Based on the weight / age parameter, it showed that there was no effect of giving RUTF crackers on the increase in z score of weight / age. Meanwhile, the weight / height parameter showed that there was an effect of giving RUTF crackers on the increase in z score of weight / height. Juhartini's research (2016) showed a significant difference between body weight before and after giving Moringa PMT BMC biscuits for 60 days with a value of p = 0.003 [31]. In line with Symond's research (2016) where the provision of jicama tempe formula supplementation found a significant difference in bobo for z scores (weight / age) in malnourished children before and after in the intervention group ($p \leq 0.05$) [32]. The provision of RUTF crackers as much as 50 grams per day for 30 days was not sufficient to increase the change in z score significantly and if controlled by the average sample energy intake, almost all samples were below the 2019 RDA adequacy. The daily intake of the sample must be in accordance with the needs / sufficiency in order to increase the nutritional status to normal.

Conclusion

There was a difference in the mean z score of weight / height before and after the intervention in the control group (p = 0.004) There was an effect of giving RUTF crackers on the increase in z score of weight / height between the treatment group and the control group (p = 0.01)

Suggestion

Giving RUTF crackers can increase body weight, so it is recommended that toddlers continue to consume balanced nutritional food as needed because PMT is complementary not a substitute. PMT needs to be modified if it is given for a long time (30 days) to avoid boredom, thereby reducing acceptance.

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