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EFFECT OF MORINGA (*MORINGA OLEIFERA*) LEAF EXTRACT AND EGG FEEDING ON DIET IN UNDERNOURISHED TODDLERS

Hardiyanti Alawiyah Nur [1], Veni Hadju [2], Mardiana Ahmad [3], Ema Alasiry [4], Aminuddin Syam [5], Amir Mahmud Hafsa [6] and Didi Supriyadi [7]

[1,3,6] Master of Midwifery Study Programme, Hasanuddin University, Makassar, Indonesia.
[2,5] Department of Nutritional Sciences, Faculty of Public Health, Hasanuddin University, Makassar, Indonesia.
[4] Wahidin Sudirohusodo Hospital, Makassar, Indonesia.
[6] Department of MARS, Megarezky University, Makassar, Indonesia.
[7] Join Operating Body Pertamina Medco Tomori, Luwuk Banggai, Indonesia.

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Abstract

Background: Nutrient consumption in the family can be influenced by dietary patterns, such as the selection of food ingredients, food composition, type of food, frequency of feeding, and uneven food distribution patterns in the family. Objectives: To assess the magnitude of the difference in dietary changes in undernourished toddlers given Moringa leaf and egg extracts. Methods: *True Experimental, Pretest Posttest Control Group Design.* Moilong and Batui Selatan sub-districts, Banggai district. The population was 69 toddlers, totally selected and put into two different groups. The first group received moringa extract 500 mg/capsule/day and eggs 45-50 grams/grain/day, the second group received eggs 45-50 grams/grain/day. Diet was measured *using Food Frequency Questionnaire,* statistical test using *Wilcoxon and Mann Whitney test* with SPSS. Results: The intervention group experienced an increase in the mean value of diet on staple foods, animal side dishes, vegetable side dishes, vegetables and fruit (0.10, 0.47, 0, 0.30 respectively with p values = 0.257, 0.000, 1.000, 0.007). The control group with mean values on staple foods, animal side dishes, vegetable side dishes, vegetables and fruit (0.07, 0.10, 0, -0.13 respectively with p values = 0.317, 0.257, 1.000, 0.046). Conclusions: The provision of moringa leaf extract can improve the diet of undernourished toddlers especially in animal side dishes and fruit vegetables.

Keywords: Moringa Leaf Extract, *Moringa Oleifera*, Egg, Diet.

INTRODUCTION

The Sustainable Development Goals (SDGs) seek to reduce the proportion of undernourished children to less than 5% by 2025 and less than 3% by 2030. Undernutrition, defined as a condition where a person's weight is disproportionate to their height, is a particularly glaring and dangerous form of malnutrition.[1]. The 2021 Indonesia Global Survey on the Status of Nutrition (SSGI) found that among under-fives, measurements of the Body Weight to Height index (BW/TB) showed that about 0.9% of under-fives were malnourished and about 4.0% were undernourished.[2].

Toddlers who receive adequate food intake but are often sick may be undernourished due to a lack of nutritional value in the food they consume. Nutrient consumption in the family can be influenced by a variety of factors, including the selection of food ingredients, processing, food composition, types of food, serving methods, frequency of feeding, and uneven patterns of food distribution within the family.[3,4].

In the National Action Plan for Nutrition (RANPG) 2021-2024, one of the main aspects is to emphasise animal protein intake. Because animal protein source foods affect early childhood growth, and eggs are recommended because eggs are a source of protein that is high in benefits and easy to find.[5]. Eggs are an almost perfect source of animal protein. The nutritional content in 100g eggs is 131 kcal (547 kJ) energy, 2.52g

saturated fatty acids, 3.43g monounsaturated fatty acids, 0.13g cis-n3 fatty acids, 1.31g cis-n6 fatty acids, 1.44g polyunsaturated fatty acids, 0.01g trans fatty acids, 360mg cholesterol, and other important nutrients that are very good for child growth and development and have the potential to improve nutritional status early on.[6–8].

One way to improve the nutritional status of toddlers can be achieved by providing food made from local foods, such as Moringa, which is a food rich in macro and micronutrients. Moringa also contains high amounts of fibre 11.23g/100g, ash 4.56g/100g, carbohydrates 56.33g/100g, total protein 9.38g/100g and lipids 7.76g/100g. In Indonesia, Moringa trees are often planted as a living fence, planted along the edge of the land, functioning as a greening plant Protein in Moringa leaves is higher than other leaf plants so that it can be utilised in improving health and nutritional status.[9–12].

A literature review revealed that the administration of moringa leaf extract capsules had a greater effect on diet than the iron capsule group.[13].

METHODS

Study Design

The research design used was *True Experimental Design with the form of Pretest Posttest Control Group Design*. The population was 69 toddlers, sampling with total sampling, toddlers were put into two different groups. The first group received Moringa leaf extract and eggs, the second group only received eggs.

Research Subjects and Locations

This study was conducted in Moilong and Batui Selatan sub-districts, Banggai district, Indonesia, in July-October 2023. The inclusion criteria of the study subjects were toddlers aged 6-59 months who had a category (-3 SD to -2 SD) with malnutrition status and did not have a real infection. A total of 60 toddlers who met the criteria until the end of the study.

Data Collection Instruments

Data was collected using a questionnaire for demographic data, *Food Frequency Questionnaire* (FFQ) *was used to assess diet.*

Statistical Analysis

Univariate analysis was used to determine the descriptive and characteristics of all variables. Bivariate analysis used Wilcoxon test and Mann Whitney test. All statistical analyses were performed using SPSS version 24.

Ethics Approval

This study obtained ethical approval from the Research Ethics Committee of the Faculty of Public Health, Hasanuddin University (30623092126).

RESULTS

Table 1: Family Characteristics in the Intervention Group and Control Group

Characteristics	Intervention		Control		P *Value**
	n (n=30)	%	n (n=30)	%	
Mother's education					0.461
Not graduated from elementary/middle school	1	3.3	1	3.3	
Graduated from elementary/middle school	9	30	5	16.7	
Graduated from junior high school/middle school/equivalent	6	20	9	30	
Graduated from senior high school/MA/equivalent	11	36.7	12	40	
Diploma Graduation	2	6.7	2	6.7	
University Graduation	1	3.3	1	3.3	
Father's education					0.788
Not graduated from elementary/middle school	1	3.3	2	6.7	
Graduated from elementary/middle school	8	26.7	7	23.3	
Graduated from junior high school/middle school/equivalent	8	26.7	3	10	
Graduated from senior high school/MA/equivalent	11	36.7	16	53.3	
Diploma Graduation	0	0	2	6.7	
University Graduation	2	6.7	0	0	
Family Income					0.081
Under 1 million	8	26.7	7	23.3	
1-2 million	15	50	10	33.3	
2.1-3 million	4	13.3	7	23.3	
3.1-5 million	2	6.7	4	13.3	
Above 5 million	1	3.3	2	6.7	
Parenting					
Simply	24	80	25	83.3	0,513
Less	6	20	5	16.7	

* *Levene test*

Table 1, shows that generally the education of mothers of toddlers in the intervention group and control group was high school / MA / equivalent (36.7%) and (40%), the education of fathers of toddlers in the intervention group and control group was high school / MA / equivalent (36.7%) and (53.3%), family income in the intervention group and control group was 1-2 million (50%) and (33.3%). Data in Table 1 showed that there was no significant difference or homogeneity between the variables of mother's education, father's education, family income in the intervention group and control group with P values of 0.461, 0.788, and 0.081 respectively.

Based on Table 2 shows that generally toddlers aged 25-54 months in the intervention group (83.3%) and control group (70%), the gender of male toddlers in the intervention group (66.7%) and control group (60%), nutritional status -3 SD to <-2 SD in the intervention group (66.7%) and -2 SD to +1 SD in the control group (50%), exclusive breastfeeding history in the intervention group and control group is not exclusive breastfeeding (56.7%) and (66.7%). It is known that there is a difference in nutritional status variables with a P value of 0.006 while age, gender and exclusive breastfeeding history are not significantly different or homogeneous with P values of 0.016, 0.305, and 0.146 respectively.

Table 2: Characteristics of Toddlers in the Intervention Group and Control Group

Characteristics	Intervention		Control		P *Value**
	n (n=30)	%	n (n=30)	%	
Age					0.016
6-24 months	5	16.7	9	30	
25-54 months	25	83.3	21	70	
Gender					0.305
Male	20	66.7	18	60	
Women	10	33.3	12	40	
Nutritional Status					0.006
< -3 SD	1	3.3	5	16.7	
-3 SD sd < -2 SD	20	66.7	10	33.3	
-2 SD sd +1 SD	9	30	15	50	
Exclusive breastfeeding					0.146
No	17	56.7	20	66.7	
Yes	13	43.3	10	33.3	

*Levene *test*

Table 3: Baseline Dietary Variables Data

Variables	Intervention (mean + SD)	Control (mean + SD)	P *Value*[*]
Diet Staple Food	1.60±0.498	1.73±0.450	0.382
Animal Side Dishes	1.10±0.305	1.17±0.379	0.463
Vegetable Side Dishes	1.03±0.183	1.00±0.000	0.668
Vegetable and Fruit	1.57±0.504	1.63±0.490	0.923

[*]*Mann Whitney Test*

Based on Table 3 shows that there is no significant difference between the intervention group and the control group at baseline data on dietary variables on staple foods, animal side dishes, vegetable side dishes, vegetables and fruit, each P *value* = 0.382, 0.463, 0.668, 0.923 where P> 0.05.

Table 4: Differences in Dietary Changes Before and After Intervention

Diet	Pretest (mean + SD)	Posttest (mean + SD)	P *Value*[a]	Δ	P *Value*[b]
Staple food					
Intervention	1.60±0.498	1.70±0.466	0.257	0.10±-0.032	0.733
Control	1.73±0.450	1.80±0.407	0.317	0.07±-0.043	
Animal side dishes					
Intervention	1.10±0.305	1.57±0.504	**0.000**	0.47±0.199	**0.007**
Control	1.17±0.379	1.27±0.450	0.257	0.10±0.071	
Plant-based side dishes					
Intervention	1.03±0.183	1.03±0.183	1.000	0±0	1.000
Control	1.00±0.000	1.00±0.000	1.000	0±0	
Vegetable and fruit					
Intervention	1.57±0.504	1.87±0.346	**0.007**	0.30±-0.158	**0.001**
Control	1.63±0.490	1.50±0.509	**0.046**	-0,13±0.019	

[a] *Wilcoxon Test*

[b] *Mann Whitney Test*

Based on Table 4 shows that the score of staple foods in the *moringa* leaf extract (*moringa oleifera*) and egg groups before and after the intervention P *value* = 0.257, animal side dishes P *value* = 0.000, vegetable side dishes P *value* = 1.000, vegetables and fruit P *value* = 0.007. In staple foods and vegetable side dishes there is no significant difference, where P *value* > 0.05, while in animal side dishes and vegetables and fruit there is a significant difference, where P *value* < 0.05.

The contribution of *Moringa oleifera* extract on the addition of staple food score was 0.1 with an average initial score of 1.60 to 1.70 after the intervention. The addition of scores on animal side dishes was 0.47 with an average initial score of 1.10 to 1.57. The score on vegetables and fruits increased by 0.3 with an average initial score of 1.57 to 1.87.

The results of the independent variable test of the difference in dietary changes between the intervention group and the control group, there were significant changes in animal side dishes and vegetables and fruits, P *value* 0.007 and 0.001 respectively where P *value* < 0.05, in staple foods and vegetable side dishes there were no significant changes, respectively P *value* = 0.733 and 1.000 where P *value* > 0.05.

DISCUSSION

Based on family characteristics, parents' education is generally senior high school (SMA/Ma/Sederajat) with a family income of 1-2 million. Nutrition problems in Indonesia are not only related to poverty, but also to food security at the household level. Maintaining the nutritional status of toddlers requires good maternal knowledge because maternal knowledge about good food for consumption by toddlers will affect the nutritional status of toddlers. A mother's education can affect her knowledge. It is expected that the higher the education of parents of toddlers can affect maternal knowledge, so that mothers understand about good nutritional intake. Nutritional intake is related to the nutritional status of toddlers [14,15].

The characteristics of toddlers are generally undernourished toddlers with a Z score of -3 SD to < -2 SD, the age of toddlers with a range of 25-54 months, male gender and breastfeeding history with not exclusive breastfeeding. The total number of research subjects was 60 toddlers who met the inclusion and exclusion criteria, and the intervention of Moringa leaf and egg extract was carried out for 3 months. Data collection on general characteristics was carried out through face-to-face interviews using a questionnaire.

The distribution of toddlers on family and toddler characteristics did not differ between the intervention and control groups, so the study subjects were declared homogeneous.

Based on the results of the *Wilcoxon* test on the pretest and posttest of the intervention group, the diet variables consisting of staple foods, animal side dishes, vegetable side dishes, vegetables and fruits obtained P *value* = 0.257, 0.000, 1.000, 0.007 respectively, which means that in staple foods and vegetable side dishes there is no significant difference where P> 0.05, while in animal side dishes and vegetables and fruits there is a significant difference where P < 0.05. The control group in the pretest and posttest of each staple food, animal side dishes, vegetable side dishes, obtained P *value* = 0.317, 0.257, 1.000 which means there is no significant difference, where P> 0.05, while for vegetables and fruit with P *value* = 0.046 where P < 0.05 there is a significant difference.

Based on the results of the study, there was an increase in the average diet of the intervention group with a mean difference of 0.1 in staple foods, 0.47 in animal side dishes, and 0.3 in vegetables and fruits. This is due to the content of moringa, namely vitamins that act as coenzymes or regulators of metabolic processes and are very important for many vital body functions. This is supported by research conducted by Suhartini et.al. (2021) with the title "Moringa Oleifera capsule and diet in young women with dropout school" with the results that there are differences in diet before and after giving moringa capsules. Moringa contains vitamins A (alpha and beta carotene), B, B1, B2, B3, B5, B6, B12, C, D, E, K, folic acid, biotin. Because it has been proven by several studies that the substances contained in moringa have an effect on improving post-intervention eating patterns. [13].

The results of the test between the intervention group and the control group of staple foods and vegetable side dishes, respectively *P Value* = 0.733 and 1.000, which means there is no significant difference, in animal side dishes and vegetables and fruits obtained *P Value* = 0.007 and 0.001, which means there is a significant difference.

CONCLUSIONS

The provision of *Moringa* (*Moringa Oleifera*) leaf extract and eggs has a greater effect than the provision of eggs alone on dietary changes (animal side dishes and vegetables & fruits).

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