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THE EFFECT OF TABURIA FORTIFICATION AND NUTRITION EDUCATION OF MOTHERS TO ON NUTRITIONAL STATUS OF 12-24 MONTHS OLD CHILDREN IN INDONESIA : RANDOMIZED CONTROLLED TRIAL STUDY

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ABSTRACT

Background: Mother's nutritional knowledge and parents' feeding practices will influence children's eating behavior which have an impact on the child's growth.
Objective: The purpose of this study was to determine the effects of Taburia fortification and nutrition education of mothers on the nutritional status of children in Waipare Public health center in East Nusa Tenggara.
Materials and Methods: This study was a randomized controlled trial. A total of 180 mothers and their children aged 12-24 months who had malnourished (z-score -3 to -2). The group divided into teams were the intervention group (IG) (n=90) and the control group (CG) (n=90). The IG give intervention for three months. The mothers were given nutrition education, while their children were given taburia. The CG, mothers were given nutrition education. Data feeding rules obtained using a self-administered feeding practice-Questionnaire (FPQ). Dietary intake assessment of macronutrient and micronutrient three-day food records, nutritional status, and percentage of child's sick day was conducted before and after the intervention.
Results: The result of the study showed that there was no significant difference in the mean increase (P> 0.01) between knowledge scores in IG and CG, post-intervention. Lower percentage of sickness among children in IG than CG. The average nutrient intake, WAZ (0.97±0.52), WLZ (1.02±0.42) of IG increased and was higher than CG after the intervention. The LAZ of IG increased (0.34±0.66 SD) while on the CG declined (0.27±0,31 SD).
Conclusion: Thus, The Taburia fortification intervention was useful in improving WAZ, LAZ, WLZ in children who experienced malnutrition, but the intervention nutrition education of mothers can increase WAZ and WLZ.
Keywords: Dietary intake; Feeding practice; Intervension study; Malnutrition; Taburia fortification

INTRODUCTION

Malnutrition continues to be a main public health problem in the developing countries among continents such as in Asia, Afrika dan Oceania. There was one in every ten who suffering wasting that increased risk of death among under five children.[1] The condition is associated with many long-time period consequences, including poor cognitive or academy performance, stunted motor development, impaired bodily performance, reduced income in adulthood, pregnancy, and decrease beginning weight in offspring.[2] The direct cause of malnutrition is food intake and infectious diseases. Infectious diseases that often occur in children are diarrhea and respiratory infections.[3]

The results showed that feeding patterns both in terms of quality, quantity and frequency of feeding to children can overcome this nutritional problems.[4,5] A various inter-disciplinary approach is needed to address the problem of malnutrition in the age group 12-24 months. This condition is adjusted to the physiological, medical, behavioral development aspects, the relationship between parents and children, as well as the environment.[7] The results of several studies indicate that supplementation in the form of macronutrients and micronutrients can overcome the problem of malnutrition in children.[8–10]

Ministry of Health of the Republic of Indonesia created a program to deal with the problem of malnutrition in children by providing food supplements in the form of sprinkles.[11] Taburia fortification is a nutritional sprinkle, weighted one gram, which contains multivitamin (A, B1, B2, B6, C and D) dan multimineral (iron and zinc). The benefit of Taburia is to help tackle nutritional problems, optimizing growth and development, increasing endurance and infant's appetite.[11] Parents' feeding practices will influence children's eating behaviour which have an impact on the child's growth.[12] The results of several studies indicate that good feeding practices such as feeding time, frequency of feeding, and serving are beneficial for children's growth. Therefore that nutrition education is given related to nutrition children and the practice of feeding mothers for children.[4,13,14] Based on the result of Basic Health Research (RIKESDAS) in 2013, the prevalence rate of children with malnutrition in Indonesia was 19.6% and short stature children of 37.2%, but in East Nusa Tenggara

Province is approximate >30% and short stature children is >50%.[6] Preliminary survey results in the prevalence of children under five years old suffering nutritional problems in Sikka regency is higher than East Nusa Tenggara Province, with 38.7% and severe malnutrition is 40.8%.

Gaps in data on the quality and quantity of children's food intake and age-appropriate feeding practices are one of the main causes of malnutrition among children under five in in Waipare Public health center in East Nusa Tenggara, Indonesia. The objective of the study was to determine the effect of micronutrients in the form of Taburia fortification and nutrition education of mothers on the nutritional status of children aged 12-24 months in Waipare Public Health Center, Sikka Regency, East Nusa Tenggara Province -Indonesia. The study was approved by the Ethical Review Committee, School of Medicine, Diponegoro University. The Mothers on behalf of their children have informed nearby the nature of the study and provided their informed consents.

METHODS

The study was conducted in in Waipare Public health center in East Nusa Tenggara, Indonesia. The study population is made up of mothers and their children aged 12-24 months who are permanent residents of the study area. This study was conducted in Waipare Public Health Center in Sikka Regency, East Nusa Tenggara Province – Indonesia. Participants in this study were mothers and their children who were 12 to 24 months old who were experiencing moderately malnourish (z-score -3 to -2) were recruited into the study via an invitation letter. The unit of randomization was the study area on a 1:1 basis into either the control or intervention group. The recruitment of group members is randomly selected. Cluster randomization was used to confirm administrative efficiency, pointed risk of experimental contamination and improvement of subject compliance.[15]

The working area of Waipare Public Health Center consists of 6 villages in the coastal area and 3 villages in the mountainous region. The coastal area is divided into 2 parts. Three villages for the intervention group and 3 control group villages while in the mountainous area, 2 intervention group villages and one control group village with the same number of participants of both groups. Random distribution by considering the distance so that information about taburia will not be exposed to the control group. The intervention group was only known by the enumerators while the researchers were tasked with educating mothers in the intervention group and the control group. They were informed that they can remove from the study at any time deprived of any consequences.

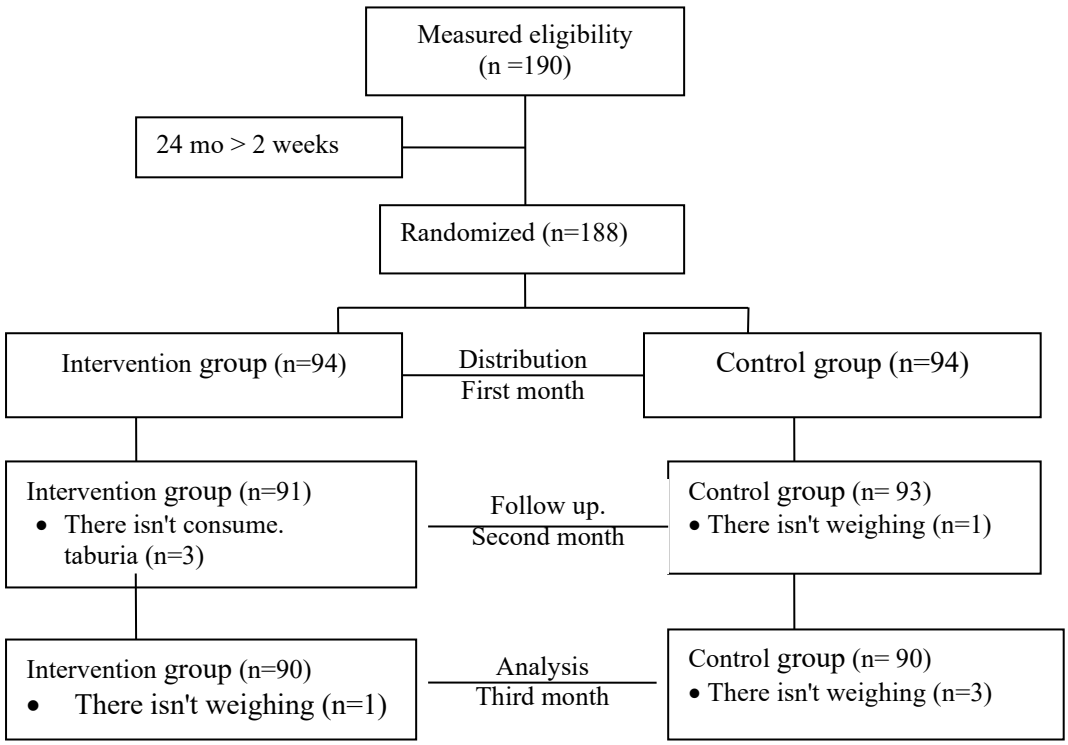

Figure 1: Study flow of participants

Ethical clearance for this study was obtained from Faculty of Medicine, Diponegoro University (Ref No.348/DRP/EC/FK/RSDK). District government grants research permit (ref No. 072/736 / Kesbangpol) permission to collect data at the selected facilities was obtained in Waipare Public

health center in East Nusa Tenggara. Verbal informed consent was obtained from all participants prior to the interview. Some of the variables measured in this study are variables in children such as age, sex, anthropometry, food intake data, sickness frequency data in the last 3 months while maternal variables such as nutritional knowledge data, child feeding practices. The anthropometric indexes weight-for-age z score (WAZ), length-for-age z score (LAZ), and weight for length (WLZ); and the incidence of underweight children, wasting. Weight and length were measured with naked children and by using electronic children's weighing scale (SECA 334). Anthropometric indexes (WAZ, LAZ, and WLZ) were calculated using who anthro software version 3.1.[16] Children who did not weigh for 3 months periodically and experienced sick during the study were excluded from the study. A total of 8 children dropped out of the study. Three children due to diarrhea and treatment at the Waiara health center and 5 people did not follow the weighing periodically.

Children's food intake was measured by the 24-hour recall method for 3 days. We asked about food intake exclusive breastfeeding, and continued breastfeeding, intake consumption complementary foods by using the 24-hour recall form. Analysis of total food intakes such as energy, carbohydrates, fats, and proteins as well as vitamins (A, B1, B2, B6, C, and D) and minerals (iron, zinc) used the nutri survey 2017 software using the Indonesian food data base.[17] Data on children's sick days are recorded by mothers and collected to enumerators every month using questionnaire. Collected data is sick children's infectious diseases (diarrhea and respiratory infections). One episode of diarrhea counted for a week.[18] However, if the frequency of the diarrhea is more than a week, it will be excluded from study participants and will be referred to the health center or hospital. Symptoms of respiratory infections such as acute respiratory infection were defined as the presence fluid of nasal discharge, nasal congestion, or cough, with or without fever or wheezing. One episode of infectious disease counted for two week.[19]

The mother's knowledge questionnaire about the practice of children feeding under two years is guided by the rules of feeding recommended by the World Health Organization (WHO).[20] Then the questionnaire was validated according to the characteristics of the study respondents. Maternal knowledge questionnaires include breast milk (3 items), complementary foods (4 items), minimum dietary diversity (5), and frequency of feeding (3 items). The 15 items in the knowledge section were rated on a true/false/don't know response (1 mark = correct answer, 0 marks = wrong) with a minimum score of 0 points and a possible maximum score of 15 points. A knowledge level with a higher score designated improved participant's knowledge. Items in the practice feeding children section were rated on a four-point scale (1 mark = never, 4 marks = always). The total practice score assessed the practice of good feeding practices for children aged 12-24 months. The possible minimum score was 11 and the possible maximum score was 44. A higher total score in this section indicates better feeding practice for children aged 12-24 months. All items were positively structured in the practice sections therefore reverse scoring did not apply. The whole questionnaire took 15-20 minutes to complete. The inner reliability using Cronbach's alpha coefficient of knowledge mother and children feeding practice providers was 0.850 and 0.974 respectively. Measurement of the anthropometric index (WAZ, LAZ, WLZ), food intake and percentage of children's sick days, maternal knowledge and feeding practices in children were done before and after the intervention.

There were two intervention schemes given for three months. Taburia fortification was given to the intervention group only, while maternal nutrition education was given to all groups. Children consume one sachet of taburia for two days therefore every child gets 15 sachets of sprinkle taburia for a month. Taburia was sprinkled on a child's meal at breakfast. Counseling about maternal nutrition was using videos and leaflets. Counseling was conducted every month. Taburia Fortification usage monitoring is conducted every month by collecting taburia sachets that have been used.

Statistical analysis**,** continuous variables are accessible as mean and standard deviation (SD) while categorical variables are accessible as absolute (n) and comparative (%) frequencies. A p-value of <0.05 was considered statistically significant. Analysis of independent t-test and Mann-Whitney were used to determine of differences the infant's sex, food intake, percentage of sick days differences and nutritional status of infants, maternal nutrition knowledge score and score of feeding practices among groups. Analysis of dependent t-test and Mann-Whitney were used to determine the differences between the infant's sex, food intake, percentage of sick days differences and nutritional status of infants, maternal nutrition knowledge score and score of feeding practices before and after research for the control group and intervention group.

RESULT

The study participants came from eight villages as the working area of Waipare Health Center. Out of 190 participants, a total of 188 were appropriate to inclusion criteria in this study. Ninety-four participants were allocated in each group of

intervention and control. Four participants in the intervention group did not participate in the study until the end. It was because thevfour children did not consume taburia as they forget and did not take weight measurements. While the control group was 4 participants because they did not take weight measurements. Therefore, only 180 participants were comprised in the final analysis. The Study flow of participants is shown in Figure 1.

Respondent Characteristics

The average for the age of children at the intervention group was 15.3 ± 4.9 months. While the control group is 15.4 ± 4.7 months. Mann-Whitney test results showed that the age of the children in both groups did not differ with p = 0.886. Most of the children in both groups were female (76.1%) and male (23.9%). All participants never had participated in any taburia fortification study and nutrition education.

Tabel 1. The Effect of Taburia Fortification and Maternal Nutrition Education on the Average Intake of Children, Anthropometrics Indexes, Percentage of Sick Days, Maternal Knowledge, and Child Feefing Practices in Both Groups

Variable	Time	Intervention group (n=90)		Control group (n=90)		p - value
		Mean (SD)	P-value	Mean (SD)	P-value	
WAZ	Pre	-2.30(0.3)[5]	0.001[4]	-2.22 (0.3)[5]	0.001[4]	0.091[2]
	post	-1.40 (0.6)[5]		-1.92 (0.3)[5]		0.001[2]
	d	0.97 (0.3)		0.43 (0.01)		0.001[2]
LAZ	Pre	-2.30 (1.3)	0.001[3]	-1.51 (0.9)	0.001[3]	0.001[1]
	post	-1.94 (1.4)		-1.81 (0.9)		0.557[1]
	d	0.35 (0.1)		- 0.26 (0.01)[5]		0.001[2]
WLZ	Pre	-2.06 (0.9)	0.001[3]	-1.42 (0.7)	0.001[3]	0.001[1]
	post	0.59 (1.0)		-2.06 (0.9)		0.001[1]
	d	1.02 (0.01)		0.55 (0.2)		0.001[1]
Energy (kkal)	Pre	876.5 (96.4)	0.001[3]	895.9 (78.8)	0.001[3]	0.550[1]
	post	1103.7 (87.9)		1090.6 (45.8		0.001[1]
	d	227.2		194.7		0.001[1]
Protein (g)	pre	12.4 (3.7)	0.001[3]	12.6 (4.5)	0.001[3]	0.507[1]
	post	21.6 (3.5)		18.4 (2.8)		0.001[1]
	d	9.2[5]		5.8[5]		0.003[2]
Vitamin A (RE)	Pre	260.4 (71.5)	0.001[3]	257.1 (3.3)	0.041[3]	0.200[1]
	post	421.6 (56.4)		267.5 (3.3)		0.001[1]
	d	161.2		20.4		0.002[1]
Vitamin D (mcg)	Pre	9.29 (2.14)	0.005[3]	9.59 (3.6)	0.942[3]	0.340[1]
	post	15.90 (1.7)		10.80 (1.8)		0.013[1]
	d	6.61		1.21		0.030[1]
Vitamin B1(mg)	Pre	0.39 (0.1)	0.001[3]	0.37(0,1)[5]	0.001[4]	0.953[2]
	post	0.56 (0.3)		0.40 (0.4)		0.008[1]
	d	0.17[5]		0.03[5]		0.042[2]
Vitamin B2 (mg)	Pre	0.33 (0.2)[5]	0.001[4]	0.33 (0.1)[5]	0.001[4]	0.911[2]
	post	0.60 (0.1)[5]		0.46 (0.6)[5]		0.001[2]
	d	0.27[5]		0.13[5]		0.23[2]
Vitamin B6 (mg)	Pre	0.36 (0.1)[5]	0.001[4]	0.37 (0.1)	0.001[3]	0.047[2]
	post	0.56 (0.3)		0.42 (0.1)		0.027[1]
	d	0.20[5]		0.05		0.464[2]
Vitamin C (mg)	Pre	30.39 (3.5)	0.001[3]	29.80 (6.9)	0.001[3]	0.113[1]
	post	40.90 (8.6)		35.67 (5.9)		0.002[1]
	d	10.51		5.87		0.034[1]
Iron (mg)	Pre	3.54 (1.6)	0.001[3]	3.49 (1.2)	0.001[3]	0.831[1]
	post	7.32 (0.64)		5.16 (1.1)		0.039[1]
	d	3.78		1.67		0.001[1]
Zinc (mg)	Pre	2.85 (1.8)	0.001[3]	2.97(0.8)	0.006[3]	0.3651
	post	4.64 (1.8)		3.33(1.0)		0.039[1]
	d	1.79		0.36		0.001[1]
Sick prevalence episode of infection in children	Pre	0.84 (1.7)	0.001[3]	0.42 (1.0)	0.001[3]	0.164[1]
	post	0.17(0.5)		0.21(0.6)		0.015[1]
	d	0.67		0.21		0.030[1]
mother's nutritional knowledge	Pre	3.8 (2.1)	0.001[4]	4.2 (3.4)	0.001[4]	0.080[2]
	post	13.9 (1.7)		14.1 (1.5)		0.091[2]
	d	10.1 (0.3)		9.9 (1.1)		0.557[2]
Children feeding practice	Pre	19.2 (3.4)	0.001[3]	19.7 (3.7)	0.001[3]	0.145[1]
	post	40.3 (2.8)		43.2 (0.5)		0.800[1]
	d	21.1 (1.2)		23.5 (2.2)		0.422[1]

1: Independent t test, 2 : Mann-Whitney test , 3: Dependent t test, 4 : Wilcoxon, 5: median (standard error), SD : standard deviation

Nutritional status of the children

Inclusion criteria in this study is a child with the anthropometric indexes weight-for-age z score (WAZ) (-3 SD to -2 SD Z score). Preliminary data analysis results before the study showed that most of the WAZ in the two groups did not show a statistically significant difference. But the anthropometric indexes length-for-age z score (LAZ), weight-for-length z score (WLZ) in the two groups did show a statistically significant difference. The average anthropometric index LAZ, WLZ in the intervention group was lower than in the control group. After conducting intervention by giving taburia fortification in the intervention group and nutrition education in both groups. There was an increase in the anthropometric index (WAZ, WLZ) in both groups during the three months of the study. The average anthropometric index WAZ of children in the intervention increased 0.97±0.3 SD higher than children in the control group of 0.43 ± 0.01 SD. The average anthropometric index WLZ of children in the intervention groups increased by 1.02 ± 0.01 SD higher than children in the control group of 0.55 ± 0.2 SD. The average anthropometric index LAZ of children in the intervention increased by 0.35 ± 0.1 SD while in the control group of has decreased by 0.26 ±0.01 SD. Statistically shows that there are significant differences in changes in the anthropometric index (WAZ, LAZ, WLZ) of children between the intervention group and the control group. Based on the WAZ anthropometric index, the nutritional status category of children in both groups after participating in the study was good nutritional status (Table 1).

Knowledge Of Mother Nutrition and Feeding Practices nn Children Aged 12-24 Months

Maternal knowledge about nutrition in children before research in both groups was low. The results of data analysis showed the mean score of maternal knowledge in the intervention and control groups 3.8 ± 2.1, and 4.2 ± 3.4. Most mothers answered incorrectly in the mother's knowledge questionnaire. Statistically, there was no significant difference in the mother's knowledge in the intervention and control groups. After counseling three times over three months, an increase in the knowledge score of mothers in the treatment and control groups was 10.1 ± 0.3 and 9.9 ± 1.1. The increase in maternal knowledge scores in the intervention group was higher than in the control group. The majority of mothers answered correctly to the mother's knowledge questionnaire.

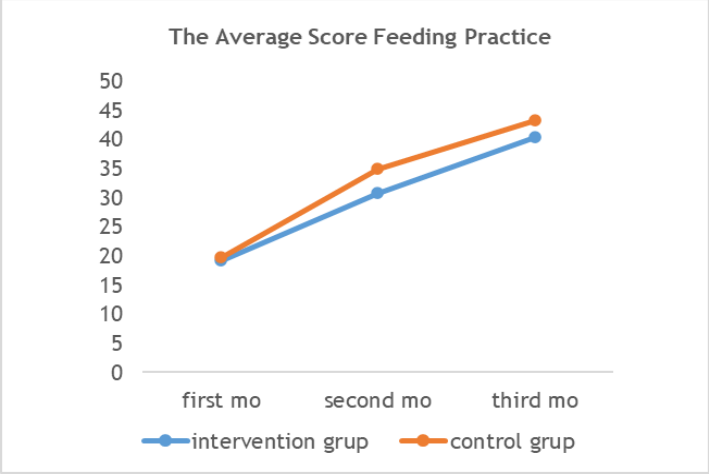

Figure 2. Trend of Feeding Practice

Statistically, there was no significant difference both in the mean increase in maternal knowledge scores and in the mean scores of maternal knowledges after the study between the treatment group and the control group. Feeding practices carried out by mothers there on children not in accordance with those recommended by WHO. Preliminary data analysis results show the average score of feeding practices in the intervention group and the control group of 21.1 ± 1.2 and 23.5 ± 2.2. The mean score of feeding practices in the control group was higher than in the intervention group. The application of feeding practices carried out by the intervention group was 47.9% smaller than the control group by 53.4%. But statistically did not show a significant difference in feeding practices by mothers in both groups at the beginning of the study. After nutrition education three times in three months there was an increase in feeding practices in both groups. The average score of applying feeding

practices in the intervention group was 40.3 ± 2.8 while in the control group it was 43.2 ± 0.5. Statistically, there are significant differences in the application of feeding practices before and after the research in both groups. There was no significant difference in the mean increase in scores between the treatment and control groups. The application of feeding rules practices according to the age of the child in two groups> 90% (Table 1).

Dietary Intake

The characteristics of energy, protein, and vitamin and mineral intake in both groups at the beginning of the study were less than the Recommended Dietary Allowances (RDA, based on Indonesian RDA).[21] The mean fulfillment of energy needs in the intervention group was 64.9%, the RDA was lower than the control group 66.3%. The average protein fulfillment in the intervention group was 62%, the RDA was smaller than the control group by 63%. Statistically, there was no significant difference in the mean energy and the mean protein intake between the intervention group and the control group. Fulfillment needs of vitamins (A, D, B1, B2, B6, C) and minerals (iron, zinc) <50% RDA. Statistics also show no significant difference in mean vitamin intake (A, D, B1, B2, B6, C) and minerals (iron, zinc) between the intervention group and the control group (Table 1).

After the taburia fortification intervention and nutrition education for three months, there was an increase in all intakes in both the intervention group and the control group. Fulfillment of the energy and protein needs of the two groups were classified as good at > 80% RDA. fulfillment of energy and protein requirements in the intervention group 81.7%, 108% RDA higher than the control group 80.7%, 92% RDA. All children in the intervention group had a percentage of vitamin consumption (A, D, B1, B2, B6, C), minerals (iron, zinc) > RDA while in the control group was less than RDA but the average vitamin intake (A, D, B1, B2, B6, C), and minerals (iron, zinc) increase after the study (Table 1).

Percentage of sick day episodes in children

The dominant infectious disease in children in both study groups was upper respiratory tract infection. Statistically the percentage of sick day episodes in the two groups at the start of the study did not differ. After the study the percentage of sick days decreased in the intervention group 0.67% higher than the control group of 0.21%.

DISCUSSION

The purpose of the study to determine the effect of Taburia Fortification and nutrition education of mothers on the nutritional status of children aged 12-24 months in Waipare Health Centre, Sikka Regency, East Nusa Tenggara Province -Indonesia. The majority of the mothers had knowledge less about the nutrition of children and also feeding practices in children aged <2 years. This could be due to mothers not being exposed to nutritional information delivered by health workers due to their area being far from Waipare's public health center. The results of several studies indicate that nutritional education in the form of counseling can improve knowledge and practice of feeding and healthy eating habits of children so that it impacts on good child growth.[13,22]

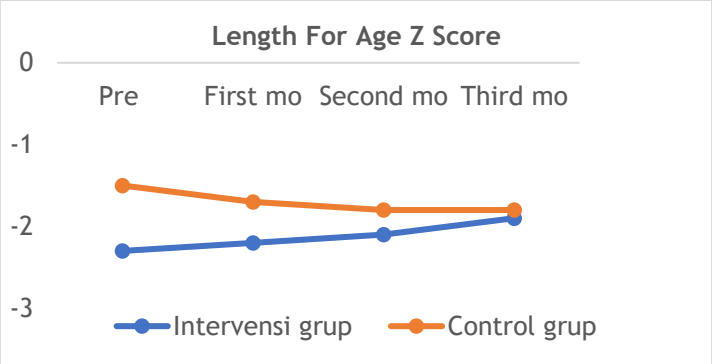

Figure 3. Trend of the LAZ Scores

The research shows that nutrition education can influence the practice of child feeding mothers in age-appropriate children. This can be known from the results of the evaluation every month. Eight indicators of child feeding according to age recommended by WHO, as many as two indicators that have the lowest value in the two study groups.[20] These indicators are the Minimum dietary diversity and the consumption of iron-rich or iron-fortified foods indicators.[21] Most children only consume two food groups such as corn and fish or rice and fish. Children are consuming less vegetables and fruit. Children usually consume iron sources from fish and never consume iron-fortified foods. This is due to

minimal family income and also livelihood as fishermen and farmers.[22] The results showed that age-appropriate infant and young child feeding affected the anthropometry indexes of WAZ, HAZ and WHZ. Various indicators of food affect increasing HAZ, WAZ scores by 0.09 and 0.06.[23] However, in this study more than 80% of mothers had carried out age-appropriate feeding practices but the effect on only WAZ was 0.43 while HAZ had no effect, even decreased by -0.26. this is due to the inadequate income of families to prepare foodstuffs.

All Mothers perceived positive effects in their children after used taburia for increasing appetite. The results of a systematic review show daily multimicronutrient supplementation gives a good effect when compared to one type of vitamin or mineral. Multimicronutrient supplementation improved longitudinal growth in children.[24] The result of subsequent studies that explain multimicronutrient supplementation increases the growth of children 6-24 months (anthropometric indexes WAZ, LAZ, and WLZ).[25] The same results of this study also when measured by dichotomous showed significant differences in the increase in WAZ, LAZ, and WLZ scores between the intervention group and the control group. The intervention group improved mean WAZ, LAZ, WLZ scores by 0.97,0.35, 0.59 higher than the control group by 0.43,-0.25, 0.55.

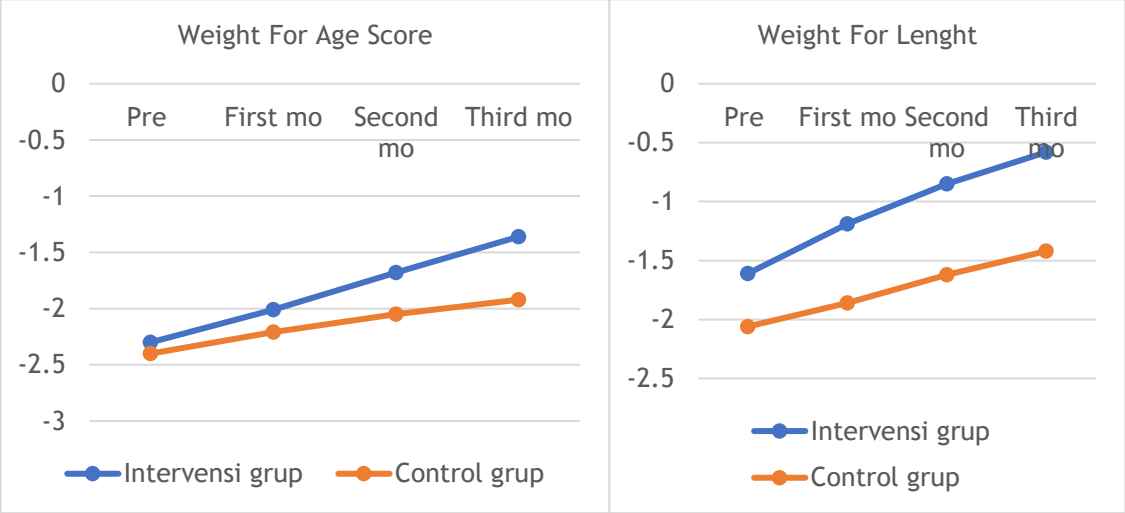

Figure 4. Trend of the WAZ and WLZ Scores

The results of this study are almost the same as the research conducted in Bhutan. Multi micronutrient (Vita-Mix-It sachet) giving every two days for 26 months can increase the HAZ score by 0.30. In addition, it also affects the increase in WAZ scores and WAZ.[26] Research conducted in Pakistan shows that multi micronutrient supplementation in children up to 24 months of age has an effect on increasing anthropometric indexes of HAZ. but not on WAZ and WHZ.[27] The results of this study and the two previous studies are different, due to the long intervention time. The possibility of many other factors that are not controlled such as macronutrient nutrient intake and environmental health and other factors.

CONCLUSION

In summary, nutrition education for mothers can improve the mother's nutritional knowledge and feeding practices that are appropriate for the child's age. The next effect on the nutritional status of children is the enhancement of the anthropometric indexes WAZ and HAZ. But has no effect on enhancement anthropometric indexes LAZ. The provision of Taburia Fortification for three months affects the nutritional status of children aged 12-24 months. Anthropometrics indexes WAZ, LAZ, and WLZ increased. Overall, there was better improvement in the nutritional status of children aged 12-24 months. Provide input to health workers in waipare health care center on nutrition education for mothers so that it can be continued after research so that nutritional problems are resolved properly. Limitations of this study are the research time is too short and infectious diseases only diarrhea and respiratory infections.

Consequently, future research considers the time of intervention and also other types of infectious diseases in children using the latest literature.

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