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Moringa Bean Cake as A Ready to Use Therapeutic (RUTF) Ingridient in Malnourished Children Aged 12-59 Months in Maluku Province: A Multicenter Project

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Abstract: Nutritional status of toddlers is a description of the nutritional status of the community that affects the low quality of human resources. Nutritional problems arise if the intake of nutrients consumed does not match nutritional needs. To analyze the effect of giving moringa bean cookies as a Ready to Use Therapeutic Food (RUTF) ingredient on weight gain in children with undernutrition aged 12-59 months in Maluku Province in 2023. This study is quasi-experimental analysis research with interrupted time series design, with population in inclusion criteria is children with malnutrition aged 12-59 months and do not have peanut allergy, the weight measured taken before and after intervention to observe the impact from RUTF. A sample of 56 children divided into treatment group and control group. Statistical analysis uses bivariate dependent t-test. Result for this study, showed that there was a significant effect of RUTF on the weight of malnourished children aged 12-59 months (p=0.000). The average weight of toddlers before the administration of RUTF (10.22 Kg) and after the administration of RUTF (11.67 Kg) with a P-value of 0.000, but there is no significant difference between intervention and control groups. Which p value is 0.25.

Keywords: Children aged 12-59 months; Moringa Nut Cookies; RUTF; Under nutrition

Introduction

Toddlers' nutritional status serves as an example of the community's nutritional status, which influences the poor caliber of human resources. When nutrient consumption falls short of nutritional requirements, nutritional issues occur (Abdullah et al., 2022). Every parent should be aware of their toddler's nutritional state since disruptions brought on by an uneven satisfaction of dietary needs may result in permanent harm.

One age group that is particularly vulnerable to nutritional issues, particularly malnutrition, is toddlers. (Budiani et al., 2020). Several community service programs have been implemented to prevent stunting, such as optimizing nutrition education for the first 1000 days of life conducted by Diva Rana Syahirah in Arjasa village, Arjasa district, by providing education to young ladies as future mothers, teaching them to promote local food wisdom, and even teaching them to sell the products (Syahirah et al., 2024). However, just like in Maluku, despite various training being conducted, the stunting rates are still increasing.

Undernutrition occurs due to food intake or the needs of macro and micro nutrients in the body are not met (Ilmayanti et al., 2020). Poor nutrition in toddlers will cause impaired growth and development of physical, mental and brain tissues that can affect the level of intelligence, decreased immunity, children can grow short or stunted and the worst is death in toddlers

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(Amalia et al., 2021). Strengthening natural resources as local food materials to prevent stunting is one of the strategies to reduce the stunting rate (Komarulzaman et al., 2023; Kristianingrum et al., 2023; Prayitno et al., 2025; Sianipar et al., 2021).

Based on the Joint Malnutrition Estimates of UNICEF-WHO Group and World Bank Group Joint Malnutrition in 2020, it shows that 6.7% or 45, million children worldwide are still malnourished, of which 13.6 million are severely malnourished (Ministry of Health of the Republic of Indonesia, 2022). This data is still a long way off of the target to be achieved, namely ending all forms of malnutrition by 2030. Indonesia is included in the countries with a high prevalence of malnourished children with a presentation of 10 to <15%. According to Riskesdas 2007 statistics, the undernutrition rate in Indonesia was 13.0% in 2007 and rose to 13.9% in 2013. The undernutrition status was 13.8% in 2018, yet there was no discernible drop, meaning that the issue remains unsolved. According to the 2021 Indonesian Nutrition Status Study (SSGI), 4.0% of Indonesia's undernourished children under five had the Weight Index by Height (W/H) measurement (Mentari et al., 2022).

The 2018 Basic Health Research (Riskesdas) found that 17.52% of children in Maluku Province between the ages of 0 and 59 months had a malnourish, based on weight-for-height (W/H) (Ministry of Health data., 2018). More recent data from the Ministry of Health and the 2025 Maluku Riskesdas indicate an increase to 19% children in Maluku had a malnourish (Ministry of health riskesdas Maluku province data., 2025). The prevalence of undernutrition which is still high must be overcome, one way that can be done is by nutritional intervention in the form of Supplementary Feeding (PMT) for every toddler who is undernourished (Kurniasih, 2020).

Supplementary feeding can be in the form of a Ready to Use Therapeutic Food (RUTF) formula based on high macronutrients can be used to improve children's nutritional status. The RUTF formula can be made into solid (flour, biscuits, candy) or semi-solid (pasta) form consisting of easily digestible ingredients such as peanuts, soybean oil, sugar, skimmed milk, and mineral mixes (Agustini et al., 2018).

Peanuts (Arachis hypogeae) are legumes that have the highest nutritional content, fat, and protein compared to other types of legumes. Peanuts have a high content of fatty acids. Fatty acids are needed for the body to metabolize and synthesize fat-soluble vitamins so that peanuts can be used as RUTF ingredients. In addition, peanuts also contain iron, vitamin E, calcium, vitamin B complex, phosphorus, vitamin A, vitamin K, lecithin, choline, and calcium (García-Montero et al., 2021; Munteanu et al., 2023; Pecoraro et al., 2024; Syahirah et al., 2024).

Because of its remarkable abundance in macronutrients and micronutrients, Moringa oleifera is commonly considered a functional food. Its exceptional nutritional value makes it a "superfood," according to the World Health Organization (WHO) (Budiani et al., 2020; Wahyuni et al., 2021). Its leaves are a rich source of vital nutrients and bioactive substances that support healthy immune system function and operate as organic antioxidants. Surprisingly, moringa offers full protein, which includes all nine essential amino acids, as well as key minerals like calcium, iron, potassium, magnesium, and zinc, and vitamins A, B-complex, C, and E. Moringa leaves provide much more nutrients than a lot of everyday foods when compared nutritionally: Triple the potassium of bananas, double the protein of yogurt, triple the vitamin C of oranges, quadruple the vitamin A of carrots, triple the calcium of four glasses of milk, and triple the iron of greens (Agustini et al., 2018; Amalia et al., 2021; Kurniasih et al., 2022).

Kurniasih et al. (2022) found that 30 malnourished children at the Cibaliung Health Center in Pandeglang Regency gained a significant amount of weight after taking Ready-to-Use Therapeutic Food (RUTF), which is made up of peanuts, soybean oil, skim milk, sugar, and a mineral mixture. The children's average weight increased from 8.87 kg prior to the intervention to 10.36 kg afterward (Wahyuni et al., 2021). Similarly, research carried out in 2018 at the Petumbuk Health Center with 26 participants showed a weight improvement in undernourished children who were given cookies fortified with moringa leaf flour, resulting in an average weight gain of 0.3 kg post-intervention (Abidin et al., 2021).

Maluku Province, according to data from the local Health Office from January to March 2023, recorded the number of toddlers 0-59 months old, which was 6,620 toddlers, with 439 undernourished toddlers (BB/U) and 543 underage toddlers or 8.2%. Maluku Province is one of the districts with a low prevalence.

One of the widely circulated moringa products is moringa nuggets and moringa pudding, as part of a community service carried out by Jannah in Selong Belanak village in 2023 (Jannah et al., 2023). Although many studies have been conducted proving that moringa and peanuts are nutritious foods, there has yet to be research with a sufficiently large sample size, specifically focused on children with malnutrition. Therefore, this research is considered important to conduct, considering that Maluku is an island province, where 2/3 of its islands are arid, and natural resources are limited. Moringa itself has a bitter taste and leaves a bitter aftertaste. Thus, it is important for us to find a recipe that tastes good and is liked by children while also providing results comparable to the government's

standard RUTF that is currently widely circulated and used to enhance the eradication of stunting in Maluku. With this foundation, the researcher initiated a study titled "Moringa Nut Cookies as Ready-to-Use Therapeutic Food (RUTF) Ingredients for Undernourished Children Aged 12–59 Months in Maluku Province : A Multicenter Project".

Method

This research employed an experimental analytical approach using a quasi-experimental analysis research with interrupted time series design. The sample determination process begins with the data collection from medical records. All children diagnosed with malnutrition in the medical records from Gorom, Tulehu, and Leimena Hospitals, in 2019-2023, are selected, and then randomization is conducted to determine the treatment group and the control group. Subsequently, the children's weight and height are re-measured at the beginning. The sample is then given standard supplementary food in the control group, while the treatment group is provided with RUTF containing moringa and peanuts. The samples are then monitored, and weight gain is measured weekly. Compliance with feeding is monitored daily through WhatsApp groups, where each sample is required to send a photo of the child eating. A total of 56 participants were included and divided into two groups: treatment and control. The data were analyzed using bivariate dependent t-test, with assistance from SPSS version 25 for statistical processing.

The study utilized the WHO Growth Standards for weight-for-length/height (W/H) as reference materials for evaluating the nutritional status of children aged 0–2 years and 2–5 years, for both boys and girls. These standards were sourced directly from the official World Health Organization (WHO) website and are grounded in the 2006 WHO guidelines (World Health Organization, 2006). Nutritional classification was determined by applying the W/H index in alignment with WHO's recommended assessment criteria.

There were two types of supplemental feeding used in this study. Commercially made Marie Regal biscuits, produced by PT Khong Guan Biscuit Factory Indonesia Ltd., Jakarta, were distributed to participants in the control group (Standart RUTF, using in Maluku). On the other hand, a manually prepared form of Ready-to-Use Therapeutic Food (RUTF) which made from moringa leaves and nut. was given to the intervention group. To create the DIY supplement, the RUTF's contents were combined in a hygienic manner after being purchased from approved local suppliers.

Result and Discussion

Characteristics of Respondents by Age and Gender. In this study, we found majority age in 25-59 months which is 66.7% from 56 samples. Where the majority gender is woman in 55.4%. The different between woman and man is not very significant, because there is just 6 people between them.

Table 1. Characteristics of Respondents by Age and Gender

Characteristics Respondent	Frequency (n=56)	Percentage
Child Age		
12-24 months	22	39.3%
25-59 months	34	60.7%
Gender		
Woman	31	55.4%
Man	25	44.6%

Characteristic of responden based on weight Increament. In this study we found RUTF Moringa mix nuts is increased of weight is more than 400 gr in 28 sample, same with the sample which using instant biscuits.

Table 2. Characteristics of Respondents based on Weight Increa

Weight gain	Frequency (n=56)	Percentage
RUTF Nut Cookies Moringa	28	100%
< 200 gr	4	14.3%
200-400 gr	8	28.6%
> 400 gr	16	57.1%
Instant Biscuits	28	100%
< 200 gr	5	17.9%
200-400 gr	9	32.1%
> 400 gr	14	50.0%

Weight difference before and after the intervention of RUTF compare with Instant biscuit were also obtained for the treatment and controls group with instant biscuits that the probability of obtaining (p) is 0.000 so that a probability value (p) 0.000 < 0.05 is obtained, meaning that there is a significant effect of RUTF and instant biscuit administration on the weight of malnourished children aged 12-59 months after the intervention.

Table 3. Weight Difference before and after the Intervention of RUTF and Instant Biscuits

Gift	Weigth Change	Frequency (n)	p-value
RUTF	Before intervention	28	0.000*
	After intervention	28	0.000*
Instant	Before intervention	28	0.000*
Biscuits	After intervention	28	0.000*

The assessment of the difference in weight gain between the two groups of research samples given RUTF and the group given instant biscuits can be illustrated in table 4, that after the intervention, the average weight gain of the moringa bean cookie group was 1.45 Kg and the instant biscuit group was 1.08 Kg, the results of the statistical test A p-value of 0.25 >0.05 showed that there was no difference in weight gain between the two sample groups.

Table 4. Differences in Weight Gain after Intervention in Maluku Province

Weight gain	Frequency (n)	p-value
Moringa Nut Cookies	28	0.25*
Instant Biscuits	28	

Respondent's Weight Before and After the Intervention

This study showed that there was a significant change in the weight of children with undernutrition before and after the administration of RUTF of moringa bean cookies (treatment) and instant biscuits (control) with the same p-value of p=0.000 ($p < 0.05$), which indicates that the RUTF of moringa bean cookies and instant biscuits can increase the weight of children with undernutrition aged 12-59 months in Maluku Province.

Giving moringa bean cookies as a RUTF can increase the weight of children with malnutrition aged 12-59 months because the moringa bean cookie RUTF is a high-calorie food made from a mixture of ingredients that are easily digested by children, such as peanuts, cooking oil made from palm oil, sugar, wheat flour, skimmed milk, milo powder and mineral mix which is replaced with the addition of moringa leaf flour. This instant contains carbohydrates, protein, calcium, fiber, vitamins A, B1, and D in each piece.

According to the researcher, another factor that also affects the weight result in the administration of RUTF, moringa bean cookies and instant biscuits is the diet or diet of the child which can result in an increase in the child's weight. However, in this study, no dietary food recall was carried out, so the researcher did not know the number of calories consumed by children who were given additional food in the form of instant biscuits.

Weight Gain before and after the Intervention

This study showed that there was no significant difference in children's weight gain between the treatment group that was given RUTF, moringa bean cookies and the control group that was given instant biscuits. This study compared the administration of moringa bean cookie RUTF (treatment) with instant biscuits (control) to obtain children's weight gain but there was no significant difference in children's weight gain between the two groups. This can occur due to several factors such as the time for providing treatment and monitoring to children is not long, the child's health condition is not long cannot be controlled and other factors are parenting, food intake, and environmental health. Therefore, the consumption of RUTF, moringa bean cookies and instant biscuits can both be used as an alternative food supplement to meet nutritional needs and increase weight in malnourished children aged 12-59 months.

Conclusion

There was no significant difference in weight gain between the RUTF groups, moringa bean cookies, and instant biscuits in malnourished children aged 12-59 months in Maluku Province, according to the findings of the study carried out in the Bula, Gorom, Tulehu, and Ambon City Health Centers' Working Area. The analysis using the paired t-test and independent t-test revealed that there was an effect of giving moringa bean cookies and instant biscuits on weight gain in children with undernutrition aged 12 to 59 months.

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Author Contributions

Conceptualization, SRW and AP; methodology, and CHT; validation, PU and RMK; formal analysis, MR, and PU; investigation, SRW and AP; resources, SRW and AP; data curation, AP and SRW: writing-original draft preparation, SRW; writing-review and editing, SRW and RMK; visualization, SRW and AP. All authors have read and approved the published version of the manuscript.

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Conflicts of Interest

The authors declare that there is no conflict of interest in this article. The funder Medical Faculty of Pattimura University had no role in the research design, collection, analysis, interpretation of data, or writing of the publication from the beginning to the completion of this study.

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