

## ORIGINAL ARTICLE

# Improvement of Toddler Weight With Giving of Moringa Leaf Extract Biscuit (*Moringa oleifera*)

\*Rinawati Sembiring<sup>1</sup>, Santhana Letchmi Panduragan<sup>2</sup>, Satheesh Babu Natarajan<sup>2</sup>, Ruma Poddar<sup>3</sup>, Agnes Purba<sup>1</sup>, Henny Syapitri<sup>1</sup>, Elsarika Damanik<sup>1</sup>, Taruli Rohana Sinaga<sup>1</sup>

<sup>1</sup> Faculty of Pharmacy & Health Sciences, Sari Mutiara Indonesia University, Jalan Kapten Muslim No.79, 20123, Helvetia, Medan, Sumatera Utara, Indonesia

<sup>2</sup> Lincoln University College, 2, Jalan Stadium SS 7/15, 47301 Petaling Jaya, Selangor, Malaysia

<sup>3</sup> Lincoln University College, Wisma Lincoln, 12-18, Jalan SS 6/12, 47301 Petaling Jaya, Selangor, Malaysia

## ABSTRACT

**Introduction:** Weight is an indicator of the nutritional status of toddlers; it shows if they have poor nutrition, undernutrition, good nutrition, or overnutrition. One of the interventions carried out to solve the malnutrition problem is the provision of supplementary foods with various innovations, such as fortified biscuits with the extract of Moringa leaves (*Moringa oleifera*). This study aims to determine the effect of supplemental moringa biscuits on improving the nutritional status of toddler's nutritional as seen from the increase in toddler weight. **Methods:** This quasi-experimental study uses a pre- and post- test design approach. The number of respondents in this study was 113 toddlers. The research was carried out in the work area of the Hinai Kiri Health Centre Integrated Service Unit, Langkat Regency, North Sumatra Province. **Results:** This shows that there is a significant difference in the weight of the toddler between the first measurement (before the intervention) and the second measurement (a month after the intervention). In the third measurement (2 months after the intervention) there was an increase in the average toddler's weight, namely 1.18 kg with a p-value = 0.005 which indicated a significant difference between the toddler's weight with the first measurement and the third measurement (2 months after the biscuit intervention). **Conclusion:** *Moringa oleifera* contains multivitamins that are effective in improving the nutritional status of malnourished toddlers. It is suggested that Moringa leaf extract can be used as a supplement to toddlers diets which can be processed according to toddlers' tastes.

Malaysian Journal of Medicine and Health Sciences (2023) 19(SUPP9): 140-145. doi:10.47836/mjmhs.19.s9.21

**Keywords:** Weight, Biscuits; *Moringa oleifera*; Toddlers

## Corresponding Author:

Rinawati Sembiring,  
Email: rinawatipandiaz@yahoo.com  
Tel: +62 822-9137-5002

## INTRODUCTION

Malnutrition in children occurs when a child's nutritional intake does not match their needs. Toddlers are vulnerable to malnutrition. Children with malnutrition in the long term will have a tendency to experience growth and development disorders, which impact their health conditions. Generally, children who suffer from growth disorders are smaller than their peers. In addition, malnutrition can also affect children's cognitive development. Their cognitive development may be slower or their IQ level may be lower than that of normal children. Children with malnutrition are estimated to be more at risk of losing 10-13 IQ points (1).

Regulation of the Minister of Health Number 2 of 2020 concerning Children's Anthropometric Standards, regulates the anthropometric standards used to measure or assess children's nutritional status. The anthropometric standards used by the Nutrition Surveillance Program consist of indexes for body weight for age, length/height for age, and weight for length/height. WHO classifies the assessment of nutritional status based on the Anthropometric Index according to the category of nutritional status in the Growth Standards for children aged 0-5 years (2).

When it comes to malnutrition, the government pays close attention to thin children, but not as much as they do to children who are too short for their age. So malnutrition is still a nutritional problem that needs special attention from all parties in Indonesia. Several previous studies have found that being underweight in toddlers can be caused by various factors, including the mother's education, the history of the disease,

environmental health, and family expenses in one month (3,4).

Data obtained from Basic Health Research (2018) shows that the proportion of cases of malnutrition in toddlers in Indonesia is 17.7% with the highest prevalence rate was in East Nusa Tenggara Province, which is 29.5% (5). Meanwhile, the 2019 North Sumatra Province Health Profile shows a prevalence of malnutrition of around 0.32%, up from 1.66% in 2018 to 1.98% in 2019 (6).

However, the decrease in prevalence occurred in underweight toddlers, in 2018, the percentage of children under five was 2.33%, dropping to 2.13% in 2019 (a decrease of around 1.1%). Even though the prevalence of malnutrition and wasting in North Sumatra is relatively low, this problem remains serious and requires careful handling. This is serious because toddlers with undernourished conditions will fall into a worse nutritional status and can even cause death (7).

One thing that has been done to reduce the number of toddlers who aren't getting enough food is to give them extra food (8). Giving supplemental food can be modified with various innovations according to the tastes of toddlers, for example, by giving biscuits made from flour and Moringa leaf extract (*Moringa oleifera*). This study aimed to determine the benefits of giving *Moringa oleifera* (*Moringa* leaf) extract biscuits for increasing toddler weight.

Moringa leaves are a food that is widely known to be consumed as an alternative food and is believed to provide many benefits. Moringa leaves (*Moringa oleifera*) are a food ingredient that is rich in macro- and micronutrients. The high nutritional value of Moringa leaves can be utilized to meet the nutritional needs of toddlers during their growth period. Many studies have shown that Moringa leaves (*Moringa oleifera*) contain more nutrients than other food ingredients, namely vitamin C is 7 times higher than vitamin C in oranges, vitamin A is 4 times higher than vitamin A found in carrots, the calcium content is equivalent to 4 cups of calcium in milk, the iron content is 3 times more than the iron found in spinach, the potassium content is 3 times that of bananas, and the protein is 2 times higher than in yoghurt (9).

## MATERIALS AND METHODS

This type of research is quasi-experimental with a pre- and post-test design approach. The intervention was in the form of giving Moringa leaf biscuits (*Moringa oleifera*) to a sample of 113 toddlers who were experiencing malnutrition, covering all genders, were not suffering from serious or chronic illnesses, and

had received consent from their parents to be respondents in the study.

The effectiveness of Moringa leaf biscuits was measured by comparing the respondent's body weight before and after receiving the biscuits. The implementation of this research was carried out in the work area of the Hinai Kiri Health Centre Integrated Service Unit, Langkat Regency, North Sumatera Province.

Prior to the supplementation of the Moringa leaf biscuits, proximate tests and material tests were carried out in the laboratory of the Centre for Industrial Research and Standardization in Medan which resulted in the biscuit content consisting of 400 mg of Moringa leaf powder in each 30-gram biscuit, which contains 33.6% carbohydrates, 2.12% fat, 30.2% protein, and 25.7% crude fibre. The intervention was carried out on toddlers for one month (each toddler received a total of 30 pieces of Moringa leaf biscuits; one chip was consumed daily for one month) and for two months after the intervention (each toddler received a total of 60 pieces of Moringa leaf biscuits; one piece was consumed every day for two months).

Provision of Moringa leaf biscuits and monitoring were assisted by midwives and health workers to ensure that each respondent regularly consumed Moringa leaf biscuits. After one month of intervention and two months of intervention, the toddler's weight was measured again. The researcher collected the data, which was then analyzed using univariate and bivariate tests using paired t-tests.

## Ethical Approval

This research has obtained the feasibility of research ethics testing from the Ethics Committee of Sari Mutiara Indonesia University to ensure that this research does not conflict with human values and norms with Ethical Test Certificate No. 395/F/KEP/USM/VII/2022.

## RESULTS

### Characteristics Data of Toddler Respondents

According to the data in Table I, it shown that the majority of toddlers are female 67 (59.30%), and the majority of toddlers aged 3 – < 4 years (36.3%). From the parents' occupations, the majority of parents of toddlers work as farmers and employees (43.4%). Respectively is IDR 1,000,000 to < IDR 2,000,000 per month with a total of 97 people (85.8%).

### The Differences in Average Toddler Weight in Measurement I (before intervention with Measurement II (after one month of intervention)

Table II shows that the average toddler weight in the first measurement (before being given Moringa

**Table I : Characteristics Data of Toddler Respondents**

No.	Characteristics	n	%
1.	<b>Gender</b>		
	Male	46	40.70
	Female	67	59.30
	<b>Total</b>	<b>113</b>	<b>100.0</b>
2.	<b>Age</b>		
	1 - < 2 years	19	16.8
	2 - < 3 years	26	23.0
	3 - < 4 years	41	36.3
	4 - < 5 years	27	23.9
	<b>Total</b>	<b>113</b>	<b>100.0</b>
3.	<b>Parental Occupation</b>		
	Farmer	49	43.4
	Fisherman	10	8.8
	Employee	49	43.4
	Self-Employed	5	4.4
	<b>Total</b>	<b>113</b>	<b>100.0</b>
4.	<b>Parents Income Per Month (IDR)</b>		
	< 1 million	2	1.8
	1 - < 2 million	97	85.8
	2 - < 3 million	9	8.0
	3 - 4 million	5	4.4
	<b>Total</b>	<b>113</b>	<b>100.0</b>

**Table II : Distribution of Average Toddler Weight in Measurement I (before intervention) With Measurement II (after one month of intervention)**

Variable	Mean	SD	SE	P value
Weight				
Before Intervention	9.41	1.68	0.15	0.005
One Month After The Intervention	9.73	1.74	0.16	

biscuits) was 9.41 kg and the standard deviation was 1.68. In the second measurement, carried out after one month of intervention by giving moringa biscuits, an average body weight of 9.73 kg and a standard deviation of 1.74. Thus, the difference in the average value between measurements before the intervention of giving moringa biscuits and after one month's intervention was 0.32 with a standard deviation of

0.34, the result of the statistical test p-value = 0.005. Thus it was concluded that there was a significant difference in under-five weight before the intervention and after one month's intervention.

**Table III : Distribution of Average Toddler Weight in Measurement I (Before Intervention) With Measurement III (Two Month after the Intervention)**

Variable	Mean	SD	SE	p- value
Weight				
1st measurement	9.41	1.68	0.15	0.005
2nd measurement	10.59	1.85	0.17	

**Differences in Average Toddler Weight in Measurement I (Before Intervention With Measurement III (Two Month After The Intervention)**

Based on Table III, the average toddler weight in the first measurement (before being given Moringa biscuits) was 9.41 kg and the standard deviation was 1.68. Whereas in the third measurement (after two months of intervention) an average of 10.59 kg and a standard deviation of 1.85 were obtained. This shows that there is a difference in the average value between measurements before the intervention and after two months of intervention, which is 1.18 kg and a standard deviation of 1.02, the statistical test results obtained p-value = 0.005. Thus, it was concluded that there was a significant difference between the toddler's weight before the intervention and two months after the intervention/gifting moringa biscuits).

**DISCUSSION**

Toddlers aged 0-59 months are in a period of very rapid growth and development. Toddlers are also a group that is vulnerable to nutrition; they are prone to experiencing nutritional disorders because toddlers often experience problems meeting nutritional needs for various reasons (10). Food consumption has a very important role in the growth process and supports children's intelligence (1).

Several interventions have been carried out to reduce the incidence of malnutrition in toddlers one of which is by providing supplementary food. Children are usually more receptive to sweet and attention-grabbing foods, such as candy and other sweet treats, nuggets, biscuits, bread, and chips. Fortified food with Moringa leaf extract in the form of biscuits is very good to serve as an alternative food with a high nutritional content that the body needs, especially for toddlers, to support their growth and development (11).

Moringa leaves (*M. oleifera*) are a food ingredient that is rich in macro- and micronutrients. The high nutritional value of Moringa leaves can be utilized to meet the nutritional needs of toddlers during their growth period (12). Based on various research results, it was found that *Moringa oleifera* contains multivitamins such as vitamins A, B, and C, as well as calcium, potassium, iron, and protein, in higher amounts, compared to other food sources. On top of that, *Moringa oleifera* is easy to digest. The *Moringa oleifera* also contains various macro and micronutrients as well as antioxidants. In addition, Moringa seeds are also good for use as the main ingredient for medicinal purposes (13).

One of the indicators used to assess the growth of toddlers is their age and weight. If the toddler's weight matches his age, his nutritional status is declared good or normal. With a good or normal toddler's nutritional status the growth process and development of toddlers can also run optimally, the immune system will be good so the health status of toddlers, in general will also be good. However, if underweight, toddlers can be at risk of experiencing infectious diseases such as influenza and other infections. Thus, toddlers with normal weight can make their immune systems better than toddlers with malnutrition (14,15).

Body weight is one of the indicators that describe body mass. When body mass changes, it's very sensitive to body mass. For example: if you are experiencing an infection, it can reduce your appetite resulting in a decrease in the amount of nutrient intake consumed. However, if the body is in a normal state, and there are no health problems or disorders, the appetite, will also remain good so that a balance is obtained between the intake of nutrients consumed and the nutritional needs properly met, and body weight will also be maintained according to age (16). On the other hand, in abnormal circumstances, there are 2 possibilities for weight development, namely that it can develop faster or more than normal. If nutritional intake is less than the child's needs, there will be a risk of malnutrition (17).

Changes in body weight are an important indicator when monitoring the growth of children. If the child's weight gain is lower than it should be, then the child's growth can be disrupted, and the child will be at risk of experiencing undernourishment, and vice versa if the weight is heavier than it should be for the child's age, which should indicate the child is experiencing obesity (18).

This is also regulated in the provisions of the WHO anthropometric standard of 2005 which states that undernutrition or malnutrition is a state of nutritional status that is assessed based on a body weight index based on age, which is generally referred to as underweight or very thin (19). The threshold for a

child's nutritional status based on the body weight/age index for children aged 0-60 months includes malnutrition if  $< -3SD$ , malnutrition if  $-3 SD$  to  $< -2SD$ , adequate nutrition if they are at  $-2 SD$  to  $2 SD$  and over nutrition if it is at  $> 2 SD$ . A child's growth status can be determined in two ways, assessing the growth line or by calculating the child's body weight gain compared to the minimum child's weight gain.

In this study, toddler weight was measured using digital scales. The toddler's weight measured in (Measurement I) before the intervention was an average of 9.41 kg and the toddler's weight measured in (Measurement II) one month after being given the Moringa leaf extract biscuit intervention was an average of 9.73 kg, the weight measured in (Measurement III) two months after being given the Moringa leaf extract biscuit intervention was an average of 10.59 kg. This indicates that there is an increase in the body weight of the toddler respondents. The toddler's weight showed an increase from the first measurement (before the intervention) to the second measurement (one month after the moringa biscuit intervention) of 0.32 kg and the toddler's weight increase from the first measurement (before the intervention) to the third measurement (two months after being given the extract moringa biscuits) is 1.18 kg.

Based on the results of statistical tests with the Dependent T-Test where in the Measurement I (before the intervention) and Measurement II (one month after the intervention with Moringa biscuits) the results obtained were  $p\text{-value} = 0.005$ , so it can be concluded that there is a significant difference between toddler weight at Measurement I (before the intervention) with the Measurement II (after a month of intervention with the consumption of 1 moringa biscuit per day with a total of 30 biscuits consumed) while the results of the Dependent T-Test on the Measurement I (before the intervention) and the Measurement III (two months after intervention with consuming 1 moringa per day with a total of 60 moringa biscuits consumed) obtained  $p\text{-value} = 0.005$ , it can be concluded that there is a significant difference between toddler weight in the first measurement (before intervention) and the third measurement (after two month of intervention by consuming 1 moringa per day with a total consumption of 60 moringa biscuits).

This increase in body weight reflects the effect of giving biscuit supplementary food containing moringa leaf extract (*Moringa oleifera*) which has an impact on toddlers' weight gain caused by various nutritional contents, such as good protein, iron, vitamin A, and calcium, and stimulates immune cells. These elements synergize so that they are able to optimally increase the absorption of nutrients by the body,

and intestines, and ultimately be able to increase the weight of undernourished toddlers (20). Freshly picked Moringa leaves have a nutritional content of 100 grams which is equivalent to 8 grams of dried Moringa leaves which are effective in increasing the weight of children under five years who experience Caloric Energy Deficiency and malnutrition (21).

This research is in line with the results of research conducted by Riska Mayangsari et al, in 2020 which found that there was a significant effect of giving 6 biscuits equivalent to 100 grams per day to improve nutritional status in toddlers who were experiencing malnutrition (22). The results of Yulia Fitri et al, 2020's research are also in line with this study which says that providing biscuits (dry snacks) with the addition of 100 mg of Moringa leaf powder per day for 3 weeks significantly increases toddler's weight (p-value = 0.000) (20).

## CONCLUSION

Moringa leaves are effective in improving the nutritional status of malnourished toddlers. As a result, Moringa leaves can be used as a Supplemental Meal Programme in toddlers that can be processed according to the toddlers' preferences.

## ACKNOWLEDGMENT

The authors would like to express their deepest gratitude to Sari Mutiara Indonesia University, which has supported them morally and materially.

## REFERENCES

1. Amirullah A, Putra AT, Al Kahar AA. Deskripsi status gizi anak usia 3 sampai 5 tahun pada masa Covid-19. *Murhum: jurnal pendidikan anak usia dini*. 2020 Jul 9;1(1):16-27. <https://doi.org/10.37985/murhum.v1i1.3>
2. Kemenkes RI. Peraturan Menteri Kesehatan tentang Standar Antropometri Anak. Kementerian Kesehatan RI. 2020.
3. Agustina SA, Rahmadhena MP. Analisis determinan masalah gizi balita. *Jurnal Kesehatan*. 2020 Mar 1;11(1):008-14. <https://doi.org/10.35730/jk.v11i1.685>
4. Flynn J, Alkaff FF, Sukmajaya WP, Salamah S. Comparison of WHO growth standard and national Indonesian growth reference in determining prevalence and determinants of stunting and underweight in children under five: a cross-sectional study from Musi sub-district. *F1000Research*. 2020 Jun 17;9:324. <https://doi.org/10.12688/f1000research.23156.2>
5. Badan Penelitian dan Pengembangan Kementerian Kesehatan Republik Indonesia. (2018). Hasil Utama RISKESDAS 2018. Jakarta: Kemenkes RI.
6. Dinas Kesehatan Provinsi Sumatera Utara. (2019). Profil Kesehatan Provinsi Sumatera Utara Tahun 2019. Medan: Dinas Kesehatan Provinsi Sumatera Utara
7. Irawan IR, Sudikno S, Julianti ED, Nurhidayati N, Rachmawati R, Sari YD, Herianti H. Faktor Risiko Underweight Pada Balita Di Perkotaan Dan Perdesaan Indonesia [Analisis Data Studi Status Gizi Balita Indonesia 2019]. *Penelitian Gizi dan Makanan (The Journal of Nutrition and Food Research)*. 2022 Oct 15;45(1):47-58. <https://doi.org/10.22435/pgm.v45i1.6041>
8. Efendi AP, Safitri SA, Putra OI, Geofani C, Santoso FW, Septianingrum NM. Prevention of stunting in children by making processed products from traditional plants. *Community Empowerment*. 2022 Jan 30;7(1):54-60. <https://doi.org/10.31603/ce.5630>
9. Indriani L, Zaddana C, Nurdin NM, Sitinjak JS. Pengaruh pemberian edukasi gizi dan kapsul serbuk daun kelor (*Moringa oleifera* L.) terhadap kenaikan kadar hemoglobin remaja putri di universitas pakuan. *MPI (Media Pharmaceutica Indonesiana)*. 2019 Dec 19;2(4):200-7. <https://doi.org/10.24123/mpi.v2i4.2109>
10. Munifa M. Gizi seimbang balita dan stunting dengan media audio visual terhadap peningkatan pengetahuan ibu balita di TPA Kota Palangka Raya. 2021
11. Has DF, Ariestiningsih ES. The effectiveness of BIMA-X (biscuits and *Moringa oleifera* leaf Extract) to handling children with malnutrition. *International Conference on Community Development (ICCD 2020)* 2020 Oct 20 (pp. 191-195). Atlantis Press. <https://doi.org/10.2991/assehr.k.201017.043>
12. Gita RS, Danuji S. Studi pembuatan biskuit fungsional dengan substitusi tepung ikan gabus dan tepung daun kelor. *BIOEDUSAINS: Jurnal Pendidikan Biologi dan Sains*. 2018 Dec 26;1(2):155-62. <https://doi.org/10.31539/bioedusains.v1i2.323>
13. Mustapa Y, Hadju V, Indriasari R, Hidayanti H, Sirajuddin S, Russeng SS. The effect of *Moringa oleifera* to hemoglobin levels of preconception women in the health center tibawa district tibawa, gorontalo. *Open Access Macedonian Journal of Medical Sciences*. 2020 Sep 15;8(T2):104-8. <https://doi.org/10.3889/oamjms.2020.5201>
14. Clement A, Olatunde M, Patrick O, Joyce O. Effect of drying temperature on nutritional content of *Moringa oleifera* leave. *World Journal of Food Science and Technology*. 2017 Sep 11;1(3):93-6. <https://doi.org/10.11648/j.wjfst.20170103.11>
15. Muliawati D. Pemanfaatan Ekstrak Daun Kelor (*Moringa oleifera*) Dalam Meningkatkan Berat Badan Balita. *Jurnal Kesehatan Madani Medika* 2020 Jun 11 (1):44-53 <https://doi.org/10.36569/jmm.v11i1.98>

16. Gantini T, Putranto K, Muftiah S. Evaluasi Pencegahan dan Penanggulangan Gizi Buruk Melalui PMT-P Balita di Desa Cikanyere Kabupaten Cianjur. *AGRITEKH (Jurnal Agribisnis dan Teknologi Pangan)*. 2022 Aug 31;3(1):51-6. <https://doi.org/10.32627>
17. Dhanny DR, Sefriantina S. Hubungan Asupan Energi, Asupan Protein dan Status Gizi terhadap Kejadian Tuberkulosis pada Anak. *Muhammadiyah Journal of Nutrition and Food Science (MJNF)*. 2022 Feb 18;2(2):58-68. <https://doi.org/10.24853/mjnf.2.2.58-68>
18. Septikasari M. Status gizi anak dan faktor yang mempengaruhi. Uny Press; 2018 Apr 2.
19. De Onis M, Onyango AW. WHO child growth standards. *The Lancet*. 2008 Jan 19;371(9608):204.
20. Fitri Y, Santy P. Effect of Providing Moringa Snacks on Underweight Toddler. *Science Midwifery*. 2022 Dec 15;10(5):4178-81. <https://doi.org/10.35335/midwifery.v10i5.965>
21. Fathnur A. Efektivitas Puding Kelor (Moringa oleifera) Terhadap Perubahan Berat Badan Balita Kurang Gizi: The Effectiveness of The Kelor (Moringa oleifera) Pudding On Changes In Weight Of The Nutrition. *Jurnal Agrisistem*. 2018;14(2):134-40.
22. Mayangsari R, Rasmiati K. Effect of supplementation of F100 biscuits modified with Moringa oleifera flour substitution on nutritional status of under-five children with malnutrition in Kendari City Indonesia. *Public Health of Indonesia*. 2020 Mar 18;6(1):28-34. <http://dx.doi.org/10.36685/phi.v6i1.318>