

The Effect of Snakehead Fish and Potato Starch Biscuits on The Weight of Wasting Toddlers in Makrayu Health Center, Palembang

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Article Info

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Submitted: 27-08-2025

Accepted: 24-11-2025

Published: 01-12-2025

Citation:

Saffa, K. A., Nilawati, N. S., & Sadiq, A. (2025). The Effect of Snakehead Fish and Potato Starch Biscuits on The Weight of Wasting Toddlers in Makrayu Health Center, Palembang. *Media Gizi Kesmas*, 14(2), 271-277. <https://doi.org/10.20473/mgk.v14i2.2025.271-277>

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ABSTRACT

Background: Wasting is a manifestation of chronic malnutrition, with low weight for height. The city of Palembang, especially the operational area of Makrayu Health Center, recorded second-highest prevalence of wasting in Palembang by 54 out of 4.396 toddlers experiencing wasting (1.22%). Local nutrition intervention, such as local food-based supplementary feeding, becomes a focal strategy to solve this problem.

Objectives: The effect of biscuits made of snakehead fish and potato flour on the body weight in wasted toddlers was measured.

Methods: This research is a quasi-experimental study with a one-group pretest-posttest design without a control group. The sample consisted of 33 toddlers aged 12-59 months who were wasting in the Makrayu Palembang Health Center work area. The intervention, in the form of providing snakehead fish biscuits and potato starch, was carried out for 14 days. Data were collected through body weight measurements before and after the intervention and assessment of nutrient intake using the 24-hour recall method. Data were analyzed using a dependent t-test.

Results: Giving snakehead fish biscuits and potato starch showed a significant increase in body weight in wasting toddlers after the intervention, with an average increase of 0.32 kg. In addition, there was an increase in energy, protein, fat, and carbohydrate intake, which supported the improvement of nutritional status.

Conclusion: There is an effect of giving snakehead fish biscuits and potato starch on the weight gain of wasting toddlers in the Makrayu Palembang Health Center work area ($p=0.000$).

Keywords: Biscuits, Malnutrition, Potato Starch, Snakehead Fish, Supplementary Food, Wasting Toddlers

INTRODUCTION

Children who experience wasting are at risk of delayed growth and development, reduced immune system function, increased vulnerability to and severity of infectious diseases, and a heightened risk of death, especially for children with severe wasting (United Nations Children's Fund, World Health Organization, and World Bank Group, 2018). The 2023 Indonesian Health Survey reported that the prevalence of wasting in Indonesia was 6.4% among children under five. Meanwhile, the city of Palembang had a prevalence of wasting children as high as 11.5%. According to a report from the Palembang City Health Office, in 2024, the Makrayu

Community Health Center catchment area had the second-highest prevalence of wasting children among all Community Health Centers in Palembang, with 54 out of 4,396 children under five experiencing wasting based on the weight for height index. The frequency of wasting children younger than five at Makrayu Community Health Center is 1.22%. Detecting wasted toddlers as early as possible is very important so that intervention can be provided more quickly. One measurement method that can be applied independently to identify wasted children (UNICEF, 2022) is to measure the z-score of weight according to height or length. Comparing a toddler's weight to their height is one way to

determine whether they are wasting away. If the weight of an infant is lower than their height or length, it is a sign that the child is experiencing energy deficiency and is suffering from wasting. Based on the study conducted by (Syarfaini *et al.*, 2022), there is a significant association between energy, protein, fat, and carbohydrate intake and the incidence of wasting among children under five. One of the factors that may contribute to wasting in children, thereby affecting their growth and development, is energy consumption. Children with inadequate carbohydrate intake have a 7.12 times higher risk of experiencing wasting. Protein is required for recovery and for the synthesis of body tissues that are impaired due to organ dysfunction; therefore, protein intake is significantly associated with the incidence of wasting among children under five. Ensuring adequate nutrient intake can serve as a preventive measure against wasting in children. In addition, providing supplementary feeding interventions is also one of the strategies to address the issue of wasting in children under five.

Wasting causes children to explore their environment less, cry frequently, have less interaction with other children, lack cheerfulness, and tend to be more apathetic (Soliman *et al.*, 2021). The growth and development of toddlers has a significant impact on their later lives. When children experience unidentified and untreated growth and development issues or failures, they will not achieve their maximum growth potential. This will have an impact on the quality of the future generation of the nation. Wasting children are also more susceptible to infectious diseases. There is a significant relationship between a history of illness and the occurrence of wasting in children aged 1–5 years, as well as behavioral disorders, cognitive impairment, and an increased risk of death (Siregar *et al.*, 2022). The Ministry of Health of the Republic of Indonesia has established comprehensive policies to address child malnutrition. These policies include prevention, promotion, and mitigation of child malnutrition. Prevention efforts are carried out through growth monitoring at *Posyandu* (integrated community health posts), and malnourished children are assisted through the provision of supplementary therapeutic feeding programs. This program helps children aged 6 to 59 months recover from malnutrition by providing food with adequate nutrition to meet their dietary needs (Anugrahini *et al.*, 2021).

Locally sourced foods, which are easy to access, are used as raw materials for supplementary therapeutic food preparation. Snakehead fish is an ideal high-protein source for supplementary therapeutic food for wasting children because it contains a high amount of protein. In addition to high-protein foods, high-energy foods also need to be included in supplementary foods to intervene in cases of wasting. One food ingredient high in energy

is potato flour. According to the Indonesian Food Composition Table 2020, snakehead fish contains 80 kcal of energy, 16.2 g of protein, 0.5 g of fat, 2.6 g of carbohydrate, and 170 mg of calcium. Based on the Indonesian Food Composition Table, 100 grams of potato flour contains 347 kcal of energy, 0.3 g of protein, 0.1 g of fat, 85.6 g of carbohydrate, and 20 mg of calcium. Based on the collected data, the author aims to study the effect of biscuits made from snakehead fish and potato flour on the weight changes of wasting children found in the working area of Makrayu Community Health Center, Palembang. In addition, snakehead fish and potato flour are sources of energy and protein that are easily accessible to all sectors of the community.

METHODS

This study used a quasi-experimental research design with a one-group pretest-posttest design without a control. The intervention was carried out on respondents without a comparison group. The target population of this study was wasting toddlers at the Community Health Center, Makrayu, Subdistrict West Ilir II, Palembang. The subjects included in this study were wasting toddlers at the Community Health Center Makrayu aged 12–59 months, with a weight/height z-score of -3 SD to <-2 SD. The sample size was determined using the Isaac and Michael formula (Sugiyono, 2013). The minimum sample size required in this study was 30.2, or rounded up to 30 samples with a 10% reserve, resulting in a total of 33 samples selected using the simple random sampling method. Respondents were selected using simple random sampling, meaning that all elements in the population had an equal chance of being selected as respondents. The respondents were selected by drawing lots from a list of 54 toddlers who were available, namely toddlers with a z-score of BB/TB -3 SD to <-2 SD at the Makrayu Palembang Health Center, resulting in 33 respondents. Respondent data was collected in January 2025.

The intervention treatment was in the form of giving snakehead fish biscuits and potato flour to respondents for 14 days. The study was conducted over a 14-day intervention period, referring to the methodological framework of (Wulandari *et al.*, 2022), who evaluated the administration of Ready to Use Therapeutic Food (RUTF) formulated from catfish flour and mung beans in toddlers with wasting. Their study demonstrated that a 14-day intervention resulted in a mean weight gain of 0.35 kg among participants. Toddlers aged 12–23 months were given 4 biscuits per day, and toddlers aged 24–59 months were given 6 biscuits per day as needed. Each snakehead fish and potato flour biscuit weighs 15 grams and contains 4 grams of snakehead fish. Accordingly, toddlers aged 12–23 months are provided with a total of 16 grams of snakehead fish

per day, while toddlers aged 24–59 months receive 24 grams. The biscuits also contain potato flour, with toddlers aged 12–23 months receiving 12 grams and those aged 24–59 months receiving 18 grams. The snakehead fish and potato flour biscuits are consumed as snacks, with intake divided into two servings per day, in the morning and afternoon snack periods. The amount of biscuits provided is differentiated because the nutritional requirements for supplementary food for toddlers aged 12–23 months and 24–59 months are different. Data analysis was separated into two sections: univariate data analysis and bivariate data analysis. Univariate analysis was used to describe the variables related to the independent variable to obtain a picture of the respondents characteristics using a frequency distribution table. For bivariate analysis, the processed data were then analyzed to test the difference between initial observations (before giving snakehead fish biscuits and potato flour) and final observations (after giving snakehead fish biscuits and potato flour). The results of body weight before and after giving biscuits were processed and statistically tested using the t-dependent test. Test criteria: Reject H_0 if $t\text{-count} < t\text{-table}$ and accept H_0 if $t\text{-count} > t\text{-table}$ otherwise. This study has acquired ethical code approval by the Health Research Ethics Committee of the Ministry of Health Polytechnic of Palembang with certificate number 1038/KEPK/Adm2/XI/2024.

RESULTS AND DISCUSSION

The researchers independently produced snakehead fish and potato flour biscuits. The process began with roasting the minced snakehead fish in a pan to achieve a very low moisture content, ensuring product stability and improved shelf life. The dried fish was then mixed into the biscuit formulation along with other ingredients, including potato flour. After achieving a homogeneous dough, it was portioned into 15-gram units, shaped, and topped with chocolate chips. The biscuits were baked in an oven at 180°C for 25 minutes to achieve the desired texture and quality. The division of toddler age categories is carried out using the supplementary therapeutic food nutritional value requirement division category according to the supplementary therapeutic food provision technical guidelines, according to the Ministry of Health in 2024. According to research (Asri and Nooraeni, 2021), toddlers under two years old (0–23 months) are 1.357 times more likely to be wasting than toddlers over two years old (24–59 months). Biological factors such as chromosome specifications, low birth weight, infection, social status, and environmental influences also contribute to toddlers being susceptible to wasting (Nata and Setiadi, 2023).

Table 1. Descriptions of Respondents

Variables	n	%
Age		
12-23 months	13	39.4
24-59 months	20	60.6
Gender		
Male	14	42.4
Female	19	57.6
Total	33	100

There were 33 toddlers participating in this study, with a minimum age of 13 months and a maximum age of 57 months, with a mean age of 31.36. The respondents were divided into boys and girls, with 14 boys (42.4%) and 19 girls (57.6%). Nutritional intake data were obtained from direct interviews with toddlers parents using a 1x24-hour food recall. Calculation of toddler intake adequacy categories used age categories according to the 2019 AKG. Providing 4 pieces of snakehead fish biscuits and potato flour for toddlers aged 12–23 months contains 269.5 kcal of energy, 8.8 g of protein, 12.4

g of fat, and 29.96 g of carbohydrates. Providing 6 pieces of snakehead fish biscuits and potato flour for toddlers aged 24–59 months contains 404.4 kcal of energy, 13.2 g of protein, 18.6 g of fat, and 44.94 g of carbohydrates. Table 2 shows that after the intervention of providing snakehead fish biscuits and potato flour for 14 days, it has an effect on increasing the intake of energy, fat, protein, and carbohydrates in toddlers. To ensure toddlers consumed the snakehead fish and potato flour biscuits for 14 days as required, researchers carried out daily monitoring using a Food Frequency Questionnaire (FFQ).

Table 2. Nutritional Intake Categories

Nutritional Intake	Intervention			
	Before		After	
	n	%	n	%
Energy Adequate	2	6.1	32	97
Inadequate	31	93.9	1	3
Protein Adequate	0	0	14	42.4
Inadequate	33	100	19	57.6
Fat Adequate	2	6.1	31	93.9
Inadequate	31	93.9	2	6.1
Carbohydrate Adequate	2	6.1	32	97
Inadequate	31	93.9	1	3
Total	33	100	33	100

Research conducted by (Mardiana, Yulianto and Tuzzuhro, 2024) stated that there was an increase in average energy intake after giving Gajaberry cookies made from snakehead fish, wheat flour, corn flour, and strawberry jam to malnourished toddlers by 363.85 kcal. Research conducted by (Widodo *et al.*, 2015) stated that there was an increase in average protein intake after giving blondo-based biscuits, snakehead fish, and brown rice to wasting toddlers by 16.6 grams. Similar research conducted by (Kusumawati, 2015) stated that there was a difference in average fat intake after the intervention of instant porridge based on snakehead fish and pumpkin for malnourished toddlers of 3.49 grams and a difference in average carbohydrate intake of 30.21 grams.

Children's energy needs based on the AKG are divided into 2, namely children aged 1-3 years

and 4-6 years. Intake is categorized as good if it is $\geq 80\%$ of the Recommended Dietary Allowance (RDA). For children aged 1-3 years, 80% of the energy sufficiency in one day is 1080 kcal, while for children aged 4-6 years, 80% of their energy sufficiency in one day is 1120 kcal. 80% of the protein sufficiency in one day for children aged 1-3 years is 16 grams, while for children aged 4-6 years, 80% of their protein sufficiency in one day is 20 grams. For children aged 1-3 years, 80% of the fat sufficiency in one day is 36 grams, while for children aged 4-6 years, 80% of their fat sufficiency in one day is 40 grams. The carbohydrate and protein needs of children aged 1-3 years are 80% in one day, which is 172 grams, while for children aged 4-6 years, the protein requirement is 80% in one day, which is 176 grams.

Table 3. Frequency Distribution and Average Differences in Nutrient Intake

Nutritional Intake	Mean	Min	Max	SD	P-value
Energy					
Before	962.5	759.6	1124.8	80.37	
After	1295.2	1051.2	1295.2	94.38	
Protein					
Before	12.03	9.5	14.1	1	
After	16.8	13.1	18.2	1.18	<0.001
Fat					
Before	32.08	23.5	37.5	2.67	
After	43.18	35	48.5	3.14	
Carbohydrate					
Before	156.4	123.4	182.8	13.07	
After	210.4	170.8	236.6	15.33	

The results of the t-dependent statistical test showed a p-value of 0.000 (<0.05), which means there is a difference in the average intake of energy, protein, fat, and carbohydrates before and after the intervention of providing snakehead fish biscuits and potato flour to wasting toddlers in the working area of the Makrayu Palembang Health Center. A significant increase in energy, protein, fat, and carbohydrate intake in toddlers after providing

snakehead fish biscuits and potato flour for 14 days indicates that this intervention is effective in helping restore the nutritional status of wasting children. Research conducted by (Syarfaini *et al.*, 2022) found a significant relationship between energy intake and wasting in toddlers ($p=0.000$). Energy intake is one element that can affect waste in toddlers growth and development. Additionally, studies conducted in Cimpaeun, Depok, revealed that

toddlers with low family income, low maternal nutritional understanding, and inadequate calorie and protein consumption were more likely to experience wasting. Toddlers who did not consume enough energy had a 4.4-fold increased risk of wasting compared to those who did (Azamia and Triyanti, 2024). According to research by Yetri (2023), malnourished toddlers average protein and carbohydrate consumption significantly changed following the snakehead fish meatball intervention ($p=0.000$). Toddlers typically ingest insufficient amounts of carbohydrates because they eat fewer carbohydrates, like rice. This affects the total amount of energy used. Lack of carbs may drain a child's energy and result in weight loss, which will impact the toddler's nutritional status and impede growth (Puspasari and Andriani, 2017). A study conducted by (Rochmawati, Marlenywati and Waliyo, 2016) found that carbohydrate intake plays a significant role in the occurrence of malnutrition in toddlers. Toddlers who consume fewer carbohydrates are 1.688 times more likely to experience wasting than

toddlers who consume more carbohydrates. Research conducted by (Syarifaini *et al.*, 2022) found a significant connection between fat intake and wasting in toddlers ($p=0.010$). Insufficient dietary fat intake will result in a decrease in calorie and energy intake for body activity and metabolism. Lower energy intake will also lead to decreased body mass and tissue and problems with the absorption of fat-soluble vitamins.

To determine the difference in average body weight in toddlers before and after the intervention, a dependent t-test was conducted. Table 4 shows that there was an increase in body weight after being given snakehead fish biscuits and potato flour to the treatment group for 14 days, with an average weight gain of 0.32 kg. The results of the paired t-test obtained a p-value <0.05 , namely 0.000, meaning that there was a significant difference in average body weight in toddlers given snakehead fish biscuits and potato flour on changes in body weight of wasting toddlers.

Table 4. Difference in Average Body Weight Before and After Intervention

Initial Mean $\pm$ SD	Final Mean $\pm$ SD	p	t
9.94 $\pm$ 1.87	10.26 $\pm$ 1.85	<0.001	-7.701

The maximum weight of toddlers before intervention was 15 kg, and the minimum weight of toddlers before intervention was 7 kg, with a mean or average of 9.94 kg. After the intervention, the maximum weight of infants was 15.3 kg, and the minimum weight of infants before the intervention was 7.5 kg, with a mean or average of 10.26 kg. (Sihite and Rotua, 2023) found that wasting toddlers who received additional meals gained an average of 100–500 grams of weight. According to studies by Hartono and Saimi (2024), giving wasting children more food has a favorable effect, with an average weight gain of 0.57 kg in toddlers aged 24–59 months ($p = 0.002$). The nutritional value of the potato flour biscuits and snakehead fish can account for the treatment group's notable weight gain. These biscuits are a well-balanced and nutrient-dense complement because they combine high protein from snakehead fish with energy from potato flour. For toddlers who are wasting, regular consumption for 14 days ensures sufficient energy and nutrient intake, promoting improved nutritional status and weight gain. Muscle catabolism brought on by prolonged starvation is also lessened by this improvement in protein status. Children's bodies don't need to break down body protein for energy when they consume enough carbohydrates from potato flour, which promotes the growth of muscle and tissue. Children's appetite and metabolism are also enhanced by adequate energy (World Health Organization, 2024). This helps maintain a positive nitrogen balance, which is necessary for gaining weight. Protein-based supplemental foods, such as snakehead fish, are an

excellent way to improve nutritional status and increase weight in malnourished toddlers, according to a review of the literature on complementary therapies (Sastri and Dewi, 2024). Due to their greater biological value and digestibility, animal protein sources have been demonstrated to be more efficient than plant protein sources in improving the nutritional status of malnourished children (FAO, 2019). The weight gain of the toddlers following the intervention shows how well biscuits prepared from potato starch and snakehead fish may reduce waste. These findings are consistent with the Protein Energy Malnutrition (PEM) theory, which states that wasting happens as a result of long-term protein and energy deficiencies that cause muscle mass loss and body tissue loss (WHO, 2024). By providing both macronutrients in the proper amounts, promoting tissue synthesis, and enhancing nutritional status, the intervention in this study assisted in restoring the energy-protein balance, offering quickly digested complex carbs that contribute to total energy intake, potato starch enhances the protein component. The carbohydrate protein-sparing effect (Gropner & Smith, 2020) states that eating enough carbs guarantees that dietary proteins are used for growth rather than as a source of energy. The biscuit formulation's combination of protein from snakehead fish and carbs from potato starch successfully produces a protein-sparing effect, allowing nutrients to be used efficiently for tissue growth and repair rather than catabolism.

This weight gain indicates that the intervention was effective in improving the

nutritional status of wasting toddlers. Snakehead fish, the main ingredient in biscuits, is known to contain high levels of animal protein, essential amino acids, and healthy fats, which play a vital role in tissue repair and growth (Sari, Harahap and Lubis, 2020). The potato starch in biscuits acts as a source of complex carbohydrates with a moderate glycemic index, providing sustained energy for children. Adequate complex carbohydrates prevent protein from being used as a primary energy source, allowing protein to be focused on growth. Potato flour, which is a source of complex carbohydrates, also provides the energy needed by toddlers during nutritional recovery (Permenkes, 2019). Potato flour Potatoes are also high in energy density (due to their low water content) and are easily formed into complementary feeding products or preferred snacks such as biscuits, thus increasing acceptance and frequency of consumption, two key factors for increasing daily energy intake in toddlers. Recent evidence places potatoes as a quality carbohydrate in the diet, while their moderate to high GI in certain preparations explains why potatoes are effective as an energy carrier in situations of deficit, provided portion sizes and processing methods are controlled (Fleming and Morris, 2024). In addition to their high nutritional content, the biscuits practical and easily accepted format is also a contributing factor to the intervention's success. Because of their tasty flavor and crunchy texture, biscuits are a popular snack among kids, allowing for regular daily ingestion during the intervention period (Fitriani, Maulana, and Wibowo, 2019).

The practical and locally sourced nature of this research makes it affordable and sustainable for the community. Because it focuses on increasing weight gain in malnourished children, a significant issue in Indonesia, this research has significant implications for public health. In addition to its benefits, this study's small sample size and conclusions are less applicable to other communities because it is exclusive to Makrayu Health Center.

CONCLUSION

Prior to the intervention, toddlers average intake of energy, protein, fat, and carbohydrates was still insufficient, but it improved following. Before the intervention, the average weight of wasting toddlers was 9.94 kg; following therapy, it was 10.26 kg. Giving snakehead fish biscuits and potato flour to wasting toddlers in the Makrayu Palembang Health Center's operating region had an impact on their weight gain ($p < 0.001$), with an average weight difference of 0.32 kg before and after the intervention. Future studies must take into account portioning the biscuits according to toddlers daily intake. Consistent consumption of supplementary foods has the potential to support improvements in

the nutritional status of children with wasting toward achieving normal growth parameters.

Acknowledgement

Thank you to Dr. Nurul Salasa Nilawati, SE, S.Gz, M.Si, and Mr. Ahmad Sadiq, SKM, MKM, who have participated in completing this research until the end. I also express my deepest gratitude to the Makrayu Community Health Center in Palembang, along with the staff and respondents who have helped me throughout the research, whom I cannot mention one by one.

Conflict of Interest and Funding Disclosure

None

Author Contributions

KAS: conceptualization, investigation, writing the original draft, and editing. NSN: methodology, supervision, and formal analysis. AS: formal analysis and writing review

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