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ORIGINAL ARTICLE

The Effect of Dried Noodle with Patin Fish and Pumpkin Flour on Body Weight of Children

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ABSTRACT

Background: Programs targeting malnutrition in toddlers are critical for preventing undernutrition and mitigating more severe health complications. The substitution with high-protein local-ingredients into noodle products can offer a promising strategy. Dried noodles enriched with Patin fish and pumpkin flour present a viable alternative for supplementary feeding programs. Assessing their effectiveness is essential to optimize supplementary feeding interventions.

Methods: In a pre-experimental study, a pretest-posttest design involving 26 wasted children aged 24-59 months was employed. The study procedures comprised product preparation, anthropometric assessments that were conducted before and after the interventions, a 10-day supplementary feeding program, and a 24-hour dietary intake recall.

Results: Palata noodles could provide approximately 13% of daily caloric requirements and 30-40% of daily protein needs. Among the evaluated foods, spaghetti exhibited the highest level of food waste, while the omelet had the lowest. Statistical analysis demonstrated the significant effect of supplementary feeding on average caloric intake before and after the interventions. Additionally, dietary recall data indicated an increase in the average intake of all nutrients. Observational data showed an average weight gain of 0.7 kg among participants. It was shown that supplementary feeding had a significant impact on the body weight of toddlers before and after the interventions.

Conclusion: Supplementary feeding by administration of dried noodles with Patin fish and pumpkin flour substitution significantly impacted weight gain and the intake of zinc, iron (Fe), and beta-carotene in wasted toddlers. However, no significant effect was observed on the daily intake of energy, protein, and fat among the participants.

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Introduction

The first five years of a child's life are considered a golden age, as up to 90% of physical growth and brain cell development occurs during this period (1, 2). Nutritional intake is a direct factor of child development and inadequate energy and protein intake can directly affect nutritional status, potentially leading to chronic energy and protein deficiencies, stunted growth, and impaired cognitive development (3, 4). In Indonesia, the prevalence of

under-nutrition (wasted) increased from 7.1% in 2021 to 7.7% in 2022. The 2022 National Nutritional Survey revealed that the prevalence of wasted toddlers in Central Java exceeded the national average of 7.9% (5). A report by the Indonesian People's Representatives Council identified several risk factors for stunting in the country, including maternal and child undernutrition, low household income, limited nutritional knowledge, unsanitary environmental conditions, and restricted access to health services (6). To address these challenges, the Central Java Provincial Health Office has included a targeted program for wasted toddlers in its strategic plan, focusing on supplementary feeding as part of an additional food supply initiative (7).

Supplementary feeding involves providing food to toddlers in the form of snacks and other supportive activities, ensuring the quality, safety, and nutritional adequacy of the food. The selection and preparation of supplementary feeding prioritize the use of locally sourced ingredients or traditional dishes to enhance accessibility and cultural acceptance (8-10). The target group for supplementary feeding includes toddlers aged 6-59 months with malnutrition, defined by a weight-for-height z-score between -3 SD and <-2 SD. The quality standard for supplementary food specifies that every 100 grams of the product must contain a minimum of 8-10 grams of protein (11, 12). Dried noodles with 7.5% yellow pumpkin and Patin fish substitution were demonstrated to provide 15.47% protein that exceeds the standard quality requirement of 8-10% protein for supplementary feeding in wasted toddlers (13).

The effectiveness of supplementary feeding in wasted toddlers was indicated in the Citeras Health Center area, Garut, where 7 toddlers were classified as wasted (based on weight-for-height) and achieved a well-nourished status following the supplementary feeding intervention (14). Similarly, in the Paguyaman Health Center, Boalemo Regency, the average weight-for-age of respondents increased from 8.438 kg to 9.088 kg after the intervention (15). A previous study illustrated a significant difference in the daily intake of elementary school students after implementing dried noodles with Patin fish flour as supplementary feeding. The intervention resulted in weight gain for 70% of participants and increased protein intake for 38.7% of participants with wasted nutritional status. Tlogosari Wetan Health Center, the largest in Semarang city covers 5 villages. A nutritional report from February 2024 indicated that 62.96% of toddlers aged 24-59 months in the area had wasted nutritional status (BW/height) (16). Based on the background provided, the researchers are interested in studying the effectiveness of administering dried noodles with Patin fish and pumpkin flour substitution on the nutrient intake and weight gain of wasted toddlers at Tlogosari Wetan Health Center.

Materials and Methods

In a pre-experimental study using a pretest-posttest design, 26 wasted children aged 24-59 months were enrolled. The study population consisted of all 54 undernourished toddlers aged 6-59 months in the Tlogosari Wetan Health Center's service area, Semarang, Indonesia. A sample of 26 toddlers was selected based on the criteria of being 24-59 months and having a weight-for-height z-score between -3 SD and <-2 SD. The processed Palata noodles were prepared as supplementary feeding and the food was given to toddlers, while delivered to their homes. Except for additional food in the form of the Palata noodles supplementary feeding, toddlers consumed different foods, depending on the food provided by their parents.

The product was prepared in the Food Technology and Nutrition Laboratory at the Health Polytechnic of the Ministry of Health in Semarang. The product formulation for this research involved adding 7.5% yellow pumpkin flour and 30 g of Patin fish per 100 g of flour. The production process included making dried noodles from raw materials, followed by drying applying a baking method, and finally preparing a total of seven different recipes. All processes were carried out by the research team, including the final delivery stage. The variations of Palata noodles of the seven recipes were fried noodles, chicken noodle soup, spaghetti, Palata balls, Schotel, Palata rolled noodle and omelet (Figure 1). Ech sample was provided with the same quantity and variety of meals throughout the research period. The nutritional composition of each recipe was shown in Table 1.

The research began with pre-intervention measurements, including intake assessment through a 24-hour dietary recall and weight measurements using a digital body weight scale. Measurements were conducted with the samples wearing minimal clothing. The toddler's height was measured using a microtoise, which was done by the toddler standing barefoot and wearing a hair tie or hat. The Palata noodles supplementary feeding was administered for 10 consecutive days, with a variety of Palata noodles dishes. During this period, intake was assessed using the 24-hour recall method and Comstock visual estimation. After the intervention, a follow-up intake assessment was conducted using the 24-hour recall method, along with weight measurements. Weight measurement data were analyzed statistically using SPSS software (Version 20, Chicago, IL, USA).

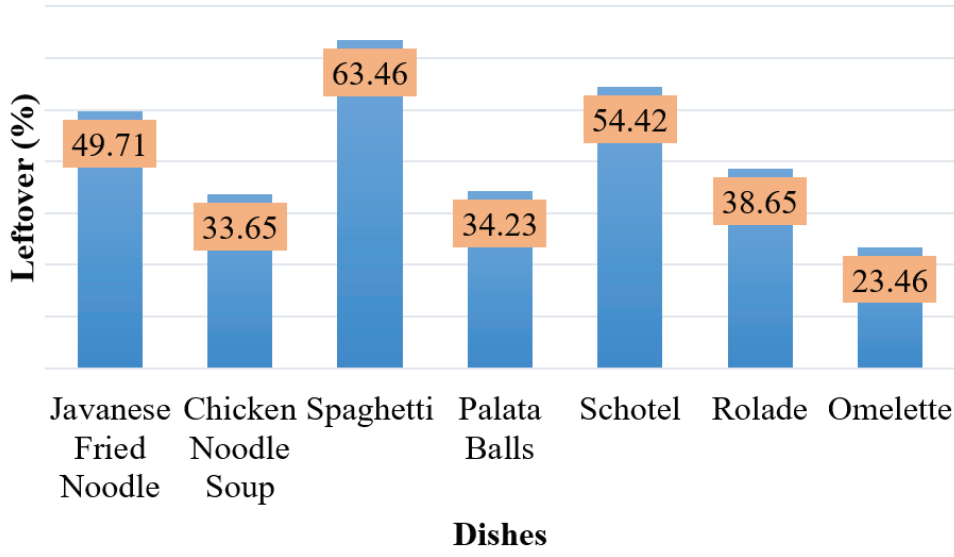

Figure 1: Chart by type of dishes.

Table 1: Nutritional composition of Palata recipes.

Recipe	Energy (kcal)	Fat (g)	Protein (g)	Carbohydrates (g)	Zinc (mg)	Calcium (mg)	Fe (mg)	Beta-carotene (µg)
Fried noodles	298.8	14.9	13.2	15.9	1.4	57.4	3.7	738.7
Chicken noodles soup	290.7	12.9	11.7	34.4	1.1	36.4	1.9	268.6
Spaghetti	414.7	16.5	30.5	19.1	2.1	166.4	2.1	592
Palata balls	363.4	12	28.83	15.3	1.1	49.8	2.23	1068.07
Schotel	383.1	19.8	22.45	25.85	2.6	310.05	1.85	376.75
Rolade	254.9	11.78	10.41	27.09	0.863	16	0.9875	225.75
Omelet	178.2	9.3	10.6	11.4	0.85	22.2	1.3	526.2

Descriptive statistics were used for univariate analysis to present sample characteristics, while bivariate analysis with a paired t-test was employed to assess differences in intake and weight before and after the intervention. The study was conducted from April to September 2024.

Results

A total of 26 wasted toddlers were enrolled as the samples were distributed across 5 villages in the Tlogosari Wetan Health Center's working area. Among the participants, 65.38% were male, while 34.62% were female. The selected toddlers aged 24-59 months, as children in this age group typically consumed foods with similar textures and varieties of family meals. In contrast, toddlers younger than 24 months primarily consumed softer-textured foods. The target participants in this study were wasted toddlers; however, it was also found that 3.85% of the toddlers were severely wasted, and 73% were underweight, based on weight-for-height measurements with a Z-score between <-2 SD and -3 SD.

Participant's intake of Palata noodles varied. Two types of Palata noodles dishes of Schotel and Javanese fried noodles, had an average acceptance rate less than 50%. Most toddlers felt full quickly after consuming Schotel, while the majority did not prefer Javanese fried noodles. Analysis of leftovers based on the type of dish revealed that the most preferred dishes among toddlers, in order, were Palata noodle omelet, chicken noodle soup, Palata balls, Palata rolled noodles, Javanese fried noodles, Schotel, and spaghetti. Additionally, the trend in food intake varied according to the day of administration, suggesting that menu variations influenced the toddler's food intake. The normality test of macronutrient intake revealed that all data were normally distributed. A paired t-test was then conducted, and the results showed that Palata noodles had no significant effect on energy, protein, fat, or carbohydrate intake before and after the intervention. However, the average intake of macronutrients increased, with a 20%, 27%, 12% and 15% increase in energy, protein, fat, and carbohydrates, respectively. On average, toddlers consumed 58% of the Palata noodles, which was sufficient to improve the intake of macronutrients.

All micronutrient intake data were not normally distributed, so the influence test was carried out utilizing the Wilcoxon method. The results showed no significant effect of Palata noodles on calcium intake. However, the average calcium intake was 118

mg, which corresponded to 59% of the recommended intake for children aged 0-5 months, 43% for children aged 6-11 months, 18% for children aged 1-3 years, and 11% for children aged 4-5 years. In contrast, the intake of zinc (Zn), iron (Fe), and beta-carotene showed significant improvements. The administration of Palata Noodles could positively affect the intake of zinc, iron, and beta-carotene. The normality test of body weight before and after the administration of Palata noodles showed a normal distributed of data (p>0.05), with p values of 0.083 and 0.717, respectively. The data were then analyzed using the paired t-test, which indicated a significant effect of Palata noodles on the weight of toddlers with p<0.001. Similarly, the normality test for body height data showed a p=0.027, and the paired t-test yielded a p<0.001, indicating that Palata noodles had a significant effect on the height of toddlers. Regarding the findings, Table 2 represents nutritional adequacy recommendation for Indonesian (PERMENKES No. 28 of 2019), Table 3 displays macronutrient intake before and after Palata noodles administration; and Table 4 exhibits body weight and height test results before and after Palata noodles administration.

Table 2: Nutritional adequacy recommendation for Indonesian population (PERMENKES No. 28 of 2019).

Nutrient	Requirement	
	1-3 years old	4-5 years old
Energy (kcal)	1350	1400
Protein (g)	20	25
Fat (g)	45	50
Carbohydrates (g)	215	220
Fiber (g)	19	20
Calcium (mg)	650	500
Phosphorus (mg)	460	1000
Iron (mg)	7	10
Vitamin A (REE)	400	450
Vitamin B1 (mg)	0.5	45
Vitamin C (mg)	40	0.6
Potassium (mg)	2600	900
Sodium (mg)	800	2700

Table 3: Macronutrient intake before and after administration of Palata noodles.

Type of intake	Mean±SD	Significant (2-tailed)
Energy		
Before	1.027.56±320.44	p>0.99
After	1.237.13±252.44	
Protein		
Before	40.05±14.37	p>0.99
After	51.09±11.24	
Fat		
Before	48.03±21.77	p>0.99
After	54.73±13.75	
Carbohydrate		
Before	119.68±34.84	p=0.270
After	138.66±36.49	
Zinc		
Before	3.79±1.73	p<0.001
After	5.45±4.51	
Calcium		
Before	282.75±267.51	p=0.130
After	400.21±337.82	
Fe		
Before	3.56±1.96	p<0.001
After	6.31±5.85	
Beta carotene		
Before	868.77±753.36	p<0.001
After	1.096.13±385.02	

Table 4: Body Weight and Height Test Results Before and After Palata Noodles Administration.

Criteria	Mean±SD	Sig. (2-tailed)
Body weight		
Before	10.50±1.59	$p<0.001$
After	10.68±1.64	
Height		
Before	86.33±6.76	$p<0.001$
After	87.48±6.89	

Discussion

Diet and lifestyle can greatly influence health and susceptibility to diseases as the nutritional needs of cells and their role in quantity and quality of these cells are crucial for cell renewal and repairing process in damaged tissues (17). This study revealed the potential of high-protein functional food products as an alternative for supplementary feeding. Noodles are one of the foods with broad acceptability across various age groups and regions (18). Consequently, this food modification holds significant potential for acceptance and utilization, as it is widely accepted by the public and can be adapted into a diverse range of culinary preparations from various regions. Supplementary feeding provides toddlers a safe and high-quality snack and supports the activities. It ensures food quality, safety, and an adequate nutritional value too. These foods are typically based on local ingredients or dishes. If local food ingredients are scarce, commercially available manufactured foods can be used, revealing that attention is given to packaging, labeling, and expiration dates to ensure food safety.

The leftovers from the 7 recipes provided to the subjects over 10 days showed to be the toddler's food preferences. The highest amounts of leftovers occurred on the third and fifth days (Spaghetti Palata). Several factors may have contributed to this issue, including toddler's dislike of the unique seasoning, illness or reduced appetite, and the development of oral aversion. Additionally, high leftovers at certain meal times could be influenced by limited menu variety, food appearance, and flavor combinations (19). The results of observations and interviews revealed that, during the intervention period, toddlers experienced pain, reduced appetite, and developed oral aversion, which aligns closely with the conditions described above. This finding contrasts with previous research on the acceptability of local-based food supplements for stunted toddlers, which showed that stunted toddlers generally had good acceptability of such foods (18).

There were 26 subjects in this study, while a larger proportion was male participants (65.38%). This finding is consistent with other researchers who reported stunting conditions to be more prevalent in boys because boys have higher protein and energy requirements than girls (20, 21). Table 2 illustrates nutritional adequacy recommendation for Indonesian People (PERMENKES No. 28 of 2019) (22). Palata noodles contribute 13% of the daily caloric intake for toddlers aged 1-3 years and 4-6 years, based on the nutritional adequacy recommendation for Indonesians. In terms of protein, Palata noodles provide 40% of the daily intake for 1-3 years age group and 30% for 4-5 years age group. Additionally, Palata noodles contribute 20% of the daily fat intake for toddlers across all age groups. For the 2-3 years age group, Palata noodles contribute 26% of the daily zinc, 8% of iron, 11% of beta-carotene, and 6% of calcium intake. Among 4-year-old age group, the contributions were 15% for zinc, 4% for calcium, 12% for iron, and 11% for beta-carotene.

Analysis of the average macronutrient intake revealed that Palata noodles had no significant effect on the average intake before and after administration. However, recall results indicated an average increase in energy intake by 20%, protein by 27%, fat by 12%, and carbohydrates by 15%. This finding is consistent with other researches, which demonstrated that supplementary feeding can improve the intake and nutritional status of toddlers (14, 15, 23-25). Sufficient food consumption as supplementary feeding in accordance with the recommendations and adoption of healthy eating patterns can help improve the nutritional status of toddlers. Supplementary feeding can serve as an effective alternative to meet daily intake needs. The relationship between adherence to supplementary feeding and improvement of nutritional status of toddlers has been shown to have a significant influence (26).

Dietary intake plays a crucial role in improving the nutritional status of toddlers. Adequate feeding helps toddlers meet their nutritional needs and is a key factor in promoting increases in both weight and height (26). Lack of energy consumption can lead to undernourishment, and if sustained over a prolonged period, it can result in malnutrition (27). This occurs due to insufficient glucose intake from food, leading to the depletion of the body's glycogen stores. As

a result, the body is unable to perform its primary functions and must rely on non-carbohydrate energy sources, such as proteins and lipids. This disruption in metabolism contributes to the abnormal nutritional status of toddlers (28). Low protein intake makes toddlers more vulnerable to infectious diseases, which in turn negatively impacts their nutritional status (28).

Protein and amino acids are essential for normal growth and the formation of the extracellular matrix by chondrocytes. In humans, protein deficiency can lead to growth failure (29)epigenetics and environment (mainly stress and availability of nutrients. Fats contain essential fatty acids that play a crucial role in regulating health. Fat consumption also contributes to energy storage, as the body uses fat to transport and dissolve fat-soluble vitamins, both of which significantly impact toddler growth. Carbohydrates are vital for child growth, providing energy for the brain and nervous system, regulation of metabolism, and serving as a primary energy source for the body's activities (30).

Micronutrient intake also showed an increase in the average intake of zinc, calcium, iron, and beta-carotene revealing that, of the four micronutrients, the administration of Palata noodles had no effect on calcium intake. Calcium homeostasis is essential for bone health and growth. A low calcium intake was shown to result from insufficient milk consumption after weaning that can be considered a potential risk factor for stunting in children, particularly in regions such as Africa (29) epigenetics and environment (mainly stress and availability of nutrients. The substitution of calcium content in dried noodles with Patin fish and pumpkin flour has been 36.87 mg per 100 grams. These noodles can fulfill 5.6% of the daily calcium needs for children aged 1-3 years and 3.6% of the daily calcium needs for children aged 4-6 years (31).

In our study, the modified recipe for Palata noodles contained 170-400 calories, and the Palata Omelet, the dish with the lowest nutritional value, provided 178.2 calories and 9.3 grams of protein. Compared to the minimum nutritional needs for toddlers aged 24-60 months, this processed noodle meets 13.2% of the daily calorie requirement and was qualified as a snack. Additionally, its protein and fat content fulfilled 46% and 23% of the toddlers' daily needs, respectively. Meanwhile, the spaghetti dish offered the highest nutritional value, with 414.7 kcal per serving (30% of the daily energy requirement), 16.5 grams of protein (82% of the daily requirement), and 30.5 grams of fat (67% of the daily requirement). After the administration of supplementary feeding for 10 days, the results showed a weight increase of 0.7 kg in toddlers. The influence test indicated that supplementary feeding had a significant effect on body weight before and after the intervention. However, this finding contrasts with research by others revealing that suboptimal adherence to supplementary feeding consumption led to no significant improvement in the nutritional status of toddlers (23, 26). Adequate food consumption with adherence to supplementary feeding recommendations, and healthy eating patterns are crucial for improving toddlers' nutritional status. It was shown that supplementary feeding can serve as an effective alternative to meet daily intake needs, and the relationship between adherence to supplementary feeding and improvements in nutritional status were shown to pose a significant impact (26).

In our study, most toddlers did not finish their supplementary feeding, yet there was a significant weight gain. This may be attributed to the fact that, despite many toddlers not finishing the supplementary feeding, the average consumption remained relatively high (around 58%). Palata noodles contributed approximately 260 kcal per day, which is close to the standard for supplementary feeding set by the Ministry of Health, which recommended 300-450 kcal for the 24-59 month age group. The strength of this research is the main ingredient of supplementary feeding including dry patin noodles with pumpkin flour that contained high calories and protein as well as being a source of Fe and Zn needed by wasting toddlers. However, there was a limitation that must be taken into account as the final product (seven servings of Palata noodle) was not tested.

Conclusion

Supplementary feeding of dried noodles with substitution of Patin fish and pumpkin flour had a positive effect on weight gain and the intake of zinc, iron, and beta-carotene in wasted toddlers. However, there was no significant impact on the daily intake of energy, protein, and fat. In this study, seven Palata noodles recipes were used as part of the intervention, with five recipes being well-accepted by toddlers, achieving an average intake above 50%. For future studies, it is recommended to investigate the relationship between adherence to supplementary feeding n and weight gain or nutritional status in toddlers to provide a more comprehensive understanding. Additionally, future researches should focus on analyzing the nutritional content of each supplementary feeding recipe and exploring new approaches to enhance toddler intake, thereby maximizing the benefits of SF.

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Authors' Contribution

F.F is owner of the initial idea & collected the data (primary and secondary) of food ingredients, body data, and toddlers' height. Y.Y analyzed toddlers' weight and nutrition status & provided the additional input about Processing Nutrition Composition of Palata Recipe. D.NS completed the library search & conducted direct data collection from respondents.

Conflict of Interest

None declared.

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