MUNG BEAN PUDDING AS A LOCAL ADDITIONAL SIDE DISH TO IMPROVE THE NUTRITIONAL STATUS OF PRESCHOOL CHILDREN

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ABSTRACT

Meeting the nutritional needs of preschool children is an important part of efforts to maintain growth and prevent nutritional problems. Mung bean is a local food ingredient that can be processed into pudding as a supplementary food. This study aimed to analyze changes in body weight and anthropometric indicators after the provision of mung bean pudding as a local supplementary food for preschool children. This study used a one-group pretest–posttest design. The participants were 42–74 months old. The primary variables included body weight before and after the intervention and changes in z-scores. Pudding consumption adherence was recorded as a percentage. Data were analyzed using a paired t-test and Wilcoxon signed-rank test; mean change, 95% confidence interval, and Cohen's dz were calculated for changes in body weight. The association between adherence and change in body weight was analyzed using Spearman correlation. Mean body weight increase was 0.34 kg (95% CI 0.30–0.39; paired t-test p < 0.001; Wilcoxon p < 0.001; Cohen's dz = 3.31). The mean z-score increased with a mean change of 0.20 and Wilcoxon p < 0.001. Nutritional status based on weight-for-height did not change, Mean adherence was 96.30%. The correlation between adherence and change in body weight was rho = 0.220, p = 0.312. The data showed significant increases in body weight and z-score after the provision of mung bean pudding. The findings are interpreted as an increase in anthropometric indicators during the intervention period.

KEYWORDS

mung bean pudding; local supplementary food; preschool children; nutritional status; anthropometry

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INTRODUCTION

Nutritional status during the preschool period is an important indicator of child health because this period is characterized by physical growth, cognitive development, increased physical activity, and rapid changes in eating patterns (Ali et al., 2024; Ifalahma, 2024). Inadequate energy and nutrient intake may lead to suboptimal growth, while excessive energy intake in the context of an unbalanced diet may contribute to overweight (Cliffer et al., 2021). Therefore, nutritional interventions for preschool children need to consider food quality, nutrient adequacy, child acceptance, affordability, and sustainability. Local food-based supplementary foods are one approach that has been widely studied to improve children's intake and anthropometric status (Ficagna, et al, 2025). Azimi et al. (2020), in children aged 24–59 months with mild to moderate malnutrition, found that locally based ready-to-use supplementary food (RUSF) increased body weight, BMI, and weight-for-height z-score compared with the usual diet. Talavera et al. (2020), in preschool children in rural communities, also found that RUSF increased the likelihood of correcting mild acute malnutrition. These findings indicate that supplementary foods with adequate nutrient density can form part of strategies for nutritional recovery and prevention of nutritional problems.

Evidence from developing countries also indicates that locally produced supplementary products can provide anthropometric benefits. Borg et al. (2020) evaluated locally produced RUSF in Cambodia and demonstrated its relevance for preventing growth faltering. Khan et al. (2023) reported that locally produced RUSF in Pakistan resulted in positive changes in anthropometric indicators and micronutrient status. Makori et al. (2024), in a randomized controlled trial in Tanzania, found differences in recovery from moderate acute malnutrition among groups receiving RUF, CSB+, and standard care. Overall, these studies support the principle that supplementary foods should be designed to meet nutritional needs within the local context.

Mung bean (Vigna radiata) is a plant-based food source containing protein, carbohydrates, fiber, minerals, and several bioactive components. The use of legumes in children's foods has been studied in various contexts (Fetiyuna et al., 2021). Rani et al. (2024), for example, conducted a randomized controlled trial in school-aged children and found that consumption of mung bean-based food combined with vitamin C-rich guava increased hemoglobin and reduced anemia, although it did not increase iron stores. These findings indicate that mung bean may be a relevant food component in strategies to improve children's diet quality.

In Indonesia, Rachmadewi et al. (2023) showed that ready-to-use therapeutic foods based on local recipes, including a mung bean-based formulation, could have efficacy and acceptability comparable to peanut-based RUTF in children with severe acute malnutrition. This study is important because it demonstrates that local ingredients can be used not only as household foods but also developed into nutritional intervention products that are acceptable to children. Research on local foods in Indonesia also demonstrates the potential of food-based approaches (Mardani et al., 2024). Composite flour developed from Indonesian local food sources, incorporating mung bean as a source of protein and lipid, has been used to formulate supplementary foods for children with moderate acute malnutrition (Griswold et al., 2021). Although this formulation study was not a trial of mung bean pudding in preschool children, it provides a basis for using local ingredients to develop supplementary foods with nutritional profiles designed to meet children's needs.

Food form is an important aspect of successful nutritional interventions. Pudding has a soft texture, an adjustable taste, and can be prepared using relatively simple ingredients. This form may increase children's acceptance compared with supplementary

foods with a harder texture (Rachmah et al., 2023). However, acceptance and anthropometric effects still need to be demonstrated using research data rather than assumed solely from product characteristics. In addition, the success of supplementary feeding is not determined only by nutrient content. Consumption adherence, frequency of administration, portion size, the child's health condition, dietary intake outside the intervention, and family characteristics may influence outcomes (Surono et al., 2025). Studies of supplementary feeding in children indicate that adherence and duration of exposure are important factors in interpreting results. Therefore, adherence data in this study were used as a supporting variable (Griswold et al., 2021).

This study is relevant to midwifery because monitoring child growth, development, and nutritional status is part of maternal and child health services. Midwives can play a role in educating families about selecting nutritious local foods, monitoring growth, early detection of nutritional problems, and coordinating with nutrition professionals when problems are identified (Ifalahma et al., 2026). Simple local food interventions may become an educational option if proven safe, acceptable, and appropriate to children's nutritional needs. The aim of this study was to analyze changes in body weight and z-score in preschool children after the provision of mung bean pudding as a local supplementary food. The secondary objectives were to describe weight-for-height nutritional status, head circumference status, consumption adherence, and the relationship between adherence and change in body weight.

RESEARCH METHOD

This study used a one-group pretest–posttest design. It is described as an experimental/quasi-experimental study. The study data consisted of 23 preschool children. Ages ranged from 42–74 months, with a mean age of 62.00 ± 11.30 months. The sample consisted of 9 boys and 14 girls.

Table 1. Population and Sample

Characteristic	Value
Number of subjects	23 children
Age, mean ± SD	62.00 ± 11.30 months
Age range	42–74 months
Boys	9 (39.1%)
Girls	14 (60.9%)
Height, mean ± SD	109.98 ± 7.04 cm
Adherence, mean	96.30%
Adherence, range	85–100%

The intervention consisted of mung bean pudding as a local supplementary food, administered 3 times per week for 4 weeks. Conceptually, mung bean pudding can function as a supplementary food because mung beans are a source of plant protein and carbohydrates. The pudding form can be prepared with a texture appropriate for children.

The primary outcome was body weight before and after the intervention. The additional anthropometric outcome was the z-score. Descriptive variables included baseline nutritional status based on weight-for-height, head circumference, sex, age, height, and consumption adherence. Weight-for-height nutritional status was recorded as Normal, Overweight, and Severely Overweight.

Continuous data are presented as means and standard deviations. Change in body weight was calculated as post-test body weight minus pre-test body weight. A paired t-test was used to assess the difference in mean body weight, while the Wilcoxon signed-rank test was used as a supporting non-parametric test. A 95% confidence interval was

calculated for the change in body weight, and Cohen's dz was used as a within-subject effect size. Change in z-score was analyzed using the Wilcoxon test because the change data were highly uniform and the parametric assumptions for effect estimation did not provide stable information. The relationship between adherence and change in body weight was analyzed using Spearman's rho. A p-value < 0.05 was considered statistically significant.

The data were analyzed using anonymous codes. No children's names are included in the article. Because there was no control group, the increase in body weight may have been influenced by normal growth, changes in other dietary patterns, family activities, health conditions, or external factors during the study period. Therefore, the findings primarily indicate temporal changes associated with the period of mung bean pudding administration.

RESULT AND DISCUSSION

Results

A total of 23 children were analyzed. The majority were girls (60.9%). The largest age group was children older than 72 months. Baseline nutritional status based on weight-for-height showed that 19 children (82.6%) were normal, one child (4.3%) was overweight, and three children (13.0%) were severely overweight. Head circumference status showed that 18 children (78.3%) were normal and five children (21.7%) were recorded as having microcephaly.

Table 2. Respondent Characteristics

Characteristic	n	%
Boys	9	39.1
Girls	14	60.9
Weight-for-height Normal	19	82.6
Weight-for-height Overweight	1	4.3
Weight-for-height Severely Overweight	3	13.0
Head circumference Normal	18	78.3
Head circumference Microcephaly	5	21.7

Table 3. Change in Body Weight

Parameter	Pre-test	Post-test	Change	95% CI	p	Cohen's dz
Body weight (kg)	19.27 ± 3.82	19.62 ± 3.77	+0.34	0.30–0.39	<0.001	3.31

Mean body weight increased from 19.27 kg to 19.62 kg. The mean increase was 0.343 kg or approximately 343 grams. The paired t-test showed a statistically significant difference ($t = 15.89$; $p < 0.001$), and the Wilcoxon signed-rank test also showed $p < 0.001$. The 95% confidence interval for the mean increase in body weight was 0.299–0.388 kg. Cohen's dz of 3.31 indicates a large within-subject change. This value should be understood as a measure of paired change within a single group, not as a measure of superiority compared with a control group.

Table 4. Change in Z-score

Indicator	Pre-test	Post-test	Δ / Wilcoxon test
Z-score	0.78	0.98	+0.20; p < 0.001

The mean z-score increased from 0.78 to 0.98, with a mean increase of 0.20. The Wilcoxon signed-rank test yielded $p < 0.001$. All individual changes in z-score in the

dataset moved toward an increase, resulting in very small variation in change; therefore, a standard parametric effect size was not calculated as the primary effect measure.

Table 5. Change in Nutritional Status Categories

Weight-for-height status	**Baseline**	**Post**-intervention
Normal	19 (82.6%)	19 (82.6%)
Overweight	1 (4.3%)	1 (4.3%)
Severely Overweight	3 (13.0%)	3 (13.0%)

Although body weight and z-score increased statistically, the distribution of weight-for-height nutritional status categories did not change. This is important for interpretation: the study demonstrated an increase in anthropometric indicators but did not demonstrate movement between nutritional status categories during the observation period.

Adherence and Its Relationship with Change in Body Weight

Mean consumption adherence was 96.30%, with a range of 85–100%. Spearman correlation between adherence and change in body weight yielded rho = 0.220 and p = 0.312. Thus, there was no statistically significant relationship between the level of adherence and the magnitude of weight gain.

Intervention Tolerance

All 23 children in the dataset were recorded as having completed the intervention, and there were no records of intervention discontinuation or intolerance in the notes column.

Discussion

The main finding of the study was that children's body weight increased significantly after the period of mung bean pudding administration. The mean increase was 0.343 kg, with a 95% confidence interval of 0.299–0.388 kg. This increase was accompanied by a mean z-score increase of 0.20. The finding is consistent with the principle that additional food intake may contribute to weight gain when supplementary foods are consumed in addition to routine intake and provide adequate energy and nutrients.

This finding is consistent with Azimi et al. (2020), who evaluated locally based RUSF in children aged 24–59 months with mild to moderate malnutrition. The RUSF group experienced greater increases in body weight and BMI than the control group. Although that study used a randomized controlled trial design and a population different from the present study, the direction of the findings supports the hypothesis that supplementary foods with good nutrient density can affect growth indicators.

Talavera et al. (2020) also demonstrated benefits of RUSF among preschool children in rural areas. The study found a higher proportion of correction of mild acute malnutrition in the RUSF group. This result is relevant because it demonstrates that supplementary feeding in preschool children can be a component of nutritional recovery strategies. However, the present study differs because most children were in the normal weight-for-height category at baseline.

Borg et al. (2020) studied locally produced ready-to-use supplementary food among children in Cambodia. The study demonstrated the importance of using local ingredients in the design of child nutrition interventions. The use of local foods may improve availability, acceptability, and program sustainability, but success still depends on formulation quality and implementation (Wegmüller et al., 2022).

Rachmadewi et al. (2023) provide particularly relevant evidence regarding mung beans. In a randomized controlled trial among children with severe acute malnutrition in

Indonesia, several local RUTF formulations, including a mung bean-based formulation, were tested and showed efficacy and acceptability comparable with standard products. Although the population in that study was different and the product was not pudding, the findings support the consideration of mung bean as a suitable ingredient in nutritional intervention foods.

Fetiyuna et al. (2021) developed composite flour from Indonesian local food ingredients, including mung bean, for RUSF formulation. The study demonstrated that local ingredients can be combined into supplementary food products designed to meet children's nutritional needs. This supports the rationale for using mung bean in supplementary foods, but it cannot be used to infer the nutritional content of the pudding in the present study because the pudding recipe was not available in the dataset.

Rani et al. (2024) demonstrated another potential benefit of mung beans in school-aged children. Consumption of mung bean dal with vitamin C-rich guava increased hemoglobin and reduced anemia, although it did not increase iron stores. This finding highlights that the benefits of mung beans are not limited to energy or protein, but may also form part of dietary patterns that support micronutrient quality. However, the outcome in the present study was anthropometry rather than hemoglobin.

Khan et al. (2023), in a study of locally produced RUSF in Pakistan, also found positive changes in children's anthropometry and micronutrient status. These results indicate that local food interventions can affect more than one nutritional indicator. However, differences in age, nutritional status, product formulation, and intervention duration mean that these results are more appropriately used as context than as direct comparators.

Makori et al. (2024), in a three-arm randomized trial among children aged 6–59 months with moderate acute malnutrition, found differences in recovery among RUF, CSB+, and standard care. The study emphasizes that the form and composition of supplementary foods may affect nutritional recovery (Guzmán et al., 2022). In the present study, because there was no comparison group, it cannot be determined whether mung bean pudding is more effective than other supplementary foods.

Nnam et al. (2025), in a study of locally formulated complementary foods in Nigeria, also demonstrated that local food formulations can affect anthropometric parameters and micronutrient status. This supports the concept that local food strategies can be part of community-based nutrition interventions (Omer et al., 2022). However, differences in age and formulation type should still be considered.

Jiang et al. (2024), in 578 preschool children in China, provided evidence that locally tailored nutritious breakfast combined with nutrition education reduced the occurrence of undernutrition and wasting and increased BMI-for-age z-score. This finding is relevant to the present study because it demonstrates that structured food interventions in preschool settings can affect nutritional status. However, the Jiang study was a cluster randomized clinical trial with a control group and a substantially longer duration.

Ansuya et al. (2023), in a home-based nutrition intervention program for preschool children, also demonstrated benefits in weight gain and reductions in the proportion of malnutrition. The program involved nutrition education and demonstrations of nutritious foods (Webster et al., 2023). This finding reinforces the importance of combining supplementary foods with family education because consumption of a single product does not occur independently of the overall dietary pattern (Mehta et al., 2022).

Categorical nutritional status did not change in this study. This is not contradictory to the increases in body weight and z-score. Anthropometric categories are determined using defined thresholds; a small increase within the same category does not necessarily result in movement to another category. In children who are already in the normal category,

an increase in body weight does not necessarily mean that their category should change. This finding demonstrates the importance of distinguishing continuous outcomes from categorical outcomes when interpreting results. In addition, three children in the dataset were classified as Severely Overweight from baseline and remained in that category. This is an important finding from a child health perspective. Supplementary foods should not be provided uniformly without considering baseline nutritional status (Hlaing et al., 2026). In children at risk of overweight, weight gain needs to be monitored carefully, and interventions should be adjusted to individual needs (Olsen et al., 2021). Therefore, the concept of local supplementary foods should always be placed within a framework of meeting appropriate nutritional needs rather than simply increasing body weight (Kadiyala et al., 2021).

A smaller mean weight gain among children with higher baseline body weight may also occur physiologically. Heavier children do not necessarily require the same additional energy as children with undernutrition (Hartman et al., 2024). Therefore, intervention targets should not consist solely of increasing body weight, but should include improving overall diet quality and supporting growth appropriate to the growth curve (Lelijveld et al., 2021). The absence of a significant relationship between adherence and change in body weight should also be interpreted cautiously. A rho of 0.220 indicates a weak positive direction, but $p = 0.312$. The relatively narrow adherence range of 85–100% may reduce statistical ability to detect a dose–response relationship. In addition, changes in body weight are influenced by other food intake, activity, illness, and natural growth.

A strength of this study is the use of actual anthropometric data in preschool children and paired measurements in the same individuals. Thus, each child served as their own comparator. The analysis also did not rely solely on p-values but reported the magnitude of change and confidence interval. The main limitation is the absence of a control group. In preschool children, natural growth can result in increased body weight even in the absence of an intervention. In addition, the data did not include the exact duration, number of portions, energy and protein content of the pudding, or other food intake. Therefore, the increase in body weight cannot be attributed exclusively to mung bean pudding.

From a midwifery perspective, these findings support the importance of counseling on local foods as part of child health promotion. Midwives can help parents understand that supplementary foods should be provided according to need, while considering nutritional status, dietary variety, hygiene, and the child's response. Mung bean pudding may be one local food alternative, but it should not replace a diverse diet. For future research, a randomized controlled trial with a control group would provide stronger causal evidence. The pudding composition should be analyzed in a laboratory or calculated using a standardized recipe, including energy, protein, fat, carbohydrates, iron, and relevant micronutrients. Dose, frequency, intervention duration, adherence, acceptability, and adverse effects should be systematically recorded. Outcomes should include weight-for-age, height-for-age, weight-for-height/BMI-for-age z-score, as well as dietary and micronutrient indicators when resources permit.

CONCLUSION

Based on data from 23 preschool children, administration of mung bean pudding as a supplementary food was followed by increases in body weight and mean z-score. Mean consumption adherence was 96.30%. Although anthropometric indicators increased, weight-for-height nutritional status categories did not change during the observation period. Therefore, the most appropriate conclusion is that anthropometric indicators

increased after the period of mung bean pudding administration, rather than that nutritional status categories changed. Mung bean pudding has potential as a local food-based supplementary food alternative. Future studies should use a control group, a larger sample, a documented product protocol, and more complete measurements of dietary intake and nutritional content.

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