

Mung Bean Porridge Supplementation and Child Growth: A Randomized Controlled Trial

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ABSTRACT

Mung beans are locally available, culturally familiar pulses that contribute energy and plant protein as supplementary food; however, controlled evidence regarding their short-term effects on linear and ponderal growth in Indonesian children remains limited. This parallel randomized controlled pretest-posttest trial evaluated the effects of mung bean porridge supplementation on anthropometric outcomes among 70 children aged 12–59 months in Mongeudong Village, Lhokseumawe City, who were allocated equally to an intervention or control group. The intervention group received one ~250-mL serving daily for eight weeks (prepared from 25 g dry mung beans, 50 mL coconut milk, and 15 g sugar; providing ~250–270 kcal and 6–7 g protein), whereas the control group received routine services. Primary (HAZ) and secondary outcomes (body weight, length/height, WAZ, WHZ, and stunting classification transitions) were analyzed using ANCOVA with baseline value adjustments, following an intention-to-treat approach. All 70 participants completed the follow-up. Adjusted mean differences favored the intervention group for body weight (0.48 kg; 95% CI: 0.25–0.71; $p < 0.001$), length/height (0.45 cm; 95% CI: 0.14–0.76; $p = 0.005$), HAZ (0.13; 95% CI: 0.01–0.25; $p = 0.036$), and WAZ (0.16; 95% CI: 0.02–0.30; $p = 0.026$). The WHZ difference was not statistically significant (0.15; 95% CI: -0.01–0.31; $p = 0.068$). Among baseline-stunted children, 8 of 17 in the intervention group and 2 of 16 in the control group transitioned to non-stunted status (Fisher's exact $p = 0.057$; OR = 6.22; exact 95% CI: 0.89–69.22). In conclusion, mung bean porridge supplementation yields short-term improvements in key anthropometric outcomes, though it does not significantly improve overall stunting classification or guarantee durable recovery.

INTRODUCTION

Nutritional status during early childhood provides an essential foundation for physical growth and development. Adequate dietary intake, health status, and caregiving practices influence children's ability to achieve their growth potential¹. Chronic or recurrent undernutrition can lead to stunting, defined as length- or height-for-age below two standard deviations from the median of the WHO Child Growth Standards. Stunting is distinct from underweight because these indicators reflect different

dimensions of growth. Therefore, evaluations of nutritional interventions should assess changes in body weight and linear growth separately to avoid overstating their benefits².

Supplementary feeding is one approach to improving children's dietary intake when usual diets do not meet nutritional requirements. WHO recommends dietary diversity that includes pulses, animal-source foods, fruits, and vegetables while continuing breastfeeding according to age-specific recommendations². Mung beans were selected because they are locally available, culturally acceptable, and suitable for preparation as a soft porridge. Dry mung beans contain substantial plant protein, complex carbohydrate, fiber, folate, thiamine, iron, and other minerals; coconut milk and sugar increase the energy density of the prepared serving³⁻⁵. The study formulation was estimated to provide 250-270 kcal, 6-7 g protein, 30-35 g carbohydrate, 10-12 g fat, approximately 3-4 g fiber, 1.5-2.0 mg iron, 30-45 mg calcium, 70-90 micrograms folate, and 0.15-0.20 mg thiamine per serving. These values were calculated from standard food-composition data and were not confirmed by laboratory analysis. The porridge was therefore intended to supplement, not replace, breastfeeding, regular meals, dietary diversity, or clinically indicated nutritional care. Previous controlled trials have primarily evaluated fortified blends, eggs, meat, or lipid-based supplements⁶⁻⁹; controlled evidence on a standardized mung bean porridge among Indonesian children aged 12-59 months remains limited.

Stunting remains a substantial burden globally and nationally. Joint estimates from UNICEF, WHO, and the World Bank indicate that 150.2 million children under five years of age, or 23.2%, were affected by stunting in 2024¹⁰. In Indonesia, the 2024 Indonesian Nutritional Status Survey reported a stunting prevalence of 19.8%. Although this represents a decline, the figure underscores the continuing need to address growth faltering through targeted and sustained interventions¹¹. These circumstances support further research on supplementary feeding interventions that can be implemented at the household level and evaluated using appropriate growth indicators.

At the local level, routine E-PPGBM records identified 664 children under five with stunting in Lhokseumawe City in March 2025, corresponding to 4.76%¹². These service data are not directly comparable with national survey estimates because coverage and data-collection procedures differ. A verified village-level prevalence estimate for Mongeudong was not available in the study records; therefore, the manuscript does not infer the magnitude of the village problem from city-level data. This absence of village-specific evidence strengthened the rationale for a local evaluation while preventing overstatement of local prevalence.

Previous research provides a basis for investigating mung bean-based supplementary foods. Maria and Risnawati studied 24 children under five whose weights fell below the red line on their growth monitoring charts, comparing modisco-enriched mung bean porridge with mung bean porridge over approximately two months, with albumin levels and body weight as outcomes⁵. However, the benefits of the modisco formulation cannot be attributed solely to mung beans because it contained

additional ingredients. Furthermore, increases in body weight or albumin levels do not, by themselves, demonstrate improved linear growth or reduced stunting risk. These findings leave unanswered questions about the effects of a standardized mung bean porridge formulation when nutritional status and linear growth indicators are assessed concurrently¹³.

Research on mung bean porridge should distinguish the amount offered from the amount consumed. If eaten in addition to the habitual diet, the porridge may increase energy and amino-acid availability for tissue accretion, while iron, folate, thiamine, and other micronutrients may support metabolism and hematopoiesis. Nevertheless, plant protein quality, phytate-related mineral bioavailability, displacement of usual foods, infection, inflammation, age, and baseline nutritional status may modify the growth response¹⁴. Consequently, a food supplement cannot be assumed to prevent or reverse stunting without sustained intake, adequate dietary diversity, infection control, and sufficiently long follow-up.

Previous studies have shown that complementary foods can influence child growth, but most evaluated fortified products or animal-source foods in younger infants and over longer periods^{15,16}. It remained uncertain whether a locally prepared mung bean porridge could improve short-term growth among children aged 12-59 months in this Indonesian community. The prespecified primary outcome was post-intervention HAZ adjusted for baseline HAZ. Secondary outcomes were body weight, length/height, WAZ, WHZ, and individual transitions in stunting classification. The study hypothesized that the intervention group would have a higher adjusted post-intervention HAZ than the control group; analyses of secondary outcomes were supportive and interpreted separately.

MATERIALS AND METHODS

Study Design and Setting

This study was a parallel, two-group randomized controlled trial with baseline and immediate post-intervention measurements. It was conducted in Mongeudong Village, Banda Sakti District, Lhokseumawe City, Aceh, Indonesia. The source population comprised 365 children aged 12-59 months residing in the village. Seventy eligible children were enrolled and individually randomized in a 1:1 ratio to the intervention group (n=35) or control group (n=35) using a computer-generated random sequence. The intervention lasted eight weeks.

Sample-size determination: The available protocol did not document an a priori calculation, including the assumed effect size, alpha level, statistical power, or allowance for attrition. The final sample of 70 children represented the prespecified feasible sample recruited from the accessible population. A post hoc power calculation was not used as a substitute because it would not correct the absence of prospective justification. This limitation is reported transparently and should be considered when interpreting confidence intervals and nonsignificant comparisons.

Participants and Sampling

The target population comprised all children aged 12–59 months residing in Mongeudong Village. Participants were recruited using consecutive sampling. Children who met the eligibility criteria were consecutively recruited until the required sample size of 70 participants was achieved. The inclusion criteria were: (1) children aged 12–59 months; (2) residing in Mongeudong Village during the study period; (3) having a parent or primary caregiver who was willing to participate in the study; (4) being able to consume the supplementary food provided according to the intervention protocol; and (5) having written informed consent from a parent or legal guardian.

Children were excluded if they had severe medical conditions requiring intensive treatment, congenital conditions likely to affect growth assessment, or known allergies to an intervention ingredient. Eligible participants were assigned in a 1:1 ratio using a computer-generated sequence prepared before enrollment. The surviving study documentation did not identify who generated the sequence, enrolled participants, or implemented assignment, and it did not document the use of sequentially numbered opaque envelopes or another allocation-concealment mechanism. Allocation concealment and independence of these roles therefore cannot be confirmed. Participants who did not complete follow-up would have remained in their originally assigned group for the primary analysis whenever outcome data were available.

Intervention

The intervention group received mung bean porridge as supplementary food once daily for eight consecutive weeks. The porridge was provided in addition to the child's usual diet and was not intended to replace regular meals. Each serving was prepared using 25 g of dry mung beans, 50 mL of coconut milk, 15 g of granulated sugar, and potable water sufficient to produce a final volume of approximately 250 mL. This formulation was adapted from a previous Indonesian intervention involving malnourished children, which used 25 g of mung beans, 50 mL of coconut milk, and 15 g of sugar per daily serving¹⁷.

Before preparation, the mung beans were sorted to remove damaged beans and foreign materials, washed under clean running water, and soaked in potable water for approximately four hours. The soaked beans were drained and boiled in approximately 200 mL of potable water for 30–40 minutes until soft. The beans were then mashed to obtain a smooth consistency suitable for children aged 12–59 months. Coconut milk and sugar were added, and the mixture was simmered for approximately 5–10 minutes while being stirred continuously. Boiled water was added as necessary to obtain a final volume of approximately 250 mL. The porridge was allowed to cool to a safe feeding temperature before being transferred into a clean, covered, food-grade container.

Based on standard food-composition data, each serving was estimated to provide approximately 250-270 kcal, 6-7 g protein, 30-35 g carbohydrate, 10-12 g fat, 3-4 g dietary fiber, 1.5-

2.0 mg iron, 30-45 mg calcium, 70-90 micrograms folate, and 0.15-0.20 mg thiamine. The values were estimates rather than laboratory-confirmed measurements and varied with the coconut-milk concentration and cooking yield. The porridge was therefore classified as an energy- and protein-containing supplementary food, not a nutritionally complete meal.

The porridge was centrally prepared each morning using the same written recipe, ingredient source, calibrated weighing scale, measuring utensils, cooking duration, serving container, and distribution procedure. Food handlers washed their hands before preparation and used clean utensils, potable water, covered storage containers, and thoroughly cooked ingredients. Preparation and distribution were documented using daily production and distribution records.

One serving was administered during the mid-morning period, approximately 1.5–2 hours after breakfast, under caregiver supervision. Children were encouraged to consume the porridge within two hours after preparation. Caregivers were instructed not to share the serving with other household members and not to use it as a replacement for breakfast, lunch, dinner, breastfeeding, or other age-appropriate foods. The amount consumed was recorded as completely consumed, partially consumed, or not consumed. Where possible, the remaining amount was measured to estimate actual intake.

Porridge that had remained at room temperature for more than two hours, had been visibly contaminated, or had not been consumed within the permitted period was discarded and was not reheated or served again. Containers and utensils were washed with detergent and clean running water after each use. Caregivers also recorded vomiting, diarrhea, abdominal discomfort, allergic reactions, refusal, or other adverse responses occurring after consumption. Participants with suspected adverse reactions were evaluated by the designated healthcare professional, and further administration was suspended when clinically indicated.

The control group did not receive mung bean porridge from the research team and continued to receive routine health and nutrition services available in the community. Household consumption of mung bean porridge was not prohibited because doing so would interfere with usual dietary practices. Caregivers in both groups were asked to record supplementary foods, nutritional products, dietary counselling, or other nutrition interventions received during follow-up so that potential co-interventions could be identified.

Anthropometric Assessment

Anthropometric measurements were performed at baseline and immediately after the eight-week intervention by trained assessors using the same equipment at both assessments. Body weight was measured with a digital pediatric scale to the nearest 0.1 kg; recumbent length and standing height were measured with a length board or stadiometer to the nearest 0.1 cm. Instrument brands and model numbers were not retained in the available study documentation. The scale was zeroed

before each child and checked against a known standard weight before each measurement session; the length board and stadiometer were checked for stable placement and zero alignment. Each measurement was obtained twice, and a third was obtained when weight differed by more than 0.1 kg or length/height by more than 0.5 cm; the mean of the two closest measurements was analyzed. Formal intra- and inter-observer reliability coefficients were not calculated, which is acknowledged as a limitation.

Anthropometric measurements were converted into age- and sex-standardized z-scores using the WHO Child Growth Standards. The primary outcome was post-intervention LAZ/HAZ adjusted for baseline LAZ/HAZ. Secondary continuous outcomes were body weight, recumbent length or standing height, WAZ, and WHZ. The secondary categorical outcome was individual transition in stunting classification. Stunting was defined as LAZ/HAZ < -2 SD. No biochemical outcome was measured.

Intervention Adherence and Monitoring

Adherence to the intervention was monitored throughout the 8-week intervention period. Parents or caregivers were instructed to record the consumption of the mung bean porridge. The research team periodically monitored compliance and documented missed administrations and relevant difficulties in consuming the supplementary food. Episodes of illness, including diarrhea, fever, respiratory infections, or other conditions that could affect appetite and nutritional status, were recorded during the intervention period.

Potential Confounding Variables

Child age, sex, baseline anthropometry, and baseline stunting classification were available for analysis. Routine monitoring forms recorded whether intercurrent illness or another nutrition program was reported during follow-up, but the dataset did not contain analyzable frequencies, duration, or severity. Habitual dietary intake was not quantified using a validated 24-hour recall, food-frequency questionnaire, or weighed-food record; socioeconomic and maternal characteristics were also unavailable. These factors were therefore not included as covariates and are treated as potential residual confounders rather than measured variables.

Data Quality Control

Data quality was maintained through standardized training of research personnel responsible for anthropometric measurements and intervention monitoring. Anthropometric instruments were checked and calibrated before data collection. The same measurement procedures were applied during baseline and post-intervention assessments. Data collection forms were reviewed for completeness after each assessment. The research team also monitored adherence to the intervention and documented any deviations from the intervention protocol.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 27. The normality of continuous variables was assessed using the Shapiro–Wilk test. Normally distributed continuous variables were presented as mean $\pm$ standard deviation (SD), whereas non-normally distributed variables were presented as median and interquartile range (IQR). Categorical variables were presented as frequencies and percentages.

Baseline characteristics between the intervention and control groups were compared to assess group comparability. The independent-samples t-test was used for normally distributed continuous variables, whereas the Mann–Whitney U test was used for non-normally distributed variables. Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate.

Within-group changes from baseline to post-intervention were assessed using paired-samples t-tests for normally distributed variables or Wilcoxon signed-rank tests for non-normally distributed variables. The primary analysis followed the intention-to-treat principle: all randomized participants were analyzed in their assigned groups. Because all 70 participants had baseline and post-intervention anthropometric data, no outcome data were missing, and no imputation was required. The intervention effect on each continuous post-intervention outcome was evaluated using ANCOVA, with group as the independent variable and the corresponding baseline value as a covariate. No additional covariates were included because quantitative dietary, socioeconomic, maternal, adherence-dose, and illness data were unavailable.

The intervention effect on continuous outcomes was reported as an adjusted mean difference (AMD) with a 95% confidence interval (CI) and p-value. Children were classified as stunted (LAZ/HAZ < -2 SD) or not stunted (LAZ/HAZ ≥ -2 SD). Individual transitions between baseline and posttest were tabulated as stunted-to-stunted, stunted-to-not stunted, not stunted-to-stunted, and not stunted-to-not stunted. Within-group paired changes were examined using the exact McNemar test. The proportion of baseline-stunted children who transitioned to non-stunted status was compared directly between randomized groups using Fisher's exact test, with an odds ratio and 95% CI. All tests were two-sided and $p < 0.05$ was considered statistically significant.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Health Research Ethics Committee of the Health Workforce Education and Training Association-Health Scientific Progress (KEPK PROMISE), approval number 037/PROMISE/KEPK/II/2026. Written informed consent was obtained from a parent or legal guardian before enrollment. Participation was voluntary, and withdrawal did not affect access to routine services.

RESULTS

Table 1. Baseline characteristics of children in the intervention and control groups

Characteristic	Intervention (n = 35)	Control (n = 35)	p-value
Age, months, mean $\pm$ SD	31.2 $\pm$ 8.4	30.7 $\pm$ 8.1	0.801
Sex, n (%)			0.806
Male	18 (51.4)	19 (54.3)	
Female	17 (48.6)	16 (45.7)	
Body weight, kg, mean $\pm$ SD	9.8 $\pm$ 1.4	9.7 $\pm$ 1.5	0.778
Length/height, cm, mean $\pm$ SD	80.4 $\pm$ 6.2	80.1 $\pm$ 6.5	0.844
HAZ, mean $\pm$ SD	-1.95 $\pm$ 1.00	-1.90 $\pm$ 1.10	0.842
WAZ, mean $\pm$ SD	-1.20 $\pm$ 0.82	-1.18 $\pm$ 0.87	0.923
WHZ, mean $\pm$ SD	-0.55 $\pm$ 0.91	-0.51 $\pm$ 0.94	0.860
Stunted at baseline, n (%)	17 (48.6)	16 (45.7)	0.811

A total of 70 children aged 12–59 months were included in the analysis, consisting of 35 children in the intervention group and 35 children in the control group. All participants completed the baseline and post-intervention anthropometric assessments. The intervention group received mung bean porridge as supplementary food for 8 weeks, while the control group continued to receive routine health and nutrition services.

Table 1 presents the baseline characteristics. Mean age was 31.2 $\pm$ 8.4 months in the intervention group and 30.7 $\pm$ 8.1 months in the control group; boys constituted 51.4% and 54.3%, respectively. Seventeen children (48.6%) in the intervention group and 16 (45.7%) in the control group were stunted at baseline. No statistically significant baseline differences were observed in the characteristics available for analysis. Dietary intake, household socioeconomic status, maternal characteristics, detailed illness history, and co-interventions were not available as analyzable baseline variables and are not presented as if measured.

Table 2. Anthropometric outcomes before and after the 8-week intervention

Outcome	Intervention (n = 35)	Control (n = 35)
Body weight, kg		
Baseline, mean $\pm$ SD	9.8 $\pm$ 1.4	9.7 $\pm$ 1.5
Posttest, mean $\pm$ SD	10.6 $\pm$ 1.4	10.0 $\pm$ 1.5
Length/height, cm		
Baseline, mean $\pm$ SD	80.4 $\pm$ 6.2	80.1 $\pm$ 6.5
Posttest, mean $\pm$ SD	82.0 $\pm$ 6.1	81.2 $\pm$ 6.4
HAZ		
Baseline, mean $\pm$ SD	-1.95 $\pm$ 1.00	-1.90 $\pm$ 1.10
Posttest, mean $\pm$ SD	-1.70 $\pm$ 0.95	-1.78 $\pm$ 1.05
WAZ		
Baseline, mean $\pm$ SD	-1.20 $\pm$ 0.82	-1.18 $\pm$ 0.87
Posttest, mean $\pm$ SD	-0.86 $\pm$ 0.79	-1.01 $\pm$ 0.84
WHZ		
Baseline, mean $\pm$ SD	-0.55 $\pm$ 0.91	-0.51 $\pm$ 0.94

Outcome	Intervention (n = 35)	Control (n = 35)
Posttest, mean $\pm$ SD	-0.20 $\pm$ 0.88	-0.34 $\pm$ 0.91

Table 2 shows the anthropometric measurements before and after the 8-week intervention. In the intervention group, mean body weight increased from 9.8 $\pm$ 1.4 kg at baseline to 10.6 $\pm$ 1.4 kg after the intervention. In the control group, mean body weight increased from 9.7 $\pm$ 1.5 kg to 10.0 $\pm$ 1.5 kg. Mean length/height increased from 80.4 $\pm$ 6.2 cm to 82.0 $\pm$ 6.1 cm in the intervention group and from 80.1 $\pm$ 6.5 cm to 81.2 $\pm$ 6.4 cm in the control group. The HAZ also increased in both groups, with a greater improvement observed in the intervention group. The mean HAZ increased from -1.95 $\pm$ 1.00 to -1.70 $\pm$ 0.95 in the intervention group, compared with an increase from -1.90 $\pm$ 1.10 to -1.78 $\pm$ 1.05 in the control group.

Table 3. Within-group changes in anthropometric outcomes from baseline to posttest

Outcome	Intervention: Mean change $\pm$ SD	p-value	Control: Mean change $\pm$ SD	p-value
Body weight, kg	0.80 $\pm$ 0.45	<0.001	0.30 $\pm$ 0.40	<0.001
Length/height, cm	1.60 $\pm$ 0.70	<0.001	1.10 $\pm$ 0.60	<0.001
HAZ	0.25 $\pm$ 0.25	<0.001	0.12 $\pm$ 0.22	0.004
WAZ	0.34 $\pm$ 0.27	<0.001	0.17 $\pm$ 0.24	0.001
WHZ	0.35 $\pm$ 0.31	<0.001	0.17 $\pm$ 0.28	0.001

The within-group analysis is presented in Table 3. In the intervention group, body weight, length/height, HAZ, WAZ, and WHZ increased from baseline (all $p < 0.001$). In the control group, body weight ($p < 0.001$), length/height ($p < 0.001$), HAZ ($p = 0.004$), WAZ ($p = 0.001$), and WHZ ($p = 0.001$) also increased. These paired within-group findings do not by themselves demonstrate an intervention effect; inference regarding between-group differences was based on the baseline-adjusted ANCOVA results.

The mean changes were consistently larger in the intervention group, but comparison of change magnitudes was not based on the separate within-group p -values.

Table 4. Adjusted effect of mung bean porridge on post-intervention anthropometric outcomes

Outcome	Adjusted mean difference	95% CI	p-value
Body weight, kg	0.48	0.25 to 0.71	<0.001
Length/height, cm	0.45	0.14 to 0.76	0.005
HAZ	0.13	0.01 to 0.25	0.036
WAZ	0.16	0.02 to 0.30	0.026
WHZ	0.15	-0.01 to 0.31	0.068

Table 4 presents the ANCOVA results adjusted for the corresponding baseline outcome. Adjusted mean differences favoring the intervention group were 0.48 kg for body weight (95% CI: 0.25-0.71; $p < 0.001$), 0.45 cm for length/height (95% CI: 0.14-0.76; $p = 0.005$), 0.13 for HAZ (95% CI: 0.01-0.25;

$p=0.036$), and 0.16 for WAZ (95% CI: 0.02-0.30; $p=0.026$). The adjusted WHZ difference was 0.15 (95% CI: -0.01-0.31; $p=0.068$) and was not statistically significant. Each child was offered one standardized serving daily; however, quantitative totals for the amount actually consumed, percentage adherence, illness episodes, and household co-interventions were not available in the analytic dataset. Consequently, dose-response and per-protocol analyses were not performed.

Table 5. Individual transitions in stunting classification from baseline to post-intervention and direct between-group comparison

Individual transition in stunting status	Intervention, n (%)	Control, n (%)
Stunted to stunted	9 (25.7)	14 (40.0)
Stunted to not stunted	8 (22.9)	2 (5.7)
Not stunted to stunted	1 (2.9)	0 (0.0)
Not stunted to not stunted	17 (48.6)	19 (54.3)
Total	35 (100.0)	35 (100.0)
Exact McNemar p-value	0.039	0.500
Recovery among children stunted at baseline	8/17 (47.1)	2/16 (12.5)
Direct between-group comparison	Fisher exact $p=0.057$; OR=6.22	Exact 95% CI=0.89-69.22

Table 5 presents individual changes in stunting classification. In the intervention group, 8 of 17 children (47.1%) who were stunted at baseline transitioned to non-stunted status, 9 remained stunted, 1 transitioned from not stunted to stunted, and 17 remained not stunted. In the control group, 2 of 16 baseline-stunted children (12.5%) transitioned to non-stunted status, 14 remained stunted, no child transitioned from not stunted to stunted, and 19 remained not stunted. The exact McNemar test indicated within-group change in the intervention group ($p=0.039$) but not in the control group ($p=0.500$). The direct between-group comparison of recovery among children stunted at baseline did not reach statistical significance (Fisher's exact $p=0.057$; OR=6.22, exact 95% CI: 0.89-69.22). Therefore, the different within-group p-values should not be interpreted as proof of a between-group intervention effect on stunting classification.

DISCUSSION

This randomized study achieved its objective of estimating short-term anthropometric differences after eight weeks of supplementation. Baseline-adjusted body weight, length/height, WAZ, and HAZ were higher in the intervention group, whereas WHZ was not significantly different. The adjusted HAZ difference was 0.13 (95% CI: 0.01-0.25). Although statistically significant, its clinical importance is uncertain because no minimal clinically important difference was prespecified, the confidence interval approached zero, and follow-up was brief. The direct comparison of recovery among children stunted at baseline was also nonsignificant. The results therefore indicate an

association between randomized assignment and selected short-term anthropometric outcomes, not demonstrated prevention or reversal of stunting.

Comparison with prior trials requires attention to intervention and population differences. Christian et al¹⁸. supplied fortified chickpea-, rice-lentil-, wheat-soy-, or lipid-based foods daily from 6 to 18 months and reported endline LAZ advantages of approximately 0.07-0.10¹⁸. Iannotti et al. provided one egg daily for six months to Ecuadorian infants and reported a 0.63 LAZ increase and reduced stunting prevalence⁷. Krebs et al. compared meat with an energy-matched fortified cereal from 6 to 18 months across four countries and found no between-group difference in linear growth velocity⁶. Meta-analytic evidence for small-quantity lipid-based supplements also indicates modest average reductions in stunting rather than uniform recovery^{8,9}. These studies differ from the present trial in age, baseline nutritional status, nutrient density, food matrix, intervention duration, adherence support, and comparator; their effect estimates are not directly exchangeable with the 0.13 HAZ difference observed here.

Across studies, the common element was provision of an additional food with anthropometric follow-up, whereas dose, nutrient composition, duration, comparator, and outcome timing differed substantially^{8,9}. The present trial included children aged 12-59 months and lasted only eight weeks, compared with six months in the egg trial and approximately one year in the fortified-food and meat-versus-cereal trials. Eight weeks may detect short-term weight change and modest movement in standardized scores, but it is insufficient to establish sustained catch-up growth or recovery from chronic linear growth deficits. Movement across the HAZ -2 threshold may reflect a small score change near the cutoff and does not necessarily represent durable recovery. Longer follow-up with repeated growth-velocity measurements is required.

A plausible explanatory pathway is that the offered supplement increased energy and nutrient availability when consumed in addition to regular meals. Mung bean protein, carbohydrate, fiber, folate, thiamine, and iron, together with energy from coconut milk and sugar, could support tissue accretion and metabolic processes^{4,19}. However, this mechanism was not demonstrated because actual intake, dietary displacement, biomarkers, and adherence dose were not quantified. Improvements in the control group indicate contributions from normal growth, routine services, or unmeasured co-interventions. The findings should therefore be attributed to assignment to the overall supplementation package under study conditions, not to a proven mung-bean-specific biochemical effect.

The absence of a significant adjusted WHZ difference is compatible with concurrent gains in both weight and length/height, because WHZ represents weight relative to body length rather than either dimension alone. Plant-based supplementation may also produce variable responses because protein digestibility and mineral bioavailability are influenced by food preparation and phytate, while

infection and inflammation can redirect nutrients away from growth^{19–21}. These explanations are biologically plausible but were not tested in this trial. The offered formulation and estimated nutrient content are now reported, but the consumed dose remains unknown; consequently, no dose-response inference is justified.

Relationships among the study variables should be distinguished from statistically demonstrated correlations. Group-level increases in WAZ and HAZ do not establish that children with the greatest weight gains also experienced the largest increases in HAZ, because individual-level correlation analyses were not reported. Furthermore, WAZ and WHZ both incorporate body weight and are therefore not entirely independent indicators. Biologically, linear growth is influenced by interactions among dietary intake, health status, and hormonal regulation. Prendergast et al. found that inflammation in infants was associated with lower insulin-like growth factor-1 concentrations and impaired growth²². These findings provide a biological rationale for considering infection as a factor that may limit responses to supplementary feeding. However, inflammatory markers and growth-related hormones were not measured in the present study, so this biological pathway remains a theoretical explanation.

The findings support further evaluation of locally available supplementary foods within services using standardized recipes, food-safety controls, consumption measurement, and repeated growth assessment. They do not yet justify presenting mung bean porridge as an effective stand-alone treatment or prevention strategy for stunting. Limitations include the small feasibility-based sample without a documented prospective power calculation, single setting, incompletely documented allocation concealment and role separation, absence of assessor blinding, unrecorded instrument models, no formal observer-reliability coefficients, short follow-up, and unavailable quantitative data on habitual diet, socioeconomic and maternal factors, illness, adherence dose, and co-interventions. These limitations allow residual confounding, restrict mechanistic interpretation, and limit inference to short-term anthropometric outcomes.

CONCLUSION

Eight weeks of mung bean porridge supplementation was associated with higher baseline-adjusted body weight, length/height, WAZ, and HAZ than routine care, whereas WHZ was not significantly different. The small HAZ difference represents a short-term anthropometric change whose clinical importance and persistence are uncertain. The study did not establish a significant between-group improvement in stunting classification and should not be interpreted as demonstrating prevention or treatment of stunting. Larger, prospectively powered trials with concealed allocation, blinded outcome assessment, quantified intake and adherence, relevant covariate measurement, and longer follow-up are required.

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