ONLINE FIRST

ORIGINAL ARTICLE

Effectiveness of the Kampung Bunga Program in Accelerating Stunting Reduction in Central Lampung Regency, Indonesia

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doi: 10.22442/jlumhs.2026.01497

ABSTRACT

OBJECTIVE: This study evaluated the association of the Kampung Bunga program in accelerating stunting reduction in Central Lampung Regency.

METHODOLOGY: A cross-sectional study was conducted from May 2025 to February 2026 involving 563 children aged 0–59 months in Central Lampung Regency. The stunting group comprised 138 children, while the non-stunting group comprised 425. The sample was recruited using a multistage cluster sampling technique. Anthropometric measurements, structured questionnaires, and maternal health records were used for data collection. Clinical nutritional indicators were measured and calculated, including height-for-age z-scores (HAZ), weight-for-age z-scores (WAZ), and mid-upper arm circumference(MUAC). Maternal-related risk factors included education level, antenatal care (ANC) attendance, exclusive breastfeeding practices, and nutritional status during pregnancy. Community health intervention variables included participation in Kampung Bunga program activities. Chi-square tests, independent t- tests, and multivariate logistic regression were performed as appropriate for the data, with statistical significance set at $P < 0.05$.

RESULTS: The prevalence of stunting was lower among program participants (18.3%) than among the non-participants (31.7%; $P < 0.001$). Multivariate analysis found that Kampung Bunga participation (AOR = 0.42; 95% CI: 0.28–0.63), complete ANC visits (AOR = 0.51; 95% CI: 0.34–0.76), exclusive breastfeeding (AOR = 0.47; 95% CI: 0.31–0.71), and higher maternal education were identified as significant protective factors against stunting ($P < 0.05$).

CONCLUSION: Stunting prevalence was significantly lower among participants of the integrated community-based nutritional intervention. We recommend scaling up this intervention in parallel with the continued strengthening of maternal education and antenatal care services to accelerate stunting reduction.

KEYWORDS: Stunting, Community Health Intervention, Maternal Risk Factors, Nutritional Indicators

INTRODUCTION

Stunting, defined as a height-for-age z-score standard deviation from the World Health Organization (WHO) Child Growth Standards median, is one of the most prevalent forms of chronic malnutrition worldwide[1,2]. This status indicates that the child has suffered too long from poor nutrition, repeated infections and inadequate psychosocial stimulation in the first 1,000 days of life[3]. Worldwide, there are estimated to be 149 million stunted children under five years of age, the vast majority living in Asia and Africa[4].

Indonesia has one of the highest prevalences of childhood stunting in Southeast Asia, with the most recent estimates indicating that two out of five children suffer from chronic malnutrition[5]. National survey data suggest that the prevalence of stunting in Indonesia remains a serious public health problem at 29.6%, well above the World Health Organization (WHO) limit[6].

There are important regional disparities within Indonesia, with rural areas always showing a higher prevalence of stunting than urban settings. Lampung Province, located in South Sumatra, has experienced ups and downs in its stunting rate, and several districts have seen their number of stunted children rise sharply over the past few years. Central Lampung Regency, which has a demographic composition dominated by rural communities, is classified as a stunting priority area for intervention.

Stunting has a multifactorial etiology with immediate, underlying, and structural determinants[7]. At the immediate level, low dietary intake and infectious diseases are direct impediments to linear growth and development among children[8]. The root causes include household food insecurity, inappropriate feeding and care practices for mothers and young children, and low access to health services and sanitation[9]. Maternal-related factors have always been shown to be one of the most important predictors of child stunting according to various studies with different cultural backgrounds[10].

Community-based approaches are effective in addressing the multifaceted drivers of child stunting[11]. These programs tend to combine anthropometric and dietary assessments, nutritional advice, education for mothers or caregivers, and action across other sectors that families rely on for their well-being to create an environment conducive to child growth. In Indonesia, the government has made preventing stunting a priority through multiple national and local programs, particularly targeted nutritional interventions during the first 1,000 days of life. The Kampung Bunga Program is a community health action in Central Lampung Regency, a recently locally developed program to accelerate stunting reduction, which consists of growth monitoring and nutritional supplementation for children 0-59 months, maternal health education, improving environmental sanitation practices towards open defecation-free (ODF) communities, and simultaneously graduated through a community empowerment strategy.

Although community-based interventions to prevent child stunting have been widely implemented in Indonesia, limited empirical evidence exists for this strategy in specific local contexts. Previous studies in Lampung Province have identified risk factors for stunted growth, such as exclusive breastfeeding, maternal nutritional status, and maternal education. However, to our knowledge, no study has directly assessed the clinical impact of the Kampung Bunga program on nutrition-related indicators or stunting. Therefore, this study aimed to evaluate the clinical nutritional indicators, maternal risk factors, and community health intervention participation in a setting comparing children aged 0–59 months in participating versus non-participating areas in Central Lampung Regency.

METHODOLOGY

Study Design and Setting

This study used a cross-sectional analytical design in Central Lampung Regency, Lampung Province, Indonesia. Central Lampung Regency consists of several sub-districts that differ in terms of health infrastructure status and level of socioeconomic development. The Kampung Bunga program has also been applied to selected villages in the regency, allowing for comparisons of outcomes between communities that received a project and others that did not.

Population and Sample

The study population comprised all children aged 0–59 months who resided in Central Lampung Regency. A total of 563 mother-child pairs were recruited using a multistage cluster sampling technique. In the first stage, the sub-districts were stratified based on the Kampung Bunga program implementation status (participating versus non-participating). In the second stage, the villages were randomly selected from each stratum. In the third stage, eligible mother-child pairs were systematically sampled from village health post registries. The sample size was calculated using the formula for comparing two proportions, assuming a stunting prevalence of 30% in non-participating areas and 20% in participating areas, with 80% power, 95% confidence level, and a design effect of 1.5, yielding a minimum required sample of 540, which was rounded to 563 to account for potentially incomplete responses.

The inclusion criteria were as follows: (1) children aged 0–59 months at the time of data collection; (2) permanent residence in the study area for 6 months or more; and (3) willingness to provide informed consent from mothers. The exclusion criteria were as follows: children with congenital anomalies or chronic diseases affecting growth, children suffering from severe acute illness at the time of assessment, and incomplete anthropometric data.

Data Collection

Trained research officers, including nutritionists and midwives, collected data using standardized training on anthropometric measurement methods and administration of questionnaires between Nov 2025 and May 2026. The data collection instruments included:

Anthropometric measurements: Length/height of the child was measured using an infantometer (for children < 24 months) and a stadiometric ruler (for children ≥ 24 months) to the nearest 0.1 cm. Body weight was measured using digital scales calibrated to the nearest 0.1 kg [weight]. Mid-upper arm circumference was measured to the nearest 0.1 cm using MUAC tape. Duplicate measurements were performed, and the mean value was recorded. Z-scores for height-for-age (HAZ), weight-for-age (WAZ), and weight-for-height were generated based on the 2006 WHO Child Growth Standards using WHO Anthro. We defined stunting as HAZ < −2 standard deviations (SD).

Structured questionnaire: A structured questionnaire was developed and administered through face-to-face interviews with mothers to collect information on sociodemographic characteristics (maternal age, education, occupation, household income, and family size), maternal health factors (ANC attendance, nutritional status during pregnancy, and history of complications), child feeding practices (exclusive breastfeeding, complementary feeding initiation, and dietary diversity), child health history (immunization status and history of infectious diseases), and

participation in the Kampung Bunga program (enrolment status, duration of participation, and types of activities attended).

Before data collection, the questionnaire was pretested among 30 mothers with children aged 6–59 months in Bandar Lampung, an area with similar characteristics to the study site but not included in the final sample. The pilot study was conducted to assess the clarity, comprehensibility, and appropriateness of the questionnaire items. Based on the pilot study results, a panel of three experts in public health and nutrition evaluated content validity, yielding a Content Validity Index (CVI) of 0.92, indicating acceptable content validity. Internal consistency reliability was assessed using Cronbach's alpha coefficient. The overall reliability of the questionnaire was $\alpha = 0.81$, with subscale values ranging from 0.71 to 0.80 for the respective domains, all exceeding the acceptable threshold of 0.70. Item-total correlations were examined, and items with correlation coefficients below 0.30 were revised or removed. Minor modifications in wording and question sequencing were made based on feedback from the pilot respondents to improve clarity before final administration.

Health record review: Maternal and child health books were reviewed to verify ANC attendance records, birth weight, birth length, and immunization history.

Variables

The outcome variable was stunting status, defined as a binary variable (stunted: yes/no) based on height-for-age z-score (HAZ) < -2 standard deviations according to WHO Child Growth Standards. The independent variables were classified into three domains: (1) sociodemographic characteristics, including child sex (male/female), child age (0–23/24–59 months), maternal education (low ≤ primary/middle secondary/high tertiary), maternal age (< 20/20–35/> 35 years), household income (below/above minimum wage), and participation in the Kampung Bunga program (yes/no); (2) clinical and anthropometric indicators, including birth weight (low birth weight < 2,500 g/normal ≥ 2,500 g), birth length (< 48 cm/≥ 48 cm), and maternal nutritional status during pregnancy assessed by mid-upper arm circumference (MUAC < 23.5 cm indicating chronic energy deficiency/MUAC ≥ 23.5 cm normal); and (3) child health and nutrition practices, including exclusive breastfeeding (yes/no), antenatal care visits (incomplete < 4/complete ≥ 4), immunization status (incomplete/complete), and dietary diversity (inadequate/adequate).

Data Analysis

The data were entered into EpiData 3.1, and the analyses were performed using SPSS version 26.0 software. Descriptive statistics were reported as frequencies and percentages for categorical variables and means with standard deviation for continuous variables. Bivariate analysis was performed using chi-square tests for categorical variables, and independent t-tests or Mann-Whitney U tests for continuous variables. In this step, the backward stepwise method was used to enter the multivariate binary logistic regression ($p < 0.25$ in the bivariate analysis). AORs were reported with 95% confidence intervals (CIs). Statistical significance was set at $P < 0.05$. Variance inflation factors were used to check for multicollinearity, and goodness of fit was assessed using the Hosmer-Lemeshow test.

Ethical Considerations

This study was approved by the Tanjung Karang Ministry of Health Polytechnic (approval number: No. 822/KEPK-TJK/XI/2025.

RESULTS

The results in **Table I** indicate that child age, maternal education, maternal age, household income, and participation in the Kampung Bunga program were all associated with stunting status ($p < 0.05$). Stunting was significantly more prevalent in children aged 24–59 months than in younger children (28.7% vs 18.4%, $p = 0.003$). The highest prevalence (36.4%) of stunting was found among children whose mothers had low levels of education. In comparison, the lowest prevalence (15.1 %) was found among those whose mothers had high levels of education ($p < 0.001$).

Table I: Distribution of Sociodemographic Characteristics and Stunting Status (N = 563)

Variable	Category	Total n (%)	Stunted n (%)	Not Stunted n (%)	P-value*
Child sex	Male	293 (52.0)	78 (26.6)	215 (73.4)	0.142
	Female	270 (48.0)	60 (22.2)	210 (77.8)	
Child age (months)	0–23	228 (40.5)	42 (18.4)	186 (81.6)	0.003
	24–59	335 (59.5)	96 (28.7)	239 (71.3)	
Maternal education	Low (≤ primary)	187 (33.2)	68 (36.4)	119 (63.6)	< 0.001
	Middle (secondary)	224 (39.8)	47 (21.0)	177 (79.0)	
	High (tertiary)	152 (27.0)	23 (15.1)	129 (84.9)	
Maternal age (years)	< 20	42 (7.5)	16 (38.1)	26 (61.9)	0.038
	20–35	438 (77.8)	99 (22.6)	339 (77.4)	
	> 35	83 (14.7)	23 (27.7)	60 (72.3)	
Household income	Below minimum wage	246 (43.7)	82 (33.3)	164 (66.7)	< 0.001
	Above minimum wage	317 (56.3)	56 (17.7)	261 (82.3)	
Kampung Bunga participation	Yes	298 (52.9)	55 (18.5)	243 (81.5)	< 0.001
	No	265 (47.1)	83 (31.3)	182 (68.7)	

*Chi-square test was used for all the categorical variables. The significance level was set at $p < 0.05$.

Table II shows that all clinical nutritional parameters and a large number of maternal risk factors were significantly associated with stunting. Children with low birth weight had 3.35 times higher

odds of stunting than those with normal birth weight ($p < 0.001$). For example, non-exclusive breastfeeding was associated with nearly 2.5 times higher odds of stunting ($P < 0.001$). Never receiving ANC had 2.67 times higher odds ($P < 0.001$), and maternal chronic energy deficiency during pregnancy had 2.39 times higher odds of stunting ($P < 0.001$).

Table II: Association between Clinical Nutritional Indicators, Maternal Risk Factors, and Stunting Status (N = 563)

Variable	Category	Stunted n (%)	Not Stunted n (%)	OR (95% CI)	P-value
Birth weight	LBW (< 2500 g)	28 (50.0)	28 (50.0)	3.35 (1.91–5.87)	< 0.001*
	Normal (≥ 2500 g)	110 (21.7)	397 (78.3)	Ref	
Birth length	< 48 cm	39 (41.5)	55 (58.5)	2.65 (1.67–4.21)	< 0.001*
	≥ 48 cm	99 (21.1)	370 (78.9)	Ref	
Exclusive breastfeeding	No	84 (33.9)	164 (66.1)	2.48 (1.71–3.60)	< 0.001*
	Yes	54 (17.1)	261 (82.9)	Ref	
ANC visits	Incomplete (< 4)	52 (38.5)	83 (61.5)	2.67 (1.77–4.03)	< 0.001*
	Complete (≥ 4)	86 (20.1)	342 (79.9)	Ref	
Maternal nutritional status during pregnancy	KEK (MUAC < 23.5 cm)	35 (39.8)	53 (60.2)	2.39 (1.48–3.85)	< 0.001*
	Normal (MUAC ≥ 23.5 cm)	103 (21.7)	372 (78.3)	Ref	
Immunization status	Incomplete	48 (34.3)	92 (65.7)	1.93 (1.28–2.91)	0.002*
	Complete	90 (21.3)	333 (78.7)	Ref	
Dietary diversity	Inadequate	62 (35.2)	114 (64.8)	2.22 (1.51–3.26)	< 0.001*
	Adequate	76 (19.6)	311 (80.4)	Ref	

*Chi-square test; OR = Odds Ratio; CI = Confidence Interval; Ref = Reference category.

Table III presents the final multivariate model, which demonstrated an adequate fit (Hosmer-Lemeshow $\chi^2 = 6.842$, $p = 0.554$). A backward stepwise binary logistic regression was employed, and the final model explained 28.7% of the variance in stunting status (Nagelkerke

R^2 = 0.287). After adjusting for all covariates, all retained variables consistently functioned as protective factors against stunting (AOR < 1). Normal birth weight conferred the strongest protective effect, with 59% lower odds of stunting compared to low birth weight (AOR = 0.41; 95% CI: 0.22–0.76; p = 0.005). Kampung Bunga program participation was similarly protective, reducing the odds of stunting by 58% relative to non-participation (AOR = 0.42; 95% CI: 0.28–0.63; p < 0.001). Exclusive breastfeeding was associated with 53% lower odds of stunting compared to non-exclusive breastfeeding (AOR = 0.47; 95% CI: 0.31–0.71; p < 0.001). Complete antenatal care (ANC) visits (≥ 4 visits) reduced the odds of stunting by 49% compared to incomplete visits (AOR = 0.51; 95% CI: 0.34–0.76; p = 0.001). Higher maternal education was associated with 42% lower odds of stunting relative to lower education (AOR = 0.58; 95% CI: 0.39–0.86; p = 0.007). Adequate dietary diversity reduced the odds of stunting by 41% compared to inadequate diversity (AOR = 0.59; 95% CI: 0.38–0.91; p = 0.016). Finally, household income above the minimum wage was associated with 38% lower odds of stunting compared to income below the minimum wage (AOR = 0.62; 95% CI: 0.41–0.94; p = 0.024).

Table III: Multivariate Logistic Regression Analysis of Factors Associated with Stunting (N = 563)

Variable	B	AOR	95% CI	P-value
Kampung Bunga participation (Yes vs. No)	−0.868	0.42	0.28–0.63	< 0.001
Complete ANC visits (≥ 4 vs. < 4)	−0.673	0.51	0.34–0.76	0.001
Exclusive breastfeeding (Yes vs No)	−0.755	0.47	0.31–0.71	< 0.001
Maternal education (High vs Low)	−0.545	0.58	0.39–0.86	0.007
Birth weight (Normal vs LBW)	−0.892	0.41	0.22–0.76	0.005
Dietary diversity (Adequate vs Inadequate)	−0.531	0.59	0.38–0.91	0.016
Household income (Above vs Below minimum wage)	−0.478	0.62	0.41–0.94	0.024

Hosmer-Lemeshow test: χ^2 = 6.842, p = 0.554; Nagelkerke R^2 = 0.287. The backward stepwise binary logistic regression method was used. AOR, Adjusted Odds Ratio; CI = Confidence Interval.

DISCUSSION

This research provides evidence for the implementation of the Kampung Bunga program in decreasing the prevalence rate of stunting among children aged 0–59 months in Central Lampung Regency. The stunting prevalence for the special population estimates of 24.5% was lower than the national average, yet higher than the WHO threshold of 20%, indicating that stunting remains a serious public health issue in this area[12,13]. In particular, the significantly lower prevalence of stunting, especially among Kampung Bunga participants (18.3%) compared to non-participants (31.7%), was observed throughout the community-based nutritional intervention, substantially improving the acceleration of stunting reduction.

This result suggests that Kampung Bunga participation had the strongest negative association with stunting (AOR = 0.42) among the variables tested, based on multivariable logistic regression adjusted for child age, sex, maternal education, household income, and sanitation access. Participation was defined as a binary variable (ever/never participated in the program). This finding strengthens our assertion that community health interventions should continue to be redesigned to address uncontrolled multifactor determinants of stunting. The study results are consistent with previous systematic reviews showing that community-based nutritional programs, including growth monitoring, counseling, and supplementation, are significantly associated with improved nutrition outcomes in low- and middle-income settings [14,15]. Skills-based training provides an intensive, practice-based intervention package; thus, it is highly plausible that the observed association relates to its multimodal approach targeting multiple determinants,

The large preventive impact of full ANC attention (AOR = 0.51) is consistent with the meta-analytic investigation by Tari et al. THIS IS EXAMPLE OF (Tari et al. (2023) showed a lower risk of stunting in children who attended ANC multiple times compared to their non-attending counterparts (0.81 times, aOR = 0.81; 95% CI:01,72 – 0,90). Incomplete ANC was strongly associated with increased odds of low birth weight [pooled OR = 6.29, 95% CI: (2.11–18.82)], which is a key risk factor for later stunting. ANC visits also help to scale up nutritional counseling, iron-folic acid supplementation, and early diagnosis of pregnancy complications, which ensure favorable fetal growth and reduce the risk of stunting [18,19].

One important finding was the effect of exclusive breastfeeding (AOR = 0.47). Toddlers who were exclusively breastfed had a reduced risk of stunting (exclusive breastfeed vs non-exclusive breastfeed: aOR = 0.54; 95% CI: 0.35–0.85). Exclusive breastfeeding was significantly associated with stunting (OR = 11.111; $p < 0.001$). The first six months of life, during which exclusive breastfeeding offers ideal nutrition and immunological support, is a critical period for preventing growth faltering[20].

Higher maternal education (AOR = 0.58) has been consistently identified as a protective factor against childhood stunting in the literature. In the present study, children of mothers with low education (primary level or below) had significantly higher odds of stunting compared to those with secondary education or above (aOR = 3.01; 95% CI: 1.92–4.73). This finding aligns with studies, which reported maternal education as one of the most frequently identified predictors of stunting across multiple studies[21,22]. These findings support investing in education for females as a means of reducing stunting over the long term.

The association of low birth weight with stunting (AOR = 0.41 for normal birth weight) is well known and reflects the link between intrauterine growth restriction and postnatal growth faltering. In the coastal areas of Indonesia, low birth weight conferred a nearly 4·5-fold increased

risk of stunting[23]. Our results highlight the significance of prenatal interventions aimed at maternal nutrition and health as a way to prevent low birth weight and its downstream effects.
Better dietary diversity, measured using the Minimum Dietary Diversity (MDD) indicator for children aged 6–23 months based on WHO/UNICEF guidelines, was independently protective against stunting (AOR = 0.59). This finding corroborates evidence from the Indian subcontinent demonstrating strong associations between low dietary diversity scores and poor linear growth outcomes, including stunting [24,25]. These findings further support the importance of programs promoting the consumption of a diverse diet among young children as part of comprehensive stunting prevention strategies.

CONCLUSION

The Kampung Bunga program is significantly associated with a reduction in the prevalence of stunting in children aged 0–59 months in Central Lampung Regency. Compared with nonparticipants, participants had 58% lower odds of stunting after adjusting for potential confounders. Other independent protective factors included attending all recommended antenatal care visits, being exclusively breastfed, higher maternal education, normal birth weight, adequate dietary diversity, and higher household income. The community-based model of the program, which integrates growth monitoring, nutritional counseling (ANC), maternal education, and environmental improvement, offers a good opportunity to accelerate the reduction of stunting in rural Indonesia. We recommend that policymakers scale the program up to further sub-districts, adapt its framework for use in comparable rural contexts throughout Indonesia, and make improvements to maternal education, universal access to quality antenatal care, and exclusive breastfeeding promotion as central components of their strategy against stunting.

Ethical Permission: Tanjung Karang, Ministry of Health Polytechnic, Indonesia, ERC approval letter No. 822/KEPK-TJK/XI/2025.
Conflict of interest: There is no conflict of interest between the authors.
Financial Disclosure / Grant Approval: No funding agency was involved in this research.
Data Sharing Statement: The corresponding author can provide the data supporting the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

AUTHOR CONTRIBUTION

Trigunarso SI: Conceptual framework and study design, the acquisition and management of data from multiple sources/methods to ensure robust data collection, the analysis using appropriate statistical techniques and interpretive frameworks, and the initial draft and revision of the manuscript to the final version.
Oktaviani I: Research design, data acquisition and curation, statistical/interpretive analysis, writing the initial draft, and substantial revisions and final approval.
Nugroho A: Conceptualization, multi-source data collection/curation, analysis, the initial draft, and the review and editing process.
Nurkhoiriyah Y: The design, data acquisition, analysis, writing, revision, and approval of the manuscript.
Sarlinda F: Conceptual design, data curation, analysis, drafting, revision, and final approval.

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