



Nutrition, active play, and caregiver psychoeducational guidance as predictors of early childhood stunting prevention: a rural-urban study in Indonesia

Nutrición, juego activo y orientación psicoeducativa para cuidadores como predictores de la prevención del retraso del crecimiento infantil: un estudio rural-urbano en Indonesia

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Abstract

Introduction: Early childhood stunting prevention requires more than nutritional intervention; it also involves caregiver behavior, early childhood physical activity, psychoeducational guidance, and local caregiving knowledge.

Objective: This study examined whether nutrition practices, active play practices, and caregiver psychoeducational guidance predicted early childhood stunting prevention behaviors in rural and urban/semi-urban communities in Indonesia.

Methodology: A quantitative cross-sectional comparative-predictive design was employed involving 300 caregivers of children aged 24–59 months, including 150 participants from a rural area and 150 from an urban/semi-urban area in Jombang Regency, Indonesia. Data were collected using structured questionnaires and analyzed using descriptive statistics, reliability testing, rural-urban comparison, correlation analysis, and hierarchical multiple regression.

Results: Urban/semi-urban caregivers reported higher psychoeducational guidance, nutrition practices, and stunting prevention behaviors than rural caregivers, while active play practices did not differ significantly. Nutrition practices were the strongest predictor, followed by caregiver psychoeducational guidance and active play practices, with the final model explaining 55% of the variance in stunting prevention behaviors.

Discussion: The findings suggest that prevention behaviors are shaped by integrated caregiving practices involving nutrition, movement opportunities, caregiver guidance, and local context.

Conclusion: Community-based prevention should combine adequate feeding, active play, caregiver guidance, and culturally grounded communication.

Keywords

Nutrition practices; active play practices; early childhood physical activity; psychoeducational guidance; stunting prevention.

Resumen

Introducción: La prevención del retraso del crecimiento en la primera infancia requiere más que intervenciones nutricionales; también implica el comportamiento de los cuidadores, la actividad física en la primera infancia, la orientación psicoeducativa y los conocimientos locales de crianza.

Objetivo: Este estudio examinó si las prácticas nutricionales, el juego activo y la orientación psicoeducativa para cuidadores predicen las conductas de prevención del retraso del crecimiento infantil en comunidades rurales y urbanas/semiurbanas de Indonesia.

Metodología: Se utilizó un diseño cuantitativo transversal, comparativo y predictivo con 300 cuidadores de niños de 24 a 59 meses: 150 de una zona rural y 150 de una zona urbana/semi-urbana del distrito de Jombang, Indonesia. Los datos se recopilaron mediante cuestionarios estructurados y se analizaron con estadística descriptiva, pruebas de fiabilidad, comparación rural-urbana, correlaciones y regresión múltiple jerárquica.

Resultados: Los cuidadores de zonas urbanas/semiurbanas informaron niveles más altos de orientación psicoeducativa, prácticas nutricionales y conductas de prevención del retraso del crecimiento que los cuidadores de zonas rurales, mientras que las prácticas de juego activo no difirieron significativamente. Las prácticas nutricionales fueron el predictor más fuerte, seguidas por la orientación psicoeducativa para cuidadores y las prácticas de juego activo. El modelo final explicó el 55% de la varianza en las conductas de prevención del retraso del crecimiento.

Discusión: Las conductas de prevención están determinadas por prácticas integradas de cuidado que combinan nutrición, oportunidades de movimiento, orientación para cuidadores y contexto local.

Conclusión: Los programas comunitarios deben integrar alimentación adecuada, juego activo, orientación familiar y comunicación culturalmente contextualizada.

Palabras clave

Prácticas nutricionales; juego activo; actividad física en la primera infancia; orientación psicoeducativa; prevención del retraso del crecimiento.



Introduction

Stunting is no longer sufficient to be understood only as a nutritional deficit; it should also be viewed as a developmental condition that affects children's physical growth, movement opportunities, motor competence, and daily participation in active play. Recent evidence shows that stunting reflects accumulated exposure to inadequate nutrition, poor caregiving, limited health-service access, and insufficient developmental stimulation during the early years of life (Mulyani et al., 2025). This developmental perspective is important because early childhood growth is closely linked to physical functioning, gross motor development, and children's ability to participate in movement-based activities. Recent evidence also emphasizes that interventions targeting fundamental motor skills and physical activity are relevant for preschool children's developmental outcomes, while motor competence remains closely connected to children's physical performance and movement participation (Fernández-Valero et al., 2023; Kurt-Bayrakdar et al., 2024). Spittle et al. (2023) emphasized that no single feeding strategy is sufficient to address growth faltering, while Dadrás et al. (2024) highlighted that child undernutrition is shaped by multiple household, maternal, and environmental determinants. Accordingly, stunting prevention requires an integrated approach that combines adequate nutrition, responsive caregiving, psychoeducational support, local caregiving knowledge, and opportunities for active movement in everyday family and community settings.

In Indonesia, stunting remains strongly influenced by maternal, household, and contextual factors, including place of residence, maternal education, household wealth, child age, feeding practices, access to health services, and local caregiving beliefs. Supadmi et al. (2024) found that residence, maternal education, wealth status, child age, and early initiation of breastfeeding were significantly associated with stunting among Indonesian children. Rural-urban disparities also remain critical, as children living in rural areas often experience different patterns of service access, food availability, sanitation, parental knowledge, and exposure to community health programs compared with children living in urban areas (Laksono et al., 2024; Siramaneerat et al., 2024). In addition, Jokhu & Syauqy (2024) reported that concurrent wasting and stunting among Indonesian children were associated with multiple child and household-level determinants, while Astuti et al. (2024) showed that traditional feeding practices may influence child growth outcomes when they are not aligned with adequate dietary diversity and child-feeding recommendations. In this study, local knowledge refers to caregivers' culturally embedded beliefs, feeding traditions, child-rearing norms, and community-based understandings of child health that shape how nutrition, play, and health guidance are practiced in daily family life. These findings suggest that stunting prevention behavior is not formed only by the availability of health services, but also by how caregivers negotiate biomedical recommendations, local feeding traditions, growth monitoring, child stimulation, and active play within their everyday caregiving routines.

Community-based health education has become a key strategy for strengthening caregivers' knowledge, self-efficacy, and preventive behavior related to child growth. Mardani et al. (2024) showed that nutrition education based on the Health Belief Model improved mothers' knowledge, self-efficacy, complementary feeding practices, and child undernutrition outcomes in Indonesia. However, community-based health education should not be reduced to information delivery alone. From a guidance and counseling perspective, it can be conceptualized as caregiver psychoeducational guidance, namely structured educational and developmental support that strengthens caregivers' knowledge, confidence, decision-making, self-efficacy, and consistency in applying growth-promoting practices at home. Lailan et al. (2026) further argued that education-based interventions can be strengthened when supported by data-driven systems and local implementation mechanisms, while Setiawan et al. (2026) highlighted the role of family-based support in improving maternal-child health behaviors. Thus, caregiver psychoeducational guidance is relevant because stunting prevention depends not only on what information is delivered, but also on whether caregivers are supported to transform that information into culturally meaningful, practical, and developmentally appropriate caregiving routines.

Although nutrition is central to stunting prevention, active play is increasingly recognized as a complementary component of early childhood health because it supports gross motor skills, physical fitness, coordination, social interaction, and overall developmental stimulation. Pan et al. (2025) reported that sports-related and physical activity factors were associated with stunting among children under five, indicating that children's movement behavior deserves greater attention in growth-related research.



Evidence from early childhood physical activity studies further shows that active play interventions can improve gross motor skills and support healthier movement behavior among young children (Spring et al., 2024). Further evidence supports this argument by showing that game-based motor stimulation, supervised free play, and movement-based learning can contribute to children's motor development, physical activity engagement, and broader developmental outcomes (Kamelia & Widyanoro, 2025; Kurnia et al., 2024; Suryadi et al., 2024). For this reason, active play should be positioned not merely as recreation, but as both structured and unstructured movement opportunities that support gross motor development and complement nutrition-based stunting prevention. In this sense, active play represents a developmental caregiving practice that connects physical activity, family routines, local play culture, and early childhood growth.

Despite the growing literature on stunting, nutrition education, local feeding practices, and early childhood physical activity, limited quantitative evidence has tested an integrated rural–urban model that places nutrition practices, active play, caregiver psychoeducational guidance, and local knowledge within the same framework of early childhood stunting prevention. Previous studies have often examined nutritional determinants, maternal education, feeding practices, or physical activity interventions separately, leaving a gap in understanding how these factors operate together within family and community-based prevention systems. Rico-González et al. (2026) found that combined preschool-based interventions integrating physical activity and nutrition may produce beneficial outcomes, while Salazar et al. (2025) showed that community-based programs promoting physical activity and healthy eating can support healthier behaviors among preschool children. Jiang et al. (2025) also confirmed that physical activity interventions are effective for improving fundamental movement skills in early childhood. Stunting prevention behaviors in this study refer to caregivers' general preventive actions, including regular growth monitoring, health-service utilization, hygiene practices, consultation with health workers, and consistent application of child growth recommendations; nutrition practices and active play are treated as separate predictors to avoid conceptual overlap. The novelty of this study lies in testing a quantitative rural–urban model that integrates nutrition practices, active play, caregiver psychoeducational guidance, and local knowledge as predictors of early childhood stunting prevention behaviors. Therefore, this study aims to examine the extent to which nutrition practices, active play, and caregiver psychoeducational guidance predict stunting prevention behaviors among caregivers of young children, while comparing rural and urban communities in Indonesia. By combining nutrition, physical activity, psychoeducational guidance, and local knowledge perspectives, this study offers a more comprehensive framework for understanding how caregivers support early childhood growth and development in everyday life.

Method

Study Design and Setting

This study employed a quantitative cross-sectional comparative-predictive design to examine whether nutrition practices, active play practices, and caregiver psychoeducational guidance statistically predicted early childhood stunting prevention behaviors. The cross-sectional design was used because the study measured caregivers' current nutrition-related behaviors, support for children's active play, psychoeducational guidance experiences, and preventive caregiving practices at one point in time. The comparative component was used to examine rural–urban differences, while the predictive component was used to identify the contribution of the main predictors after controlling for demographic and contextual variables.

The study was conducted in Jombang Regency, East Java, Indonesia, in two community settings with different socio-geographical characteristics. Desa Ngusikan was selected to represent a rural community, whereas Kelurahan Jombatan was selected to represent an urban/semi-urban community. These sites were selected because they differ in social structure, health-service access, caregiving environment, food availability, local caregiving norms, and children's opportunities for movement-based play. Recent studies indicate that stunting determinants may vary across rural and urban settings, particularly in relation to maternal education, household resources, feeding practices, and health-service access (Siramaneerat et al., 2024; Supadmi et al., 2024).



Participants and Sampling

The target population consisted of mothers or primary caregivers of children aged 24–59 months living in the selected rural and urban/semi-urban communities. This age group was selected because children in this developmental period are actively involved in feeding transitions, growth monitoring, gross motor development, and play-based physical activity. Participants were recruited using stratified community-based sampling, with area of residence as the stratification variable. The rural stratum consisted of caregivers from Desa Ngusikan, while the urban/semi-urban stratum consisted of caregivers from Kelurahan Jombatan. Eligible participants were identified through Posyandu records and community health worker networks.

The study involved 300 caregivers, with 150 participants from the rural area and 150 from the urban/semi-urban area. The balanced allocation was used to facilitate comparison between the two residential contexts. Sample adequacy for the primary hierarchical multiple regression analysis was evaluated using G*Power version 3.1 through the procedure for linear multiple regression, fixed model, R^2 increase. The calculation was based on a conventional medium effect size ($f^2 = .15$), an alpha level of .05, statistical power of .95, three tested explanatory variables entered in the second block, and nine total variables in the full model, including six control variables. The medium effect-size benchmark was selected because directly comparable prior estimates for the incremental contribution of the three caregiving-related variables in an Indonesian rural–urban context were limited. The calculation indicated a minimum required sample size of 119 participants. Accordingly, the final sample of 300 caregivers exceeded the minimum requirement for examining the additional variance in caregiver-reported stunting-prevention behaviors associated with nutrition practices, active play practices, and caregiver psychoeducational guidance after adjustment for the selected control variables.

Participants were included if they were mothers or primary caregivers of children aged 24–59 months, had lived in the study area for at least six months, had participated in Posyandu or community health activities at least once in the previous six months, and agreed to provide informed consent. Caregivers were excluded if their children had congenital disorders or severe chronic illnesses affecting growth, if they were unable to complete the questionnaire independently or with assistance, or if their questionnaire responses contained more than 10% missing data.

Variables and Measures

Data were collected using a structured questionnaire consisting of demographic characteristics, caregiver psychoeducational guidance, nutrition practices, active play practices, and stunting prevention behaviors. All main variables were measured using a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree.

The dependent variable was general stunting prevention behaviors. Nutrition practices and active play practices were treated as separate predictor variables and were therefore not included as core indicators of the dependent variable to avoid construct overlap. This distinction was made to strengthen conceptual clarity between predictors and outcome.

Local knowledge was not treated as an independent predictor in the main regression model. Instead, it was used as a contextual interpretive dimension to explain how rural and urban caregivers applied nutrition practices, active play, and psychoeducational guidance in everyday family routines. In this study, local knowledge refers to caregivers' culturally embedded beliefs, feeding traditions, child-rearing norms, local play practices, and community-based understandings of child health.

Table 1. Operational Definition of Study Variables

Variable	Operational definition	Main indicators	Scale
Caregiver Psychoeducational Guidance	Structured educational and developmental support that helps caregivers understand child growth, strengthen self-efficacy, make informed caregiving decisions, and apply growth-promoting practices at home	Participation in guidance activities, clarity of messages, caregiver confidence, decision-making support, self-efficacy support, application of advice	Likert 1–5
Nutrition Practices	Caregivers' daily feeding and dietary practices to support child growth	Meal frequency, dietary diversity, protein intake, fruit and vegetable intake, food hygiene, limitation of low-nutrient snacks	Likert 1–5



Active Play Practices	Caregivers' support for children's movement-based activities and gross motor stimulation	Daily active play, outdoor play, running, jumping, climbing, dancing, ball play, traditional movement games, screen-time limitation	Likert 1-5
Stunting Prevention Behaviors	Caregivers' general preventive actions to support healthy child growth	Posyandu attendance, growth monitoring, health-service utilization, hygiene and sanitation, use of child growth records, consultation with health workers	Likert 1-5
Rural-Urban Residence	Socio-geographical classification of participants' residence	Rural = Desa Ngusikan; urban/semi-urban = Kelurahan Jombatan	Categorical
Child Growth Context	Child anthropometric information used to describe the growth context of participants	Height, weight, age, height-for-age status when available	Descriptive

Caregiver Psychoeducational Guidance Scale

Caregiver psychoeducational guidance was measured using items assessing caregivers' exposure to structured educational and developmental support related to child growth and stunting prevention. The scale assessed participation frequency, clarity of guidance messages, perceived usefulness, caregiver confidence, decision-making support, self-efficacy support, and application of advice in daily caregiving.

This construct reflects a preventive-developmental guidance perspective, in which caregiver support is not limited to one-way information delivery but also includes strengthening caregivers' confidence, awareness, and consistency in applying growth-promoting routines. Recent evidence suggests that community-based and family-centered education can improve maternal knowledge, feeding practices, health-service engagement, and stunting prevention behavior (Mitra et al., 2026).

Nutrition Practices Scale

Nutrition practices were measured through caregivers' reported behaviors related to child feeding and dietary management. The scale assessed meal frequency, dietary diversity, provision of animal-source and plant-based protein, fruit and vegetable intake, food hygiene, responsive feeding, and limitation of low-nutrient snacks and sweetened drinks.

The scale also considered the influence of local feeding traditions as part of the caregiving context, although local knowledge was not analyzed as a separate predictor in the main regression model. Recent studies indicate that feeding practices, complementary feeding knowledge, and household nutrition behavior are associated with child growth and stunting prevention in Indonesian community settings (Astuti et al., 2024).

Active Play Practices Scale

Active play practices were defined as caregiver-supported or child-initiated movement-based activities involving gross motor movement, such as running, jumping, climbing, dancing, ball play, outdoor play, and traditional movement games. The scale assessed daily active play, outdoor play opportunities, caregiver involvement, motor stimulation, safe play space, traditional movement games, and limitation of excessive screen time.

Active play was included because early childhood physical activity is increasingly recognized as an important component of healthy growth, motor development, physical fitness, and overall well-being. Pan et al. (2025) found that sports-related and physical activity factors were associated with stunting among children under five, while Lee et al. (2025) emphasized that active outdoor play is related to higher physical activity and lower sedentary behavior. Recent evidence also shows that physical activity interventions can improve physical fitness and fundamental movement skills in preschool children (Li et al., 2021; Ma & Luo, 2023; Wang et al., 2022).

Stunting Prevention Behaviors Scale

Stunting prevention behaviors were measured as caregivers' general preventive actions to support healthy child growth. The scale focused on regular Posyandu attendance, growth monitoring, health-service utilization, hygiene and sanitation practices, use of child growth records, and consultation with health workers when growth problems were identified.

Nutrition practices and active play practices were measured as independent predictor variables and were not included as core indicators of this scale. This separation was applied to strengthen construct validity and avoid conceptual overlap between predictors and outcome. Recent evidence suggests that



stunting prevention behavior is shaped by knowledge, service access, maternal competence, community support, and preventive health practices (Raflizar et al., 2025; Soviyati et al., 2023; Yusriadi et al., 2024).

Instrument Validity and Reliability

The questionnaire was developed specifically for this study based on the operational definitions of caregiver psychoeducational guidance, nutrition practices, active play practices, and caregiver-reported stunting-prevention behaviors, informed by relevant literature on child-growth promotion, nutrition-related caregiving, early childhood physical activity, and preventive health behavior. During instrument development, conceptual separation between the explanatory variables and the outcome variable was maintained: nutrition practices and active play practices were measured as distinct caregiving constructs and were not included as indicators of caregiver-reported stunting-prevention behaviors. The initial questionnaire was reviewed by experts representing public health, nutrition, early childhood development, physical activity, and guidance and counseling. The review focused on item relevance to the intended construct, clarity of wording, contextual appropriateness for Indonesian caregivers, and potential overlap among constructs. Based on this review, items requiring refinement because of unclear wording, overlapping meaning, or insufficient conceptual specificity were revised or removed before pilot testing. As quantitative content-validity coefficients were not available for reporting, the expert-review procedure is presented as a qualitative content-review process rather than as statistical evidence of content validity.

A pilot test was conducted with 30 caregivers who had characteristics similar to those of the target participants but were not included in the final analytical sample. The pilot test assessed item readability, clarity of meaning, response feasibility, and the practicality of questionnaire administration in the community setting. Items identified as ambiguous, overlapping, or difficult to understand were refined before the main data collection. The final questionnaire consisted of four six-item scales: caregiver psychoeducational guidance, nutrition practices, active play practices, and caregiver-reported stunting-prevention behaviors. All items were rated on a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. Scale scores were computed as the mean of the six items within each construct, with higher scores indicating stronger reported levels of the respective caregiving practice or preventive behavior. In the final analytical sample, all four scales demonstrated acceptable to good internal consistency: caregiver psychoeducational guidance (Cronbach's $\alpha = .87$), nutrition practices (Cronbach's $\alpha = .84$), active play practices (Cronbach's $\alpha = .82$), and caregiver-reported stunting-prevention behaviors (Cronbach's $\alpha = .88$). These findings indicate satisfactory internal consistency of the scale scores in the present sample. However, because item-level statistics and factor-analytic results were not available for reporting, the present study does not claim that the factorial structure or full construct validity of the scales has been established. This measurement limitation is acknowledged in interpreting the findings, and further studies are needed to evaluate the instruments using exploratory and confirmatory factor analysis in independent caregiver samples.

Table 2. Measurement Structure of the Questionnaire

Scale	Number of items	Score range	Interpretation	Reliability
Caregiver Psychoeducational Guidance	6	6–30	Higher scores indicate stronger exposure to caregiver guidance, self-efficacy support, and practical developmental education	$\alpha = .87$
Nutrition Practices	6	6–30	Higher scores indicate better child-feeding and dietary practices	$\alpha = .84$
Active Play Practices	6	6–30	Higher scores indicate stronger caregiver support for active play and gross motor stimulation	$\alpha = .82$
Stunting Prevention Behaviors	6	6–30	Higher scores indicate stronger general preventive behaviors	$\alpha = .88$

Data Collection Procedure

Data collection was conducted from November 2025 to February 2026. Permission was obtained from local authorities, community health centers, Posyandu coordinators, and community health workers. Trained research assistants approached eligible caregivers during Posyandu activities, community meetings, or household visits.



Participants received information about the study objectives, voluntary participation, confidentiality, and their right to withdraw at any stage. Written informed consent was obtained before questionnaire administration. Caregivers completed the questionnaire independently or with assistance from trained research assistants when needed. For participants with limited reading ability, items were read aloud neutrally without influencing responses. To reduce response bias, participants were assured that there were no right or wrong answers and that their responses would not affect their access to health services. Research assistants were trained to avoid leading explanations and to maintain neutral communication during data collection.

Anthropometric data were obtained from the most recent Posyandu records when available. If recent records were unavailable, children's weight and height were measured by trained health workers using standardized procedures. Anthropometric data were used only to describe the child growth context and were not treated as the primary outcome variable, because the main outcome of this study was caregiver stunting prevention behavior.

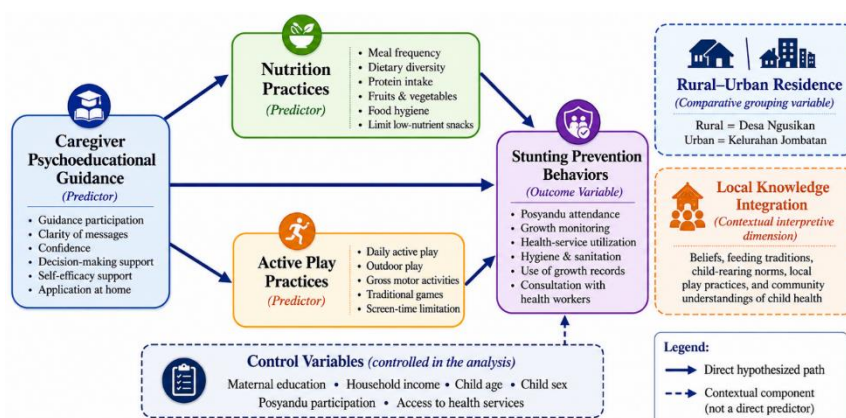
Ethical Considerations

This study was approved by the Research Ethics Committee of LPPM Darul Ulum University, Indonesia (approval number: 121/LPPM-UNDAR/ETIK/IX/2024, dated 23 September 2024). Written informed consent was obtained from all participating caregivers before data collection. Participants were informed that participation was voluntary, that they could withdraw at any time without consequences for accessing health services, and that questionnaires and child records were coded and stored securely with access limited to the research team. Any anthropometric measurements were conducted by trained health personnel following standard safety procedures to ensure the welfare of children and maintain ethical safeguards throughout the study.

Analytical Framework

The analytical model tested whether nutrition practices, active play practices, and caregiver psychoeducational guidance statistically predicted stunting prevention behaviors. Rural-urban residence was used primarily as a grouping variable for comparative analysis between Desa Ngusikan and Kelurahan Jombatan. Maternal education, household income, child age, child sex, Posyandu participation, and access to health services were included as control variables. Local knowledge was used as an integrative contextual dimension to interpret how caregivers applied nutrition, active play, and psychoeducational guidance within family and community practices. It was not included as a direct predictor in the main regression model.

Figure 1. Presents the conceptual and analytical model of the study.



Data Analysis

Data were analyzed using IBM SPSS Statistics version 29. Scale scores were computed as the mean of item responses after initial data screening. Of the 300 caregivers, 6 cases (2%) were excluded due to more than 10% missing item responses. Remaining missing values for individual items were minimal.

($\leq 1\%$ per variable) and were handled using person-mean substitution to compute scale scores. Descriptive statistics, including means and standard deviations, were calculated for all main scales, and internal consistency was evaluated using Cronbach's alpha (caregiver psychoeducational guidance $\alpha = .87$, nutrition practices $\alpha = .84$, active play practices $\alpha = .82$, stunting-prevention behaviors $\alpha = .88$). Distributional characteristics were assessed using skewness, kurtosis, and visual inspection of histograms and residual plots to verify that assumptions for subsequent analyses were adequately met.

Rural–urban differences were examined using independent samples t-tests for normally distributed continuous variables and Mann–Whitney U tests for non-normally distributed variables. Chi-square tests were used to compare categorical demographic characteristics between rural and urban/semi-urban participants. Pearson correlation analysis was used to examine relationships among caregiver psychoeducational guidance, nutrition practices, active play practices, and stunting prevention behaviors. Spearman correlation was used when normality assumptions were not met.

Hierarchical multiple regression was used to examine the adjusted associations between caregiver psychoeducational guidance, nutrition practices, active play practices, and caregiver-reported stunting-prevention behavior scores. In Block 1, control variables were entered, including maternal education (0 = below senior high school, 1 = completed senior high school or higher), household income (0 = low, 1 = middle-to-high), child age (in months, continuous), child sex (0 = boy, 1 = girl), Posyandu participation (0 = irregular, 1 = regular), and access to health services (0 = limited, 1 = adequate). In Block 2, the three main explanatory variables—nutrition practices, active play practices, and caregiver psychoeducational guidance—were added. Regression results were reported using unstandardized coefficients (B), standardized coefficients (β), 95% confidence intervals, p values, R^2 , adjusted R^2 , and change in R^2 (ΔR^2). Residuals were inspected and found to approximate normality based on skewness and kurtosis, with linearity and homoscedasticity confirmed via residual plots. No influential cases exceeded Cook's distance thresholds, and independence of residuals was verified (Durbin–Watson ≈ 2.0). Multicollinearity was not a concern, with all tolerance values >0.2 and VIF <5 . Because the outcome is an averaged Likert-type self-report score, estimates are interpreted as associations among reported scale scores rather than as effects on clinical or anthropometric outcomes.

Results

Participant Characteristics

A total of 300 caregivers of children aged 24–59 months participated in this study, consisting of 150 caregivers from the rural area and 150 caregivers from the urban/semi-urban area. The mean age of caregivers was 31.42 years (SD = 5.18), while the mean age of children was 41.26 months (SD = 9.34). Scale scores were calculated by averaging item responses, with higher scores indicating stronger endorsement of the measured construct.

As shown in Table 1, rural and urban/semi-urban caregivers differed significantly in caregiver education and household income. Urban/semi-urban caregivers were more likely to have completed senior high school or higher and to report middle-to-high household income. However, the groups did not differ significantly in child sex distribution, child age, or regular Posyandu participation.

Table 3. Demographic Characteristics of Participants

Characteristic	Rural (n = 150)	Urban/Semi-urban (n = 150)	Total (N = 300)	p-value
Caregiver age, mean (SD)	32.10 (5.42)	30.74 (4.88)	31.42 (5.18)	.023
Child age in months, mean (SD)	41.80 (9.61)	40.72 (9.05)	41.26 (9.34)	.317
Boys, n (%)	78 (52.0)	74 (49.3)	152 (50.7)	.641
Girls, n (%)	72 (48.0)	76 (50.7)	148 (49.3)	.641
Caregiver completed senior high school or higher, n (%)	82 (54.7)	116 (77.3)	198 (66.0)	< .001
Middle-to-high household income, n (%)	63 (42.0)	104 (69.3)	167 (55.7)	< .001
Regular Posyandu participation, n (%)	128 (85.3)	136 (90.7)	264 (88.0)	.153

Note. Continuous variables were compared using independent samples t-tests, while categorical variables were compared using chi-square tests.



Reliability and Descriptive Statistics of Study Variables

All scales demonstrated acceptable to good internal consistency, with Cronbach's alpha values ranging from .82 to .88. These results indicate that the four scales had adequate reliability for subsequent analysis. The highest mean score was found for caregiver psychoeducational guidance, followed by stunting prevention behaviors, active play practices, and nutrition practices.

Table 4. Reliability and Descriptive Statistics of Main Variables

Variable	Number of items	Possible range	Mean	SD	Cronbach's α
Caregiver Psychoeducational Guidance	6	1-5	3.73	0.67	.87
Nutrition Practices	6	1-5	3.60	0.61	.84
Active Play Practices	6	1-5	3.62	0.58	.82
Stunting Prevention Behaviors	6	1-5	3.69	0.63	.88

Note. Mean scores represent average item scores for each scale.

Rural-Urban Differences in Main Study Variables

Independent samples t-tests were conducted to examine rural-urban differences in the main variables. Urban/semi-urban caregivers reported significantly higher caregiver psychoeducational guidance, nutrition practices, and stunting prevention behaviors than rural caregivers. The effect sizes for these differences were large for caregiver psychoeducational guidance, nutrition practices, and stunting prevention behaviors. However, active play practices did not differ significantly between rural and urban/semi-urban caregivers, and the effect size was small.

Table 5. Rural-Urban Differences in Main Variables

Variable	Rural Mean (SD)	Urban/Semi-urban Mean (SD)	t	p	Cohen's d
Caregiver Psychoeducational Guidance	3.43 (0.65)	4.03 (0.58)	8.43	< .001	0.98
Nutrition Practices	3.31 (0.57)	3.88 (0.55)	8.82	< .001	1.02
Active Play Practices	3.66 (0.59)	3.58 (0.57)	-1.19	.235	0.14
Stunting Prevention Behaviors	3.43 (0.60)	3.95 (0.55)	7.82	< .001	0.90

These results indicate that caregivers in urban/semi-urban settings reported greater access to psychoeducational guidance, stronger nutrition practices, and higher stunting prevention behaviors. In contrast, active play practices appeared relatively similar across both settings, suggesting that movement-based play may be present in rural and urban/semi-urban communities, although it may take different forms according to local family routines and environmental conditions.

Correlations among Study Variables

Pearson correlation analysis showed that caregiver psychoeducational guidance, nutrition practices, and active play practices were positively and significantly correlated with stunting prevention behaviors. Nutrition practices had the strongest correlation with stunting prevention behaviors, followed by caregiver psychoeducational guidance and active play practices.

Table 6. Correlations among Main Variables

Variable	1	2	3	4
1.Caregiver Psychoeducational Guidance	1			
2.Nutrition Practices	.52**	1		
3.Active Play Practices	.31**	.35**	1	
4.Stunting Prevention Behaviors	.58**	.65**	.47**	1

Note. **p < .01.

The correlation results indicate that caregivers who reported stronger psychoeducational guidance, better nutrition practices, and stronger active play practices also tended to report stronger stunting prevention behaviors.



Hierarchical Regression Predicting Stunting Prevention Behaviors

Prior to the regression analysis, the assumptions of linearity, normality of residuals, homoscedasticity, multicollinearity, and influential observations were evaluated. Visual inspection of residual plots indicated no substantial deviation from linearity or homoscedasticity. Residuals were approximately normally distributed based on skewness and kurtosis values within acceptable ranges. Multicollinearity was not a concern, with all tolerance values exceeding 0.2 and Variance Inflation Factor (VIF) values below 5. No influential cases were identified, as all Cook's distance values were below the conventional threshold of 1.0. These diagnostics support the appropriateness of the data for hierarchical multiple regression analysis.

Hierarchical multiple regression estimated the adjusted associations of nutrition practices, active play practices, and caregiver psychoeducational guidance with caregiver-reported stunting-prevention behavior scores, after adjustment for the specified demographic and contextual variables.

The control-variable model was statistically significant, $F(6, 293) = 12.84$, $p < .001$, and accounted for 20% of variance in caregiver-reported stunting-prevention behavior scores. After the three principal self-report practice variables were added, the full model was statistically significant, $F(9, 290) = 38.76$, $p < .001$, and accounted for 55% of variance; the additional variables accounted for an increment of 35%, $\Delta R^2 = .35$, $p < .001$. Because the independent variables and outcome are related self-report caregiving constructs, this amount of explained variance should be interpreted cautiously.

Table 7. Hierarchical Regression Predicting Stunting Prevention Behaviors

Predictor	B	SE	β	95% CI for B	t	p
Block 1: Control variables						
Maternal education	0.08	0.04	.12	[0.01, 0.16]	2.21	.028
Household income	0.07	0.04	.09	[-0.00, 0.15]	1.88	.061
Child age	0.01	0.01	.03	[-0.01, 0.02]	0.72	.473
Child sex	0.02	0.05	.02	[-0.08, 0.12]	0.41	.681
Posyandu participation	0.18	0.05	.18	[0.08, 0.28]	3.46	.001
Access to health services	0.21	0.05	.21	[0.11, 0.31]	4.02	< .001
Block 2: Main predictors						
Caregiver Psychoeducational Guidance	0.27	0.05	.29	[0.17, 0.37]	5.41	< .001
Nutrition Practices	0.39	0.06	.38	[0.27, 0.51]	6.87	< .001
Active Play Practices	0.24	0.05	.24	[0.14, 0.34]	4.62	< .001

Table 8. Model Summary of Hierarchical Regression

Model	R	R ²	Adjusted R ²	ΔR^2	F	p
Model 1: Control variables	.45	.20	.18	—	12.84	< .001
Model 2: Controls + main predictors	.74	.55	.54	.35	38.76	< .001

In the adjusted model, nutrition practice scores had the largest positive association with caregiver-reported stunting-prevention behavior scores, followed by psychoeducational guidance and active play practice scores. The coefficients indicate statistical associations within this sample; they do not demonstrate that any practice reduced children's stunting or changed anthropometric status.

Contextual Notes on Local Knowledge

Local knowledge was not operationalized as a measured variable and was not analyzed in the statistical model. Consequently, no results are reported regarding its effect, contribution, or role in explaining rural-urban score differences. Local caregiving practices remain a relevant consideration for the design and acceptability of future programs, but their empirical role must be tested in future research using an explicit operational definition and appropriate measurement or qualitative methods.

Summary of Main Findings

The findings showed that urban/semi-urban caregivers reported higher caregiver psychoeducational guidance, nutrition practices, and stunting prevention behaviors than rural caregivers, whereas active play practices did not differ significantly between the two groups. Caregiver psychoeducational guidance, nutrition practices, and active play practices were all positively associated with stunting prevention behaviors. In the hierarchical regression model, nutrition practices, caregiver psychoeducational

guidance, and active play practices significantly predicted stunting prevention behaviors after controlling for maternal education, household income, child age, child sex, Posyandu participation, and access to health services.

Discussion

This study examined whether nutrition practices, active play practices, and caregiver psychoeducational guidance predicted early childhood stunting prevention behaviors in rural and urban/semi-urban communities in Indonesia. The findings showed that urban/semi-urban caregivers reported higher psychoeducational guidance, better nutrition practices, and stronger stunting prevention behaviors than rural caregivers, while active play practices did not differ significantly between the two groups. The regression model further indicated that nutrition practices were the strongest predictor of stunting prevention behaviors, followed by caregiver psychoeducational guidance and active play practices. These findings suggest that stunting prevention should be understood not only as a nutritional or biomedical agenda, but also as a family-based developmental process involving feeding routines, movement opportunities, caregiver support, and culturally embedded caregiving practices. This interpretation is consistent with recent evidence showing that stunting is shaped by interconnected maternal, household, environmental, and behavioral determinants rather than by inadequate food intake alone (Amalia et al., 2025; Dadras et al., 2024; Mulyani et al., 2025; Sharn et al., 2025).

Nutrition practices emerged as the strongest predictor of stunting prevention behaviors. Caregivers who reported better dietary diversity, meal frequency, protein provision, food hygiene, and limitation of low-nutrient snacks also tended to report stronger preventive behaviors, including growth monitoring, use of child health services, and consultation with health workers. This finding confirms that nutrition practices remain the core behavioral foundation of stunting prevention, while also indicating that feeding behavior is more effective when embedded in broader preventive routines. Previous studies have similarly shown that complementary feeding knowledge, household nutrition behavior, and culturally familiar food practices are closely related to child growth and stunting prevention in Indonesian community contexts (Astuti et al., 2024). Burger et al. (2025) further emphasized that local food-based complementary feeding may strengthen maternal competence in preventing stunting, suggesting that nutrition guidance should be practical, affordable, and connected to household food realities.

Active play practices also significantly predicted stunting prevention behaviors, although their contribution was smaller than nutrition practices. This result is important for the physical activity and child development field because it positions active play as part of growth-promoting caregiving, not merely as recreational activity. Active play provides children with opportunities for gross motor stimulation, coordination, physical fitness, social interaction, and movement confidence. Monyeki et al. (2026) found that physical activity-related factors were associated with stunting among children under five, while Dobell et al. (2023) showed that physical activity interventions can improve fundamental movement skills in early childhood. Similar evidence also indicates that structured movement activities can support physical fitness and motor competence among preschool children (Gao et al., 2026). This interpretation is also supported by recent studies showing that game-based motor stimulation, supervised free play, kinesthetic movement activities, and project-based motor learning can strengthen gross motor skills and movement participation among young children (Kurnia et al., 2024; Kusmiyati et al., 2024). Therefore, active play should be integrated into stunting prevention programs as a low-cost, developmentally appropriate strategy that complements nutrition and caregiving support.

The absence of significant rural–urban differences in active play practices deserves careful interpretation. Although urban/semi-urban caregivers reported higher psychoeducational guidance, nutrition practices, and prevention behaviors, active play appeared relatively similar across settings. This may indicate that rural and urban children both engage in movement-based play, but the form, space, supervision, and cultural meaning of play may differ. In rural communities, active play may occur through outdoor movement, neighborhood interaction, and traditional games. In urban/semi-urban communities, active play may depend more on caregiver supervision, available play space, structured play opportunities, and screen-time management. This interpretation is consistent with studies showing that children’s active play and movement behavior are shaped by family routines, environmental affordances, and opportunities for safe outdoor play (Morgenthaler et al., 2024; Tang & Woolley, 2023; Taylor et al.,



2024; Wahyudin et al., 2025). Recent evidence further suggests that culturally integrated movement activities, traditional play, and game-based coordination activities may create meaningful opportunities for children's physical, motor, and social development across different community contexts (Efatri et al., 2026; Kamelia et al., 2025; Mardiansyah et al., 2024). Thus, active play promotion should not follow a single model across settings; it should be adapted to local spaces, safety conditions, caregiver routines, and community play culture.

Caregiver psychoeducational guidance also made a significant contribution to stunting prevention behaviors. This finding shows that caregiver support should go beyond one-way health education and should include structured guidance that strengthens knowledge, confidence, decision-making, self-efficacy, and consistency in applying growth-promoting routines at home. From a guidance and counseling perspective, caregiver psychoeducational guidance reflects a preventive-developmental approach because it helps families translate information into daily caregiving actions. This aligns with recent studies showing that family-based and community-based education can improve maternal knowledge, attitudes, self-efficacy, and preventive practices related to child growth (Setiawan et al., 2026; Sulisnadewi et al., 2026). Other studies also indicate that caregiver confidence, maternal self-efficacy, and structured family-based support are important in strengthening maternal competence and health-related behavior related to stunting prevention (Mardani et al., 2024; Setiawan et al., 2026; Wahyudin et al., 2026). Therefore, the contribution of guidance and counseling in this context lies in supporting caregiver behavior change, not in replacing medical or nutritional services.

The rural–urban differences found in psychoeducational guidance, nutrition practices, and stunting prevention behaviors reinforce the importance of contextualizing prevention strategies. Urban/semi-urban caregivers may have better access to health services, education, information, and service networks, which may support stronger preventive behavior. Rural caregivers, on the other hand, may face constraints related to distance, income, food diversity, health literacy, and reliance on informal caregiving norms. Siramaneerat et al. (2024) showed that determinants of stunting differ between urban and rural areas in Indonesia, while Supadmi et al. (2024) found that residence, maternal education, wealth status, child age, and breastfeeding-related factors were associated with stunting among Indonesian children. Place-based analysis is therefore necessary because local variation can shape how families access guidance, apply nutrition practices, and support children's growth (Dewi et al., 2025; Nisrina & Sinaga, 2025). Rural–urban residence should not be treated merely as a demographic category, but as a social context that shapes caregiving opportunities and constraints.

Local knowledge provides an important contextual lens for interpreting these findings. In this study, local knowledge was not modeled as a direct statistical predictor, but was used to understand how caregivers may interpret and apply nutrition, active play, and psychoeducational guidance in everyday family routines. Local feeding traditions, child-rearing norms, community advice, and traditional movement games may support prevention when they align with child growth recommendations, but they may also require adaptation when they limit dietary diversity, delay health-service use, or restrict developmental stimulation. Chowdhury & Alzarrad (2025) emphasized that community-based education is more acceptable when it connects with local practices and family realities. Thus, integrating local knowledge does not mean accepting every traditional practice without critique. Rather, it means identifying which local practices can be strengthened, which need to be modified, and how professional guidance can be communicated in culturally meaningful ways.

Theoretically, this study contributes by testing an integrated model that combines nutrition practices, active play practices, caregiver psychoeducational guidance, and local knowledge within a rural–urban framework. Unlike studies that examine nutrition, health education, or physical activity separately, this study shows that stunting prevention behaviors are associated with a constellation of caregiving practices that operate together in family and community settings. This finding extends previous evidence on combined nutrition and physical activity approaches in early childhood by showing that caregiver guidance and local knowledge are also important in shaping prevention-oriented behavior (Rico-González et al., 2026). It also supports broader evidence that early childhood physical activity contributes not only to motor development, but also to children's holistic development and participation in daily learning and social experiences (Kamelia et al., 2025). For the field of physical activity and health, the study strengthens the argument that active play should be considered part of early childhood growth promotion. For guidance and counseling, it extends the preventive-developmental role of psychoeducational



support into family and community health promotion. Practically, the findings suggest that stunting prevention programs should combine practical nutrition guidance, low-cost active play routines, and caregiver guidance sessions that strengthen self-efficacy and decision-making. Such programs may be implemented through collaboration among Posyandu cadres, health workers, early childhood educators, family counselors, and local community actors.

Several limitations should be acknowledged. First, the cross-sectional design limits causal interpretation. Although nutrition practices, active play practices, and caregiver psychoeducational guidance statistically predicted stunting prevention behaviors, the direction of these relationships cannot be confirmed. Second, the study relied on caregiver self-report, which may be affected by social desirability and recall bias. Third, local knowledge was used as a contextual interpretive dimension rather than as a fully tested quantitative predictor, so its direct statistical contribution remains unexplored. Fourth, anthropometric data were used to describe the child growth context, while the primary outcome was caregiver prevention behavior. Fifth, the study was conducted in one regency, which may limit generalizability to other Indonesian regions with different cultural, geographic, and health-service contexts. Future studies should use longitudinal or intervention designs, include objective measures of children's physical activity and growth, and examine whether local knowledge moderates the relationship between psychoeducational guidance and prevention behavior.

Overall, the findings support an integrated prevention model in which nutrition practices, active play practices, and caregiver psychoeducational guidance are associated with stronger stunting prevention behaviors. Nutrition remains the strongest behavioral predictor, but active play and psychoeducational guidance add important developmental and behavioral dimensions to prevention. The study also shows that rural-urban context and local knowledge matter in shaping how caregivers apply health recommendations in daily life. An effective stunting prevention strategy should therefore combine adequate feeding, movement-based play, caregiver guidance, and culturally grounded communication to support children's healthy growth and development.

Conclusion

This study demonstrates that nutrition practices, active play practices, and caregiver psychoeducational guidance are significant predictors of early childhood stunting prevention behaviors in rural and urban/semi-urban communities in Indonesia. Nutrition practices emerged as the strongest predictor, confirming the central role of daily feeding quality and dietary management in prevention-oriented caregiving. However, the findings also show that stunting prevention should not be viewed only through a nutritional lens. Active play practices contribute to prevention behaviors by emphasizing movement-based play, gross motor stimulation, and children's opportunities for physical activity, while caregiver psychoeducational guidance supports caregivers' knowledge, confidence, decision-making, self-efficacy, and consistency in applying growth-promoting routines at home. The rural-urban comparison indicates that differences in access to guidance, nutrition practices, and prevention behaviors are shaped by social and contextual conditions. Local knowledge also provides an important lens for understanding how caregivers interpret and apply health recommendations in everyday family life. This study contributes by integrating nutrition, active play, caregiver psychoeducational guidance, and local knowledge into a rural-urban model of early childhood stunting prevention behavior. The findings may inform community-based stunting prevention programs, early childhood physical activity promotion, and preventive-developmental guidance practices aimed at strengthening caregivers' capacity to support children's healthy growth and development.

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