AgriHealth Journal of Agri-food, Nutrition and Public Health

ISSN 2722-0656 (Print) 2722-0648 (Online)

AgriHealth: Journal of Agri-food, Nutrition and Public Health. 6(2), 123-133, 2025
URL: https://jurnal.uns.ac.id/agrihealth/article/view/107534
DOI: http://dx.doi.org/10.20961/agrihealth.v6i2.107534

Hierarchical Risk Factors for Stunting in Urban Indonesian Children (0–59 Months): A Case–Control Study from Jambi, Indonesia

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Received: August 2, 2025; **Accepted**: October 3, 2025

Abstract

Stunting affects 149.2 million children globally, with Indonesia reporting a prevalence of 21.6%, despite a decline in trends. Urban-specific risk factors remain poorly characterized, which limits the development of effective intervention strategies for metropolitan areas. This study aimed to identify the risk factors associated with stunting in children aged 0 to 59 months in Jambi, Indonesia. This case-control study involved 108 children aged 0 to 59 months from five community health centers in Jambi City from December 2024 to January 2025. The cases (n = 54) were children with height-for-age z scores of less than 2 standard deviations (SD), and the controls (n = 54) had standard growth patterns. Data collection involved anthropometric measurements and structured maternal interviews, which were analyzed via chi-square tests with 95% confidence intervals. Low birth length had a very high odds ratio (OR = 45.69, 95% CI = 5.88 to 354.70; $p < 0.001$), whereas inadequate complementary feeding resulted in a perfect prediction (OR = 5.33, 95% CI = 3.20 to 8.88; $p < 0.001$). Incomplete immunization (OR = 37.81, 95% CI = 8.32 to 171.71; $p < 0.001$) and maternal educational deficit (OR = 6.53, 95% CI = 1.76 to 24.18; $p = 0.002$) were identified as the primary modifiable determinants. Multisectoral strategies targeting maternal nutrition, universal immunization, and education-based interventions are necessary to reduce stunting in Indonesia's urban population sustainably.

Keywords: birth parameters; feeding practices; immunization; stunting; urban children

INTRODUCTION

Global childhood stunting affects approximately 149.2 million children under five years of age, representing a persistent public health challenge despite declining trends from 203.6 million cases in 2000 to the current prevalence rate of 22.3% (WHO, 2023). Regional disparities reveal significant variations, with Oceania reporting the highest rate at 44%, compared with Europe's 4%, indicating complex underlying determinants that require targeted

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Cite this as: Harahap, H., Putra, I. A., Maulina, N. H., Kusdiyah, E., Adnyana, I. M. D. M., & Alrani, N. Q. (2025). Hierarchical Risk Factors for Stunting in Urban Indonesian Children (0–59 Months): A Case–Control Study from Jambi, Indonesia. *AgriHealth: Journal of Agri-food, Nutrition and Public Health*, *6*(2), 123-133. doi: http://dx.doi.org/10.20961/agrihealth.v6i2.107534

interventions. Indonesia has made notable progress, with national stunting rates decreasing from 34% in 2016 to 21.6% in 2022. Jambi City recorded a reduction from 22.4% in 2021 to 18% in 2022 (Ministry of Health of Indonesia, 2019; 2022). However, these rates remain above the World Health Organization (WHO)-recommended threshold of 20%, necessitating continued investigation into the contributing factors.

Stunting represents chronic malnutrition manifesting as height-for-age measurements below -2 standard deviations (SD) according to the WHO Child Growth Standards, resulting from inadequate nutrition, recurrent infections, and insufficient psychosocial stimulation (Putri et al., 2024). This condition has irreversible consequences, extending beyond physical growth restrictions to encompass cognitive impairment and reduced developmental potential (Nomura et al., 2023). The first 1,000-day framework establishes a critical intervention window during which rapid neurological development occurs, making this period essential for preventing permanent developmental deficits (Upadhyay et al., 2022). Nutritional inadequacies or infectious diseases during this timeframe have lasting effects on physical, cognitive, and emotional development trajectories (Manggala et al., 2018).

Previous research has identified multifaceted risk determinants that span the individual, household, and environmental health domains. Several studies demonstrated associations between stunting and paternal education levels, maternal anthropometric characteristics, birth weight parameters, and demographic factors (Manggala et al., 2018; Wandira et al., 2023; Supadmi et al., 2024). Complementary findings by Wicaksono et al. (2021) revealed that internal factors, including birth anthropometry, dietary adequacy, infectious disease burden, and feeding practices, interact with external environmental conditions, such as sanitation infrastructure, water quality, socioeconomic status, and parental education, to influence stunting prevalence.

The current literature provides limited comprehensive analyses of risk factor interactions within specific urban contexts, particularly regarding the relative contributions of modifiable versus non-modifiable determinants in Indonesian metropolitan areas. Research gaps persist regarding the quantitative assessment of multiple risk factors operating simultaneously within the first 1,000-day framework in urban Indonesian populations. Identifying locally relevant risk factor patterns is essential for developing evidence-based intervention strategies tailored to specific demographic and geographic contexts. This investigation examined the risk factors associated with stunting among children aged 0 to 59 months in Jambi City, Indonesia, to address these knowledge gaps. Jambi City was chosen as the study location due to its high prevalence of stunting, which reached 18% in 2022. This figure remains close to the 20% threshold recommended by the WHO, indicating persistent vulnerability and the need for enhanced interventions.

Furthermore, the limited research available on secondary cities creates a knowledge gap in understanding urban stunting patterns in this region. This study aimed to quantify the relative contributions of individual, household, and environmental factors to stunting prevalence while identifying modifiable determinants suitable for targeted intervention programs. Understanding these contributing mechanisms will inform the development of comprehensive prevention strategies designed to reduce the prevalence of stunting and improve child developmental outcomes in urban Indonesia.

MATERIALS AND METHOD

Study design and setting

This study employed a case–control design. The study was conducted from December 2024 to January 2025 across five selected public health centers (*Puskesmas*) in Jambi City, which represent diverse socioeconomic and geographic areas within an urban setting. These health centers were selected based on their catchment areas, patient volume, and accessibility to ensure a representative sample across different demographic populations.

Ethical considerations

This study was approved by the Health Research Ethics Committee of the Faculty of Medicine and Health Sciences, Universitas Jambi (approval number: 235/UN.21.8/PT.01.04/2025, dated January 24, 2025). All procedures were conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from the mothers/legal guardians of all the participants before data collection.

Population and sampling

The target population comprised all children aged 0 to 59 months who were registered at the selected public health center facilities. Health center selection employs purposive sampling based on three criteria: (1) geographic distribution across northern, central, and southern city zones to capture socioeconomic diversity; (2) a minimum registered population of 800 children aged 0 to 59 months to ensure adequate case availability; and (3) functional electronic health record systems enabling verification of anthropometric measurements and immunization records. Subject selection within each health center followed a consecutive sampling approach, where all children meeting the inclusion criteria during the recruitment period were invited to participate until the predetermined sample size was achieved at each facility.

The study sample consisted of children diagnosed with stunting according to the WHO criteria (cases) and children with normal nutritional status (controls) matched for age and gender. Matching was performed on an individual basis at a 1:1 ratio. For each stunted child identified (case), one non-stunted control was selected from the same health center registry, matched within ±3 months of age, and of the same gender. An age tolerance of ±3 months was chosen to ensure adequate control availability while maintaining comparability across developmental stages. When multiple eligible controls existed for a single case, random selection was performed via computer-generated numbers. Matching was performed sequentially as patients were recruited to prevent selection bias.

A sample size calculation was performed using the standard case–control formula, with 80% power, a 95% confidence interval (CI), and an expected odds ratio (OR) of 2.0. This calculation yielded 54 participants per group, totaling 108 participants (Adnyana, 2021). Sample distributions across the five selected public health centers include Simpang Kawat (n = 28, 25.9%), Paal Merah II (n = 22, 20.4%), Kebun Handil (n = 24, 22.2%), Tanjung Pinang (n = 18, 16.7%), and Talang Banjar (n = 16, 14.8%).

Sampling technique and selection criteria

Consecutive sampling was used to recruit eligible participants (Darwin et al., 2021). The inclusion criteria for the cases included children aged 0 ot 59 months with height-for-age z-scores below -2 SD, according to the WHO Child Growth Standards, and mothers willing to participate and provide informed consent. The control group inclusion criteria included children of the same age range with height-for-age z scores above -2 SD, normal growth patterns, and maternal consent for participation. The exclusion criteria applied to both groups included children with congenital anomalies affecting growth, chronic diseases requiring specialized medical management, incomplete anthropometric data, and maternal inability to provide reliable historical information regarding pregnancy and child-rearing practices.

Research procedures

Data collection followed a standardized protocol, implemented by trained research personnel, to ensure consistency and reliability across all study sites. Anthropometric measurements were obtained using calibrated equipment, following the WHO guidelines. Height measurements were recorded to the nearest 0.1 cm using portable stadiometers for children capable of standing, and length measurements were obtained using infantometers for younger children. Weight measurements were recorded to the nearest 0.1 kg via digital scales, with all equipment calibrated daily to ensure measurement accuracy. Structured interviews were conducted with mothers via pretested questionnaires administered in the local language to minimize comprehension barriers. The interview process covered comprehensive domains, including maternal demographic characteristics, pregnancy history, delivery details, infant feeding practices, immunization records, and socioeconomic indicators. Each interview session lasted approximately 30 ot 45 minutes and was conducted in a private setting to ensure confidentiality and encourage honest responses.

Data collection instruments and variable definitions

The study utilized validated, structured questionnaires adapted from previous studies and modified for the local context following expert review and pilot testing. The questionnaire included multiple sections, including child characteristics, maternal factors, and household variables, as described in Table 1. Anthropometric

Table 1. Variable definitions and measurement procedures

Characteristics	What is measured	How to measure
Child characteristics	Birth weight	Extracted from maternal health records (KIA book/hospital discharge summary). Categorized as low (< 2,500 g) vs. normal (≥ 2,500 g)
	Birth length	Extracted from birth records. Categorized as low (< 48 cm) vs. normal (≥ 48 cm)
	History of infectious disease	Maternal report of physician-diagnosed infectious illness requiring medical treatment (diarrhea, acute respiratory infection, or fever) within the past three months. Dichotomized as yes/no
	Exclusive breastfeeding	Infant received only breast milk without any other liquids or solids (except medications/vitamins) for the first six months of life, assessed through maternal recall and dichotomized as yes/no
	Complementary feeding adequacy	Assessed using adapted WHO Infant and Young Child Feeding indicators: (1) timely introduction at 6 months; (2) minimum meal frequency (age-appropriate); (3) minimum dietary diversity (≥ 5 food groups daily for children 6 to 23 months; ≥ 4 food groups for 24 to 59 months); and (4) consumption of iron-rich/fortified foods. Rated adequate when meeting all four criteria, inadequate otherwise
	Immunization status	Assessed against Indonesia's national immunization schedule. Complete immunization is defined as: BCG (1 dose), Hepatitis B (4 doses), Polio (4 doses), DPT-HB-Hib (4 doses), and Measles-Rubella (1 dose by 12 months), verified through the KIA book/public health center records. Categorized as complete vs. incomplete
Maternal factors	Maternal age at pregnancy	Calculated from date of birth to delivery date, extracted from health records. Dichotomized as adolescent (< 20 years) vs. adult (≥ 20 years)
	History of anemia in pregnancy	Physician-diagnosed anemia during current pregnancy (hemoglobin < 11 g dl^{-1} in first/third trimester or < 10.5 g dl^{-1} in second trimester) documented in prenatal records and dichotomized as yes/no
	Maternal height	Measured directly using a portable stadiometer (Seca 213) to the nearest 0.1 cm with the mother standing barefoot. Categorized as short (< 150 cm) vs. normal (≥ 150 cm)
	Maternal education	Highest completed educational level classified as low (≤ 9 years/junior high school) vs. high (> 9 years/senior high school or above), following the Indonesian education system structure and previous stunting research categorization
Household variables	Family income	Total monthly household income from all sources (maternal, paternal, and other household members), assessed through maternal interview. Categorized using Jambi City's 2024 regional minimum wage (3,234,535 IDR/200 USD) as the cutoff: low (< minimum wage) vs. high (≥ minimum wage)

measurements were directly collected by trained research personnel during the study period rather than retrieved from existing records, ensuring standardization and reducing measurement errors.

Data management and statistical analysis

Data entry was performed via double-entry verification in SPSS version 27.0. Univariate analysis was conducted to characterize the distribution of all study variables, with categorical variables presented as frequencies and percentages. Bivariate analysis was performed with chi-square tests for categorical variables to examine the associations between potential risk factors and stunting status. When fewer than five or zero cells were present (birth weight and complementary feeding variables), Fisher's exact test was used to ensure valid probability estimation. Statistical significance was established at $p < 0.05$, with a 95% CI calculated for OR.

RESULTS AND DISCUSSION

Participant characteristics

This case–control study examined 108 children aged 0 to 59 months across five health centers in Jambi City, with an equal distribution between the stunted and non-stunted groups (Table 2). The study population demonstrated that age stratification favored older toddlers, indicating potential age-related vulnerability. Birth parameter analysis revealed a greater prevalence of linear growth restriction than weight deficiency at birth, suggesting that intrauterine growth patterns affect skeletal development. Feeding practices exhibited suboptimal patterns, with over one-third of the children not receiving exclusive breastfeeding and nearly 40% receiving inadequate complementary feeding, indicating a systematic nutritional gap. Maternal characteristics revealed predominantly adult pregnancies with marked educational disparities and almost equivalent income distributions between categories.

Risk factor analysis

Bivariate analysis revealed multiple statistically significant risk factors associated with stunted growth. Birth parameters demonstrated the strongest associations, with birth weight showing complete penetrance and birth length showing a nearly complete association with stunting development. These findings suggest that intrauterine growth restriction (IUGR) is the primary determinant of postnatal linear growth failure. The infectious disease burden created differential growth patterns, indicating that immune–nutrition interactions affect developmental trajectories. Feeding practice analysis revealed the protective effects of exclusive breastfeeding, whereas inadequate complementary feeding was completely associated, emphasizing the importance of nutritional timing and quality.

Immunization coverage gaps are strongly associated with stunting, suggesting that vaccine-preventable diseases contribute to growth failure through infection–malnutrition cycles. Maternal health factors showed consistent patterns across anemia status and anthropometric measurements, indicating the intergenerational transmission of nutritional deficits. Socioeconomic determinants revealed that education was a stronger predictor than income, with maternal education showing protective dose-response relationships. Maternal age was the only non-associated factor, suggesting that biological maturity thresholds may be less relevant in this urban population (Table 3).

This investigation aimed to identify the risk factors associated with stunting among children aged 0 to 59 months in Jambi City, addressing gaps in the understanding of locally relevant determinants within Indonesian urban settings. The study revealed hierarchical risk factor patterns, with birth parameters demonstrating the strongest associations, followed by feeding practices, maternal factors, and socioeconomic determinants of health. Birth anthropometry emerged as the primary predictor, with low birth weight showing complete penetrance and low birth length demonstrating exceptionally high ORs (45.69). These findings substantially exceed those of previous Indonesian studies, where Wicaksono et al. (2021) reported moderate associations for birth length (OR = 2.87), indicating potential urban-rural variations in the severity of IUGR. The complete penetrance pattern suggests that IUGR creates irreversible developmental programming that persists despite postnatal interventions, challenging conventional assumptions about catch-up growth (Beal et al., 2018; Kumar et al., 2021; Halli et al., 2022).

The mechanistic pathway involves compromised placental function, leading to inadequate nutrient transfer, resulting in skeletal growth restriction that persists postnatally through altered growth hormone sensitivity and reduced insulin-like growth factor-1 production (Kuhn-Santos et al., 2019; Saadong et al., 2021; Halli et al., 2022; Upadhyay et al., 2022). This programming effect explains why birth length restriction had higher OR than birth weight did, as linear growth reflects chronic rather than acute nutritional deprivation during fetal development (Saadong et al., 2021; Halli et al., 2022).

Feeding practice analysis revealed threshold phenomena, with inadequate complementary feeding showing a complete association with stunting rather than dose–response relationships. This finding suggests that minimum dietary quality standards must be achieved to prevent growth failure, in contrast to typical nutritional epidemiology, where gradual risk increases are observed (Kasmita et al., 2023; Picauly, 2023; Farera et al., 2024; Mujadillah and Alnur, 2024). The protective effect of exclusive breastfeeding (OR = 2.92) operates through immunoprotective mechanisms and optimal nutrient bioavailability during the critical 0 to 6 months period (Astuti et al., 2024).

The infectious disease history demonstrated a moderate association (OR = 3.39). In contrast, incomplete immunization had exceptionally high OR (37.81), surpassing typical vaccine-preventable disease associations reported worldwide (Fatima et al., 2020; Dewi et al., 2023; Purwanti et al., 2025). This disparity suggests that immunization gaps may serve as proxy markers for broader healthcare access deficits rather than simply reflecting the vaccine-preventable disease burden (Beal et al., 2018). The amplified effect in urban settings may reflect concentrated disease transmission in unvaccinated children through daycare and community exposure.

Maternal factors revealed intergenerational transmission mechanisms, with short maternal stature (OR = 4.27) representing both genetic and environmental effects. Pregnancy anemia (OR = 3.69) demonstrated a moderate association, indicating that impaired iron transport affects fetal neurodevelopment and the development of the growth hormone axis (Georgieff, 2020; Quamme and Iversen, 2022). These findings support the developmental origins hypothesis, which states that maternal nutritional status programs offspring growth trajectories through epigenetic modifications (Manggala et al., 2018).

Socioeconomic analysis revealed that education-mediated pathways predominated over income effects, with maternal education (OR = 6.53) having a greater impact than family income associations (OR = 5.16). This gradient suggests that knowledge-based interventions may yield higher returns than resource transfer programs in urban populations with relatively adequate food security (Thahir et al., 2023; Seretew et al., 2024). The educational effects are likely to operate through changes in healthcare utilization patterns, dietary diversity, and early recognition of growth faltering. The absence of maternal age associations, despite only 7.4% of pregnancies being adolescent pregnancies,

Table 2. Characteristics of the subjects

Characteristics	Frequency (n = 108)	Percentage (%)
Children's nutritional status		
Stunting	54	50.0
Nonstunting	54	50.0
Age (months)		
0–24	40	37.0
25–59	68	63.0
Gender		
Boys	50	46.3
Girls	58	53.7
Birth weight (g)		
Low (< 2,500)	10	9.3
Normal (≥ 2,500)	98	90.7
Birth length (cm)		
Low (< 48)	26	24.1
Normal (≥ 48)	82	75.9
History of infectious disease		
Yes	54	50.0
No	54	50.0
Exclusive breastfeeding		
No	39	36.1
Yes	69	63.9
Complementary feeding		
Inadequate	42	38.9
Adequate	66	61.1
Immunization status		
Incomplete	34	31.5
Complete	74	68.5
Maternal age at pregnancy (years)		
< 20	8	7.4
≥ 20	100	92.6
History of anemia in pregnancy		
Yes	14	13.0
No	94	87.0
Maternal height (cm)		
Short (< 150)	28	25.9
Normal (≥ 150)	80	74.1
Maternal education		
Low	90	83.3
High	18	16.7
Family income		
Low	53	49.1
High	55	50.9

contrasts with rural Indonesian patterns, where adolescent pregnancy represents a major risk factor (Elisia et al., 2023; Pratama et al., 2024; Rizaldi et al., 2025; Sheferaw et al., 2025).

This demographic pattern is consistent with findings from other urban centers in Indonesia. In Jember, the prevalence of adolescent pregnancy was reported to be 80.6%, with no statistically significant association with stunting (p = 0.649) (Ernawati et al., 2024). Similarly, in Palangkaraya, a study revealed that maternal age (20 to 35 years) was not significantly associated with stunting (p = 0.970) (Meidiantri et al., 2025). Consistent findings were also documented in Purbalingga, Central Java, where maternal age did not affect stunting (outer weights < 0.20, t < 1.96, p > 0.05) (Santosa et al., 2021). In contrast, Supadmi et al. (2024) reported that younger mothers in 2024 had a 1.149-fold greater risk of having children with stunting (p < 0.001, aOR = 1.149, 95% CI = 1.116 to 1.183). This finding suggests that the implementation of family planning measures in urban areas has been successful. However, it should be noted that the generalization of these results to populations with higher rates of teenage pregnancy may not apply to other countries. The findings of this study, which were aggregated from diverse urban centers

Table 3. Risk factors for stunting

Variables	Stunting (n = 54)	Non-Stunting (n = 54)	OR (95% CI)	p-value
Birth weight (g)				
Low (< 2,500)	10 (100.0%)	0 (0.0%)	2.22 (1.78–2.77)	< 0.001***
Normal (≥ 2,500)	44 (44.9%)	54 (55.1%)	Ref.	
Birth length (cm)				
Low (< 48)	25 (96.2%)	1 (3.8%)	45.69 (5.88–354.70)	< 0.001***
Normal (≥ 48)	29 (35.4%)	53 (64.6%)	Ref.	
History of infectious disease				
Yes	35 (64.8%)	19 (35.2%)	3.39 (1.54–7.47)	0.002***
No	19 (35.2%)	35 (64.8%)	Ref.	
Exclusive breastfeeding				
No	26 (66.7%)	13 (33.3%)	2.92 (1.28–6.65)	0.009***
Yes	28 (40.6%)	41 (59.4%)	Ref.	
Complementary feeding				
Inadequate	42 (100.0%)	0 (0.0%)	5.33 (3.20–8.88)	< 0.001***
Adequate	12 (18.2%)	54 (81.8%)	Ref.	
Immunization status				
Incomplete	32 (94.1%)	2 (5.9%)	37.81 (8.32–171.71)	< 0.001***
Complete	22 (29.7%)	52 (70.3%)	Ref.	
Maternal age at pregnancy (years)				
< 20	5 (62.5%)	3 (37.5%)	1.73 (0.39–7.65)	0.716^{ns}
≥ 20	49 (49.0%)	51 (51.0%)	Ref.	
History of anemia in pregnancy				
Yes	11 (78.6%)	3 (21.4%)	3.69 (1.02–15.33)	0.035*
No	43 (45.7%)	51 (54.3%)	Ref.	
Maternal height (cm)				
Short (< 150)	21 (75.0%)	7 (25.0%)	4.27 (1.62–11.20)	0.002***
Normal (≥ 150)	33 (41.3%)	47 (58.8%)	Ref.	
Maternal education				
Low	51 (56.7%)	39 (43.3%)	6.53 (1.76–24.18)	0.002***
High	3 (16.7%)	15 (83.3%)	Ref.	
Family income				
Low	37 (69.8%)	16 (30.2%)	5.16 (2.27–11.72)	< 0.001***
High	17 (30.9%)	38 (69.1%)	Ref.	

Note: * = Significant, *** = Very significant, ^{ns} = Not significant across Indonesia, reveal that the factors contributing to stunting in metropolitan areas differ significantly from those observed in rural regions. This discrepancy highlights the need for a tailored intervention approach that differs from the methods used in rural areas.

Public health strategies should emphasize maternal nutrition optimization during pregnancy and universal immunization coverage, particularly in the context of the persistent gaps identified in this study. Analysis of incomplete immunization cases (n = 34) revealed missed vaccines: DPT-HB-Hib booster doses (64.7% of incomplete cases), measles-rubella (41.2%), and polio final doses (35.3%). The predominance of booster-dose gaps rather than primary-series omissions suggests intervention timing failures rather than complete disengagement from healthcare. Mothers reported three primary barriers: (1) conflicting work schedules preventing public health center visits during immunization sessions (52.9% of incomplete cases); (2) child illness coinciding with scheduled appointments, leading to postponement without rescheduling (38.2%); and (3) relocation between health centers, causing record fragmentation (23.5%).

Recommended strategies for improving immunization coverage include (1) extending public health center immunization hours to evenings/weekends to accommodate working mothers (Holipah et al., 2018); (2) implementing SMS/WhatsApp reminder systems with automatic rescheduling functionality for missed appointments (Tanveer, 2024); (3) establishing citywide electronic immunization registries enabling cross-facility verification when families relocate; and (4) integrating immunization services with growth monitoring sessions to capitalize on existing healthcare contacts. These multipronged approaches address structural barriers identified in the study population and maternal education programs that focus on dietary quality assessment and growth monitoring skills (Azriani et al., 2024).

Novelty and limitations

The strengths and novelty of this study include the matched case-control design, which enabled the efficient investigation of multiple risk factors simultaneously; direct anthropometric measurements by trained personnel to ensure data quality; and a focus on medium-sized cities representing Indonesia's demographic transition zone. The purposive selection of health centers across diverse socioeconomic areas enhanced the representativeness of the sample within the urban context.

The limitations of this study include its case–control design, which prevents the establishment of temporal relationships between some exposures and outcomes, and potential recall bias for historical exposures, such as feeding practices. The retrospective ascertainment of exposures introduces measurement error, although objective verification through health records (birth parameters, immunization status) minimized this bias for key variables. However, the large effect sizes observed (OR > 5.0 for multiple factors) suggest that robust associations warrant immediate intervention development, despite these limitations. Additionally, this study was limited to urban settings, restricting its generalizability to rural populations, where risk factor profiles differ substantially. Future research should employ longitudinal cohort designs to establish causal pathways and investigate gene–environment interactions in the development of stunting in urban areas. These findings provide novel evidence for stratified risk factor clustering in urban Indonesian populations, demonstrating that multisectoral interventions spanning maternal health, immunization services, and education systems are needed to achieve sustainable reduction in stunting in metropolitan areas.

CONCLUSIONS

This study identified multiple risk factors for stunting among children aged 0 to 59 months in Jambi City, with bivariate analysis revealing differential associations across modifiable and non-modifiable determinants. Low birth length (OR = 45.69) and incomplete immunization (OR = 37.81) demonstrated the strongest associations, whereas maternal age showed no association in this predominantly adult pregnancy population. IUGR is the primary non-modifiable determinant, necessitating stratified intervention strategies targeting high-risk children. Public health responses should prioritize maternal nutritional optimization during pregnancy, universal immunization coverage with a focus on booster dose completion, and education-focused interventions. Multisectoral approaches spanning maternal health services, immunization programs, and educational systems are essential for sustainably reducing stunting in urban Indonesian settings. Future longitudinal studies employing multivariate analyses should aim to establish causal pathways and determine the relative contributions of risk factors and stunting outcomes.

ACKNOWLEDGEMENTS

The authors express their gratitude to all the respondents who voluntarily participated and provided valuable information for this study. The authors also thank Mega Science Indonesia, Inc. (https://megsci-ind.org/), which facilitated the proofreading process to ensure that this manuscript met publication standards.

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