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The Influence of Socio-Economic and Environmental Factors on the Nutritional Status of Toddlers in Urban and Rural Areas in Bangkinang Regency, Riau, Indonesia

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ABSTRACT

The nutritional status of toddlers is a critical indicator of sustainable human development. Disparities between urban and rural areas remain a major challenge for equitable child health in Indonesia. This study analyzed socio-economic and environmental factors' influence on toddlers' nutritional status, comparing urban and rural areas. A comparative survey design was used, with 60 respondents - 30 toddlers each from urban and rural areas. Data collection included socio-economic questionnaires, environmental checklists, and WHO Z-score anthropometric measurements. Data were analyzed using regression tests and t-tests. Nutritional status (Z-scores) was significantly better in urban children (1.1 ± 0.3) than rural children (0.5 ± 0.4), ($p = 0.000$), indicating socioeconomic and environmental disparities between populations. Family income shows the strongest correlation with nutritional status ($r = 0.632$, $p < 0.01$) and dominates the multivariate model. Mother's education has a moderate correlation ($r = 0.486$, $p < 0.05$), as does environmental score ($r = 0.458$, $p < 0.01$), which is dominant in the multivariate context. These findings suggest socioeconomic conditions and environmental quality influence child nutritional outcomes, with income and sanitation being most impactful. The study concludes that toddler nutritional status is determined by interrelated socio-economic and environmental factors varying between urban and rural contexts. These findings underscore the need for region-specific interventions and multi-sectoral policies responsive to local needs.

Key Messages:

- Nutritional status in toddlers is shaped by socio-economic and environmental factors, with significant urban–rural disparities, highlighting the need for locally tailored, multisectoral interventions and policies.

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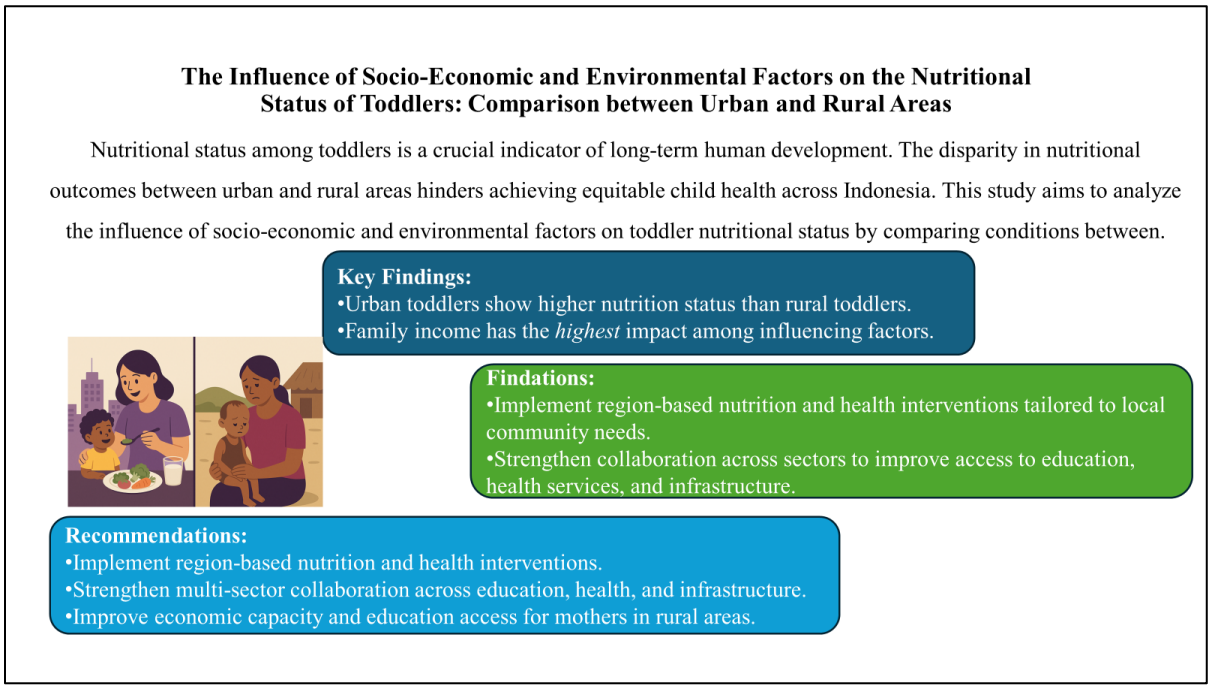
GRAPHICAL ABSTRACT



INTRODUCTION

The nutritional status of under-fives is an important indicator of the quality of public health, especially during the early growth and development of children (1). Toddlers with good nutritional status tend to experience optimal physical and cognitive development. Conversely, poor nutrition at an early age can impact on an individual's future productivity and quality of life.

In Indonesia, under-five nutrition remains a major challenge in urban and rural areas (2). Differences in socioeconomic characteristics between the two regions influence children's nutritional status (3). Factors such as family income, parental education, food consumption patterns, and access to health services have been shown to play an important role in determining the nutritional status of toddlers (4). Although toddlers in urban areas generally have better access to health facilities and nutrition information, the impact of urbanization and modern lifestyles also increases the risk of unhealthy diets (5). In addition to socioeconomic factors, the living environment greatly contributes to children's nutritional status. A clean and healthy environment supports optimal child development (6), whereas poor sanitation, limited clean water, and densely populated environments have the potential to worsen nutritional status, especially in poor and remote areas (7). Infections due to unhygienic environments, such as diarrhea and ARI, are also major risk factors for undernutrition in toddlers (8).

Low public awareness of the importance of balanced nutrition, especially in families with low education levels, can lead to inappropriate feeding practices (9). The lack of information and understanding of nutrition reflects the importance of cultural and educational factors in shaping family behavior related to meeting children's nutritional needs (10). However, government nutrition policies and interventions often show implementation gaps. Food aid and nutrition intervention programs often do not reach areas with the most pressing needs (11). This points to the need for a more adaptive and locally based approach to tackling nutrition problems. (12).

Bronfenbrenner's Social Ecology Theory offers a conceptual framework for understanding how the nutritional status of toddlers is influenced by complex interactions between individuals and their environment (13). This theory places children in a layered system, starting from the immediate environment, such as family (microsystem) and community (mesosystem), to macro policy (macrosystem) (14). In contrast, the Social Determinants of Health Theory emphasizes that health, including nutritional status, is strongly influenced by the social conditions in which individuals are born, grow, and live. Both

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theories emphasize the importance of a multidimensional approach to formulating more equitable and sustainable public health solutions (15).

Unfortunately, most available data and research are generalized and lack consideration of the geographical context. Previous studies often combined data from different regions without considering the significant differences between the social and environmental characteristics of urban and rural areas (16). Consequently, the resulting policy recommendations are less responsive to local needs (17). In addition, variables such as family income, parental education, and access to health services have been widely studied, but rarely comprehensively analyzed together with environmental factors such as sanitation, residential hygiene, and clean water availability, especially in the context of comparisons between urban and rural areas. This lacuna creates information gaps that may hinder intervention effectiveness (18).

To address this challenge, this study aims to fill this knowledge gap by comparatively analyzing the influence of socioeconomic and environmental factors on the nutritional status of toddlers in urban and rural areas. This study also aims to identify interventions most relevant to local characteristics to improve the effectiveness of nutrition programs. It is hoped that the results of this study will provide a scientific basis for formulating policies and intervention programs that are more adaptive, targeted, and evidence based.

METHODS

This study used a quantitative approach with a comparative survey design to compare the influence of socio-economic and environmental factors on the nutritional status of toddlers between urban and rural areas (19). This design was chosen because it is able to describe the relationship between variables descriptively and inferentially through data collection in a certain time (20). The population in this study is all toddlers living in urban and rural areas in Bangkinang Regency, Riau, Indonesia which is administratively stated as urban and rural areas during March 2025. The sample was taken using stratified random sampling technique based on domicile (urban and rural), with a total of 60 respondents consisting of 30 toddlers in urban areas and 30 toddlers in rural areas. The selection of the sample took into account a distribution that was representative of social and environmental variations in each region.

The instruments used in this study were in the form of a structured questionnaire and an observation sheet (21). Experts in public health nutrition and environmental health assessed the questionnaire's content validity, reviewing items for relevance and clarity. All items achieved a Content Validity Index >0.80. A pilot test with 10 non-sample respondents showed good reliability, with Cronbach's alpha of 0.82 for socio-economic items. The questionnaire contains questions about the socio-economic conditions of the family such as the level of education of the parents, employment, and income. The observation sheet was used to record the conditions of the living environment and nutritional status of toddlers based on anthropometric measurements, such as weight-for-age (WAZ), height-for-age (HAZ), and weight-for-height (WHZ), based on WHO Child Growth Standards. Classifications were: Normal (-2 to +2 SD), Underweight/stunting/wasting (< -2 SD), and Overnutrition (> +2 SD) (22).

The data collection procedure begins with coordination with local health workers to record toddlers according to inclusion criteria. Socio-economic data was collected through interviews with parents or caregivers of toddlers. In contrast, environmental data and nutritional status measurements were carried out directly by researchers with the help of previously trained Integrated Health Post (In Indonesia: posyandu) cadres. Environmental conditions were assessed using Ministry of Health guidelines and validated tools. Assessment covered sanitation, water supply, waste management, housing density/ventilation, and cleanliness. Indicators were rated 1-4 (very poor to very good). Scores were summed for a composite environmental score (5-20), with higher scores indicating better quality. The score was analyzed as continuous and categorized into low, moderate, and high quality using tertiles. All data were then statistically analyzed through linear regression tests and independent sample t-tests to test the influence and differences between the two groups of areas (23,24) using SPSS 25.0 for windows.

RESULTS

There were 60 respondents under five who were evenly divided between city and village areas, as

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many as 30 each. The data collected included five main variables, namely family income, mother's education level, environmental quality score, and children's nutritional status in the form of Z-score according to WHO standards. The data were analyzed using a regression test to identify the influence of each factor, as well as an independent sample t-test to see the differences between urban and rural groups.

Table 1 presents the distribution of residential environmental conditions and nutritional status among toddlers**.** More than half of the participants (55%) lived in environments classified as good, while 45% were in poor residential conditions. Nutritional status based on weight-for-age (WAZ) showed that 60% of toddlers had normal weight, whereas 30% were underweight and 10% were severely underweight. Regarding height-for-age (HAZ), 65% of children exhibited normal growth, 20% were stunted, and 15% were severely stunted. Assessment based on weight-for-height (WHZ) indicated that 70% had normal weight status, 20% were moderately wasted, and 10% were severely wasted. These findings suggest the presence of both acute and chronic undernutrition within the population studied.

Table 1. Distribution of Frequency of Environmental Conditions and Nutritional Status of Toddlers

Variable	Category	n	%
Residential Environmental Conditions	Good	11	55
	Bad	9	45
Nutritional Status of weight-for-age (WAZ)	Good Nutrition	12	60
	Underweight	6	30
	Severe underweight	2	10
Nutritional Status of height-for-age (HAZ)	Normal	13	65
	Stunted	4	20
	Severe stunted	3	15
Nutritional Status of weight-for-height (WHZ)	Normal	14	70
	Moderate wasting	4	20
	Severe wasting	2	10

Table 2 shows the distribution of key sociodemographic and environmental variables, as well as nutritional status, between urban and rural toddlers. The average family income in urban areas (IDR 6,000,000 ± 1,000,000) was substantially higher than in rural areas (IDR 3,000,000 ± 800,000). Similarly, maternal education was higher in urban mothers (14 ± 1.5 years) compared to rural mothers (9 ± 2.0 years). The mean environmental quality score was also higher in urban areas (80 ± 5) than in rural areas (65 ± 6). Nutritional status, assessed using Z-scores, was significantly better in urban children (1.1 ± 0.3) compared to rural children (0.5 ± 0.4), with a statistically significant difference (p = 0.000). These findings indicate notable disparities in socioeconomic and environmental determinants of nutritional outcomes between urban and rural populations.

Table 2. Distribution of Key Variables by Area and T-Test value of Nutritional Status between Urban and Rural Areas

Variable	Urban (n=30)		Rural (n=30)		p-value
	Min – Max	Average ± Stdev	Min – Max	Average ± Stdev	
Family Income (IDR)	4,000,000 – 7,500,000	6,000,000 ± 1,000,000	1,300,000 – 5,500,000	3,000,000 ± 800,000	-
Maternal Education (year)	12 – 16	14 ± 1.5	6 – 12	9 ± 2.0	-
Environmental Score	70 – 90	80 ± 5	50 – 75	65 ± 6	-
Status Gizi (Z-score)	0.8 – 2.1	1.1 ± 0.3	-0.2 – 1.2	0.5 ± 0.4	0.000

Table 3 illustrates differences in nutritional behavior and environmental risk factors between urban and rural areas. Urban mothers demonstrated higher food hygiene practices (score: 85) and better

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nutritional knowledge (score: 80) compared to their rural counterparts (scores: 60 and 55, respectively). The frequency of toddler feeding was also greater in urban settings (3 times/day) than in rural settings (2 times/day). Regarding environmental aspects, the prevalence of diarrhea among toddlers was lower in urban areas (10%) than in rural areas (40%). Additionally, urban households had greater access to healthy toilet facilities (90%) and clean water (95%), while these figures were considerably lower in rural areas (50% and 60%, respectively). These findings highlight significant disparities in behavioral and environmental determinants of child nutrition and health.

Table 3. Pattern of Nutritional Behavior and Environment Aspect (Infection and Sanitation Risk) in Urban and Rural Areas

Variables	Urban	Rural
Nutritional Behavior	**(Average Score)**	**(Average Score)**
Food Hygiene	85	60
Maternal Nutrition Knowledge	80	55
Frequency of Feeding	3×/day	2×/day
Environmental Aspects	**(%)**	**(%)**
Toddler has diarrhea	10	40
Have a healthy toilet	90	50
Access to clean water	95	60

Table 4 presents a case comparison of extreme nutritional status among toddlers in urban and rural settings. The urban toddler (Resp A) showed a high nutritional status (Z-score = 2.1), supported by favorable socio-environmental conditions including high family income (IDR 7,200,000), maternal education (15 years), and environmental quality (score: 89). In contrast, the rural toddler (Resp B) exhibited a poor nutritional status (Z-score = -0.25), which was associated with lower income (IDR 1,800,000), limited maternal education (6 years), and a substantially lower environmental score (54). This contrast underscores the multidimensional influence of socioeconomic and environmental factors on child nutrition.

Table 4. Case Study of Nutritional Status of Extreme Toddlers in Urban and Rural Areas

Respondent Name	Area	Nutritional Status (Z-score)	Income (IDR)	Mother's Education	Environmental Score
Resp A	Urban	2,1	7,200,000	15 years	89
Resp B	Rural	-0,25	1,800,000	6 years	54

Table 5. Correlation and Multivariate Integration Between Variables with Nutritional Status

Independent Variables	Correlation		Multivariate Integration	
	Correlation Coefficient (r)	Information	Significance	Dominant Influence
Family Income	0.632	Strong positive	$p < 0.01$	Yes
Mother's Education	0.486	Moderate positive	$p < 0.05$	Less
Environmental Score	0.458	Moderate positive	$p < 0.01$	Yes

Table 5 summarizes the correlation and multivariate integration between key independent variables and nutritional status among toddlers. The results reveal that family income shows the strongest positive correlation with nutritional status ($r = 0.632$, $p < 0.01$), and is identified as a dominant influencing factor in the multivariate model. Mother's education also has a moderate positive correlation ($r = 0.486$, $p < 0.05$), indicating a meaningful though less dominant role. Similarly, environmental score shows a moderate positive correlation ($r = 0.458$, $p < 0.01$) and is also considered a dominant factor in the multivariate context. These findings suggest that socioeconomic conditions and environmental quality are interrelated and collectively influence child nutritional outcomes, with income and environmental

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sanitation emerging as the most impactful.

DISCUSSION

The nutritional status of toddlers in urban areas is significantly better than that of their rural counterparts. T-test results revealed a statistically significant difference in the average Z-scores of nutritional status between the two areas. Urban toddlers generally benefit from better access to nutritious food, healthcare, sanitation, and public infrastructure, which contribute to improved health outcomes (25).

Family income, environmental quality, and maternal education all show a positive correlation with toddlers' nutritional status, with income demonstrating the strongest association, followed by environmental and educational factors. These findings reinforce the interrelated roles of socio-economic and environmental determinants in shaping child health. This pattern is further supported by regression analyses and descriptive statistics. A case study comparing two toddlers, one from a rural area and one from an urban setting, vividly illustrates the impact of inequality in access to basic resources on children's growth. This study aligns with findings from UNICEF, WHO, and Indonesia's Ministry of Health, which identify maternal education and family income as key predictors of child nutrition (26). Importantly, the study offers new insights by showing that environmental factors play a more prominent role in rural areas. While previous literature often treats environmental aspects as secondary to economic factors, this study shows that poor environmental conditions directly contribute to malnutrition in rural communities. This finding highlights the importance of context-specific nutrition strategies.

Another strength of this study is its explicit regional comparison, which is less common in previous research that tends to focus on single areas or isolated variables. This comparative approach increases the applicability of findings for region-specific policymaking. The observed disparities reflect broader social and developmental inequalities, extending beyond economics to encompass children's basic rights to health, education, and a clean environment. These results emphasize that national development initiatives have not yet reached all segments of society equally. Improving child nutrition requires more than just supplemental feeding; it demands cross-sectoral efforts involving health, education, economic development, and environmental management (27, 28). Interventions must be tailored to the unique challenges faced by urban and rural populations. For example, while urban areas benefit from better infrastructure and access to services, rural communities struggle with limited health facilities, lower parental education, and poor environmental conditions, factors that perpetuate a cycle of vulnerability and hinder nutritional improvement.

Cultural factors also influence rural feeding and parenting practices. Traditional practices like using certain herbs or local foods (e.g., tempeh, moringa) may actually support good nutrition (29, 30). Health programs that respect and incorporate cultural knowledge are often more accepted. For example, integrating local food preparation techniques into maternal and child nutrition counseling can increase program uptake (31). Traditional beliefs that lack alignment with modern health education create barriers to behavior change (32), explaining why food assistance programs often fall short in rural areas. Thus, nutrition interventions must incorporate culturally sensitive education and community engagement.

However, genetic predispositions, pre-existing health conditions, and access to fortified foods influence the nutritional status of urban and rural toddlers. These three factors interact with social determinants like income, education, and healthcare access to shape nutritional outcomes. For effective interventions, it's important to consider both biological and structural contributors to malnutrition in toddlers. Genetic factors can influence how toddlers absorb, metabolize, or utilize nutrients, affecting growth and overall nutritional status (33). Genetic conditions like lactose intolerance, sickle cell disease, or thalassemia may affect dietary needs or nutrient metabolism (34, 35). Chronic or recurrent illnesses such as diarrhea, respiratory infections, tuberculosis, or congenital disorders directly impair nutritional status by reducing nutrient absorption, increasing energy demands, and decreasing appetite or feeding capacity (36). Meanwhile, fortified foods such as vitamin-enriched flour, iodized salt, or fortified infant cereals are a key tool in combating micronutrient deficiencies (37). In urban areas, such conditions are more likely to be diagnosed and managed since to better access to pediatric care and specialized services. Better immunization coverage and healthcare infrastructure may reduce disease burden even urban

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children in poverty pockets (slums) may still face similar risks as rural children due to overcrowding and poor living conditions. Urban toddlers are more likely to have regular access to fortified commercial foods through supermarkets, health centers, and organized feeding programs, besides parents in urban areas may also be more aware of the benefits of fortified products due to better exposure to health education and media. In rural areas, genetic conditions often go undiagnosed or untreated, which may worsen malnutrition or be misinterpreted as general undernutrition, leading to inappropriate care. Higher rates of infectious diseases due to poor sanitation and limited access to clean water, while limited access to healthcare services results in untreated or prolonged illnesses that compound nutritional deficiencies. Access may be limited by distribution barriers, affordability, or lack of awareness and some fortified foods may be underutilized due to preference for traditional diets or distrust of packaged foods.

Rather than simply reaffirming disparities, the findings emphasize the need for region-specific policy approaches. In rural areas, where environmental conditions have a more substantial impact, interventions should prioritize infrastructure improvements and community-based environmental health programs. Conversely, in urban settings, strategies that strengthen household income and maternal education may yield greater benefits. These insights underscore the importance of context-sensitive, multidimensional policies that address both structural and behavioral factors to improve child nutrition outcomes sustainably. Further research with broader geographic coverage and larger sample sizes is needed to improve policy effectiveness, alongside longitudinal studies to track changes over time. Participatory approaches can help identify local strengths and needs. At the local level, micro-data should guide policy development, and community-based programs supported by trained Integrated Health Post (Posyandu) cadres and digital tools, can better address region-specific nutrition challenges.

Finally, increasing maternal education and raising family nutrition awareness should be prioritized in national human development strategies. These efforts must go beyond formal education systems and include community outreach and informal education. By combining structural improvements with educational initiatives, Indonesia can advance toward more equitable and sustainable nutritional outcomes for its children.

CONCLUSION

The present study identified a significant disparity in the nutritional status of toddlers residing in urban versus rural areas, with urban toddlers exhibiting superior nutritional status. Socio-economic determinants, including family income and maternal education, alongside environmental factors such as sanitation and residential cleanliness, were found to substantially influence the nutritional status of toddlers. Notably, environmental factors exert a more pronounced effect in rural areas, whereas income and education are more influential in urban settings. These findings suggest that policy interventions which is focus on improving access to clean water, sanitation, and environmental health infrastructure should be tailored to local contexts to enhance their effectiveness and impact.

This research offers significant value by employing a comparative approach between two distinct areas and integrating regression and correlation analyses to examine the multidimensional impact on child nutrition. The methodological contribution is evident in the concurrent use of environmental observation instruments and socio-economic questionnaires. However, the study is limited by its regional scope and a relatively small sample size, which precludes the generalization of findings on a national scale. Future research should adopt a longitudinal design and broaden the study area to understand better the long-term dynamics of nutritional status and the effectiveness of sustainable local interventions.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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