Jurnal Kesehatan
Vol. 19, No. 1, June 2026, pp. 56~65
p-ISSN: 1979-7621, e-ISSN: 2620-7761, DOI: 10.23917/jk.v19i1.13298

Maternal and Child Characteristics, Stimulation Practices, and Their Association with Stunting: A Cross-Sectional Study

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How to Cite: Wijayanti, A. C., Isnaeani, F. N., Wulandari, W., Werdani, K. E., Puspita, W. G., Pratiwi, S. C., & Sahda, R. A. Maternal and Child Characteristics, Stimulation Practices, and Their Association with Stunting: A Cross-Sectional Study. Jurnal Kesehatan, 19(1), 56–65. https://doi.org/10.23917/jk.v19i1.13298

Article Information

Article History:
Submission: 13 October 2025
Revision: 23 January 2026
Reception: 3 November 2025

Keywords: *Child age, child development, maternal age, stimulation, stunting*

ABSTRACT

Introduction: Stunting is a form of chronic malnutrition in early life that impairs physical growth, cognitive and motor development, and long-term productivity. Puskesmas Trucuk II in Klaten Regency has the highest stunting prevalence in the district (22.7%). This study examined differences in child age, maternal age, stimulation, and child development in relation to stunting incidence. **Method**: A cross-sectional study was conducted in the working area of Trucuk II Health Center, Klaten Regency, from 1 February to 30 April 2024, involving 128 mothers of toddlers aged 24–59 months. The incidence of stunting was classified using z-score measurements based on Permenkes RI Number 2 of 2020 concerning Child Anthropometry Standards, and child development was assessed using KPSP. Data were analyzed using ANOVA. **Results**: There was no difference between the child's age (p-value: 0.071), mother's age (p-value: 0.182), stimulation (0.265), and child development (p-value: 0.840) with the incidence of stunting. **Conclusion**: No significant differences were found in child age, maternal age, stimulation, or child development between stunted and non-stunted children. Stunting may be more strongly influenced by broader nutritional, socioeconomic, and environmental factors, highlighting the need for further longitudinal research.

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INTRODUCTION

Population growth provides a strategic basis for governments to project the future quality of human resources (HR) and underscores the importance of investing in child health as a foundation for sustainable development (Kristanti & Sebtalesy, 2019; Kulkov et

al., 2024; Rudianto, 2022). However, stunting remains a persistent public health challenge with wide-ranging implications for human capital development (Rahayuwati et al., 2023). Globally, an estimated 149.2 million children (22%) were affected by stunting in 2020, with Asia accounting for a substantial proportion of this burden (UNICEF, 2022). In Indonesia, the prevalence of stunting was reported at 24.4% in 2021, while Central Java Province recorded a prevalence of 20.9% among children aged 0–59 months (Kemenkes RI, 2021, 2023). In Klaten Regency, the prevalence increased from 11.3% in 2021 to 14.9% in 2022, with the highest rate observed in the working area of the Trucuk II Community Health Center at 22.7% (Dinas Kesehatan Kabupaten Klaten, 2023).

Stunting has a long-term consequences, including reduced cognitive capacity, lower academic achievement, and an increased risk of chronic diseases in adulthood (de Onis & Branca, 2016; Sumaga et al., 2022). Stunting is multifactorial and shaped by the interaction of biological, social, and environmental determinants, such as low birth weight, maternal and child characteristics, parental educational attainment, and broader cultural and environmental contexts (Anggreani & Werdani, 2024; Chandra & Humaedi, 2022; Hadi et al., 2021; Sari & Harianis, 2022; Supriyatun et al., 2024). Beyond nutritional and environmental factors, parental provision of stimulation plays a critical role in supporting children's cognitive, motor, and socio-emotional development. Evidence indicates that children who receive adequate stimulation are more likely to achieve developmentally appropriate outcomes (Intania et al., 2021). Accordingly, monitoring child development should be conducted alongside routine nutritional assessments within primary health care settings (Mardiyati et al., 2023; Wati, 2017).

Although maternal characteristics are frequently reported in stunting research, maternal age is often treated as a descriptive variable, and its role in shaping stimulation practices and child developmental status remains insufficiently examined (Santosa et al., 2022). The interaction between maternal age, child age, stimulation practices, and child developmental status may generate distinct patterns of stunting risk; however, empirical evidence within primary health care contexts remains limited and mixed (Bliznashka et al., 2022; Kartinah et al., 2025). The high prevalence of stunting in the working area of the Trucuk II Community Health Center, Klaten Regency, underscores the need for context-specific research to inform locally responsive and integrated prevention strategies. Therefore, this study aims to analyze the role of maternal age and child age, provision of stimulation, and child development in relation to the incidence of stunting within the primary health care setting of this area.

LITERATURE REVIEW

Stunting is best conceptualized through Bronfenbrenner's Ecological Systems Theory, which posits that child development is shaped by multiple, interacting environmental layers. These include the im, mediate surroundings such as family and caregivers (microsystem), interconnections between those environments (mesosystem), broader community and institutional contexts (exosystem), cultural and societal influences (macrosystem), and temporal changes throughout development (chronosystem) (Bronfenbrenner, 1979). This framework suggests that stunting arises not only from biological or individual factors but also from complex interactions within the child's social ecology, highlighting the need to consider family dynamics, caregiving quality, community support, and policy environments collectively.

The Social Ecological Model extends this approach by emphasizing that factors at individual, interpersonal, community, institutional, and policy levels collectively influence childhood nutrition and growth outcomes (Paquette & Ryan, 2020). Nutritional practices such as breastfeeding and complementary feeding occur within these nested layers,

affected by parental knowledge, social support networks, healthcare access, and governance structures. Interventions must therefore address barriers and facilitators across these multiple levels to be effective against stunting (Bengough et al., 2022).

Nutritional ecology theory complements this perspective by integrating biological processes with environmental contexts, emphasizing that stunting results from the interplay between internal factors like nutrient metabolism and growth regulation and external influences, including food security, feeding practices, sanitation, and exposure to infections (Raiten & Bremer, 2020). This ecological view underscores the importance of understanding child nutrition within the broader physical and social environments influencing nutrient availability and utilization.

Moreover, early childhood development theories emphasize the role of adequate stimulation and responsive caregiving in supporting neurological and physical growth during sensitive developmental periods. Cognitive, emotional, and social stimulation promotes motor and language development and may reduce the impact of nutritional deficits (Lobo et al., 2024; Ramírez-Luzuriaga et al., 2021). These practices are shaped by cultural norms, knowledge, and resource availability, reinforcing the role of ecological systems in child growth. Consistent with this perspective, this study examined differences in child age, maternal age, stimulation, and child development in relation to the incidence of stunting to support integrated and multisectoral approaches to child health.

METHODS

This study employed a quantitative cross-sectional design to examine the relationships between maternal age, stimulation practices, and child development and the incidence of stunting among children aged 24–59 months in the working area of Puskesmas Trucuk II, Klaten Regency. The study was conducted from 1 February to 30 April 2024.The study population comprised parents of children aged 24–59 months residing in the working area of the Trucuk II Health Center. The sample size was calculated using the Cochran formula with a 95% confidence level ($z = 1.96$), $p = 0.5$, $q = 0.5$, and a margin of error (d) of 10% (0.1), resulting in a minimum required sample of 97 respondents. To account for potential respondent loss, an additional 10% was added, yielding a minimum target sample of 107 children. Purposive sampling was applied, and after the inclusion and exclusion criteria were implemented, a total of 128 respondents were included in the final analysis.

The inclusion criteria were parents who had children aged 24–59 months, resided in the working area of Puskesmas Trucuk II, and provided consent to participate in the study. The exclusion criteria were children identified as having a disability, children with incomplete anthropometric or questionnaire data, and respondents who withdrew during data collection. Data were collected using a structured questionnaire capturing respondent characteristics, including age, educational background, employment status, parity history, family income, child's sex, history of low birth weight and birth length, exclusive breastfeeding status, maternal age, and child age. Stunting was defined as a child's nutritional status indicating chronic undernutrition and was assessed using the height-for-age z-score (HAZ) in accordance with the Indonesian Ministry of Health Regulation (Permenkes RI No. 2 of 2020) and measured using a microtoise. Children were categorized as stunted when $HAZ < -2$ SD and as normal when $HAZ \geq -2$ SD.

Stimulation practices were defined as maternal activities intended to support basic developmental abilities and were measured using a structured questionnaire, classified as good when the respondent's T-score exceeded the mean/median and poor when it was equal to or below the mean/median. Child development was defined as age-appropriate functioning in the fine motor, gross motor, communication, and social interaction domains

and was assessed using the Developmental Pre-Screening Questionnaire (KPSP) for children aged 24–59 months. Developmental status was categorized as appropriate (9–10 affirmative responses), doubtful (7–8 affirmative responses), or delayed (≤6 affirmative responses).

Univariate analysis was conducted to describe respondent characteristics using frequency distributions. Bivariate analysis examining the associations between maternal age, stimulation practices, and child development with the incidence of stunting was performed using ANOVA with a 95% confidence interval. This study received ethical approval from the Research Ethics Committee of the Faculty of Health Sciences, Universitas Muhammadiyah Surakarta (Approval No. 185/KEPK-FIK/I/2024).

RESULTS AND DISCUSSION

The results showed that this study's total number of respondents was 128. The results of the univariate analysis in Table 1 below relate to the characteristics of respondents in this study.

Table 1. Descriptive Frequency of Characteristic Respondent (N= 128)

Variable	Categories	Frequency (n)	Percentage (%)
Maternal Age	20 – 29 years	55	43.0
	30 – 39 years	61	47.7
	40 – 49 years	12	9.4
Educational Status	Elementary	3	2.3
	Junior High School	17	13.3
	Senior High School	94	73.4
	Bachelor's Degree	14	10.9
Job's Status	Housewife	101	78.9
	Farmer	4	3.1
	Trader	1	0.8
	Enterpreuner	2	1.6
	PNS/TNI/POLRI	1	0.8
	Others	9	7.0
History of Parity	Primipara (1)	71	55.5
	Multipara (2 – 4)	57	44.5
Families Income	< Rp 2.244.000	93	72.7
	≥ Rp 2.244.000	35	27.3
Child's Gender	Male	51	39.8
	Female	77	60.2
Child's Age	24 – 36 Months	50	39.1
	37 – 59 Months	78	60.9
Birth Weight History	BBLR (< 2500 gram)	18	14.1
	BBLN (≥ 2500 gram)	110	85.9
Birth Length History	< 46 cm	34	26.6
	≥ 46 cm	94	73.4
Breastfeeding Status	Exclusive	111	86.7
	Unexclusive	17	13.3

Based on Table 1. Descriptive Frequency of Characteristic Respondent majority of respondents' characteristics were the age of the maternal age as much as 30 - 39 years as many as 61 respondents (47.4%), a history of high school education as many as 94 respondents (73.4%), work status as a housewife (IRT) as many as 101 respondents (78.9%), 71 respondents (55.5%), and family income of < 2,244,000 as many as 93 respondents (72.7%). As for the characteristics of children, the majority were female as many as 77

respondents (60.2%), the age of children (37 - 59 months) as many as 78 respondents (60.9%), the history of birth weight showed that the majority of children had a birth weight history (≥ 2500 grams) as many as 110 respondents (85.9%), a history of birth length ≥ 46 cm as many as 94 respondents (73.4%), and exclusive breastfeeding status as many as 111 respondents (86.7%).

Table 2. Results of Differential Test Analysis Between Child Age, Mother's Age, Provision of Stimulation, and Child Development with the Incidence of Stunting

Variable	Categories	n	Mean	Std. Deviation	95% CI Lower – Upper	F	P-Value
Child's Age	Stunted	36	38.72	9.904	35.37 – 42.07	3.312	0.071
	Not stunted	92	42.63	11.291	40.29 – 44.97		
Maternal Age	Stunted	36	30.08	4.129	28.69 – 31.48	1.801	0.182
	Not stunted	92	31.37	5.133	30.31 – 31.43		
Providing Stimulation	Stunted	36	28.78	1.791	28.17 – 29.38	1.225	0.265
	Not stunted	92	28.26	2.528	27.74 – 28.78		
Child Development	Stunted	36	8.28	1.323	7.83 – 8.73	0.041	0.840
	Not Stunted	92	8.33	1.168	8.08 – 8.52		

Table 2 indicates that none of the examined variables differed significantly between stunted and non-stunted children aged 24–59 months. Stunted children were slightly younger, with a mean age of 38.72 months (SD = 9.904; 95% CI: 35.37–42.07), compared with 42.63 months (SD = 11.291; 95% CI: 40.29–44.97) in the non-stunted group ($F = 3.312$; $p = 0.071$). Mean maternal age, providing stimulation, and child development scores were also comparable between groups (maternal age: $F = 1.801$, $p = 0.182$; stimulation: $F = 1.225$, $p = 0.265$; child development: $F = 0.041$, $p = 0.840$). Overall, the results show no statistically significant differences by stunting status.

This study is consistent with findings from the Kertek 2 Health Center, Wonosobo Regency, which also reported no association between maternal age and stunting ($p = 0.799$) (Claudia, 2024). However, these findings differ from studies conducted in Karubaga, Tolikara Regency, which reported that mothers who were classified as adolescents (<20 years) at the time of pregnancy had a higher risk of having stunted children compared to mothers aged 20–34 years (Wanimbo & Wartiningsih, 2020). Other studies have also reported that the optimal maternal age for pregnancy is between 20 and 35 years, as early marriage and early pregnancy may increase the risk of inadequate energy and protein intake and inappropriate parenting practices (Dwinanda et al., 2017; Manggala et al., 2018; Nope, 2023). Energy and protein deficiencies can inhibit growth through reduced plasma insulin levels, decreased synthesis of Insulin Growth Factor-1 (IGF-1), and impaired cell and tissue maintenance potentially leading to stunting (Anasiru & Domili, 2018; Sumartini, 2022).

Stunting is defined as linear growth failure indicated by a length- or height-for-age z-score below −2 SD based on World Health Organization growth standards and normal growth occurs when a child's growth is appropriate for their age (Saracho, 2023; Sumardiyono, 2020). In this study, child age was not significantly associated with stunting ($p = 0.071$). This finding contrasts with previous studies reporting a higher risk of stunting at ages 6–24 months, a critical period associated with the transition to complementary feeding (Rukmana et al., 2016). Complementary feeding plays an essential role in fulfilling macro- and micronutrient requirements for growth, and appropriate dietary diversity and feeding frequency have been shown to reduce the risk of stunting by up to sevenfold (Husnah et al., 2022; Mitra, 2019; Mutingah & Rokhaidah, 2021; Susilowati & Waskita, 2019).

Differences in findings may be explained by variations in maternal knowledge, socio-cultural beliefs regarding the timing of complementary feeding, and household economic capacity, which influences food selection and quality (Hendra et al., 2016; Syafitri et al., 2024; Wulandari et al., 2025). These factors were not directly measured in this study and may have contributed to residual confounding.

Providing stimulation was also not significantly associated with stunting (p = 0.265). In this study, stimulation was defined as maternal activities intended to support basic developmental abilities and was measured using a structured questionnaire. Although stimulation plays an important role in child growth and development, its influence may be more directly related to neurodevelopmental outcomes rather than linear growth (Kisnawaty et al., 2023; Ulfah et al., 2018). Additionally, previous research suggests that limited awareness and environmental support may reduce the quality and consistency of stimulation provided by mothers (Mulia & Kurniati, 2023; Umaroh et al., 2023). This result contrasts with findings reporting a significant relationship between stimulation and stunting (p = 0.000), indicating that differences in measurement tools and variable categorization may contribute to inconsistent findings (Hidayah et al., 2019).

Similarly, child development was not significantly associated with stunting (p = 0.840), despite evidence that children with delays in cognitive, gross motor, fine motor, language, and speech development tend to have a higher risk of stunting (Surtiningsih & Yanti, 2019). Child development in this study was assessed using the Developmental Pre-Screening Questionnaire (KPSP), which categorizes development as appropriate, doubtful, or delayed. While KPSP is useful for early screening, it may not be sufficiently sensitive to capture subtle developmental differences related to chronic nutritional deprivation, particularly in a cross-sectional study design.

Overall, the lack of significant associations observed in this study may be explained by several factors, including the cross-sectional design, which limits causal inference; the use of categorical variable definitions that may obscure dose–response relationships; and the relatively limited sample size, which may reduce statistical power. Furthermore, stunting is influenced by complex and interacting direct and indirect factors, including dietary intake, recurrent infections, birth outcomes, socioeconomic conditions, sanitation, access to health services, infrastructure, and policy environments (Pertiwi et al., 2024; Priyono, 2020; Rollè et al., 2019). These factors were not comprehensively assessed in this study and may have a stronger influence on stunting than the variables examined.

CONCLUSION

This study found no statistically significant differences in child age, maternal age, provision of stimulation, or child development between stunted and non-stunted children aged 24–59 months in the working area of Puskesmas Trucuk II, Klaten Regency. These findings suggest that these factors were not independently associated with stunting in this setting, indicating that broader nutritional, socioeconomic, and environmental determinants may have a stronger influence.

The findings should be interpreted in light of several limitations. The cross-sectional design limits causal inference, the use of questionnaire-based and categorical measures may reduce sensitivity to detect subtle effects, and the relatively small sample size and limited assessment of key confounders, such as dietary intake, sanitation, and household conditions, may have affected the results. Future studies using longitudinal designs and more comprehensive indicators are needed to better understand the pathways underlying stunting and to inform targeted interventions.

ACKNOWLEDGEMENT

The researcher would like to thank the Riset Kompetitif LRI grant funders of Universitas Muhammadiyah Surakarta in Batch 2 2023/2024, the respondents, and the Trucuk II Health Center, Klaten Regency, for their contribution, assistance, and cooperation.

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