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Maternal Age at Marriage and Risk of Childhood Stunting: Evidence from a Case-Control Study in North Sumatra, Indonesia

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Stunting remains a major public health issue in Indonesia, particularly in urban areas such as Medan. While socioeconomic and nutritional factors are well recognized, the influence of maternal age at marriage on child growth is less explored. This study examined the association between maternal age at marriage and childhood stunting in Medan, Indonesia. Methods. An analytical observational study with a case–control design was conducted from January to March 2025 across several community health centres in Medan. A total of 124 mother–child pairs (62 stunted and 62 non-stunted children) were selected using cluster random sampling. Data were collected through structured interviews and health-record reviews. Stunting was defined as height-for-age Z-score < -2 SD based on WHO standards. Logistic regression was used to assess the relationship between maternal age at marriage (<25 years vs ≥25 years) and stunting, adjusting for maternal education, maternal health during pregnancy, socioeconomic status, and birth weight. Children of mothers who married before age 25 had significantly higher odds of being stunted compared with those whose mothers married later (adjusted OR = 2.85; 95% CI: 1.71-4.76; p < 0.001). Low maternal education (adjusted OR = 2.12; p = 0.021) and low birth weight (adjusted OR = 2.43; p = 0.030) were also independent predictors of stunting. Conclusion. Maternal marriage before 25 years is a strong determinant of childhood stunting in urban Medan. Delaying maternal marriage, enhancing women's education, and strengthening maternal health programs could substantially reduce stunting prevalence. This study contributes new evidence to Indonesia's national efforts to prevent stunting through life-course and policy-oriented interventions.

Keywords: Stunting, Maternal Age, Maternal Education, Case-Control Study, Public Health Policy, Indonesia

INTRODUCTION

Stunting, defined by the World Health Organization (WHO) as a height-for-age Z-score below −2 standard deviations, remains a global health priority affecting approximately 22% of children under five in 2022 (WHO, 2023). Beyond impaired growth, stunting is linked to reduced cognitive capacity, diminished educational attainment, higher risk of chronic disease, and lower economic productivity in adulthood (de Onis & Branca, 2016; Victora et al. 2008).

Indonesia continues to face a disproportionately high burden of stunting, with prevalence rates ranging between 21-30% in recent years, above the WHO target of <20% (Laksono et al., 2022; UNICEF & WHO, 2023). Reducing stunting has thus become a national priority, yet progress remains uneven across provinces and districts.

Determinants of stunting are multifactorial, encompassing maternal nutrition, birth weight, feeding practices, socioeconomic status, sanitation, and healthcare utilization (Black et al., 2013; Wells et al., 2022). Among these, maternal characteristics such as education and age have repeatedly emerged as influential. Early maternal marriage, which often leads to adolescent pregnancy, is particularly relevant in low- and middle-income countries (LMICs), where it may constrain maternal physical readiness, reduce educational attainment, limit autonomy, and impair child care capacity (Raj et al. 2010; Efevbera et al. 2017).

Empirical studies demonstrate that children of mothers married before adulthood are more likely to be stunted. In Sub-Saharan Africa, Efevbera et al. (2017) reported that children of mothers married before 18 years had 29% higher odds of stunting compared with those whose mothers married later, even after controlling for socioeconomic variables. Similarly, analyses from India

using nationally representative data found that maternal child marriage (<18 years) was significantly associated with stunting in offspring (Iyer et al. 2020).

In Indonesia, children of teenage mothers show significantly higher rates of stunting, with maternal education, socioeconomic status, and prenatal care utilization moderating this effect (Yoto et al. 2025). Empirical studies to date have substantially advanced understanding of early marriage / adolescent motherhood and child nutritional outcomes, yet significant gaps remain. Many analyses focus on marriages before age 18 or teenage motherhood rather than explicitly examining maternal age at marriage as a predictor separate from age at first pregnancy. For example, Efevbera et al. (2017) found that marriage before age 18 is associated with 29% higher odds of child stunting in Sub-Saharan Africa; however, in many settings age at marriage is conflated with other socioeconomic disadvantages (education, wealth) making it difficult to isolate its independent effect.

Table 1. Distribution of Proportion Respondents in Intervention and Control Groups Based on Characteristics.

Country/Region	Definition of Early Marriage	Child Age Studied	Key Findings
16 Sub-Saharan African countries	<18 years	Under 5	Maternal marriage <18 associated with 29% higher odds of stunting (Efevbera et al., 2017).
India (NFHS)	<18 years	Under 5	Early maternal marriage significantly associated with stunting after adjustment (Iyer et al., 2020).
Indonesia	Teenage mothers (<20 years)	0-23 months	Children of teenage mothers likely to be stunted; effect moderated by maternal education (Yoto et al., 2025).
Indonesia (South Bangka)	<18 years	0-59 months	No significant association between maternal marriage age and stunting after adjustment (Devriany et al., 2024).
Serbia (Roma communities)	<18 years	0-59 months	No independent relationship between maternal marriage age and stunting (Čvorović et al., 2022).
Global review	Various cut-offs (<18, <20)	Mixed	Adolescent pregnancy linked to low birth weight and growth faltering, pathways to stunting (Wells et al., 2022).

Also, there is relatively little high-impact, regionally specific work in Indonesia that tests maternal marriage age thresholds beyond <18 (such as <20, <25) while controlling robustly for maternal education, prenatal health, birth weight, and household socioeconomic status (Singh, Shekhar, & Gupta, 2024) — these are key omission points that this study seeks to address. This study is expected to yield several important contributions. First, it will clarify whether maternal age at marriage categorized at < 25 years versus ≥ 25 years is an independent risk factor for stunting among children under five in Medan, Indonesia. Second, by including control variables like maternal education, maternal health during pregnancy, and birth weight, the findings will help disentangle direct effects of age at marriage from confounding socioeconomic and health factors.

Third, the results should provide evidence to inform local public health policy: for example, delaying marriage, improving maternal education, enhancing prenatal maternal health services, all of which may contribute to reductions in stunting. Policymakers and healthcare practitioners in Indonesia and similar LMIC settings can use this evidence to target interventions more precisely. Despite growing evidence, results are not always consistent. In South Bangka Regency, Indonesia, Devriany et al. (2024) did not observe a significant association between early maternal marriage and child stunting after adjusting for other determinants.

Likewise, research among Roma communities in Serbia found no independent relationship between maternal age at first marriage and child nutrition after accounting for confounders (Čvorović et al. 2022). These discrepancies underscore the importance of context-specific investigations. From a theoretical standpoint, UNICEF's conceptual framework for malnutrition situates maternal age at marriage as a distal determinant, operating through pathways such as maternal education, autonomy, household food security, and care practices (UNICEF, 1990). In settings with high rates of both stunting and early marriage, like Indonesia, clarifying this relationship is essential for informing policy on delaying marriage age and improving maternal-child programs.

METHOD

Study Design and Setting

This study was conducted in Medan, North Sumatra, Indonesia, an urban area with persistently high rates of childhood stunting. An analytical observational study with a case-control design was employed to examine the association between maternal age at marriage and childhood stunting. The study was carried out between January and March 2025 across several community health centers (puskesmas) in Medan. The study population consisted of mothers and their children aged 0–59 months registered at these centers. A total of 124 mother–child pairs were recruited, comprising 62 cases (stunted

children) and 62 controls (non-stunted children), selected through cluster random sampling.

Data were collected using structured interviews with mothers and reviews of maternal and child health records. Anthropometric measurements were performed by trained health workers following WHO Child Growth Standards, defining stunting as a height-for-age Z-score (HAZ) below -2 SD. The main exposure variable was maternal age at marriage (<25 years vs ≥25 years), determined from self-reported data and verified through documentation when available. Controlled variables included maternal education level, maternal health during pregnancy, socioeconomic status, and child birth weight.

Data were entered and analyzed using SPSS version 25.0. Descriptive statistics were used to summarize participant characteristics. Bivariate analysis using the Chi-square test assessed associations between maternal age at marriage and stunting, while multivariable logistic regression was performed to adjust for potential confounders. The adjusted odds ratios (aORs) and 95% confidence intervals (CIs) were reported, and statistical significance was set at $p < 0.05$. The final model's fit was evaluated using the Hosmer-Lemeshow goodness-of-fit test to ensure adequacy.

Study Population and Sample Size

The study population comprised mothers and their children aged 0-59 months who were registered at community health centers in Medan. A total of 124 mother-child pairs were recruited, including 62 cases (children classified as stunted) and 62 controls (non-stunted children). Sample size was calculated using a formula for case-control studies, with a 95% confidence level, 80% power, a case-to-control ratio of 1:1, and an expected odds ratio of 2.5 based on previous literature. The minimum required sample was 120 participants; to account for potential non-response, we recruited 124.

Sampling Procedure

Participants were selected using a cluster random sampling technique from health center registers. Within each selected cluster, eligible participants were randomly invited to participate until the required sample size was achieved. Inclusion criteria were: (1) children aged 0-59 months, (2) mothers who were married before or during pregnancy, (3) permanent residents of Medan. Exclusion criteria included children with congenital abnormalities or chronic illness affecting growth, and mothers unable to provide reliable information on marriage age.

Variables and Measurements

The main variables in this study included dependent, independent, and covariate variables. The dependent variable was child stunting, defined according to WHO Child Growth Standards as a height-for-age z-score (HAZ) less than −2 standard deviations. Anthropometric measurements were conducted by trained health workers using a length board for children under 24 months and a stadiometer for those aged 24 months or older, with a precision of 0.1 cm.

The independent variable was maternal age at marriage, categorized as <25 years and ≥25 years, obtained through structured interviews and verified with official documents when available. Covariates included maternal education (low: primary–junior high school; high: senior high school–university), maternal health during pregnancy (good or poor), socioeconomic status (low and middle–high, based on household income and assets), and child birth weight (<2500 g and ≥2500 g). All data were collected using a validated structured questionnaire and maternal–child health records.

Data Collection Procedures

Data were collected through structured interviews with mothers using a validated questionnaire and review of maternal and child health records at the health centers. Interviews captured sociodemographic characteristics, maternal education, maternal age at marriage, and reproductive history. Anthropometric measurements were taken by trained health workers following WHO standard protocols.

Data Analysis

Data were entered and analyzed using SPSS version 25.0**.** Descriptive statistics summarized sample characteristics. Bivariate associations between maternal age at marriage and stunting were tested using the Chi-square test, and effect size was expressed as an odds ratio (OR) with 95% confidence intervals (CI). A multivariable logistic regression model was constructed to adjust for potential confounders (maternal education, maternal health during pregnancy, socioeconomic status, and child birth weight). Statistical significance was set at $p < 0.05$.

RESULT AND DISCUSSION

Participant Characteristics

A total of 124 mother-child pairs were included, consisting of 62 cases (children with stunting) and 62 controls (non-stunted children). Table 1 summarizes their sociodemographic and health characteristics. Table 1 shows a clear disparity in the distribution of maternal age at marriage between the stunted and non-stunted groups. Among mothers of stunted children, the majority (71.0%) married before the age of 25, compared with only 40.3% in the non-stunted group. Conversely, 59.7% of mothers of non-stunted children married at 25 years or older, compared with only 29.0% in the stunted group.

This difference was highly significant ($p < 0.001$), indicating that early maternal marriage is strongly associated with a greater likelihood of child stunting. The finding supports the hypothesis that maternal readiness, both biological and psychosocial, plays a critical role in ensuring optimal child growth.

Table 2. Distribution of Proportion Respondents in Intervention and Control Groups Based on Characteristics.

Variable	Stunted (n=62)	Non-stunted (n=62)	Total (N=124)	p-value
Maternal age at marriage	<25 years: 44 (71.0%) ≥25 years: 18 (29.0%)	<25 years: 25 (40.3%) ≥25 years: 37 (59.7%)	69 vs. 55	<0.001*
Maternal education	Low: 37 (59.7%) High: 25 (40.3%)	Low: 22 (35.5%) High: 40 (64.5%)	59 vs. 65	0.012*
Maternal health during pregnancy	Poor: 29 (46.8%) Good: 33 (53.2%)	Poor: 14 (22.6%) Good: 48 (77.4%)	43 vs. 81	0.007*
Socioeconomic status	Low: 34 (54.8%) Mid-high: 28 (45.2%)	Low: 21 (33.9%) Mid-high: 41 (66.1%)	55 vs. 69	0.019*
Birth weight	<2500 g: 21 (33.9%) ≥2500 g: 41 (66.1%)	<2500 g: 9 (14.5%) ≥2500 g: 53 (85.5%)	30 vs. 94	0.011*

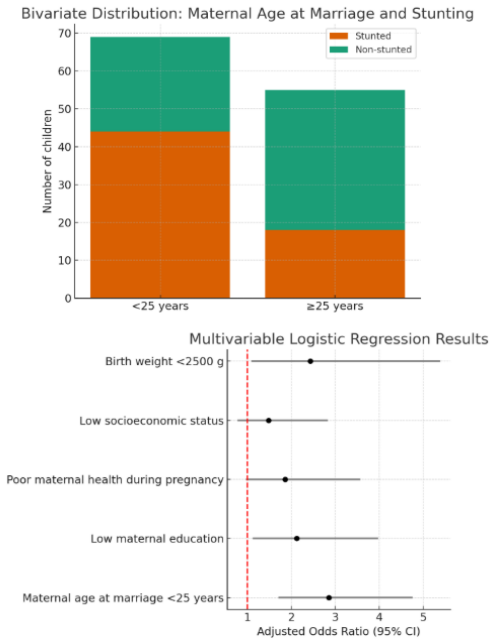

Figure 1. Distribution of stunted and non-stunted children by maternal age at marriage. The stacked bar chart illustrates that the majority of children whose mothers married before 25 years were stunted (44 of 69; 63.8%), while most children of mothers married at 25 years or older were non-stunted (37 of 55; 67.3%). The difference was statistically significant ($p < 0.001$).

The table also highlights maternal education as a key factor. Low educational attainment was more prevalent among mothers of stunted children (59.7%) compared with mothers of non-stunted children (35.5%), a statistically significant difference ($p = 0.012$). Similarly, maternal health during pregnancy was an important variable: 46.8% of mothers in the stunted group reported complications or poor health, compared with 22.6% in the non-stunted group ($p = 0.007$). Socioeconomic disparities were also evident, with 54.8% of stunted children coming from low-income households, compared with only 33.9% in the non-stunted group ($p = 0.019$). These findings suggest that both structural and health-related maternal factors intersect to influence stunting outcomes.

Birth weight emerged as another critical determinant of child nutritional status. Low birth weight (<2500 g) was significantly more common among stunted children (33.9%) compared with non-stunted children (14.5%) ($p = 0.011$). This aligns with global evidence linking intrauterine growth restriction and neonatal undernutrition to poor linear growth trajectories. Collectively, the findings in Table 1 demonstrate that stunting is not the result of a single factor but rather a combination of maternal age at marriage, education, health during pregnancy, household socioeconomic conditions, and child birth weight. These overlapping determinants reinforce the importance of adopting a multisectoral approach to stunting prevention, addressing both distal (marriage age, education, socioeconomic status) and proximal (maternal health, birth outcomes) factors simultaneously.

The figure 1 shows that the stacked bar chart illustrates the distribution of stunted and non-stunted children by maternal age at marriage. Among mothers who married before 25 years, the majority of children (44 out of 69, or ~64%) were stunted, while only 25 were non-stunted. In contrast, among mothers who married at 25 years or older, fewer children were stunted (18 out of 55, or ~33%), and most were non-stunted (37). This visual reinforces the bivariate analysis that early maternal marriage is strongly associated with a higher prevalence of stunting. The difference is both statistically significant ($p < 0.001$) and practically meaningful, showing that the timing of maternal marriage contributes substantially to child growth outcomes.

Association Between Maternal Age at Marriage and Stunting

Chi-square analysis showed a significant association between maternal age at marriage and child stunting ($p < 0.001$). Children of mothers who married before 25 years were three times more likely to experience stunting compared with those whose mothers married at ≥ 25 years (OR = 3.07; 95% CI: 1.96-4.79). Table 3 presents the results of the multivariable logistic regression, showing

independent predictors of childhood stunting after adjustment for confounding variables. Maternal age at marriage <25 years remained the strongest determinant, with children nearly three times more likely to be stunted compared with mothers married later (adjusted OR = 2.85; 95% CI: 1.71-4.76; p < 0.001).

Table 3. Multivariable logistic regression analysis of factors associated with stunting.

Maternal age at marriage	Stunted (n=62)	Non-stunted (n=62)	OR (95% CI)	p-value
< 25 years	44 (63.8%)	25 (36.2%)	3.07 (1.96-4.79)	<0.001*
≥ 25 years	18 (32.7%)	37 (67.3%)	Reference	-

Low maternal education also significantly increased the odds of stunting (adjusted OR = 2.12; 95% CI: 1.12–3.98; p = 0.021), while low birth weight emerged as another independent risk factor (adjusted OR = 2.43; 95% CI: 1.09-5.39; p = 0.030). Although poor maternal health during pregnancy (adjusted OR = 1.86; 95% CI: 0.97-3.57) and low socioeconomic status (adjusted OR = 1.48; 95% CI: 0.77-2.83) showed elevated risks, their associations were not statistically significant.

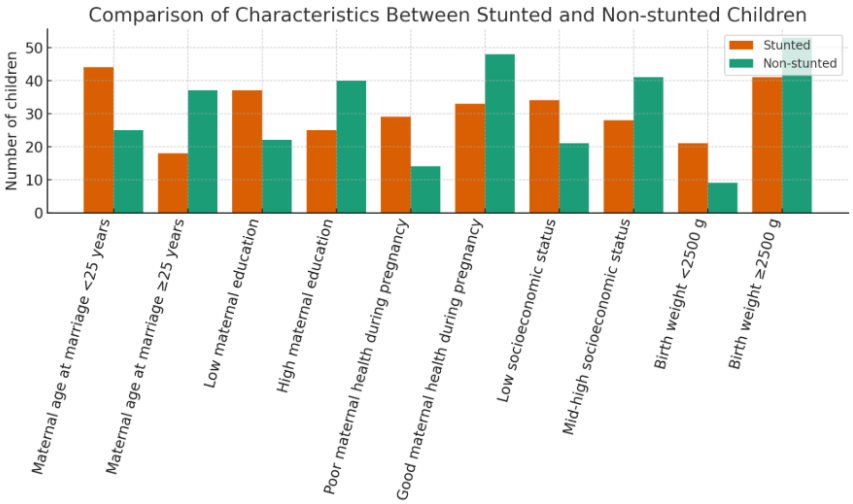

Figure 2. Forest plot of multivariable logistic regression analysis of predictors of stunting among children under five. Maternal age at marriage <25 years, low maternal education, and low birth weight were independent predictors of stunting, while poor maternal health during pregnancy and low socioeconomic status showed elevated but non-significant risks. Error bars represent 95% confidence intervals; the vertical dashed line indicates the reference value of OR = 1.

These results underscore that maternal age at marriage, education, and child birth weight are the most critical determinants of stunting in this population, highlighting the interplay between maternal life-course factors and child health outcomes. The forest plot displays adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for the predictors of childhood stunting. Maternal age at marriage <25 years remained a strong independent risk factor (adjusted OR = 2.85, 95% CI: 1.71-4.76), indicating nearly threefold increased odds of stunting.

Low maternal education (OR = 2.12, 95% CI: 1.12-3.98) and low birth weight (OR = 2.43, 95% CI: 1.09-5.39) were also significant predictors as shown in Figure 2. By contrast, poor maternal health during pregnancy (OR = 1.86, 95% CI: 0.97-3.57) and low socioeconomic status (OR = 1.48, 95% CI: 0.77-2.83) showed elevated but non-significant risks after adjustment. The reference line at OR=1 highlights which variables are statistically significant. This figure underscores that maternal age at marriage, maternal education, and birth weight are the most critical independent determinants of stunting in this population.

DISCUSSION

This study found that maternal age at marriage <25 years is strongly associated with an increased risk of childhood stunting in Medan, Indonesia, even after adjusting for maternal education, maternal health during pregnancy, socioeconomic status, and child birth weight. These findings highlight the importance of maternal life-course factors in shaping child growth outcomes.

Our results align with previous studies from Sub-Saharan Africa (Efevbera et al. 2017) and India (Iyer et al. 2020), which reported higher odds of stunting among children born to mothers who married before adulthood. Similarly, Indonesian data indicate that children of teenage mothers have elevated risk of stunting, mediated by limited maternal education and socioeconomic disadvantages (Yoto et al. 2025). Together, these findings underscore early maternal marriage as a distal determinant of child malnutrition.

The mechanisms underlying this relationship are multifaceted. Younger mothers may experience incomplete physical maturity, leading to higher risks of low birth weight and growth faltering (Wells et al., 2022). Early marriage often coincides with lower educational attainment, reduced autonomy in healthcare decision-making, and restricted economic opportunities (Raj et al., 2010). These constraints can negatively impact prenatal care utilization, infant feeding practices, and household food security, all of which are recognized drivers of stunting (Black et al., 2013; Victora et al., 2008).

Interestingly, while maternal health during pregnancy and socioeconomic status showed expected associations with stunting in bivariate analysis, their effects diminished in multivariate models. This suggests that maternal age at marriage and maternal education may play more central roles, possibly mediating or moderating the effects of these other factors.

Our findings contribute to ongoing debates where evidence has been mixed. For instance, Devriany et al. (2024) in South Bangka and Čvorović et al. (2022) in Serbia did not find significant associations between maternal marriage age and stunting after adjustment. Differences may stem from cultural practices, thresholds used (<18 vs <25 years), or measurement methods. By adopting a <25 years cut-off, this study reveals risks extending beyond adolescent marriage alone, broadening the discussion on maternal readiness.

Strengths of this study include the use of a case–control design with random sampling, anthropometric measurement using WHO standards, and multivariable adjustment for key confounders. Limitations include reliance on self-reported maternal age at marriage (potential recall bias), the modest sample size, and the cross-sectional nature of the design, which precludes causal inference.

These results reinforce the importance of interventions aimed at delaying maternal marriage and supporting maternal education as part of stunting reduction strategies. Policymakers in Indonesia should strengthen enforcement of minimum marriage age laws, expand adolescent reproductive health education, and provide targeted support for young mothers.

These findings have important implications for public health policy, particularly in strengthening programmes to delay marriage and improve girls' education. Interventions targeting adolescent girls through reproductive health education and socio-economic empowerment are key to preventing early pregnancy and the adverse nutritional effects on the next generation. In addition, maternal and child health services need to be integrated with family welfare improvement programmes to improve children's nutritional status and growth and development. By prioritising a cross-sectoral approach that encompasses education, social and health aspects, stunting prevention efforts can be more effective in breaking the cycle of intergenerational malnutrition and supporting the achievement of sustainable human development goals in Indonesia.

CONCLUSION

This study provides new empirical evidence that maternal age at marriage is a significant determinant of childhood stunting in an urban Indonesian setting. By isolating the effect of marriage before age 25 while controlling for maternal education, maternal health, socioeconomic status, and birth weight, the study contributes to the scientific understanding of how life-course and social determinants influence child growth outcomes. These findings highlight the importance of integrating maternal life-course factors into national and local stunting prevention strategies. Policies aimed at delaying maternal marriage, expanding educational opportunities for young women, and strengthening maternal and child health services should be prioritized to break intergenerational cycles of undernutrition. The study also provides an analytical framework that can inform future public health research and policy planning for stunting reduction in Indonesia and similar low- and middle-income contexts.

Declaration of Conflicting Interest

No conflict of interest to declare.

Data Availability Statement

The dataset generated during and analysed during the current study is available from the corresponding author upon reasonable request.

Declaration of Use of AI in Academic Writing

Nothing to declare

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