

Association of maternal dietary patterns, stress levels, and physical activity during pregnancy with stunting among children under five in brebes regency

Chyntia Olyvia Rizki Herwianti¹, Oktia Woro Kasmini Handayani², Sofwan Indarjo³

^{1,2,3}Magister Kesehatan Masyarakat, Universitas Negeri Semarang, Semarang, Indonesia

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ABSTRACT

Stunting remains a major public health nutrition problem in Indonesia, particularly in Brebes Regency, which has one of the highest stunting prevalences in Central Java Province. Stunting can originate during the prenatal period and is influenced by maternal lifestyle factors during pregnancy. This study aimed to analyze the relationship between maternal lifestyle during pregnancy – including dietary patterns, physical activity, and stress levels – and the incidence of stunting among children aged 24–59 months in Brebes Regency. A case-control study design was employed involving 144 respondents (72 mothers of stunted children and 72 mothers of non-stunted children) selected from several public health centers. Data were collected through structured interviews using validated questionnaires and analyzed using bivariate analysis and logistic regression. The results showed that maternal dietary patterns, stress levels, and physical activity during pregnancy were significantly associated with stunting incidence. Mothers with unbalanced dietary patterns had a higher risk of having stunted children (OR = 2.87; $p = 0.002$). Similarly, moderate-high maternal stress (OR = 2.54; $p = 0.004$) and inappropriate physical activity (OR = 2.39; $p = 0.006$) were significantly associated with increased odds of stunting. Maternal lifestyle during pregnancy plays a crucial role in determining child growth outcomes. Therefore, stunting prevention strategies should prioritize prenatal interventions through improved nutritional education, stress management, and promotion of safe physical activity for pregnant women.

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Corresponding Author:

Chyntia Olyvia Rizki Herwianti,
Magister Kesehatan Masyarakat,
Universitas Negeri Semarang,
Jl. Raya Banaran, Sekaran, Kecamatan Gn. Pati, Kota Semarang, Jawa Tengah, 50229, Indonesia
Email: chyntiaolyvia.rizkiherwiati@gmail.com

INTRODUCTION

Stunting is one of the major chronic nutritional problems that continues to pose a significant challenge in global and national health development. According to the World Health Organization, stunting reflects impaired growth resulting from long-term nutritional deficiencies, recurrent infections, and inadequate psychosocial stimulation, which adversely affect children's physical and cognitive development. Globally, the prevalence of stunting among children under five remains above the threshold set by WHO, particularly in developing countries, including Indonesia (Abeway et al., 2018; WHO, 2021; Beal et al., 2018).

In Indonesia, stunting has become a national priority because its prevalence still exceeds the targets set in the National Medium-Term Development Plan (RPJMN). The Indonesian Health Survey (SKI) reported that the national prevalence of stunting in 2023 remained above 20%, indicating the need for sustained and integrated interventions to achieve stunting reduction targets. Central Java Province is among the priority regions due to its large population and relatively high stunting prevalence compared to WHO standards (Ministry of Health of the Republic of Indonesia, 2023; BKKBN, 2023).

Brebes Regency is one of the districts with the highest stunting prevalence in Central Java Province and has been designated as a priority locus for national stunting interventions. The high prevalence of stunting in this region is influenced not only by child nutritional factors but also by socioeconomic conditions and maternal health. Relatively high poverty levels further increase the risk of chronic nutritional problems among children in this area (Ministry of Health of the Republic of Indonesia, 2023; Nurva & Maharani, 2023).

Stunting in children generally begins during the first 1,000 days of life, even starting from the prenatal period. Maternal lifestyle during pregnancy—including dietary patterns, physical activity, and stress levels—plays a crucial role in determining fetal growth and development. Inadequate nutritional intake, inappropriate physical activity, and poorly managed maternal stress can increase the risk of impaired intrauterine growth, ultimately leading to stunting (Nurfatimah et al., 2021; Permatasari, 2021; Girma et al., 2019).

Several studies have demonstrated that maternal dietary patterns during pregnancy are closely associated with children's nutritional status and body length at birth through early childhood. In addition, maternal stress during pregnancy has been shown to increase the risk of low birth weight and stunting in children, while suboptimal physical activity may further compromise maternal and fetal health (Gokhale & Rao, 2021; Babu et al., 2018; Suriati & Farisni, 2022).

Although several studies in Indonesia have examined determinants of stunting, including maternal nutrition, socioeconomic status, and child feeding practices, studies specifically focusing on maternal lifestyle during pregnancy in Brebes Regency remain limited. Previous research in Brebes has largely emphasized postnatal factors such as child feeding patterns, sanitation, and household economic conditions, while prenatal determinants—particularly the combined role of maternal dietary patterns, stress levels, and physical activity—have not been comprehensively analyzed. Moreover, most existing studies tend to assess these maternal factors individually rather than simultaneously within an integrated analytical framework, leaving the relative contribution of each factor insufficiently understood, especially in high-burden areas (Sutarto et al., 2018; Gustiansyah, 2024).

This study is important because it addresses the gap in prenatal-focused interventions within the first 1,000 days of life framework. Understanding the relationship between maternal lifestyle during pregnancy and stunting will provide evidence to strengthen preventive strategies at the antenatal level, including improving maternal nutrition, stress management, and appropriate physical activity. In addition, the use of a case-control design offers methodological advantages in identifying risk factors and estimating their magnitude through odds ratios.

While cross-sectional designs are more commonly used in stunting research in Indonesia, the application of case-control approaches to examine maternal lifestyle factors during pregnancy remains relatively limited, particularly at the district level (Notoatmodjo, 2018; Lemeshow et al., 1997; Hosmer & Lemeshow, 2000).

Therefore, this study aims to analyze the relationship between maternal lifestyle during pregnancy—including dietary patterns, physical activity, and stress levels—and the incidence of stunting among children under five in Brebes Regency.

RESULTS AND DISCUSSIONS

Characteristics of Respondents and Distribution of Stunting Incidence

The characteristics of respondents based on stunting status are presented in Table 1. The results show that the highest proportion of stunted children was found in the 24–36-month age group. This age period represents a critical phase of growth during which the effects of chronic nutritional deficiencies originating from the prenatal and early life periods become more apparent. This finding is consistent with the concept of the first 1,000 days of life, which emphasizes the importance of interventions starting from pregnancy (WHO, 2021; Beal et al., 2018).

Table 1. Characteristics of respondents based on stunting status

Characteristic	Stunted n (%)	Non-stunted n (%)
Child Age (months)		
24–36	38 (52.8)	25 (34.7)
37–48	22 (30.6)	28 (38.9)
49–59	12 (16.6)	19 (26.4)
Maternal Education		
≤ Junior High School	41 (56.9)	26 (36.1)
Senior High School	24 (33.3)	32 (44.4)
Higher Education	7 (9.8)	14 (19.5)

In addition to child age, maternal education also showed a clear difference between the stunted and non-stunted groups. Stunted children were more likely to have mothers with lower educational attainment.

Low maternal education may affect mothers' understanding of balanced nutrition, maternal health during pregnancy, and child-rearing practices, which in turn influence child growth outcomes (Hanum, 2019; Sartorius et al., 2020).

Association Between Maternal Lifestyle During Pregnancy and Stunting Incidence

The bivariate analysis of the relationship between maternal lifestyle during pregnancy and stunting incidence is presented in Table 2. The results indicate that maternal dietary patterns,

stress levels, and physical activity during pregnancy were significantly associated with stunting among children ($p < 0.05$).

Mothers with unbalanced dietary patterns had nearly three times higher odds of having stunted children compared to mothers with balanced diets. These findings highlight the importance of adequate dietary quality during pregnancy (Permatasari, 2021; Nurfatimah et al., 2021).

Table 2. Association between maternal lifestyle during pregnancy and stunting incidence

Variable	Stunted n (%)	Non-stunted n (%)	OR	p-value
Dietary Pattern				
Unbalanced	46 (63.9)	24 (33.3)	2.87	0.002*
Balanced	26 (36.1)	48 (66.7)		
Stress Level				
Moderate-High	40 (55.6)	22 (30.6)	2.54	0.004*
Low	32 (44.4)	50 (69.4)		
Physical Activity				
Inappropriate	43 (59.7)	27 (37.5)	2.39	0.006*
Appropriate	29 (40.3)	45 (62.5)		

Note: statistically significant at $\alpha = 0.05$

Maternal Dietary Patterns During Pregnancy and Stunting Incidence

Maternal dietary patterns during pregnancy emerged as a dominant risk factor for stunting, as shown in Table 2. Inadequate energy and protein intake during pregnancy can impair intrauterine growth. This condition increases the risk of low birth weight and short birth length, which are early pathways leading to stunting (Gokhale & Rao, 2021; Fitriani et al., 2020).

Visually, the dominance of unbalanced dietary patterns among mothers of stunted children is reinforced by Figure 1. The figure shows that more than half of mothers of stunted children had unbalanced dietary patterns during pregnancy. This finding reflects the low adherence to balanced nutrition principles among pregnant women in the study area (Suriati & Farisni, 2022; Gustiansyah, 2024).

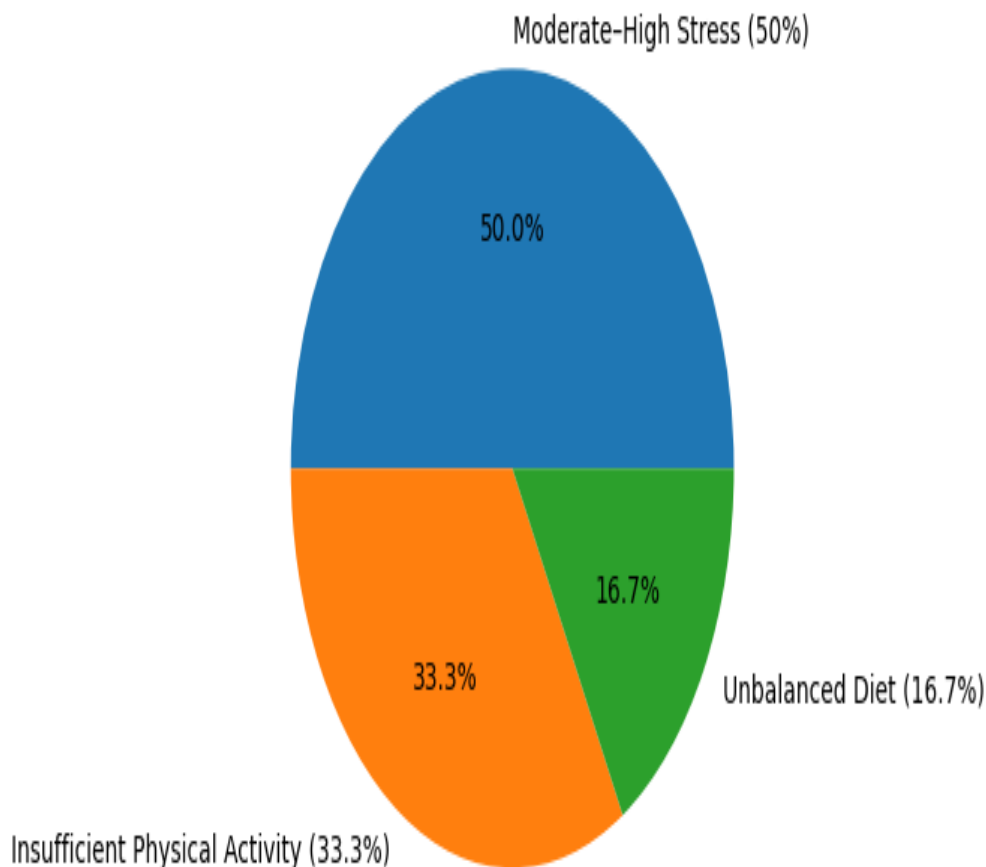


Figure 1. Proportion of maternal lifestyle risk factors among the stunted group

Maternal Stress During Pregnancy and Stunting Incidence

The results indicate that mothers who experienced moderate to high stress levels during pregnancy had a higher risk of having stunted children. Maternal stress can increase cortisol hormone levels, which may reduce nutrient flow to the fetus. This mechanism contributes to impaired intrauterine growth (Girma et al., 2019; Babu et al., 2018).

In addition to biological effects, stress also influences maternal health behaviors, such as dietary practices and adherence to antenatal care. Mothers experiencing stress tend to have poorer diet quality and suboptimal use of health services, further increasing the risk of stunting among children (Li et al., 2022; Currie et al., 2013).

Maternal Physical Activity During Pregnancy and Implications for Stunting Prevention

Maternal physical activity during pregnancy also showed a significant association with stunting incidence. Inappropriate physical activity may negatively affect maternal health and nutrient distribution to the fetus. Appropriate physical activity helps maintain metabolic balance and supports optimal fetal growth (Bisson et al., 2017; WHO, 2018).

These findings emphasize that stunting prevention should be implemented comprehensively starting from pregnancy. Interventions focusing on improving dietary patterns, managing maternal stress, and promoting safe physical activity among pregnant women are key strategies to reduce stunting prevalence. This integrated approach is particularly relevant in high-

risk areas such as Brebes Regency (BKKBN, 2023; Ministry of Health of the Republic of Indonesia, 2023).

Only two characteristic variables – child age and maternal education are presented in this study because they represent the most relevant baseline factors with clear theoretical and empirical links to stunting and are sufficient to describe the comparability between case and control groups without overloading the table; additional variables were instead incorporated into the analytical model.

The results indicate a noticeable distributional difference in child age between the stunted and non-stunted groups, with a higher proportion of stunting observed in the 24–36 month category, which corresponds to the critical period when growth faltering becomes more apparent; however, this difference should be interpreted cautiously as it was not the primary exposure variable and requires statistical confirmation beyond descriptive comparison.

Importantly, multivariate logistic regression analysis shows that maternal dietary pattern during pregnancy remains a significant predictor of stunting after controlling for other variables, suggesting that inadequate maternal nutrition is an independent risk factor rather than merely a proxy for socioeconomic or demographic conditions.

Similarly, maternal stress during pregnancy continues to demonstrate a significant association in the adjusted model, indicating that it functions as an independent determinant of stunting, likely through both biological mechanisms (e.g., hormonal pathways affecting fetal growth) and behavioral pathways (e.g., reduced dietary quality and health service utilization).

These findings underscore that maternal lifestyle factors operate both independently and synergistically in influencing child growth outcomes, reinforcing the need for integrated prenatal interventions that simultaneously address nutrition, psychosocial well-being, and maternal health behaviors rather than treating them as isolated risk factors.

CONCLUSION

This study demonstrates that maternal lifestyle during pregnancy, particularly dietary patterns, stress levels, and physical activity – is significantly associated with the incidence of stunting among children under five in Brebes Regency, with maternal diet and stress remaining independent predictors after adjustment.

These findings highlight the importance of strengthening prenatal-focused policies, including integrating balanced nutrition education, routine psychosocial screening and stress management, and guidance on safe physical activity into antenatal care services at primary health facilities.

Such interventions are essential to support optimal fetal growth and reduce the risk of stunting from the earliest stage of life. Future research is recommended to employ longitudinal or cohort designs to establish causal relationships, incorporate additional variables such as socioeconomic status and environmental factors, and explore the effectiveness of integrated maternal intervention programs in reducing stunting prevalence.

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