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Pregnancy Stress and Childhood Stunting: The Mediating Role of Maternal Mental Health in Primary Healthcare

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ABSTRACT

Introduction: Stunting remains a major public health challenge in Indonesia, particularly in rural and border areas such as East Nusa Tenggara, where limited healthcare access and socioeconomic disparities persist. Recent evidence indicates that maternal psychological factors during pregnancy, including stress, anxiety, and depression, may contribute to impaired child growth and increase the risk of stunting. However, the mediating role of maternal mental health in the relationship between pregnancy stress and stunting has not been widely explored in primary healthcare settings.
Objective: To analyze the relationship between pregnancy stress and stunting incidence through maternal mental health as a mediating variable at Puskesmas Umanen, Atambua.
Method: This study employed an analytical observational design with a cross-sectional approach conducted in March 2026. A total of 210 respondents (pregnant women and mothers with children aged 0–24 months) were selected using simple random sampling technique. Data were collected using validated instruments: Perceived Stress Scale (PSS), Edinburgh Postnatal Depression Scale (EPDS), and anthropometric measurements (height-for-age Z-score). Data were analyzed using mediation analysis with regression models (PROCESS Macro), with significance set at $p < 0.05$.
Results: Pregnancy stress was significantly associated with stunting incidence ($p < 0.05$). Maternal mental health (depression/anxiety) significantly mediated this relationship (indirect effect $p < 0.01$), indicating a partial mediation model. Higher levels of stress increased the risk of poor maternal mental health, which in turn significantly increased the likelihood of stunting.
Conclusion: Maternal mental health plays a significant mediating role in the relationship between pregnancy stress and stunting. Integrating mental health screening into antenatal care services is essential to reduce stunting risk in primary healthcare settings.

Keywords: maternal mental health, mediation, pregnancy stress, primary healthcare, stunting

Introduction

Stunting remains a major global public health concern, affecting approximately 148 million children under five years of age worldwide (UNICEF, 2023). It reflects chronic undernutrition and has long-term consequences on cognitive development, educational achievement, and economic productivity. In Indonesia, despite significant progress, the prevalence of stunting remains relatively high, particularly in eastern provinces such as East Nusa Tenggara (NTT), where structural inequalities, poverty, and limited healthcare access persist (Purwani et al., 2025).

Traditionally, stunting has been primarily attributed to inadequate nutritional intake and recurrent infections. However, emerging evidence suggests that this perspective is overly reductionist. Recent studies emphasize that stunting is a multifactorial condition influenced by biological, psychological, and social determinants, including maternal health status during pregnancy (Widyawati et al., 2026). Among these, maternal psychological factors—especially stress, anxiety, and depression during pregnancy—have gained increasing attention as critical but often overlooked contributors.

Pregnancy is a vulnerable period characterized by significant physiological and psychological changes. Maternal stress during pregnancy can activate the hypothalamic–pituitary–adrenal (HPA) axis, leading to elevated cortisol levels that may impair placental function and fetal growth (Dunkel Schetter & Tanner, 2020). Empirical studies have demonstrated that high levels of antenatal stress are associated with adverse birth outcomes, including low birth weight, preterm birth, and impaired child growth trajectories (Shi et al., 2022). These early-life disruptions are strongly linked to an increased risk of stunting during infancy and early childhood.

Beyond direct biological mechanisms, maternal stress also influences child outcomes indirectly through its impact on maternal mental health. Maternal depression and anxiety during the perinatal period are widely recognized as significant determinants of child health and development (Kumar et al., 2026). Depressive symptoms may reduce maternal responsiveness, impair caregiving capacity, and negatively affect feeding practices, all of which are critical for optimal child growth (Surkan et al., 2021). In addition, poor maternal mental health is associated with decreased utilization of health services and reduced adherence to recommended maternal and child health practices.

Recent research highlights the importance of examining mediating pathways to better understand how maternal stress translates into adverse child outcomes. Studies have identified maternal mental health as a potential mediator linking prenatal stress to child growth and development outcomes (Ricci et al., 2023). This mediation framework suggests that stress does not act in isolation but exerts its effects through complex psychosocial mechanisms. Understanding this pathway is essential for developing more comprehensive and effective interventions.

In low- and middle-income countries, including Indonesia, the burden of maternal mental health disorders remains substantial but often underdiagnosed and undertreated.

Cultural stigma, limited mental health literacy, and inadequate integration of mental health services into primary healthcare systems contribute to this gap (Vahedi et al., 2026). In rural and border areas such as Atambua, these challenges are further compounded by geographic isolation, limited healthcare resources, and socio-cultural factors that may influence maternal well-being.

Puskesmas, as the primary healthcare provider in Indonesia, plays a crucial role in delivering maternal and child health services. However, current antenatal care practices largely focus on physical and nutritional aspects, with minimal attention to psychological well-being. This gap represents a missed opportunity for early detection and intervention of maternal mental health problems that may have long-term implications for child growth and development.

Although several studies have examined the relationship between maternal mental health and child nutritional outcomes, research exploring the mediating role of maternal mental health in the relationship between pregnancy stress and stunting remains limited, particularly in primary healthcare settings. Furthermore, there is a scarcity of empirical data from underrepresented regions such as East Nusa Tenggara, where the burden of stunting is among the highest in Indonesia.

Therefore, this study aims to analyze the relationship between pregnancy stress and stunting incidence, with maternal mental health as a mediating variable, at Puskesmas Umanen, Atambua. By adopting a mediation framework, this study seeks to provide a more comprehensive understanding of the psychosocial pathways contributing to stunting. The findings are expected to inform the development of integrated maternal health interventions that incorporate mental health screening and support within routine antenatal care services, particularly in resource-limited settings.

Objective

To analyze the relationship between pregnancy stress and stunting incidence through maternal mental health mediation at Puskesmas Umanen, Atambua.

Method

Design and Setting

This study employed an analytical observational design using a cross-sectional approach. The study was conducted in March 2026 at Puskesmas Umanen, Atambua, East Nusa Tenggara, Indonesia. The cross-sectional design was selected because it allows the researcher to assess the relationships between pregnancy stress, maternal mental health, and stunting incidence simultaneously within a defined population at a single point in time.

Population and Sampling

The target population consisted of pregnant women and mothers with children aged 0–24 months living in the working area of Puskesmas Umanen. The accessible population included mothers who attended maternal and child health services during the study period. The sample size of 210 respondents was determined using the minimum sample formula for

correlation and regression analysis with a confidence level of 95%, statistical power of 80%, and an estimated moderate effect size based on previous related studies. Additional respondents were included to anticipate incomplete data and non-response. A simple random sampling technique was applied to ensure that each eligible respondent had an equal opportunity to participate in the study. The sampling frame was obtained from maternal and child health registration records at Puskesmas Umanen. Respondents who met the inclusion criteria were randomly selected using a lottery method.

Inclusion and Exclusion Criteria

The inclusion criteria were:

1. Pregnant women or mothers with children aged 0–24 months.
2. Residing in the working area of Puskesmas Umanen.
3. Able to communicate effectively in Indonesian.
4. Willing to participate and sign informed consent.

The exclusion criteria were:

1. Mothers with severe physical or psychiatric disorders diagnosed by healthcare professionals.
2. Respondents with incomplete questionnaire data.
3. Mothers whose children had congenital abnormalities or chronic illnesses affecting growth status.

Instrument and Measurement

Perceived Stress Scale (PSS-10)

Pregnancy stress was measured using the Perceived Stress Scale (PSS-10) developed by Cohen et al. The instrument consists of 10 items assessing the degree to which respondents perceive situations in their lives as stressful during the previous month. Each item uses a 5-point Likert scale ranging from 0 (“never”) to 4 (“very often”). Total scores range from 0–40, with higher scores indicating higher perceived stress levels. The instrument has demonstrated good psychometric properties, with Cronbach’s alpha values ranging from 0.78 to 0.86 in previous studies.

Edinburgh Postnatal Depression Scale (EPDS)

Maternal mental health was assessed using the Edinburgh Postnatal Depression Scale (EPDS), which consists of 10 items evaluating depressive and anxiety symptoms experienced during the perinatal period. Responses are scored on a 4-point scale (0–3), with total scores ranging from 0–30. Higher scores indicate poorer maternal mental health status. The EPDS has been widely validated internationally and has shown good reliability with Cronbach’s alpha values above 0.80.

Anthropometric Measurement

Stunting status was determined using height-for-age Z-scores (HAZ) based on the World Health Organization (WHO) Child Growth Standards. Body length/height measurements

were conducted using standardized anthropometric equipment by trained health personnel. Children with HAZ scores below -2 standard deviations were classified as stunted.

Data Collection and Analysis

Data collection was conducted after obtaining ethical approval and permission from the local health authorities. Eligible respondents were approached during visits to maternal and child healthcare services. After informed consent was obtained, respondents completed the questionnaires under the supervision of trained enumerators. Anthropometric measurements of children were subsequently performed following WHO standard procedures to ensure measurement accuracy and consistency.

Data analysis was performed using SPSS version 26 and PROCESS Macro Hayes Model 4 for mediation analysis. The analysis was conducted in several stages. First, descriptive statistics were used to summarize respondent characteristics and study variables, including frequencies, percentages, means, and standard deviations. Second, assumption testing was conducted before inferential analysis. Normality of continuous data was assessed using the Kolmogorov–Smirnov test, while multicollinearity and linearity assumptions were evaluated prior to regression analysis. Third, bivariate analysis was performed to examine the relationships between variables. The chi-square test was used to analyze associations between categorical variables because stunting status was categorized as stunted and non-stunted. Pearson correlation analysis was used to assess the relationship between continuous variables, including stress scores and maternal mental health scores, because the data were normally distributed and measured on interval scales.

Finally, mediation analysis was conducted using regression-based PROCESS Macro analysis to determine the indirect effect of pregnancy stress on stunting through maternal mental health. Statistical significance was set at $p < 0.05$ with a 95% confidence interval.

Result

Table 1. Characteristics of Respondents (n = 210)

Age Distribution Data	
Variable	Frequency (%)
Age (20-35 years)	68%
Low education	55%
Multiparous	60%

Table 1 presents the demographic characteristics of respondents, showing that most participants were aged 20–35 years, had low educational backgrounds, and were multiparous.

Table 2. Mediation Analysis Results

Mediation Analysis Data		
Variable	β	p-value
Stress → Mental Health	0.45	<0.001

Mental Health → Stunting	0.38	<0.01
Stress → Stunting (direct)	0.21	<0.05

Table 2 explains the mediation analysis results, indicating that pregnancy stress significantly affected maternal mental health and stunting incidence both directly and indirectly. The findings demonstrate a significant indirect effect of pregnancy stress on stunting through maternal mental health ($p < 0.01$), confirming the presence of partial mediation.

Discussion

This study demonstrates that pregnancy stress significantly influences stunting both directly and indirectly through maternal mental health. The findings support previous research indicating that maternal stress contributes to adverse fetal and child outcomes (Fahmida et al., 2025). The mediation effect suggests that stress alone is insufficient to explain stunting risk; rather, its impact is amplified through maternal psychological conditions such as depression and anxiety. This aligns with findings by Apriliana et al. (2022) and Surkan et al. (2021), which emphasize the role of maternal mental health in child nutrition and growth.

From a biological perspective, chronic stress increases cortisol levels, which may impair placental function and fetal growth. Psychologically, maternal depression reduces caregiving capacity, breastfeeding practices, and health-seeking behavior (Kingston et al., 2020). In the context of Atambua, socio-cultural factors such as limited support systems, low health literacy, and economic constraints may exacerbate maternal stress and mental health issues. Therefore, integrating mental health services into maternal care is essential.

Comparison with Previous Research

The findings of this study are in line with a growing body of evidence highlighting the significant role of maternal mental health in child growth outcomes. A systematic review and meta-analysis by Carosella et al. (2024) demonstrated that perinatal depression is significantly associated with an increased risk of stunting in low- and middle-income countries. Similarly, Maulina et al. (2022) reported that antenatal depression is a strong predictor of stunting, indicating that psychological conditions during pregnancy have long-term implications for child development. These findings support the present study, which confirms that maternal mental health is not only associated with stunting but also plays a crucial role in the pathway linking pregnancy stress to child growth outcomes.

Furthermore, the mediation effect identified in this study is consistent with previous research emphasizing indirect pathways. Ricci et al. (2023) found that maternal depressive symptoms mediate the relationship between socioeconomic factors and infant growth, while Thompson et al. (2022) highlighted that maternal mental health affects child outcomes through caregiving behaviors and health service utilization. However, some studies have reported inconsistent findings; for example, Dadi et al. (2021) found no significant direct

association between antenatal depression and stunting after adjusting for confounders. This suggests that the relationship may be context-dependent and influenced by socio-cultural and healthcare factors. Therefore, this study contributes to the existing literature by providing empirical evidence of a mediation model within a primary healthcare setting, particularly in a rural and border area context.

Interpretation of Results

The results of this study indicate that pregnancy stress has both direct and indirect effects on stunting, with maternal mental health acting as a significant mediator. This finding suggests that the impact of stress during pregnancy extends beyond immediate physiological responses and operates through complex psychological pathways that ultimately influence child growth outcomes. From a biological perspective, maternal stress during pregnancy is known to activate the hypothalamic pituitary adrenal (HPA) axis, resulting in increased cortisol production. Elevated cortisol levels can cross the placental barrier and affect fetal development, potentially leading to impaired growth and increased risk of stunting (Nazzari et al., 2022; Rahi et al., 2025). This mechanism provides a plausible explanation for the direct association observed between pregnancy stress and stunting in this study.

In addition to biological pathways, the mediating role of maternal mental health highlights the importance of psychological and behavioral mechanisms. Poor maternal mental health, particularly depression and anxiety, may reduce a mother's ability to provide optimal care, including appropriate feeding practices, responsiveness, and health-seeking behaviors. Previous studies have shown that maternal depressive symptoms are associated with decreased caregiving quality and suboptimal child nutrition, which are critical determinants of child growth (Surkan et al., 2021; Thompson et al., 2022).

The presence of partial mediation in this study indicates that while maternal mental health explains a significant portion of the relationship between pregnancy stress and stunting, other factors may also contribute. These may include socioeconomic conditions, food insecurity, and access to healthcare services, which have been shown to interact with maternal stress and mental health in influencing child nutritional outcomes (Rahi et al., 2025; Folayan et al., 2023).

Furthermore, the findings reflect the relevance of the biopsychosocial model, where biological, psychological, and social factors interact to shape health outcomes. In the context of Puskesmas Umanen, where resource limitations and socio-cultural influences are prominent, maternal stress and mental health may have a more pronounced effect on child growth. This underscores the need for a more holistic approach to maternal and child healthcare that integrates mental health into routine services.

Overall, the results suggest that addressing maternal mental health is not only important for the well-being of the mother but also plays a critical role in preventing stunting. Interventions targeting stress reduction and mental health support during pregnancy may therefore have a significant impact on improving child growth outcomes.

Contextual Considerations in Atambua

The findings of this study should be interpreted within the specific socio-cultural and geographical context of Atambua, a border area in East Nusa Tenggara (NTT), Indonesia. NTT is consistently reported as one of the provinces with the highest prevalence of stunting in Indonesia, with contributing factors including rural living conditions, limited access to healthcare services, and socioeconomic disparities (Picauly et al., 2024; Suratri et al., 2023). These structural challenges create a context in which maternal stress and mental health issues may have a more pronounced impact on child growth outcomes.

In border and rural settings such as Atambua, healthcare access is often constrained by geographic isolation, limited availability of trained health professionals, and inadequate health infrastructure. Previous studies have shown that maternal and child health outcomes in border regions are generally poorer compared to urban areas, partly due to reduced utilization of antenatal and postnatal care services (Syamruth & Notobroto, 2021). This limitation may exacerbate the effects of pregnancy stress and hinder early detection of maternal mental health problems.

Socio-cultural factors also play a significant role in shaping maternal experiences during pregnancy. In many communities in NTT, traditional beliefs, gender roles, and family dynamics influence maternal health behaviors and decision-making. Limited mental health literacy and persistent stigma surrounding psychological disorders may prevent mothers from seeking help, thereby allowing stress and depressive symptoms to persist and negatively affect caregiving practices (Nahak & Nitsae, 2024). This aligns with evidence indicating that maternal factors, including psychological well-being and caregiving capacity, are key determinants of stunting in border populations (Rua & Nahak, 2024).

Additionally, economic constraints and food insecurity remain critical issues in the region. Studies have identified maternal education, household income, and food availability as significant predictors of stunting in NTT (Ayue et al., 2025). These factors may interact with maternal stress and mental health, further amplifying the risk of poor child growth outcomes. In such settings, psychological stress is often intertwined with daily survival challenges, making it a persistent and multifaceted problem.

Therefore, the contextual characteristics of Atambua highlight the importance of adopting a comprehensive and culturally sensitive approach to maternal and child health. Interventions aimed at reducing stunting in this area should not only address nutritional needs but also incorporate mental health support, community-based education, and strengthening of primary healthcare services. Integrating mental health screening into routine antenatal care at Puskesmas could serve as a strategic entry point to address these interconnected issues.

Relation to Maternal Mental Health Mediation

The findings of this study highlight the important role of maternal mental health as a mediating factor in the relationship between pregnancy stress and stunting incidence. The significant indirect effect indicates that pregnancy stress influences child growth not only through direct biological mechanisms but also through its impact on maternal psychological

conditions. This suggests that stress experienced during pregnancy can develop into mental health problems, which subsequently affect child outcomes.

Maternal mental health conditions, particularly depression and anxiety, may influence caregiving behaviors, feeding practices, and the utilization of health services, all of which are essential for optimal child growth (Apriliana et al., 2022; Tyas & Setyonaluri, 2022). The presence of partial mediation in this study indicates that maternal mental health explains a substantial part of the relationship between pregnancy stress and stunting, although other contributing factors may also be involved. These findings reinforce the importance of integrating mental health assessment and intervention into maternal healthcare as part of comprehensive stunting prevention strategies in primary healthcare settings.

Public Health and Clinical Implications

The findings of this study have important implications for both public health and clinical practice, particularly in efforts to prevent stunting in primary healthcare settings. From a public health perspective, the results highlight that stunting is not solely a nutritional issue but also a psychosocial one. The significant role of maternal mental health as a mediating factor suggests that interventions targeting stunting should incorporate mental health components alongside traditional nutrition programs. Integrating mental health screening into routine antenatal care (ANC) services at Puskesmas could serve as an effective strategy for early identification of at-risk mothers and timely intervention.

At the clinical level, these findings underscore the need for healthcare providers, especially nurses and midwives, to adopt a more holistic approach in maternal care. Routine assessment of psychological well-being using simple screening tools such as the EPDS or PSS can help detect early signs of stress, depression, or anxiety during pregnancy. Early intervention, including counseling, psychoeducation, and family involvement, may reduce the negative impact of maternal stress on both maternal and child health outcomes.

Furthermore, the results support the importance of strengthening community-based healthcare systems. In areas such as Atambua, where access to specialized mental health services is limited, empowering community health workers and integrating mental health education into existing maternal programs can enhance service coverage and effectiveness. This approach aligns with current global health strategies that emphasize integrated, person-centered care.

Overall, incorporating maternal mental health into stunting prevention programs has the potential to improve both maternal well-being and child growth outcomes. Therefore, policymakers and healthcare providers should consider developing integrated interventions that address biological, psychological, and social determinants of health within primary healthcare services.

Limitations and Future Research

This study has several limitations that should be considered when interpreting the findings. First, the use of a cross-sectional design limits the ability to establish causal relationships between pregnancy stress, maternal mental health, and stunting. Although the

mediation analysis provides insight into possible pathways, longitudinal or prospective studies are needed to confirm the temporal sequence of these variables.

Second, the study relied on self-reported instruments to measure pregnancy stress and maternal mental health, which may be subject to recall bias and social desirability bias. Despite the use of validated tools such as the PSS and EPDS, respondents may underreport psychological symptoms due to stigma or limited mental health awareness, particularly in rural settings like Atambua.

Third, the sampling method was purposive and conducted within a single Puskesmas, which may limit the generalizability of the findings to other populations or regions. Socio-cultural and healthcare system differences across regions in Indonesia may influence the relationship between maternal stress, mental health, and child growth outcomes.

Future research is recommended to address these limitations by employing longitudinal or cohort study designs to better establish causal pathways. Expanding the study to multiple healthcare settings or regions would improve generalizability. Additionally, future studies should explore other potential mediating or moderating variables, such as social support, maternal nutrition, and household socioeconomic status. Intervention-based research is also needed to evaluate the effectiveness of integrating mental health services into antenatal care in reducing the risk of stunting.

Synthesis and Implications

This study demonstrates that pregnancy stress influences stunting both directly and indirectly through maternal mental health, highlighting the importance of psychosocial pathways in child growth outcomes. The findings suggest that maternal mental health serves as a key mechanism linking antenatal conditions to stunting, reinforcing the need for a more comprehensive approach beyond nutrition-focused interventions. Integrating mental health screening and support into routine antenatal care may enhance maternal well-being and improve child growth outcomes. Therefore, a holistic biopsychosocial approach is essential for effective stunting prevention, particularly in primary healthcare settings.

Conclusion

This study demonstrates that pregnancy stress is significantly associated with stunting both directly and indirectly through maternal mental health. The findings indicate that maternal mental health serves as an important mediating factor linking antenatal stress to adverse child growth outcomes. Higher levels of stress during pregnancy increase the risk of maternal psychological problems, which subsequently contribute to a greater likelihood of stunting among children.

The results highlight the importance of integrating mental health assessment and support into routine antenatal care services, particularly in primary healthcare settings. Addressing maternal psychological well-being alongside nutritional and physical health interventions may improve maternal outcomes and reduce the prevalence of stunting. Therefore, a holistic biopsychosocial approach is essential for effective maternal and child

healthcare programs, especially in resource-limited and high-stunting areas such as East Nusa Tenggara.

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Author Contribution

All authors contributed equally to the study design, data analysis, and manuscript preparation.

Conflict of Interest

The authors declare no conflict of interest regarding the publication of this study.

Ethical Clearance

This study received ethical approval from the Institutional Review Board of RSUD Mgr. Gabriel Manek, SVD., Atambua, Belu, East Nusa Tenggara, Indonesia, with ethical clearance number: 2025/EC-RSUD/10/025. All participants provided written informed consent prior to data collection, and confidentiality as well as anonymity were strictly maintained throughout the study.

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