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A mixed-methods study of pregnancy-centered antenatal care strategies for stunting prevention in Jepara Regency

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ABSTRACT

Background: *Stunting remains a major public health challenge rooted in the prenatal period. Although antenatal care (ANC) coverage in Indonesia is high, gaps in ANC quality, nutrition counseling, and risk-responsive care limit its effectiveness for stunting prevention.*
Objectives*: This study examined pregnancy-centered ANC strategies for stunting prevention in Jepara Regency using a mixed-methods approach integrating quantitative and qualitative findings.*
Methods*: An explanatory sequential mixed-methods design was applied. The quantitative phase involved a cross-sectional survey of 212 pregnant women receiving routine ANC. ANC quality was assessed using the Content-Qualified Antenatal Care (ANCq) indicator, dietary diversity using the Minimum Dietary Diversity for Women (MDD-W), and stunting prevention knowledge and practices through structured questionnaires. Multivariable generalized linear models identified predictors of stunting prevention practices. The qualitative phase included in-depth interviews with 24 purposively selected pregnant women. Reflexive thematic analysis and narrative integration were conducted.*
Results*: The mean ANCq score was 7.1 ± 1.8, indicating moderate ANC adequacy, while only 46.2% of participants achieved minimum dietary diversity (MDD-W ≥5). Higher ANCq scores (β = 2.84; p < 0.001), adequate dietary diversity (β = 5.96; p < 0.001), maternal education, and partner support were significantly associated with stronger stunting prevention practices. Qualitative findings revealed limited understanding of stunting prevention despite regular ANC attendance, a knowledge–practice gap caused by economic and pregnancy-related barriers, and the important role of family and health-system support.*
Conclusions*: Pregnancy-centered stunting prevention is strongly influenced by ANC quality, dietary diversity, education, and partner support. Strengthening risk-responsive ANC and practical nutrition counseling may improve early stunting prevention outcomes.*

KEYWORD: *antenatal care quality; dietary diversity; Indonesia; mixed-methods; pregnancy-centered care; stunting prevention*

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INTRODUCTION

Stunting, defined as chronic linear growth failure indicated by a height-for-age Z-score below −2 standard deviations, remains a major global public health problem with lifelong consequences for cognitive development, educational attainment, economic productivity, and intergenerational health equity (1). Despite global declines, stunting continues to disproportionately affect low- and middle-income countries, where maternal undernutrition, anemia, infection, and inequitable access to quality maternal health services persist (2).

In Indonesia, stunting prevention has been positioned as a national development priority, supported by multisectoral policies and large-scale maternal and child health programs. National surveillance data indicate a gradual decline in stunting prevalence to 19.8% in 2024; however, this figure remains above international targets and conceals substantial subnational and socioeconomic disparities (3). Accumulating evidence demonstrates that the origins of stunting are strongly rooted in the prenatal period, when fetal growth is highly sensitive to maternal nutritional status, anemia, gestational weight gain, infection, and psychosocial stress (4,5).

Pregnancy is therefore a critical and time-sensitive window for stunting prevention. Adverse intrauterine exposures, such as maternal anemia, inadequate dietary intake, and untreated infections are associated with fetal growth restriction, preterm birth, and low birth weight, which substantially increase the risk of stunting during infancy and early childhood (6,7). Antenatal care (ANC) is the primary service platform through which these risks are expected to be identified and mitigated, via early risk screening, individualized counseling, micronutrient supplementation, and referral for complications (8).

However, emerging global and Indonesian evidence suggests that high ANC coverage does not necessarily translate into effective stunting prevention. Studies increasingly document a persistent “coverage–quality gap,” whereby women attend ANC but do not consistently receive essential, risk-responsive components of care (9,10). A recent Indonesian mixed-methods study revealed substantial gaps in provider adherence to integrated ANC guidelines, including missed hemoglobin testing, inconsistent nutrition counseling, and limited individualized risk management, even in facilities with high ANC attendance rates (11). These deficiencies are

particularly concerning given strong epidemiological evidence linking maternal anemia and poor gestational nutrition with child stunting (6,7). Furthermore, quantitative studies have consistently shown that maternal risk factors for stunting, such as anemia, low pre-pregnancy body mass index, inadequate gestational weight gain, and low dietary diversity cluster among socioeconomically vulnerable populations. Yet, routine ANC services often apply a uniform service model, insufficiently tailored to heterogeneous pregnancy risk profiles. This misalignment limits the preventive potential of ANC and weakens its role as an upstream intervention against stunting (9).

Jepara Regency in Central Java provides a particularly relevant context for examining these challenges. While district-level reports indicate notable reductions in stunting prevalence through multisectoral efforts, aggregate improvements may obscure ongoing inequities in ANC quality and risk-based service delivery at the individual level (3). Districts experiencing declining prevalence may still harbor vulnerable subpopulations of pregnant women whose risks are insufficiently identified or addressed during routine care, underscoring the need for more granular, pregnancy-centered analysis.

To date, most stunting-related studies in Indonesia fall into one of two categories: (1) quantitative analyses identifying maternal and child risk factors for stunting, or (2) qualitative studies exploring barriers to ANC utilization and service delivery. While both strands are valuable, they are rarely integrated in a manner that links risk-based quantitative profiling of pregnant women with qualitative insights into how ANC strategies are implemented, experienced, and constrained within routine services, particularly at the district level (11). As a result, there is limited evidence to inform how ANC can be operationalized as a pregnancy-centered, risk-responsive strategy for stunting prevention, rather than as a uniform package of services. This gap is especially evident in districts like Jepara, where overall stunting prevalence is improving but the effectiveness and equity of pregnancy-focused prevention strategies remain underexplored. The novelty of this study lies in its mixed-methods, pregnancy-centered, and risk-based approach. By integrating quantitative assessment of pregnancy-related stunting risk factors with qualitative exploration of maternal and provider perspectives, this study moves beyond descriptive prevalence or utilization metrics. It provides context-specific, actionable insights into how antenatal care can be strengthened as an early preventive lever against stunting within real-world health systems. Accordingly, this study aims to examine pregnancy-centered antenatal care strategies for stunting prevention in Jepara Regency using a mixed-methods design, combining risk-based quantitative analysis with qualitative inquiry to inform

more responsive and equitable maternal health interventions.

MATERIAL AND METHODS

This study employed an explanatory sequential mixed-methods design consisting of a quantitative phase followed by a qualitative phase to further explain and contextualize the quantitative findings. The quantitative component examined pregnancy-centered antenatal care (ANC) strategies related to stunting prevention, while the qualitative component explored pregnant women's experiences, perceptions, and contextual factors influencing the implementation of these strategies. Integration was conducted at the interpretation stage using a connecting approach, in which quantitative findings informed qualitative sampling and interview guide development to generate comprehensive meta-inferences (12).

The study was conducted in Jepara Regency, Central Java, Indonesia, at selected primary health care centers (Puskesmas) and affiliated community maternal–child health services (Posyandu), which serve as the main providers of ANC and maternal nutrition services. Data collection was conducted from April to May 2025. The study population consisted of pregnant women receiving routine ANC services during the study period. Participants were eligible if they were aged ≥18 years, currently pregnant at any gestational age, registered for ANC at selected facilities, able to communicate in Bahasa Indonesia, had resided in Jepara Regency for at least six months, and provided written informed consent. Women with severe obstetric emergencies, serious chronic illnesses limiting participation, or cognitive impairments affecting questionnaire completion were excluded.

A multistage sampling strategy was used. Health facilities were purposively selected to represent geographical and service variations within the regency. Eligible pregnant women attending ANC visits were then recruited consecutively until the required sample size was achieved. Sample size estimation was performed using G*Power version 3.1 for multiple regression analysis with $\alpha = 0.05$, statistical power = 0.80, effect size $f^2 = 0.10$, and up to 10 predictors. After adding 20% to anticipate incomplete data and non-response, a minimum sample of 212 participants was obtained (13). ANC quality was assessed using the Content-Qualified Antenatal Care (ANCq) indicator developed by Arroyave et al. (14), which measures ANC contact and evidence-based service components on a scale ranging from 0–10, with higher scores indicating better ANC quality. Maternal dietary diversity was assessed using the Minimum Dietary Diversity for Women (MDD-W) developed by the Food and Agriculture Organization, based on a 24-hour dietary recall across 10 food groups. Consumption of ≥5 food groups indicated adequate dietary diversity

(15). A structured questionnaire developed by the research team was used to assess knowledge and practices related to pregnancy-centered stunting prevention. The instrument was based on WHO antenatal nutrition recommendations and Indonesian maternal nutrition programs and included 35 items covering nutrition knowledge, ANC attendance, supplementation adherence, hygiene practices, infection prevention, and family support. Knowledge items were scored dichotomously, while practice items used a 4-point Likert scale. Internal consistency reliability was evaluated using Cronbach's alpha, with values ≥0.70 considered acceptable. The qualitative phase involved semi-structured in-depth interviews with a purposive subsample of pregnant women selected according to quantitative profiles, including ANCq scores and dietary diversity status. Interviews explored barriers, facilitators, and contextual experiences related to pregnancy-centered stunting prevention. Sampling continued until data saturation was achieved, defined as the point at which no new themes emerged (16). Quantitative data were analyzed using [software name] with a significance level of $p < 0.05$. Descriptive statistics summarized participant characteristics and study variables. Multivariable generalized linear models were applied to identify predictors of pregnancy-centered stunting prevention practices while controlling for potential confounders. Qualitative data were analyzed using reflexive thematic analysis following the phases proposed by Braun and Clarke (17), including familiarization, coding, theme generation, review, and refinement. Integration of findings was achieved through narrative weaving and joint interpretation.

Ethical approval for this study was obtained from the Health Research Ethics Committee of STIKep PPNI Jawa Barat (No.[98/KEPK/STIKEP/PPNI/JABAR/IV/2025]). Written informed consent was obtained from all participants prior to data collection, and confidentiality and anonymity were maintained throughout the study.

RESULTS AND DISCUSSION

Quantitative Findings

A total of 212 pregnant women completed the quantitative survey. The mean age was 27.8 ± 5.4 years, with most participants in the second trimester (45.3%). Most had completed secondary education (58.5%), and 62.7% were multigravida. The mean ANCq score was 7.1 ± 1.8, indicating moderate antenatal care (ANC) content adequacy. However, only 46.2% of participants achieved minimum dietary diversity for women (MDD-W ≥5).

The mean pregnancy-centered stunting prevention knowledge score was 72.4 ± 12.6, while the mean practice score was 61.8 ± 14.2, suggesting a substantial knowledge–practice gap.Sociodemographic and obstetric characteristics are presented in **Table 1**.

Table 1. Sociodemographic and obstetric characteristics of participants (N = 212)

Variable	n (%) / Mean ± SD
Age (years)	
Gestational trimester	27.8 ± 5.4
First trimester	56 (26.4)
Second trimester	96 (45.3)
Third trimester	60 (28.3)
Education level	
Primary	38 (17.9)
Secondary	124 (58.5)
Tertiary	50 (23.6)
Parity	
Primigravida	79 (37.3)
Multigravida	133 (62.7)
ANCq score (0–10)	7.1 ± 1.8
Achieved MDD-W ≥5 food groups	98 (46.2)

The observed gap between maternal knowledge and pregnancy-centered stunting prevention practices suggests that awareness alone may not be sufficient to translate recommended preventive behaviors into daily practice.

Although participants demonstrated a relatively high level of knowledge, the lower practice score indicates that pregnant women may encounter individual, household, economic, or health-system barriers that limit the implementation of recommended behaviors.

This finding provides an important context for the subsequent analysis, which identified ANC content quality, dietary diversity, maternal education, partner support, and gestational age as factors associated with pregnancy-centered stunting prevention practices. Multivariable generalized linear modeling identified several significant predictors of stronger pregnancy-centered stunting prevention practices (**Table 2**).

Table 2. Multivariable predictors of pregnancy-centered stunting prevention practice score

Predictor	β (SE)	95% CI	p-value
ANCq score	2.84 (0.41)	2.03–3.65	<0.001
Achieved MDD-W ≥5	5.96 (1.28)	3.45–8.47	<0.001
Secondary or higher education	3.21 (1.09)	1.07–5.35	0.004
Partner support score	1.87 (0.52)	0.85–2.89	<0.001
Gestational age (weeks)	0.09 (0.04)	0.01–0.17	0.031

Higher ANCq scores (β = 2.84; p < 0.001), adequate dietary diversity (β = 5.96; p < 0.001), secondary or higher education (β = 3.21; p = 0.004), partner support (β = 1.87; p < 0.001), and gestational age (β = 0.09; p = 0.031) were independently associated with better implementation of pregnancy-centered stunting prevention behaviors. These findings indicate that both service-related factors and social-contextual factors contribute to maternal preventive practices during pregnancy.

The strongest quantitative predictor of pregnancy-centered stunting prevention practices was ANC content quality, measured using the ANCq indicator. This finding supports growing international evidence showing that content-qualified ANC, rather than the number of visits alone, is essential for improving maternal and child health outcomes. Studies across low- and middle-income countries have consistently demonstrated that women may attend ANC services regularly while still receiving incomplete or insufficient preventive counseling (14).

Adequate dietary diversity was also strongly associated with better pregnancy-centered stunting prevention practices. Nevertheless, fewer than half of participants achieved the minimum dietary diversity threshold. This finding is consistent with previous evidence linking maternal dietary diversity during pregnancy to improved fetal growth, birth weight, and reduced risk of child stunting (18, 20).

Maternal education and partner support also emerged as important determinants of stunting prevention practices. Educated women may have greater ability to understand and apply health information, while supportive partners facilitate adherence to nutritional recommendations and supplementation. Similar evidence has shown that family dynamics and social support substantially influence maternal nutrition practices during pregnancy (21, 23).

The quantitative findings therefore suggest that pregnancy-centered stunting prevention practices are influenced by multiple interconnected factors, including the quality of ANC content, dietary diversity, maternal education, partner support, and gestational age. To further explain these quantitative findings, a qualitative inquiry was conducted among pregnant women.

Qualitative Findings

Dietary Diversity and the Knowledge–Practice Gap

To further explain these quantitative findings, 24 pregnant women participated in semi-structured in-depth interviews. Participants were purposively selected to represent variation in ANCq scores and dietary diversity status. Data saturation was achieved after 22 interviews, with two additional interviews conducted to confirm thematic stability. Three overarching themes and seven subthemes emerged from the analysis (**Figure 1**).

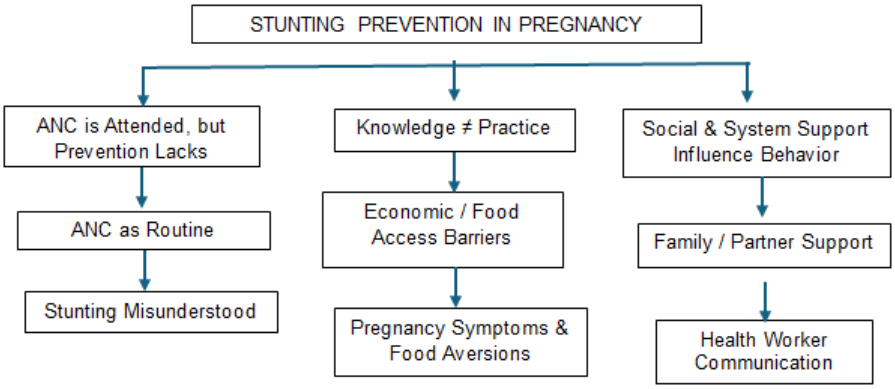

Figure 1. Thematic map

Theme 1: ANC Is Attended, but Stunting Prevention Is Not Always Understood

Many participants described ANC attendance as a routine obligation rather than a learning opportunity regarding fetal growth and nutrition. Women commonly reported that ANC visits focused mainly on physical examinations such as weight and blood pressure monitoring, with limited discussion about nutrition or stunting prevention.

"I always come to the health center because it's scheduled, but usually I just check weight and blood pressure. I didn't know that food during pregnancy could affect the child's height later." (Participant 07, multigravida)

Participants also demonstrated fragmented understanding of stunting, frequently perceiving it as a problem occurring only after birth rather than originating during pregnancy.

"I thought stunting happens after the baby is born, when the child doesn't eat enough. I didn't realize it starts from pregnancy." (Participant 12, primigravida)

The qualitative findings strengthen the quantitative association between ANC content quality and pregnancy-centered stunting prevention practices. Although ANC attendance was common, participants' experiences suggest that the content and quality of care were not always sufficient to provide comprehensive information about nutrition and stunting prevention. Similar findings have been reported in Indonesia and other South Asian settings, where ANC often prioritizes biomedical monitoring over individualized nutrition counseling and preventive education (11,24). Together, these findings suggest that ANC attendance alone is insufficient for effective stunting prevention unless supported by high-quality, pregnancy-centered counseling and risk-responsive care.

Theme 2: Knowledge Does Not Automatically Translate into Practice

Although quantitative findings showed moderate knowledge scores, interviews revealed multiple barriers preventing women from implementing recommended

nutritional practices. Economic constraints and limited food access frequently restricted dietary diversity despite awareness of nutrition recommendations.

"The midwife said I should eat fish, eggs, vegetables, but sometimes we only have rice and tempeh at home." (Participant 19)

Pregnancy-related symptoms such as nausea, vomiting, and food aversions also limited women's ability to maintain adequate dietary intake.

"When I feel nauseous, I just eat what I can tolerate. I know it's not complete, but I can't force myself." (Participant 03)

These narratives provide contextual explanation for the quantitative finding that less than half of participants achieved adequate dietary diversity, despite relatively high knowledge scores. The findings indicate that knowledge alone is insufficient to improve maternal nutrition behaviors when women face economic limitations, restricted food access, and pregnancy-related symptoms. Thus, interventions should provide feasible and context-sensitive dietary support that considers the practical circumstances of pregnant women.

Theme 3: Social and Health-System Support Shape Stunting Prevention Behaviors

Partner and family support emerged as important facilitators of pregnancy-centered stunting prevention practices. Women with supportive partners reported better adherence to nutritional advice and supplementation.

"My husband reminds me to take supplements and buys fruit when we have money. That helps a lot." (Participant 21)

Participants also emphasized that the communication style of health workers strongly influenced their understanding and ability to apply health recommendations. Practical and relatable counseling was considered more useful than general advice.

"*If the explanation is simple and related to our daily life, I remember it better. Sometimes the advice is too general." (Participant 10)*

These findings support the quantitative association between partner support and stronger stunting prevention practice scores, while also highlighting the importance of effective counseling quality within ANC services. Participants' experiences suggest that social support can facilitate the implementation of recommended behaviors, while practical and contextually relevant communication from health workers may improve women's ability to understand and apply health recommendations.

Counseling perceived as practical, simple, and connected to daily life was considered more actionable than generalized advice. Previous studies similarly demonstrate that effective maternal nutrition counseling depends on provider communication skills, contextual relevance,

and interactive engagement (24). Strengthening communication competencies among ANC providers may therefore improve the effectiveness of pregnancy-centered stunting prevention programs.

Integration of Quantitative and Qualitative Findings

Integration of findings demonstrated strong convergence between quantitative and qualitative results (**Figure 2**). Quantitatively, ANC quality, dietary diversity, maternal education, and partner support were significant predictors of pregnancy-centered stunting prevention practices. Qualitatively, women's narratives clarified how these factors operated in daily life.

Routine-focused ANC visits with limited nutrition counseling explained why ANC attendance alone was insufficient for effective prevention behaviors. Similarly, the association between dietary diversity and practice scores was contextualized by women's experiences of financial limitations, food insecurity, and pregnancy discomfort.

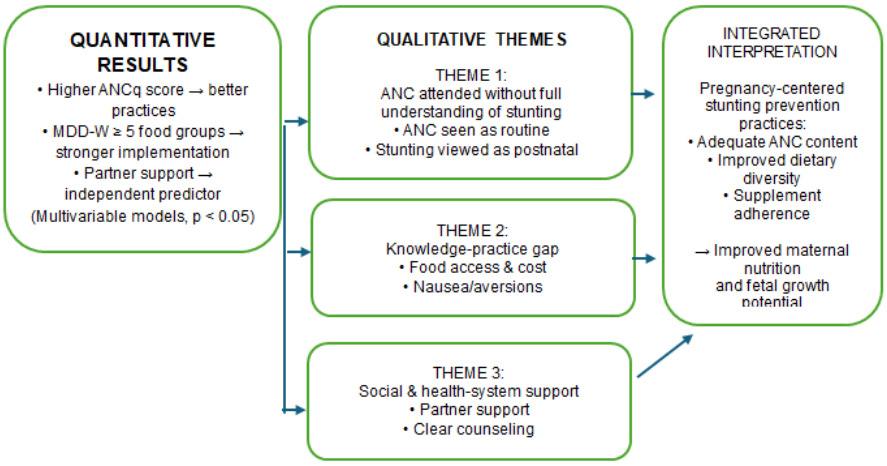

Figure 2. Graphical join display of quantitative and qualitative findings

The integration of quantitative and qualitative findings enhances the credibility and depth of this study. Statistically significant predictors identified in the quantitative phase were directly reflected in women's lived experiences during the qualitative phase, demonstrating convergence across methods. These integrated findings support a conceptual shift from ANC as a standardized service package toward ANC as a risk-responsive and pregnancy-centered preventive platform. Such an approach aligns with current recommendations for high-quality maternal health systems emphasizing effectiveness, equity, and person-centered care (9,10).

The integrated findings indicate that effective stunting prevention during pregnancy requires more than routine ANC utilization. High-quality counseling, context-sensitive nutritional guidance, and

supportive family environments are essential to translate maternal knowledge into sustainable preventive practices.

The findings have several implications for maternal and child health practice. First, ANC programs should prioritize content quality and risk-based counseling, particularly in early pregnancy. Second, nutrition counseling should be tailored to local food availability, household economics, and pregnancy-related discomforts. Third, engaging partners through simple counseling messages and shared action plans may enhance adherence to preventive behaviors. At the system level, incorporating simple screening tools for dietary diversity and social support into routine ANC may help identify women who require intensified support. Strengthening ANC in this manner is also economically justified, as early stunting prevention yields long-term human capital and productivity benefits (1,17).

Several limitations should be considered when interpreting the findings. The cross-sectional nature of the quantitative component limits causal inference, and pregnancy outcomes such as birth length or infant growth were not assessed. Self-reported measures of dietary intake and practices may be subject to recall or social desirability bias. Additionally, the study was conducted in a single regency, which may limit generalizability to other settings with different health system contexts. Nevertheless, the mixed-methods design strengthens the validity of the findings by providing contextual explanations for observed quantitative associations.

CONCLUSION AND RECOMMENDATION

This mixed-methods study demonstrates that pregnancy-centered stunting prevention in Jepara Regency is strongly influenced by the quality of ANC content, maternal dietary diversity, education, and partner support. While ANC attendance is high, gaps in risk-responsive counseling and practical support limit the translation of knowledge into effective preventive behaviors. Strengthening ANC as a pregnancy-centered, risk-based platform supported by family engagement and context-appropriate nutrition strategies has the potential to enhance early stunting prevention and sustain district-level gains in child growth outcomes.

Conflict of Interest

The authors declare that they have no competing interests.

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Data Availability Statement

The datasets generated and/or analyzed during the current study are not publicly available due to ethical and confidentiality considerations but are available from the corresponding author on reasonable request.

Author Contributions

Ita Rahmawati conceptualized the study, led data collection, and drafted the initial manuscript. Roihatul Zahroh contributed to study design, quantitative data analysis, and critical revision of the manuscript. Devi Rosita contributed to qualitative data collection and analysis and assisted in manuscript preparation. All authors reviewed and approved the final manuscript.

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