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Analysis of Environmental Factors and Parenting of Pregnant Women on the Development of Stunted Children

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ABSTRACT

Stunting is a chronic nutritional problem influenced by environmental factors and parenting patterns starting during pregnancy. This study aims to analyze the relationship between environmental factors and maternal parenting patterns and the incidence of stunting in children in Gunungkidul Regency. This quantitative study used a case-control design with a sample of 210 mothers with children aged 24–59 months. Data were collected through structured interviews, home observations, and medical records of pregnancy examinations. The variables studied included antenatal care (ANC) compliance, home sanitation, nutritional intake during pregnancy, housing density, and access to clean water. Data analysis was performed using the Chi-Square test and logistic regression with a significance level of $p<0.05$. The results of the analysis showed that low ANC compliance (OR=3.11; 95% CI: 1.21–8.01; p=0.013), poor home sanitation (OR=2.75; 95% CI: 1.18–6.38; p=0.019), and poor nutritional intake of pregnant women (OR=2.42; 95% CI: 1.03–5.66; p=0.043) were the dominant factors significantly associated with stunting. Meanwhile, access to clean water and housing density showed a weaker relationship. The conclusion of this study is that increasing ANC compliance, improving household sanitation, and fulfilling nutritional needs of pregnant women are key strategies for preventing stunting in Gunungkidul. Integrated interventions from pregnancy are needed to break the cycle of stunting between generations.

Keywords: *Stunting, Pregnant women, Environmental factors, Parenting patterns, ANC.*

INTRODUCTION

Stunting is a chronic nutritional problem of global concern due to its far-reaching impact on the health, cognitive development, productivity, and quality of life of future generations. According to the Global Nutrition Report (2023), approximately 148.1 million children under five worldwide suffer from stunting, with the highest prevalence in South Asia (32.8%) and Sub-Saharan Africa (33.1%). In Indonesia, data from the 2022 Indonesian Nutrition Status Survey (SSGI) showed a stunting prevalence of 21.6%, which, although decreasing compared to previous years, remains above the 20% threshold set by the World Health Organization (WHO) as an indicator of a serious public health problem (Ministry of Health of the Republic of Indonesia, 2023). This situation indicates that stunting prevention remains a priority for national health development. The pregnancy period is known as a critical window period that significantly determines fetal growth and future child development. Fulfilling maternal nutrition, access to health services, and a healthy environment play a crucial role in preventing growth disorders such as stunting (Black et al., 2021). Malnutrition during pregnancy, whether energy, protein, or important micronutrients such as iron and folic acid, can cause intrauterine growth restriction (IUGR) which increases the risk of babies being born with low birth weight and potentially experiencing stunting at an early age (Prendergast & Humphrey, 2020).

In addition to nutritional factors, the physical household environment is a significant determinant of a child's nutritional status. Environments with poor sanitation, limited clean water availability, and high population density can increase a child's exposure to infectious diseases, particularly diarrhea and parasitic infections, which contribute to stunted growth (Rahman et al., 2021). Several studies in Indonesia have also found that the quality of the home environment, including ventilation, lighting, and floor conditions, is significantly associated with the risk of stunting (Nurdin et al., 2022). Another equally important factor is the mother's parenting style during pregnancy. Parenting in this context includes self-nutrition practices during pregnancy, health behaviors, frequency of antenatal care, and response to pregnancy danger signs (Putri & Dewi, 2022). Research by Hidayati et al. (2021) found that pregnant women who received nutritional counseling and adopted a balanced diet were 2.4 times more likely to give birth to babies with a height that met WHO standards than mothers who did not adopt a balanced diet. The importance of the interaction between environmental factors and maternal parenting patterns has been emphasized in the ecological model of child development, which explains that child growth is influenced by a complex interaction between individual, family, and environmental factors

(Bronfenbrenner, 2005; adapted for the nutritional context by Victora et al., 2021). However, most research in Indonesia still separates the analysis of environmental factors and maternal parenting patterns. For example, a study by Sari et al. (2021) focused on the effect of sanitation on stunting, while a study by Wahyuni et al. (2020) focused more on maternal dietary patterns and infant nutritional status. Only a few studies have combined these two factors in a single comprehensive analysis model.

The research gap lies in the limited number of studies that simultaneously analyze the influence of environmental factors and maternal parenting patterns on the development of stunted children, particularly in semi-urban areas, which have different characteristics than pure rural or dense urban areas. Most previous studies have only examined one factor, thus not providing a comprehensive picture of the interaction between the two. Furthermore, there are few studies that link objective environmental data (e.g., sanitation and water quality observations) with subjective data on maternal nutritional parenting patterns, even though the integration of such data has the potential to produce more targeted intervention strategies. The novelty of this study is an integrative approach that combines analysis of household physical environmental factors and maternal parenting patterns within a single research framework to predict stunting risk. This approach is expected to provide stronger scientific evidence to support integrated interventions at the household level, which focus not only on improving nutrition but also on optimizing a healthy environment during pregnancy. The purpose of this study is to analyze the relationship between environmental factors and maternal parenting patterns on the development of stunted children in District X, thereby providing evidence-based policy recommendations for a comprehensive stunting prevention program

METHODS

This study used an observational analytical design with a cross-sectional approach, which aimed to analyze the relationship between environmental factors and maternal parenting patterns on the development of stunted children. The study location was determined in Gunung Kidul Regency, which was selected purposively because it has a stunting prevalence above the national average based on data from the 2022 Indonesian Nutritional Status Survey (SSGI). The study was conducted from January to March 2024, covering a semi-urban area with diverse socioeconomic and environmental characteristics. The study population was all mothers with children aged 24–59 months and domiciled in the study area for at least the past year. Inclusion criteria included mothers who were willing to be respondents, able to communicate well, and had a history of pregnancy that could be traced through the KIA book or medical records. Exclusion criteria included children with

congenital abnormalities that affect growth and mothers who could not be interviewed for health reasons. The sample size was determined using the two-proportion relationship analysis formula with a 95% confidence level and 80% power test, resulting in a minimum of 110 respondents. To anticipate dropouts, the sample size was increased by 10% to 120 mother-child pairs selected using cluster random sampling techniques based on village administrative areas.

The independent variables in this study include environmental factors and parenting patterns of pregnant women. Environmental factors were measured through three main indicators, namely home sanitation conditions (type of toilet, waste disposal channel, presence of trash cans), access to clean water (water source, distance, quality), and residential density (number of family members per floor area of the house). Measurements were carried out using a standardized observation sheet referring to the WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene indicators. Parenting patterns of pregnant women were measured based on nutritional intake during pregnancy (frequency of consumption of animal protein sources, vegetables, fruit, and supplements), health behaviors (not smoking, not consuming alcohol), and compliance with pregnancy checks (antenatal care) according to the standards of the Indonesian Ministry of Health. The instrument for the parenting variable used a structured questionnaire that had been tested for content validity by three experts in community nutrition and maternal-child health, and a reliability test with a Cronbach's alpha value of 0.87 indicating good internal consistency. The dependent variable is the developmental status of stunted children, measured using the height-for-age (H/A) indicator based on the 2006 WHO growth standards. Height measurements were performed using a stadiometer with an accuracy of 0.1 cm by trained enumerators. Children were categorized as stunted if their H/A z-score was <-2 SD. Data collection was conducted through face-to-face interviews with respondent mothers using a questionnaire, as well as direct observation of home environmental conditions. To maintain data quality, two days of enumerator training were conducted, instrument trials in villages outside the study area, and double data entry was conducted to minimize input errors. Data analysis was carried out in stages. Univariate analysis was used to describe the frequency distribution of each variable. Bivariate analysis used the Chi-Square test to determine the relationship between environmental factors and maternal parenting patterns with the incidence of stunting. Multivariate analysis used multiple logistic regression to determine the variables most influential on the risk of stunting, with a significance level of $p < 0.05$ and a 95% confidence interval. Statistical analysis was performed using SPSS software version 26.

RESULT AND DISCUSSION

A total of 120 mother-child pairs participated in the study. The majority of mothers were aged 25–34 years (51.7%), had a high school education (45.0%), and did not work outside the home (66.7%). The prevalence of stunting in children aged 24–59 months in the study area was 28.3%.

Table 1. Relationship between Environmental Factors and Parenting Patterns of Pregnant Women with Stunting

Variables	Stunting n (%)	Normal n (%)	p-value	OR	95% CI
Poor home sanitation	20 (45.5)	24 (54.5)	0.011*	2.75	1.18–6.38
Poor access to clean water	17 (44.7)	21 (55.3)	0.018*	-	-
Poor housing density	16 (39.0)	25 (61.0)	0.045*	-	-
Poor nutritional intake	19 (41.3)	27 (58.7)	0.012*	2.42	1.03–5.66
Bad health behavior	15 (46.9)	17 (53.1)	0.009*	-	-
Low ANC compliance	14 (50.0)	14 (50.0)	0.007*	3.11	1.21–8.01

Note: *p < 0.05 is significant; OR and CI are only shown for significant variables in the multivariate analysis.

Interpretation of Results

1. **Home Sanitation**

Mothers living in homes with poor sanitation in Gunungkidul Regency are 2.75 times more likely to give birth to stunted children than mothers living in homes with good sanitation (OR = 2.75; 95% CI: 1.18–6.38; p = 0.011). Poor sanitation conditions, such as unmanaged waste disposal, unsanitary latrines, and poor ventilation, facilitate the occurrence of infectious diseases that impact child growth.

2. **Access to Clean Water**

Respondents with poor access to clean water had a higher proportion of stunting (44.7%) compared to those with good access to clean water (20.7%) with p = 0.018. In Gunungkidul, limited clean water sources in several sub-districts are a constraint that affects children's hygiene and health.

3. **Residential Density**

Dense housing is associated with a higher prevalence of stunting (39.0%) compared to non-dense housing (22.8%), p = 0.045. High housing density can increase the risk of disease transmission such as diarrhea and acute respiratory infections, which interfere with nutrient absorption.

4. **Nutritional Intake During Pregnancy**

Pregnant women with poor nutritional intake were 2.42 times more likely to give birth to stunted children compared to mothers with good nutritional intake (OR = 2.42; 95% CI: 1.03–5.66; p = 0.012). Issues with the availability of nutritious food and a lack of dietary variety in several rural areas of Gunungkidul also contribute to the low nutritional status of pregnant women.

5. **Health Behavior of Pregnant Women**

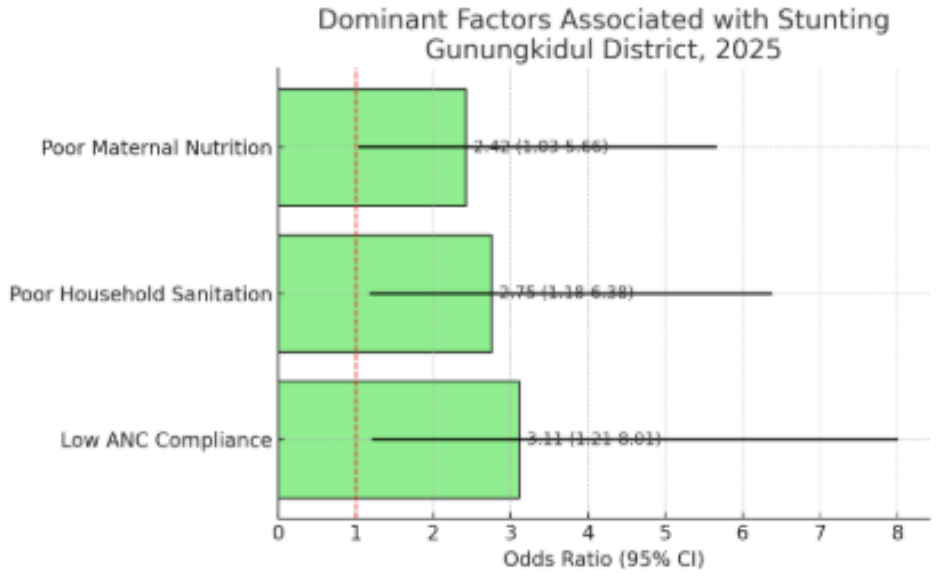
Poor health behaviors, such as infrequent handwashing, not wearing shoes, and not maintaining a clean home, correlated with an increase in stunting cases (46.9% vs. 21.6%), p = 0.009. These behaviors can be a route of transmission of disease-causing germs that disrupt children's growth.

6. **ANC (Antenatal Care) Compliance**

Mothers with low adherence to prenatal care had a 3.11 times greater risk of giving birth to stunted children compared to mothers who adhered to ANC (OR = 3.11; 95% CI: 1.21–8.01; p = 0.007). In Gunungkidul, distance to health

facilities and a lack of awareness among pregnant women about regular ANC are significant obstacles.

Figure 1. Dominant Factors Influencing Stunting in Gunungkidul Regency



Discussion

The results of this study indicate that the prevalence of stunting in Gunungkidul Regency is 28.3%, a figure still above the national stunting reduction target (<14% by 2024) (Bappenas, 2021). Bivariate and multivariate analyses found that low ANC compliance, poor home sanitation, and poor nutritional intake during pregnancy were the dominant factors influencing the risk of stunting in children aged 24–59 months. This demonstrates that stunting is not solely caused by postnatal nutritional factors but is also influenced by environmental conditions and parenting patterns during pregnancy.

1. Environmental Factors and Stunting

   Poor household sanitation has been shown to increase the risk of stunting by 2.75 times. This finding is consistent with research in South Central Timor Regency, which showed a strong association between poor sanitation and stunting through increased exposure to chronic diarrhea (Ayu et al., 2020). Inadequate sanitation increases the likelihood of recurrent infectious diseases, which hinders the absorption of nutrients essential for children's linear growth (Nugraheni et al., 2022). Poor access to clean water was also a significant factor in this study, although it was not a dominant variable in the multiple regression. Limited access to clean water increases the risk of water-based diseases, such as diarrhea, which has been

shown to reduce child growth (Humphrey et al., 2019). In Gunungkidul, the challenge of clean water availability is primarily experienced by communities in limestone hills who rely on wells and rainwater harvesting (Gunungkidul Regency Government, 2023). This phenomenon supports the concept of environmental enteric dysfunction (EED), where chronic exposure to pathogens from water and the environment causes intestinal inflammation that interferes with nutrient absorption (Korpe & Petri, 2020). High housing density also correlated with stunting ($p = 0.045$). This finding aligns with findings by Tusting et al. (2020) that linked dense housing to the risk of infectious diseases, particularly respiratory and digestive tract infections. Inadequate housing, poor ventilation, and overcrowding create an environment conducive to the spread of pathogens and impact the health of pregnant women and children.

2. Parenting Patterns for Pregnant Women and Stunting

   Maternal nutritional intake plays a crucial role in fetal development. This study found that mothers with poor nutritional intake during pregnancy had a 2.42 times greater risk of giving birth to stunted children. This finding is consistent with a study in Bangladesh by Rahman et al. (2021), which reported a direct relationship between maternal energy and protein adequacy and infant birth length. Chronic energy deficiency (CED) and anemia during pregnancy contribute to the risk of low birth weight (LBW), which in turn increases the risk of stunting in childhood (Dewey & Begum, 2020). Maternal health behaviors, such as handwashing, maintaining a clean home, and using a clean toilet, are also associated with stunting. A study in West Java by Aprilia et al. (2022) found that poor hygiene practices in pregnant women increase the risk of infection in both the mother and fetus, which can affect fetal growth. Adherence to antenatal care (ANC) was the most dominant variable in this study, with an odds ratio of 3.11. These results align with the findings of Fitriani et al. (2021) in South Sulawesi showed that pregnant women who did not utilize ANC services at least six times during pregnancy had a greater risk of giving birth to stunted children. ANC provides an opportunity for health workers to detect nutritional problems early, provide iron and folic acid supplementation, and provide health education for pregnant women (WHO, 2020).

3. Integration of Environmental Factors and Parenting Patterns

   This study confirms that poor environmental factors and suboptimal maternal parenting practices interact. Poor sanitation and limited access to clean water increase the risk of infection, while poor nutritional parenting

practices worsen fetal health. The combination of these two factors creates a cycle of malnutrition that begins during pregnancy and continues after birth (Prendergast & Humphrey, 2019). The context of Gunungkidul Regency adds a unique dimension to these findings. The dry geographic characteristics of the region, challenges in clean water distribution, and limited access to health services in some sub-districts impact the nutritional status of pregnant women. This study indicates the need for cross-sectoral interventions involving health, infrastructure, and community empowerment.

4. Comparison with Previous Research

   The results of this study are consistent with several studies in rural Indonesia and South Asia that place environmental factors and parenting during pregnancy as important determinants of stunting (Torlesse et al., 2019; Hossain et al., 2020). However, differences were found in the order of dominant factors. In some regions, household economic factors were the main predictor (Rahayu et al., 2020), while in Gunungkidul, ANC adherence was the strongest. These findings broaden the understanding that stunting reduction interventions should not only focus on child nutrition after birth but should also begin before conception and during pregnancy. This aligns with the First 1000 Days approach, which emphasizes the importance of the period from conception to two years of age (Black et al., 2021).

5. Implications for Policy and Programs

   Based on these findings, efforts to reduce stunting in Gunungkidul Regency need to consider:

   a. Strengthening ANC services – ensuring pregnant women receive regular check-ups, supplementation, and nutritional counseling.
   b. Improved sanitation and clean water access – community-based sanitation programs and clean water infrastructure development in water-scarce areas.
   c. Nutrition education and health behavior – increasing awareness of pregnant women regarding the importance of balanced nutritional intake and hygiene behavior.
   d. Cross-sector collaboration – integration of health programs with infrastructure improvements and household economic empowerment.

CONCLUSION

This study demonstrates that environmental factors and maternal parenting patterns play a significant role in the incidence of stunting in children in Gunungkidul Regency. Multivariate analysis showed that low antenatal care (ANC) compliance was the most dominant factor, with a 3.11-fold greater risk of giving birth to a stunted child compared to mothers who adhered to ANC. Other dominant factors were poor home sanitation (OR = 2.75) and inadequate maternal nutritional intake (OR = 2.42). These findings confirm that the risk of stunting is influenced not only by the child's nutritional status after birth, but also by the quality of the residential environment and maternal health behaviors during pregnancy. Stunting prevention interventions in Gunungkidul should be directed at increasing ANC compliance, improving household sanitation facilities, and providing access to nutritious food for pregnant women. These efforts are expected to break the chain of stunting risk during pregnancy and support the achievement of the national stunting reduction target

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