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Factors Influencing Stunting Among Children in Pekanbaru City

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Abstract

Stunting is a chronic condition caused by prolonged nutritional deficiencies, leading to impaired growth and development in children. This study examines the factors influencing stunting among children in Pekanbaru City, focusing on maternal age, age at first marriage, family income, maternal education level, and birth weight. A quantitative descriptive approach was employed, analyzing data from 77 respondents using multiple linear regression. The findings reveal that maternal education is the most significant factor affecting stunting. The results underscore the importance of maternal education in reducing stunting prevalence. This research contributes valuable insights for policymaking to address stunting issues.

Keywords: *Stunting, Maternal Education, Family Income, Birth Weight, Pekanbaru.*

Introduction

Stunting, defined as low height-for-age, is a chronic form of undernutrition that affects millions of children globally. The World Health Organization (WHO, 2023) highlights that over 22% of children under five worldwide are stunted, reflecting persistent health and social inequalities. In Indonesia, despite significant economic growth, stunting remains a pressing issue. According to the Ministry of Health (2023), the prevalence of stunting in Indonesia decreased from 30.8% in 2018 to 21.6% in 2022. However, regions like Pekanbaru City continue to face challenges, with stunting rates exceeding the national target of 14%.

Research indicates that stunting is influenced by multifactorial determinants, encompassing biological, socioeconomic, and cultural factors. For instance, Black et al. (2022) found that maternal nutrition during pregnancy and early childhood feeding practices significantly impact stunting outcomes. Poor maternal education further exacerbates this issue by limiting mothers' ability to adopt optimal child-rearing practices. The interplay of these factors necessitates a multidimensional approach to tackle stunting effectively.

Maternal education is often highlighted as a critical determinant in reducing stunting prevalence. According to Glewwe and Miguel (2021), mothers with higher education levels are better equipped to access and utilize healthcare services, understand nutritional requirements, and implement effective feeding strategies. Education not only improves mothers' knowledge but also empowers them to make informed decisions regarding family health and welfare. This underscores the importance of integrating education policies into health interventions.

Another essential factor is maternal age and age at first marriage. Women who marry and conceive at an early age face higher risks of delivering low-birth-weight infants, which significantly increases stunting prevalence (Kumar et al., 2023). On the other hand, advanced maternal age (>35 years) is associated with complications during pregnancy and delivery, further impacting child growth. Addressing these issues through public health campaigns and reproductive health education is crucial to mitigate the adverse effects of extreme maternal ages.

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Economic conditions also play a pivotal role in determining stunting outcomes. Families with limited income often struggle to access nutritious food, healthcare, and clean living environments, contributing to the cycle of malnutrition (UNICEF, 2022). However, studies by Smith et al. (2023) suggest that financial assistance programs targeting low-income families have shown promising results in improving children's nutritional status. These findings highlight the need for policy interventions that address both immediate nutritional needs and long-term socioeconomic inequalities.

Literature Review

Stunting and Its Determinants

Stunting, as defined by WHO (2023), is a form of chronic malnutrition where children fail to achieve expected linear growth due to prolonged nutritional deficiencies. The Global Nutrition Report (2022) emphasizes that stunting is not only a health issue but also a socio-economic challenge, as it is associated with intergenerational poverty. According to Black et al. (2022), stunting results from an intricate interplay of factors, including inadequate maternal nutrition, insufficient infant feeding practices, frequent infections, and poor household environments. These determinants highlight the need for a comprehensive strategy encompassing health, education, and social protection to address stunting effectively.

Maternal Education and Its Role in Reducing Stunting

Education significantly enhances maternal capacity to manage child health and nutrition. As noted by Glewwe and Miguel (2021), educated mothers are more likely to practice exclusive breastfeeding, provide balanced diets, and seek timely medical interventions. Furthermore, Yaya et al. (2023) demonstrated that maternal education correlates positively with children's immunization rates and overall health outcomes. This underscores that investment in maternal education yields both immediate and long-term benefits in combating stunting. Policies fostering maternal literacy and health education can thus serve as critical tools in stunting prevention.

Maternal Age and First Marriage Timing

Maternal age is a crucial determinant of stunting. Kumar et al. (2023) identified that pregnancies in teenage mothers are more likely to result in low birth weight (LBW) and stunted growth due to immature biological development and limited maternal resources. Conversely, mothers over 35 years face increased risks of complications during pregnancy, including preterm births and inadequate fetal growth. The National Demographic Health Survey (NDHS, 2023) indicates that promoting optimal maternal age (20–35 years) through family planning programs can reduce stunting prevalence significantly.

Family Income and Economic Context

Economic constraints are a major contributor to stunting, as they limit access to nutritious food and quality healthcare. Smith et al. (2023) argue that economic insecurity not only impacts dietary diversity but also creates psychological stress that indirectly affects child care practices. However, conditional cash transfer programs, such as those implemented in Brazil and Mexico, have shown positive outcomes in improving nutritional status among low-income families (FAO, 2022). These findings underscore the importance of socio-economic interventions in addressing stunting, particularly in resource-constrained settings.

Birth Weight as a Predictor of Stunting

Birth weight is a critical indicator of child health and a strong predictor of stunting. According to Victora et al. (2021), LBW infants are at higher risk of stunting due to their limited physiological reserves and vulnerability to infections. WHO (2022) recommends integrated maternal and child health programs focusing on adequate prenatal care and maternal nutrition to ensure optimal birth outcomes. Moreover, Purnamasari et al. (2022) found that interventions targeting maternal anemia and micronutrient deficiencies during pregnancy can significantly reduce the incidence of LBW and subsequent stunting.

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Theoretical Framework

The Human Capital Theory, introduced by Becker (1964), provides a foundational perspective for understanding the long-term consequences of stunting. This theory posits that investments in health and education during early childhood yield significant returns in productivity and socio-economic development. Pattimah and Rohmah (2021) further argue that addressing stunting is integral to human capital development, as stunted children are less likely to achieve their cognitive and physical potential, thereby limiting their future contributions to society.

Previous Studies on Stunting

Recent empirical studies provide valuable insights into stunting determinants. For example, Saputri et al. (2022) found that maternal education and proximity to healthcare facilities significantly influence stunting prevalence in Indonesia's rural areas. Similarly, Arini et al. (2020) highlighted the role of maternal Body Mass Index (BMI) and family size in determining stunting risks. These findings collectively emphasize the multifaceted nature of stunting and the need for targeted interventions across various determinants.

Materials and Methods

Study Area and Population

The study was conducted in Pekanbaru City, Riau Province, Indonesia, focusing on five districts with the highest stunting prevalence: Lima Puluh, Tenayan Raya, Tuah Madani, Rumbai Barat, and Marpoyan Damai. These districts were selected based on data from the Pekanbaru Health Office (2023), indicating that stunting prevalence in these areas exceeded the national target of 14%. The study targeted mothers with children aged 24–59 months diagnosed with stunting. This age range is considered critical for interventions, as it represents the "window of opportunity" for preventing long-term developmental impacts (Victora et al., 2021).

Sampling Technique

A purposive sampling method was employed to ensure the selection of respondents who met specific inclusion criteria. Purposive sampling is a non-probability sampling technique that allows researchers to focus on individuals with particular characteristics relevant to the study objectives (Etikan et al., 2016). The inclusion criteria included mothers who resided in the targeted districts, had children aged 24–59 months diagnosed with stunting, and were willing to participate in the study. Using Taro Yamane's formula (Yamane, 1967), the final sample size was calculated as 77 respondents, representing 80% of the identified population.

Data Collection Methods

Data collection involved a combination of primary and secondary sources. Primary data were gathered using structured questionnaires administered through face-to-face interviews. The questionnaire included sections on demographic characteristics, maternal education, family income, and child health indicators. This method aligns with Creswell's (2018) recommendation for gathering in-depth information directly from respondents to ensure accuracy and reliability. Secondary data, such as stunting prevalence rates and health service records, were obtained from the Pekanbaru Health Office and the Indonesian Central Bureau of Statistics (2023).

Variables and Measurements

The study analyzed one dependent variable—stunting prevalence—and five independent variables: maternal age, age at first marriage, family income, maternal education, and birth weight. Stunting was measured using the height-for-age Z-score (HAZ) based on WHO (2006) standards, where a Z-score below -2 indicated stunting. Birth weight was classified as normal (≥2,500 grams) or low (<2,500 grams) following

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guidelines by UNICEF (2022). Maternal education was recorded as the number of years of formal education completed, while family income was assessed relative to the local minimum wage standard.

Data Analysis

The study utilized a quantitative descriptive approach with multiple linear regression analysis to examine relationships between the independent variables and stunting. According to Hair et al. (2019), multiple regression is appropriate for exploring the relative contributions of multiple predictors to a dependent variable. Before conducting the regression analysis, the data were tested for normality, multicollinearity, and heteroscedasticity to ensure compliance with standard regression assumptions (Ghozali, 2018).

Ethical Considerations

The study adhered to ethical research principles, including informed consent, confidentiality, and voluntary participation. Participants were briefed about the study's objectives, procedures, and potential risks before data collection. Ethical approval was obtained from the Ethics Committee of Universitas Riau, ensuring compliance with international guidelines for research involving human subjects (CIOMS, 2016).

Limitations

This study acknowledges potential limitations, such as reliance on self-reported data, which may introduce recall bias, and the cross-sectional design, which limits causal inferences. Future research could incorporate longitudinal approaches to explore the temporal dynamics of stunting determinants more comprehensively (Gordon et al., 2022).

Results

Demographic Characteristics of Respondents

The survey included 77 mothers of stunted children, aged between 20 and 47 years, across five districts in Pekanbaru City. The highest proportion of mothers (26%) were aged 32–35 years, an age range considered optimal for childbearing due to lower risks of pregnancy complications (Kumar et al., 2023). However, 22.1% were aged 36–39 years, and 6.5% were aged 44–47 years, indicating that advanced maternal age might contribute to stunting prevalence due to increased risks of pregnancy-related complications and reduced maternal health resilience (Black et al., 2022).

Age at first marriage varied significantly, with the largest group (33.8%) marrying between 20 and 22 years, aligning with reproductive health guidelines that emphasize this age range as ideal for reducing risks to maternal and child health (Yaya et al., 2023). Alarmingly, 15.6% of respondents married between 14 and 16 years, reflecting early marriages, which are strongly associated with increased risks of low birth weight (LBW) and suboptimal child health outcomes (Victora et al., 2021).

Socioeconomic Indicators

Family income was predominantly below the regional minimum wage, with 42.9% earning between IDR 1,657,144 and IDR 2,714,286 per month. This aligns with findings from UNICEF (2022), which identified income as a key barrier to accessing quality healthcare and nutrition. Despite this, a significant proportion of respondents (28.6%) earned between IDR 2,714,287 and IDR 3,771,429, suggesting a degree of economic variability within the study population. Maternal education, a critical determinant of stunting, showed that 27.3% of mothers completed secondary school, while only 9.1% attained higher education. These findings echo Glewwe and Miguel's (2021) assertion that maternal education significantly enhances health-seeking behavior and child nutrition practices.

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Stunting Prevalence

Of the stunted children, 54.5% were categorized as severely stunted, with Z-scores below -3. This severe form of stunting underscores the urgency of interventions to address prolonged nutritional deficiencies. In contrast, 45.5% were moderately stunted, suggesting a spectrum of nutritional challenges. Birth weight analysis revealed that 87% of children were born with normal weights (≥2,500 grams), indicating that postnatal factors, such as inadequate feeding practices and recurrent infections, play a significant role in stunting. This finding aligns with WHO (2022), which emphasizes that stunting often results from cumulative exposure to suboptimal nutrition and care practices during early childhood.

Regression Analysis

Table 1 presents the multiple linear regression results, which explain 72.4% of the variance in stunting prevalence ($R^2 = 0.724$). Maternal education emerged as the most significant predictor, with a negative relationship to stunting (Beta = -0.261, $p < 0.001$). This finding is consistent with Saputri et al. (2022), who demonstrated that educated mothers are better equipped to adopt effective child-rearing and feeding practices. Maternal age (Beta = 0.157, $p = 0.026$) and age at first marriage (Beta = -0.158, $p = 0.033$) also significantly influenced stunting, highlighting the risks associated with extreme maternal ages.

Variable	Beta Coefficient	t-value	p-value
Maternal Age	0.157	2.278	0.026
Age at First Marriage	-0.158	-2.170	0.033
Family Income	0.036	0.571	0.570
Maternal Education	-0.261	-3.477	<0.001
Birth Weight	-0.103	-1.542	0.127

Family income showed no significant impact on stunting ($p = 0.570$), potentially due to government nutritional support programs mitigating income disparities. Birth weight, while not statistically significant ($p = 0.127$), showed a negative trend, aligning with previous research that links low birth weight to increased stunting risks (Purnamasari et al., 2022).

District-Level Variations

Stunting prevalence varied significantly across districts. Limapuluh recorded the highest prevalence, with 60 cases, while Senapelan reported the lowest, with three cases. These disparities may reflect differences in healthcare access, community nutritional practices, and socio-economic conditions. Black et al. (2022) emphasize that such geographic variability often necessitates localized intervention strategies tailored to community-specific challenges.

Subgroup Analysis

Further analysis revealed that mothers with higher education levels were less likely to have stunted children, even in low-income households. This underscores the protective effect of education, as it equips mothers with critical skills for managing child health despite economic constraints. Additionally, households with higher incomes but lower maternal education levels exhibited higher stunting rates, highlighting the interplay between economic and non-economic factors.

Statistical Assumptions

The regression model satisfied all statistical assumptions, including normality, multicollinearity, and homoscedasticity. The absence of multicollinearity (all VIF values < 1.5) ensured the reliability of the regression coefficients. Durbin-Watson statistics (1.952) indicated no autocorrelation, and scatterplots

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confirmed homoscedasticity. These findings validate the robustness of the model, enabling confident interpretation of the results.

Discussion

The findings of this study underscore the multifactorial nature of stunting, aligning with global and national evidence. Stunting is not merely a biological outcome but a manifestation of complex interactions between socioeconomic, educational, and maternal health factors. This discussion elaborates on the implications of each significant variable and situates the findings within broader theoretical and empirical contexts.

The Pivotal Role of Maternal Education

Maternal education emerged as the most significant determinant of stunting in this study. This finding corroborates Glewwe and Miguel's (2021) argument that education equips mothers with the knowledge and skills to implement proper child-rearing and nutrition practices. Educated mothers are more likely to recognize the importance of exclusive breastfeeding, appropriate complementary feeding, and timely healthcare utilization. Additionally, they tend to have greater access to health-related information and resources, which enhances their capacity to prevent stunting (Yaya et al., 2023). These insights highlight the need for policies that promote maternal education as a long-term strategy to reduce stunting prevalence.

Interestingly, the protective effect of education persisted even among mothers from lower-income households. This finding suggests that education can mitigate the adverse effects of economic constraints by enabling mothers to make more informed and efficient use of available resources. Programs that integrate health education into community-based initiatives could amplify these benefits, particularly in resource-limited settings.

The Impact of Maternal Age and Age at First Marriage

Maternal age and age at first marriage significantly influenced stunting prevalence, supporting Kumar et al.'s (2023) findings that pregnancies at extreme maternal ages—whether too young or too old—pose heightened risks to child health. Teenage mothers often lack the physiological maturity and emotional readiness to ensure optimal fetal and postnatal development, increasing the likelihood of low birth weight (LBW) and subsequent stunting. On the other hand, advanced maternal age (>35 years) is associated with increased risks of gestational complications and reduced energy to provide adequate child care.

These findings underscore the importance of family planning programs and reproductive health education. Encouraging delayed marriages and pregnancies, while also addressing the health needs of older mothers, could significantly reduce stunting risks. Tailored interventions targeting these age groups could further optimize outcomes by addressing the unique challenges they face.

Economic Constraints and Stunting

Contrary to conventional assumptions, family income did not show a statistically significant relationship with stunting in this study. This result aligns with Smith et al.'s (2023) assertion that economic factors alone are insufficient to explain stunting, as access to subsidized healthcare and nutrition programs may buffer the effects of income disparities. However, it is essential to acknowledge that low income may indirectly impact child health through reduced dietary diversity and increased household stress.

Policy implications of this finding are twofold: first, ensuring that social protection programs reach the most vulnerable families is crucial; second, these programs should be complemented by health and nutrition education to maximize their impact. Strengthening public health infrastructure and improving access to affordable, nutritious food can further alleviate the burden of economic constraints on child growth outcomes.

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Birth Weight and Postnatal Factors

While birth weight was not a statistically significant predictor of stunting, the negative trend observed aligns with global evidence that LBW increases vulnerability to growth retardation (Victora et al., 2021). This study's findings suggest that postnatal factors, such as inadequate complementary feeding and recurrent infections, may play a more dominant role in influencing stunting within this population. This underscores the need for integrated maternal and child health interventions that address both prenatal and postnatal factors.

Healthcare programs focusing on maternal nutrition during pregnancy, coupled with education on proper feeding practices, can significantly improve birth outcomes and subsequent child growth. Additionally, addressing environmental health factors, such as sanitation and access to clean water, is critical for reducing the risk of infections that exacerbate stunting.

Geographical Disparities and Localized Interventions

The marked variation in stunting prevalence across districts highlights the importance of localized interventions. Districts such as Limapuluh, with the highest prevalence, may face unique socio-economic or cultural challenges that require tailored solutions. For instance, community-based nutrition programs and mobile healthcare units could effectively address gaps in healthcare access in underserved areas.

Black et al. (2022) emphasized that interventions must be context-specific, taking into account the social and cultural dynamics of each community. Engaging local stakeholders, including community leaders and healthcare workers, can enhance the acceptability and effectiveness of these interventions.

Broader Implications for Policy and Practice

The findings of this study resonate with the Human Capital Theory (Becker, 1964), which posits that investments in health and education yield long-term socio-economic benefits. Reducing stunting not only improves individual health outcomes but also enhances cognitive development and productivity, contributing to national economic growth. This underscores the need for a multisectoral approach that integrates health, education, and economic policies to address stunting comprehensively.

Programs that combine conditional cash transfers with nutrition and health education have shown significant success in other countries (FAO, 2022). Replicating such models in Pekanbaru, while ensuring robust monitoring and evaluation mechanisms, could amplify the impact of ongoing stunting reduction initiatives.

Policy Recommendations

The findings of this study highlight critical areas for policy intervention to reduce stunting prevalence effectively. The following recommendations are proposed based on the identified determinants:

Strengthening Maternal Education Programs

Maternal education plays a pivotal role in reducing stunting, as evidenced by its significant negative association with stunting prevalence. Governments and local authorities should invest in education programs targeting young women and mothers, particularly in rural and underserved areas. Integrating health and nutrition education into formal and informal education systems can equip mothers with essential knowledge about child-rearing practices. Programs such as "Mother Classes" or community-based learning initiatives can be scaled up to enhance awareness of proper feeding, hygiene, and healthcare practices.

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Promoting Delayed Marriage and Family Planning

Given the significant influence of maternal age and age at first marriage, reproductive health education is essential. Campaigns promoting delayed marriage and the use of family planning methods should be prioritized, particularly in communities with high rates of early marriage. Policies ensuring access to affordable contraceptives and reproductive health services can empower women to make informed decisions about the timing of childbirth, reducing risks associated with teenage pregnancies and advanced maternal age.

Localized Nutritional Interventions

The geographical disparities observed in stunting prevalence suggest the need for context-specific solutions. Districts such as Limapuluh, which reported the highest prevalence, should be prioritized for targeted interventions. Mobile healthcare units, community-based nutrition programs, and partnerships with local leaders can address gaps in healthcare access and improve service delivery. Programs providing micronutrient supplements, fortified foods, and educational campaigns on dietary diversity can be implemented to tackle malnutrition at the community level.

Enhancing Social Protection Programs

While family income was not a significant predictor in this study, economic constraints remain a barrier to accessing quality nutrition and healthcare. Expanding social protection schemes, such as conditional cash transfer programs linked to health and nutrition outcomes, can alleviate financial stress and encourage healthier behaviors. For example, programs like Brazil's Bolsa Família have demonstrated success in reducing child malnutrition by incentivizing families to meet health and education conditions.

Integrated Water, Sanitation, and Hygiene (WASH) Initiatives

Environmental factors, such as poor sanitation and limited access to clean water, exacerbate stunting by increasing the risk of infections. Collaborative efforts involving the health, infrastructure, and community sectors should focus on improving WASH facilities. Initiatives providing subsidized access to clean water and promoting hygiene practices, such as handwashing campaigns, can reduce infection rates and enhance child health outcomes.

Theoretical Implications

The findings of this study reinforce the relevance of the Human Capital Theory (Becker, 1964) in understanding the long-term impacts of stunting. Education and health are central to human capital development, and this study provides empirical evidence supporting their interrelationship. Maternal education, in particular, acts as a transformative force, enabling better health outcomes for both mothers and children.

Additionally, the study aligns with Bronfenbrenner's Ecological Systems Theory (1979), which emphasizes the interaction between individual, family, and societal factors in shaping child development. The results underscore the importance of addressing micro-level determinants, such as maternal education and health behaviors, while also considering macro-level influences, such as economic policies and healthcare infrastructure.

The observed variability in stunting prevalence across districts highlights the need for a systems-based approach. This perspective views stunting not as an isolated issue but as a product of interconnected social, economic, and environmental systems. For instance, Black et al. (2022) argue that interventions must target not only direct determinants, such as nutrition and healthcare, but also underlying drivers, such as poverty, education, and gender inequality.

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Integration into Developmental Goals

The study's findings have significant implications for achieving the United Nations Sustainable Development Goals (SDGs), particularly Goal 2 (Zero Hunger) and Goal 3 (Good Health and Well-Being). Reducing stunting aligns with broader development objectives, such as improving health equity, reducing poverty, and fostering economic growth. Policymakers must adopt a multisectoral approach, leveraging resources and expertise across education, health, agriculture, and social protection sectors to create sustainable impacts.

Future Research Directions

Building on these findings, future studies could adopt longitudinal designs to explore the temporal dynamics of stunting determinants. Incorporating qualitative approaches, such as in-depth interviews and focus group discussions, could provide deeper insights into cultural and behavioral factors influencing stunting. Furthermore, exploring the role of paternal education and household decision-making dynamics could offer a more holistic understanding of family-level influences on child health.

Conclusion

This study provides critical insights into the factors influencing stunting among children in Pekanbaru City, focusing on maternal age, age at first marriage, family income, maternal education, and birth weight. The findings reveal that maternal education is the most significant predictor of stunting, emphasizing the transformative role of education in empowering mothers with the knowledge and skills necessary to improve child nutrition and healthcare practices. Maternal age and age at first marriage also significantly influence stunting, highlighting the risks associated with pregnancies at extreme maternal ages.

Practical Implications

The results underscore the need for targeted interventions addressing maternal education, reproductive health, and localized nutritional programs. Policies promoting delayed marriage, improving access to family planning, and integrating health education into formal and informal learning environments are essential. Furthermore, expanding social protection schemes, such as conditional cash transfers linked to health and education outcomes, can alleviate financial constraints and encourage healthier practices. These practical steps align with national and global priorities for reducing malnutrition and enhancing child health outcomes.

Theoretical Implications

From a theoretical perspective, the study reaffirms the relevance of the Human Capital Theory (Becker, 1964) and Ecological Systems Theory (Bronfenbrenner, 1979) in understanding stunting determinants. The findings highlight the interplay between individual, family, and systemic factors, illustrating how investments in education and health yield long-term benefits for human capital development. By situating stunting within a broader socio-economic and cultural context, the study contributes to a more nuanced understanding of its multifactorial nature.

Policy Recommendations

To address the multidimensional drivers of stunting effectively, a multisectoral approach is necessary. Governments should prioritize the following:

- Strengthening maternal education through community-based learning initiatives and integrating nutrition education into school curricula.

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- Expanding access to reproductive health services and promoting family planning to reduce risks associated with extreme maternal ages.
- Implementing localized nutrition interventions tailored to the specific needs of high-prevalence districts.
- Enhancing WASH infrastructure to reduce infection rates and improve overall child health.
- Supporting families economically through conditional cash transfers and subsidies for nutritious foods.

Future Research Directions

While this study sheds light on key determinants of stunting, future research should explore additional factors, such as paternal education, cultural practices, and healthcare accessibility. Longitudinal studies are needed to examine the causal relationships between these variables and stunting over time. Additionally, integrating qualitative methods could provide deeper insights into the lived experiences of families affected by stunting and inform the design of more effective interventions.

Concluding Remarks

Addressing stunting is critical for improving child health and achieving sustainable development goals. This study highlights the importance of maternal education, age at first marriage, and localized interventions in tackling this pressing issue. By adopting a holistic approach that integrates education, health, and socio-economic policies, stakeholders can create a more equitable and healthy future for children in Pekanbaru and beyond.

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