Health Sciences International Journal (HSIJ)
Vol. 3, No. 2, August 2025, pp. 168 – 181
ISSN: 3026-5037 DOI: https://doi.org/10.71357/ hsij.v3i2.69

Original Research

Assosiation of maternal factors on stunting incidence in toddlers at Cempaka Inpatient Health Center, Banjarbaru

Indah Octaviyani[1]*, Adriana Palimbo[1], Susanti Suhartati[2], Fitri Yuliana[2], Raudhatul Jannah[1]

[1]Department of Midwifery, Faculty of Health, Sari Mulia University, Indonesia
[2]Department of Midwife Profession, Faculty of Health, Sari Mulia University, Indonesia

*Corresponding author: indah.octaviyani20@gmail.com

ARTICLE INFO

Article history:
Received 01 March 2025
Accepted 11 June 2025
Published 31 August 2025

Keywords:
Stunting risk factors
Maternal risk factors
MUAC
Nutritional status
Early childhood development

ABSTRACT

Background: Stunting is a serious public health issue that affects children's physical and cognitive development, leading to long-term economic consequences. Despite various interventions, stunting prevalence remains high in Indonesia, particularly in areas with limited access to nutrition and healthcare. Maternal factors, including maternal age, nutritional status during pregnancy, and maternal height, are believed to play a crucial role in stunting incidence among children.

Objective: This study aims to analyze the relationship between maternal age during pregnancy, nutritional status based on mid-upper arm circumference (MUAC), and maternal height with stunting incidence in toddlers in the working area of Cempaka Inpatient Health Center, Banjarbaru.

Method: A case-control study design was employed, involving 212 mothers with toddlers, divided into 106 cases (stunted toddlers) and 106 controls (normal toddlers). Data were collected through structured interviews and anthropometric measurements. The relationship between maternal factors and stunting incidence was analyzed using the Chi-Square test and Odds Ratio (OR) calculations, with a significance level of $p<0.05$.

Results: The findings revealed a significant association between maternal age and stunting incidence, where mothers of high-risk age (<20 years or >35 years) had 2.950 times higher odds of having stunted children ($p=0.003$). Maternal nutritional status, measured by MUAC <23.5 cm, was also significantly associated with stunting (OR=2.865; $p=0.002$). Additionally, maternal height <150 cm increased the risk of stunting by 3.143 times compared to mothers with a height ≥150 cm ($p=0.001$).

Conclusion: Maternal factors, including age, nutritional status during pregnancy, and height, significantly contribute to stunting incidence. Strengthening maternal health interventions focusing on adequate nutrition and optimal pregnancy planning is crucial to preventing stunting from an early stage.

1. Introduction

Stunting is a serious health issue that remains a major challenge in developing countries, including Indonesia. The high prevalence of stunting reflects chronic nutritional problems related to social, economic, and maternal and child health factors stunting characterized by impaired linear growth due to chronic undernutrition, leading to a height-for-age index below the standard deviation set by the World Health Organization (WHO). This condition

Health Sciences International Journal (HSIJ)
Vol. 3, No. 2, August 2025, pp. 168 – 181
ISSN: 3026-5037 DOI: https://doi.org/10.71357/ hsij.v3i2.69

predominantly occurs within the first 1,000 days of life, from conception to the child's second birthday, a crucial period for optimal physical and cognitive development (Georgiadis & Penny, 2017; Rufaridah et al., 2024). The long-term consequences of stunting extend beyond growth impairment to include decreased cognitive function, reduced school performance, and lower economic productivity in adulthood.

Globally, 144 million children under five were affected by stunting in 2019, accounting for 21.3% of the total child population worldwide (Aramico et al., 2020). Indonesia continues to face a serious challenge with stunting, with a prevalence rate of 21.5% in 2023 (Ministry of Health - Republic of Indonesia, 2023a; Ministry of National Secretariat -Republic of Indonesia, 2024). This figure remains above the target set by the WHO, which aims to reduce stunting to below 20% by 2025. Despite ongoing government interventions, stunting remains a pressing challenge, necessitating further investigation into its determinants (WHO, 2018).

Addressing stunting requires a combination of specific and sensitive nutritional interventions. Specific interventions target direct nutritional support, such as breastfeeding promotion, micronutrient supplementation, and the provision of supplementary feeding for malnourished children through community health centers and integrated health posts. These initiatives contribute to approximately 30% of stunting reduction. Sensitive interventions, on the other hand, encompass broader strategies, including national health insurance coverage, community nutrition education, and reproductive health education for adolescents (Aminah et al., 2024; Hidayah & Fariana, 2024; Khasanah et al., 2022). While these interventions have shown some success, persistent high stunting rates indicate the need for a deeper understanding of maternal and environmental risk factors.

Maternal factors play a pivotal role in influencing stunting risk, with key determinants including maternal age, mid-upper arm circumference (MUAC), and maternal height. Studies suggest that pregnancies occurring at extreme maternal ages (<20 years or >35 years) are associated with a higher likelihood of low birth weight (LBW) infants, a well-established risk factor for stunting (Dayani & Widyantari, 2024; Permatasari et al., 2022; Shinsugi et al., 2020). MUAC, a measure of maternal nutritional status, is critical in predicting fetal growth outcomes (Dehghani et al., 2018; Haque et al., 2021). MUAC reflects the amount of muscle and fat in the arm, providing insight into overall body composition (Chawada et al., 2024; He et al., 2021). A MUAC of less than 23.5 cm indicates chronic energy deficiency (CED) (Mishra et al.,

Health Sciences International Journal (HSIJ)
Vol. 3, No. 2, August 2025, pp. 168 – 181
ISSN: 3026-5037 DOI: https://doi.org/10.71357/ hsij.v3i2.69

2020; Mutalazimah et al., 2020), which heightens the risk of intrauterine growth restriction (IUGR) and subsequent stunting (Fauziyah & Putri, 2023; Silva de Muzio Gripp et al., 2023). Furthermore, maternal height is a significant predictor of child stunting; mothers shorter than 150 cm are 7.6 times more likely to have stunted children than those above this threshold (Manggala et al., 2018).

In South Kalimantan Province, the stunting prevalence in 2022 was recorded at 24.6%, higher from national average 21.6% (Dharmawati et al., 2024). According to *Pencatatan dan Pelaporan Gizi Berbasis Masyarakat* (e-PPBGM) data as of May 2023, 16.09% of 3,151 children attending Posyandu in Banjarbaru were stunted (Ministry of Health - Republic of Indonesia, 2024b). Data from the Banjarbaru City Health Office in April 2024 showed that the Cempaka Inpatient Health Center ranked third among the city's Puskesmas with the highest number of stunting cases, totaling 145 affected children.

Although numerous studies have examined the relationship between maternal factors and stunting, there remains a research gap in understanding the specific contribution of each maternal factor to stunting. However, no study has specifically examined the simultaneous correlation between maternal age, MUAC, and height in a broader population. This research seeks to analyze the relationship between maternal age, nutritional status based on MUAC, and maternal height during pregnancy with the prevalence of stunting among children in the working area of the Cempaka Inpatient Health Center, Banjarbaru. While the association between maternal factors and stunting has been widely studied, this research offers a unique contribution by focusing on a specific local population with distinct demographic and ethnic characteristics. The Cempaka Health Center serves a diverse community, including densely populated urban neighborhoods and under-resourced rural subdistricts, providing valuable contextual insights. These locally grounded findings aim to inform targeted prevention strategies and maternal-child health policies that are more responsive to the regional realities of Banjarbaru and potentially applicable to similar areas in Indonesia.

2. Method

Research Design

This study employs a case-control design with a quantitative approach. This design allows for a comparison between stunted toddlers (cases) and non-stunted toddlers (controls) based on maternal factors during pregnancy. Confounding variables (preterm birth,

Health Sciences International Journal (HSIJ)
Vol. 3, No. 2, August 2025, pp. 168 – 181
ISSN: 3026-5037 DOI: https://doi.org/10.71357/ hsij.v3i2.69

chronic maternal illness, genetics deseases or syndroms) are controlled through exclusion criteria to strengthen internal validity.

Participants

The population in this study consists of all mothers with toddlers recorded at Puskesmas Rawat Inap Cempaka, Banjarbaru, in April 2024, totaling 1,039 individuals, comprising 145 mothers with stunted toddlers and 894 mothers with non-stunted (normal) toddlers. The sample size was determined using web-base Slovin formula (Mukti, 2025), margin error 0.05, resulting in a required sample of 106 respondents per group. Thus, the total study sample consists of 212 mothers, divided into 106 mothers with stunted toddlers (case group) and 106 mothers with normal toddlers (control group). To ensure a representative sample, the study employs a systematic random sampling technique, which minimizes selection bias and ensures proportional representation of the population, providing a reliable basis for analyzing maternal factors associated with stunting in toddlers.

Data Collection

Data were collected through structured questionnaire interviews and anthropometric measurements. The variables measured include:

- Maternal age during pregnancy, categorized as <20 years and >35 years (risky), 20-35 years (no risky).
- Nutritional status based on MUAC, categorized as CED (<23.5 cm) and normal (≥23.5 cm).
- Maternal height, categorized as shorts (<150 cm) and normal ≥150 cm.
- Stunting status of toddlers, determined based on the height-for-age index (HFA) according to WHO standards (Z-score < -2 SD classified as stunting).

Maternal age, MUAC, and height data were obtained from medical records at the Puskesmas and direct interviews with the toddlers' mothers. Anthropometric measurements were conducted by trained healthcare professionals following WHO standards. Exclusion criteria include toddlers with genetic disorders or chronic illnesses that may affect growth.

Data Analysis

Data analysis was conducted using the Chi-Square test to examine the relationship between independent variables (maternal age, MUAC, maternal height) and the incidence of stunting in toddlers. Significance was determined at a 95% confidence level (p-value < 0.05). Additionally, Odds Ratio (OR) calculations were used to measure the strength of the

Health Sciences International Journal (HSIJ)
Vol. 3, No. 2, August 2025, pp. 168 – 181
ISSN: 3026-5037 DOI: https://doi.org/10.71357/ hsij.v3i2.69

relationship between maternal factors and stunting incidence.

Ethical Clearance

This study has received ethical approval from the Ethics Committee Sari Mulia University, with approval number 384/KEP-UNISM/VII/2024. Prior to data collection, informed consent was obtained from all participants or their guardians after providing an explanation regarding the study's objectives, benefits, and their rights as participants. Confidentiality of personal data was ensured through anonymized identification, and all information collected was used solely for research purposes without disclosure to third parties.

3. Result

The study findings indicate a significant association between maternal factors and the incidence of stunting in children. Mothers in the case group had a higher proportion of risky pregnancies (56.6%) compared to the control group (11.3%). Similarly, maternal nutritional status, measured by MUAC, showed that 61.3% of mothers in the case group CED, while only 14.2% in the control group fell into this category. Furthermore, maternal height was also a crucial factor, as 60.4% of mothers in the case group were categorized as short (<150 cm), compared to only 15.1% in the control group. These results suggest that maternal age, nutritional status, and height play a critical role in child growth outcomes, particularly in relation to stunting (Table 1).

Table 1. Maternal characteristics distribution

Characteristics		Case		Control	
		Frequency (f)	Percentage (%)	Frequency (f)	Percentage (%)
Ages	No Risk	46	43.4	94	88.7
	Risky	60	56.6	12	11.3
	Total	106	100	106	100
MUAC	Normal	41	38.7	91	85.8
	CED	65	61.3	15	14.2
	Total	106	100	106	100
Height	Normal	42	39.6	90	84.9
	Short	64	60.4	16	15.1
	Total	106	100	106	100

The findings indicate a clear distinction between the case and control groups in terms

Health Sciences International Journal (HSIJ)
Vol. 3, No. 2, August 2025, pp. 168 – 181
ISSN: 3026-5037 DOI: https://doi.org/10.71357/ hsij.v3i2.69

of toddler growth. All children in the case group (100%) were classified as stunted, while none were categorized as having normal growth. Conversely, all children in the control group (100%) exhibited normal growth, with no cases of stunting. These results highlight the stark contrast between the two groups and reinforce the study's focus on identifying maternal factors associated with stunting (Table 2).

Table 2. Distribution of toddler growth status in case and control groups

Toodler Growth	Case		Control	
	Frequency (f)	Percentage (%)	Frequency (f)	Percentage (%)
Normal	0	0	106	100
Stunting	106	100	0	0
Total	106	100	106	100

Table 3 presents the association between maternal factors (maternal age, MUAC, and maternal height) and the incidence of stunting in toddlers. The OR for maternal age indicates that mothers with risky age (<20 years or >35 years) have 2.95 times higher odds of having stunted children compared to those in the no-risk category (95% CI: 1.412–6.166, p = 0.003). Similarly, mothers with CED (MUAC <23.5 cm) have 2.865 times higher odds of having a stunted child compared to those with normal MUAC (95% CI: 1.449–5.664, p = 0.002). Furthermore, mothers with short stature (<150 cm) have the highest risk, with an OR of 3.143 (95% CI: 1.619–6.104, p = 0.001), indicating a strong association between maternal height and stunting. The statistically significant p-values (<0.05) suggest that these maternal factors are significantly associated with stunting in toddlers.

Table 3. Association between maternal factors and stunting in toddlers

Health Sciences International Journal (HSIJ)
Vol. 3, No. 2, August 2025, pp. 168 – 181
ISSN: 3026-5037
DOI: https://doi.org/10.71357/ hsij.v3i2.69

Parameters		Case		Control		OR (CI 95%)	p-value
		Freq.	Percentage (%)	Freq.	Percentage (%)		
Ages	No Risk	46	43.4	94	88.7	2.950 (1.412-6.166)	0.003
	Risky	60	56.6	12	11.3		
	Total	106	100	106	100		
Nutrition Status	Normal	41	38.7	91	85.8	2.865 (1.449-5.664)	0.002
	CED	65	61.3	15	14.2		
	Total	106	100	106	100		
Height	Normal	42	39.6	90	84.9	3.143 (1.619-6.104)	0.001
	Short	64	60.4	16	15.1		
	Total	106	100	106	100		

4. Discussions

Association of mother's age during pregnancy to the incidence of stunting in toddlers

In this study, one of the factors related to the incidence of stunting in toddlers is the age of pregnant women at risk. The results showed a significant difference between the case group and the control group with a p-value of 0.003. Based on the OR value, a value of 2.950 is obtained, which means that children born to high-risk mothers have a 2.950 times higher chance of experiencing stunting than children from mothers aged 20 years to 35 years. These findings reflect that younger pregnant women tend to face higher risks, such as health complications and stunted child growth, including the risk of stunting. Based on reproductive health theory, young pregnant women are often less physically and psychologically prepared to undergo pregnancy, which increases the likelihood of health problems. Children born to mothers at an early age usually have poor parenting and have an impact on malnutrition status (Adelbertha et al., 2022; Kurniawati et al., 2022; Sani et al., 2020).

The assumption of the researcher in this study is that the age of the mother during pregnancy has a significant influence on the incidence of stunting in toddlers. Mothers who become pregnant at the age of <20 and >35 years are at higher risk of developing health complications –included gestational diabetic and preeclampsia–, which can negatively impact the growth and development of the child (Correa-de-Araujo & Yoon, 2021; Li et al., 2023). Researchers think that the physical and psychological immaturity of young mothers affects the parenting style and nutritional status of children, thereby increasing the likelihood of stunting. These findings are expected to emphasize the importance of reproductive health

Health Sciences International Journal (HSIJ)
Vol. 3, No. 2, August 2025, pp. 168 – 181
ISSN: 3026-5037 DOI: https://doi.org/10.71357/ hsij.v3i2.69

education and support for young pregnant women to prevent stunting problems in children (Pugo et al., 2023).

Association of nutritional status to the incidence of stunting in toddlers

The second factor observed in this study is the Nutritional Status (MUAC) of Mothers During Pregnancy. The results of the study obtained a p-value of 0.002 which proved that there is a significant correlation between the nutritional status of mothers during pregnancy and the incidence of stunting in toddlers. Meanwhile, the OR value obtained is 2,865, which showed that children from mothers with a LILA of less than 23.5 cm are 2,865 times more likely to be stunted than children from mothers with a MUAC value of more than 23.5 cm.

The results of this study prove that unnormal Nutritional Status during pregnancy has a higher risk of stunting in toddlers and vice versa. Mothers with MUAC less than 23.5 cm are at higher risk of giving birth to children with stunting. This is in line with research by Kpewou, et al. (2020) that there is a assosiation between maternal nutritional status during pregnancy and stunting incidence (OR 1.6). Another study, record that 46.7% of pregnant women with low MUAC, assosiated with prevalence of 30.9% t0 44.4% stunting in toddlers aged 24-59 months (Haque et al., 2021; Istiningsih & Riyanti, 2022).

These findings highlight the critical role of maternal nutrition during pregnancy in preventing stunting among children. Inadequate maternal nutritional status, as indicated by a MUAC of less than 23.5 cm, may reflect chronic energy deficiency, which affects fetal growth and development, ultimately increasing the risk of IUGR and low birth weight—both of which are strong predictors of stunting (Sètondji Géraud Roméo et al., 2020). Poor nutritional intake during pregnancy can impair placental function and limit the supply of essential nutrients to the fetus, thereby hampering optimal growth (James-Allan et al., 2024; Mikhailova et al., 2021). This emphasizes the importance of early nutritional interventions and maternal health programs that ensure adequate nutrient intake and monitoring throughout pregnancy, especially in low-resource settings (Kurniati, 2024). Ensuring optimal maternal nutrition not only supports the health of the mother but also serves as a foundational step in breaking the intergenerational cycle of malnutrition and stunting (Swain et al., 2021).

Association of maternal height during pregnancy to the incidence of stunting in toddlers

This study found a statistically significant relationship between maternal height during pregnancy and the incidence of stunting in toddlers. The p-value of 0.001 indicates a strong

Health Sciences International Journal (HSIJ)
Vol. 3, No. 2, August 2025, pp. 168 – 181
ISSN: 3026-5037 DOI: https://doi.org/10.71357/ hsij.v3i2.69

association. The odds ratio (OR) of 3.143 (95% CI: 1.619–6.104) suggests that children born to mothers shorter than 150 cm have over three times the likelihood of experiencing stunting compared to those whose mothers are taller. This highlights maternal height as a crucial risk factor in stunting. Maternal height is not just a physical measurement; it reflects the cumulative effects of nutrition, health, and socioeconomic status across a woman's life course, and is therefore a reliable indicator of intergenerational health risks (Christian, 2010). Addressing maternal stature as part of stunting prevention efforts could help break this cycle of poor maternal and child health.

Biologically, short maternal stature is associated with a range of physiological constraints during pregnancy. For example, short stature can lead to compromised cardiorespiratory function, including reduced lung capacity and increased cardiovascular strain, which elevates the risk of pregnancy-related complications. Additionally, a smaller uterine volume and limited uteroplacental blood flow may restrict fetal growth, contributing to adverse outcomes such as small-for-gestational-age (SGA) births. Short stature is also linked to cephalopelvic disproportion—an anatomical mismatch between the fetal head and maternal pelvis—leading to higher rates of cesarean delivery (Christian, 2010; French-O'Carroll et al., 2024; Kozuki et al., 2015; O'Sullivan et al., 2025). Moreover, anatomical variations in shorter women may pose challenges for anesthetic management during labor and delivery, further increasing obstetric risks. Beyond immediate pregnancy outcomes, maternal short stature perpetuates a cycle of undernutrition and poor health, contributing to stunted growth and chronic disease risk in offspring (Christian, 2010; Ferreira et al., 2008).

The findings emphasize the importance of addressing maternal height as part of broader stunting prevention strategies. Adolescence is a critical window for physical growth, during which nutritional demands rise sharply due to hormonal shifts and increased energy requirements (Bhutta et al., 2017). Ensuring a balanced diet rich in essential nutrients—such as calcium, vitamin D, and iron—is crucial for bone health and muscle development, which directly influence adult height (Bayat Balkan, 2024). Research has shown that nutritional interventions, including the provision of balanced meals and micronutrient supplementation, can significantly boost growth among undernourished adolescent girls. For example, one study found that girls who received comprehensive nutritional support grew an average of 7.97 cm per year, compared to only 6.83 cm in the control group (Srinivas et al., 2017). Poor

Health Sciences International Journal (HSIJ)
Vol. 3, No. 2, August 2025, pp. 168 – 181
ISSN: 3026-5037 DOI: https://doi.org/10.71357/ hsij.v3i2.69

nutrition during adolescence can lead to stunted growth and heightened risks during future pregnancies, affecting both maternal and fetal health (United Nations Children's Fund, 2023). Addressing undernutrition early is therefore not only essential for optimizing height but also plays a key role in reducing gender-based health disparities and enhancing life prospects for women.

Addressing stunting effectively requires early, comprehensive interventions that extend beyond pregnancy. Nutrition programs should not only support pregnant women but also target adolescent girls and women of reproductive age to improve long-term maternal health indicators such as height and MUAC. Special attention must be given to improving reproductive health education, delaying early pregnancies, and ensuring dietary adequacy during adolescence. Incorporating maternal anthropometric indicators into community health screenings and stunting prevention policies may help break the intergenerational cycle of malnutrition. Strengthening maternal health through preconception care, nutritional support, and early pregnancy monitoring will be essential to achieving national and global targets for stunting reduction.

5. Conclusion

This study concludes that maternal factors—specifically maternal age during pregnancy, nutritional status (as measured by MUAC), and maternal height—are significantly associated with the incidence of stunting in toddlers. Mothers who were pregnant at high-risk ages (<20 or >35 years), had a MUAC of less than 23.5 cm, or were shorter than 150 cm were more likely to have children affected by stunting. These findings underscore the critical role of maternal health and nutritional status during pregnancy in shaping child growth outcomes.

6. Conflict of interest

All authors declare no conflict of interest.

7. References

Adelbertha, Devi, N. C., Harahap, R. O., & Ningrum, A. G. (2022). The association of adolescent pregnancy with stunting incidence in child under five years old; Literatur review. *Jurnal Sosial Sains*, *2*(11), 1241–1250. https://doi.org/10.36418/jurnalsosains.v2i11.518

Aminah, S., Mahmudiono, T., & Nadhiroh, S. R. (2024). Policy, intervention, and management in addressing stunting in children: A systematic review. *African Journal of Reproductive Health*, *28*(10s), 348–357. https://doi.org/10.29063/ajrh2024/v28i10s.37

Aramico, B., Huriyati, E., & Dewi, F. S. T. (2020). Determinant factors of stunting and effectiveness of nutrition, information, education interventions to prevent stunting in

Health Sciences International Journal (HSIJ)
Vol. 3, No. 2, August 2025, pp. 168 – 181
ISSN: 3026-5037 DOI: https://doi.org/10.71357/ hsij.v3i2.69

the first 1000 days of life: A systematic review. *Childhood Stunting, Wasting, and Obesity, as the Critical Global Health Issues: Forging Cross-Sectoral Solutions*, 285–300. https://doi.org/10.26911/the7thicph-FP.03.30

Bayat Balkan, S. (2024). Nutrition in adolescence. In *Obstetrics & Gynecology and Nutrition* (pp. 1–16). Nobel Tip Kitabevleri. https://doi.org/10.69860/nobel.9786053359494.1

Bhutta, Z. A., Lassi, Z. S., Bergeron, G., Koletzko, B., Salam, R., Diaz, A., McLean, M., Black, R. E., De-Regil, L. M., Christian, P., Prentice, A. M., Klein, J. D., Keenan, W., & Hanson, M. (2017). Delivering an action agenda for nutrition interventions addressing adolescent girls and young women: priorities for implementation and research. *Annals of the New York Academy of Sciences*, *1393*(1), 61–71. https://doi.org/10.1111/nyas.13352

Chawada, B. L., Devaliya, J. J., & Kurian, S. (2024). Validity of "mid-upper arm circumference" as a parameter to identify undernourished children in rural Gujarat. *Indian Journal of Community Medicine*, *49*(3), 475–479. https://doi.org/10.4103/ijcm.ijcm_789_22

Christian, P. (2010). Maternal height and risk of child mortality and undernutrition. *JAMA*, *303*(15), 1539. https://doi.org/10.1001/jama.2010.469

Correa-de-Araujo, R., & Yoon, S. S. (Sarah). (2021). Clinical outcomes in high-risk pregnancies due to advanced maternal age. *Journal of Women's Health*, *30*(2), 160–167. https://doi.org/10.1089/jwh.2020.8860

Dayani, T. R., & Widyantari, K. Y. (2024). Maternal risk factors for stunting in children aged 24-59 months. *International Journal of Public Health Science (IJPHS)*, *13*(3), 1366. https://doi.org/10.11591/ijphs.v13i3.24156

Dehghani, S. M., Javaherizadeh, H., Heidary, M., Honar, N., Ataollahi, M., Ilkanipour, H., & Moravej, H. (2018). Stunting, wasting, and mid upper arm circumpherence status among children admitted to nemazee teaching hospital. *Nutrición Hospitalaria*. https://doi.org/10.20960/nh.1143

Dharmawati, A., Noor, H., & Yazidah Anwar, R. I. (2024). Application of stunting prevalence analysis based on the people's welfare survey in South Kalimantan [in Indonesia]. *Technologia : Jurnal Ilmiah*, *15*(4), 688. https://doi.org/10.31602/tji.v15i4.15951

Fauziyah, N. F., & Putri, A. S. (2023). Low birth weight and chronic energy deficiency in the mother lead to stunting: a case-control study. *International Journal of Health Science and Technology*, *4*(3), 279–284. https://doi.org/10.31101/ijhst.v4i3.2913

Ferreira, H. S., Moura, F. A., Cabral Júnior, C. R., Florêncio, T. M. M. T., Vieira, R. C., & de Assunção, M. L. (2008). Short stature of mothers from an area endemic for undernutrition is associated with obesity, hypertension and stunted children: A population-based study in the semi-arid region of Alagoas, Northeast Brazil. *British Journal of Nutrition*, *101*(8), 1239–1245. https://doi.org/10.1017/S0007114508059357

French-O'Carroll, R., Seligman, K. M., & Traynor, A. J. (2024). Parturients of short stature. in *Obstetric anesthesia and uncommon disorders* (pp. 140–158). Cambridge University Press. https://doi.org/10.1017/9781009070256.012

Georgiadis, A., & Penny, M. E. (2017). Child undernutrition: opportunities beyond the first 1000 days. *The Lancet Public Health*, *2*(9), e399. https://doi.org/10.1016/S2468-2667(17)30154-8

Health Sciences International Journal (HSIJ)
Vol. 3, No. 2, August 2025, pp. 168 – 181
ISSN: 3026-5037 DOI: https://doi.org/10.71357/ hsij.v3i2.69

Haque, M. A., Choudhury, N., Farzana, F. D., Ali, M., Raihan, M. J., Ahmed, S. M. T., Rahman, S. S., Siddiqua, T. J., Faruque, A. S. G., & Ahmed, T. (2021). Determinants of maternal low mid-upper arm circumference and its association with child nutritional status among poor and very poor households in rural Bangladesh. *Maternal & Child Nutrition*, *17*(4). https://doi.org/10.1111/mcn.13217

He, L., Yang, N., Wang, J., Huang, J., Li, W., Xu, L., Ping, F., Li, Y., & Zhang, H. (2021). Mid-arm muscle and subcutaneous fat associated with all-cause mortality independent of BMI: A prospective cohort study. *Obesity*, *29*(7), 1203–1214. https://doi.org/10.1002/oby.23179

Hidayah, N., & Fariana, Y. R. N. (2024). Lactation preparation for pregnant women to prevent stunting. *Health Sciences International Journal*, *2*(2), 169–176. https://doi.org/DOI:https://doi.org/10.71357/hsij.v2i2.42

Istiningsih, T., & Riyanti, R. (2022). Maternal risk factors associated with stunting among toddlers aged 12–24 months at Mantangai Public Health Center, Kapuas District, Central Kalimantan Province [in Indonesia]. *Malahayati Nursing Journal*, *4*(7), 1828–1838. https://doi.org/10.33024/mnj.v4i7.6673

James-Allan, L. B., Powell, T., & Jansson, T. (2024). Placental nutrient transport. In *Reference Module in Biomedical Sciences*. Elsevier. https://doi.org/10.1016/B978-0-443-21477-6.00085-7

Khasanah, U., Esyuananik, E., Laili, A. N., & Saadah, N. (2022). The effect of sensitive interventions on stunting reduction efforts. *Jurnal Berkala Epidemiologi*, *10*(3), 274–282. https://doi.org/10.20473/jbe.V10I32022.274-282

Kozuki, N., Katz, J., Lee, A. C., Vogel, J. P., Silveira, M. F., Sania, A., Stevens, G. A., Cousens, S., Caulfield, L. E., Christian, P., Huybregts, L., Roberfroid, D., Schmiegelow, C., Adair, L. S., Barros, F. C., Cowan, M., Fawzi, W., Kolsteren, P., Merialdi, M., … Black, R. E. (2015). Short maternal stature increases risk of small-for-gestational-age and preterm births in low- and middle-income countries: individual participant data meta-analysis and population attributable fraction. *The Journal of Nutrition*, *145*(11), 2542–2550. https://doi.org/10.3945/jn.115.216374

Kpewou, D. E., Poirot, E., Berger, J., Som, S. V., Laillou, A., Belayneh, S. N., & Wieringa, F. T. (2020). Maternal mid-upper arm circumference during pregnancy and linear growth among Cambodian infants during the first months of life. *Maternal & Child Nutrition*, *16*(S2). https://doi.org/10.1111/mcn.12951

Kurniati, A. (2024). Improving maternal and neonatal health outcomes: A comparative study of antenatal care interventions. *Join: Journal of Social Science*, *1*(5), 371–384. https://doi.org/10.59613/36303r04

Kurniawati, A., Sujiyatini, & Saputro, N. T. (2022). Association of maternal age during pregnancy with stunting in children age 2-3 years. *Informasi Dan Promosi Kesehatan*, *1*(2), 46–53. https://doi.org/10.58439/ipk.v1i2.17

Li, J., Li, Y., Duan, Y., Xiao, X., Luo, J., & Luo, M. (2023). Dose-response associations of maternal age with pregnancy complications and multimorbidity among nulliparas and multiparas: A multicentric retrospective cohort study in southern China. *Journal of Global Health*, *13*, 04117. https://doi.org/10.7189/jogh.13.04117

Health Sciences International Journal (HSIJ)
Vol. 3, No. 2, August 2025, pp. 168 – 181
ISSN: 3026-5037 DOI: https://doi.org/10.71357/ hsij.v3i2.69

Manggala, A. K., Kenwa, K. W. M., Kenwa, M. M. L., Sakti, A. A. G. D. P. J., & Sawitri, A. A. S. (2018). Risk factors of stunting in children aged 24-59 months. *Paediatrica Indonesiana*, *58*(5), 205–212. https://doi.org/10.14238/pi58.5.2018.205-12

Mikhailova, O. I., Mirzabekova, D. D., Kan, N. E., & Tyutyunnik, V. L. (2021). Nutritional support in pregnancy: possibilities for the prevention of obstetric complications. *Meditsinskiy Sovet = Medical Council*, *3*, 67–74. https://doi.org/10.21518/2079-701X-2021-3-67-74

Ministry of Health - Republic of Indonesia. (2023a). *Stunting in Indonesia and its determinants.* Minirstry Oh Health - Republic of Indonesia.

Ministry of Health - Republic of Indonesia. (2024b). *Surveilans Gizi dan Kesehatan Keluarga*. Minirstry Oh Health - Republic of Indonesia. https://sigizikesga.kemkes.go.id/login_sisfo/

Ministry of National Secretariat -Republic of Indonesia. (2024). *National strategy for accelerating stunting prevention and reduction 2025–2029* [in Indonesia]. Ministry of National Secretariat -bRepublic of Indonesia.

Mishra, K., Bhatia, V., & Nayak, R. (2020). Association between mid-upper arm circumference and body mass index in pregnant women to assess their nutritional status. *Journal of Family Medicine and Primary Care*, *9*(7), 3321. https://doi.org/10.4103/jfmpc.jfmpc_57_20

Mukti, B. H. (2025). Sample size determination: Principles and applications for health research. *Health Sciences International Journal*, *3*(1), 127–143. https://doi.org/10.71357/hsij.v3i1.63

Mutalazimah, M., Wijaya, Y. A., & Suswardany, D. L. (2020). Energy, protein intake and mid-upper arm circumference in pregnant women in Boyolali Regency, Indonesia. *Malaysian Journal of Medicine and Health Sciences*, *16*(SUPP6), 77–83.

O'Sullivan, J., Mahmood, H., Curry, R. A., & Frise, C. (2025). Pregnancy in a woman with extreme short stature and low body weight secondary to a collagen VI-related muscular dystrophy. *Obstetric Medicine*, *18*(2), 123–126. https://doi.org/10.1177/1753495X231219298

Permatasari, M. Kes. , Dr. E., Leersia Yusi Ratnawati, Ni'mal Baroya, Globila Nurika, Farida Wahyu Ningtyias, & Andrei Ramani. (2022). Analysis of maternal risk factors associated with stunting-prone families [in Indonesia]. *Media Gizi Indonesia*, *17*(1SP), 161–167. https://doi.org/10.20473/mgi.v17i1SP.161-167

Pugo, M. F., Banta, J. E., Grohar, A., Mataya, R., Egiebor, Q.-I., Avina, R., & Olivos, N. (2023). Risk factors for serious psychological distress among pregnant women and mothers with children less than one year of age: An evaluation of national health interview survey data (1997-2016). *Puerto Rico Health Sciences Journal*, *42*(1), 57–62.

Rufaridah, A., Dahlan, A., Komalasari, W., Marlia, S., & Oktariantiaskar, R. (2024). Improving understanding in preventing stunting in the first 1,000 days of life. *Journal of Community Service and Application of Science*, *1*(2), 92–97. https://doi.org/10.62769/yy2wh371

Sani, M., Solehati, T., & Hendarwati, S. (2020). Hubungan usia ibu saat hamil dengan stunted pada balita 24-59 bulan. *Holistik Jurnal Kesehatan*, *13*(4), 284–291. https://doi.org/10.33024/hjk.v13i4.2016

Health Sciences International Journal (HSIJ)
Vol. 3, No. 2, August 2025, pp. 168 – 181
ISSN: 3026-5037 DOI: https://doi.org/10.71357/ hsij.v3i2.69

Sètondji Géraud Roméo, P., Mèdessè Véronique, T., Carmelle, M.-A., Badirou, A., & Paul, A. (2020). Prevalence and influence of maternal undernutrition on intra uterine growth restriction (IUGR) among beninese newborns. *The Journal of Community Health Management*, *5*(3), 154–160. https://doi.org/10.18231/2394-2738.2018.0034

Shinsugi, C., Gunasekara, D., & Takimoto, H. (2020). Use of mid-upper arm circumference (MUAC) to predict malnutrition among Sri Lankan schoolchildren. *Nutrients*, *12*(1), 168. https://doi.org/10.3390/nu12010168

Silva de Muzio Gripp, M., Carvalho Nogueira, L., Echenique Amorim, G., Carrijo Santos, M., & D'Lucca Carioca, M. (2023). Intrauterine growth restriction and risk factors associated in Brazil. *International Seven Journal of Health Research*, *2*(4), 818–833. https://doi.org/10.56238/isevjhv2n4-031

Srinivas, P., Shashikala, V., Aparna, A., & Pavan, T. (2017). A study of impact of nutrition on targeted height among adolescent girls. *IOSR Journal of Dental and Medical Sciences*, *16*(07), 27–32. https://doi.org/10.9790/0853-1607012732

Swain, D., Begum, J., & Parida, S. P. (2021). Effect of preconception care intervention on maternal nutritional status and birth outcome in a low-resource setting: proposal for a nonrandomized controlled trial. *JMIR Research Protocols*, *10*(8), e28148. https://doi.org/10.2196/28148

United Nations Children's Fund. (2023). *Undernourished and overlooked: A global nutrition crisis in adolescent girls and women*. United Nations. https://doi.org/10.18356/9789213626764

WHO. (2018). *Reducing stunting in children: Equity considerations for achieving the Global Nutrition Targets 2025*. WHO.