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RESEARCH ARTICLES

Analisis Status Gizi Ibu Hamil terhadap Kejadian Stunting sebagai Upaya Pencegahan Stunting pada 1000 HPK

Analysis of Maternal Nutritional Status in Relation to Stunting Incidence as a Preventive Effort during the First 1000 Days of Life

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Abstract

Undernutrition and stunting are interrelated conditions that can affect the quality of human resources. These problems indirectly contribute to high maternal, infant, and under-five mortality rates, as well as low life expectancy. This study aimed to analyze the relationship between maternal nutritional status and the incidence of stunting in Boneatiro Village, Kapontori Subdistrict, Buton Regency, Southeast Sulawesi. This study was conducted in Boneatiro Village with a population of 123 children under five. A total of 40 respondents were selected using purposive sampling. The study employed a case-control design with a retrospective approach. Data were collected through interviews and observations of Maternal and Child Health (MCH) books. Data analysis was performed using descriptive statistics, as well as bivariate and multivariate analyses (*Chi-square* test and ordinal logistic regression). The *Chi-square* test showed a significant association between maternal body mass index (BMI) (p = 0.022) and chronic energy deficiency (CED) (p = 0.011) with the incidence of stunting. The ordinal logistic regression analysis indicated that maternal nutritional status had a significant effect on stunting in children, with p = 0.025 (95% CI −4.875 to −0.328) for BMI and p = 0.005 (95% CI −3.137 to −0.566) for CED. In conclusion, maternal nutritional status during pregnancy, particularly underweight conditions and CED, significantly influenced the incidence of stunting in children. Mothers with poor nutritional status had a higher risk of delivering stunted children, especially those classified as severely stunted.

Keywords: nutritional status, pregnant women, stunting

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Abstrak

Masalah kurang gizi dan stunting merupakan dua kondisi yang saling berhubungan dan dapat memengaruhi kualitas sumber daya manusia (SDM). Kedua masalah tersebut secara tidak langsung berdampak pada tingginya angka kematian ibu, bayi, dan balita, serta rendahnya usia harapan hidup. Tujuan penelitian ini adalah untuk menganalisis hubungan status gizi ibu hamil dengan kejadian stunting di Desa Boneatiro, Kecamatan Kapontori, Kabupaten Buton, Sulawesi Tenggara. Metode penelitian ini dilakukan di Desa Boneatiro dengan populasi sebanyak 123 balita. Sampel penelitian berjumlah 40 responden yang dipilih menggunakan teknik purposive sampling. Desain penelitian yang digunakan adalah case-control dengan pendekatan retrospektif. Data dikumpulkan melalui wawancara dan observasi buku KIA/KMS. Analisis data dilakukan menggunakan statistik deskriptif, analisis bivariat, dan multivariat (uji Chi-square dan regresi logistik ordinal). Hasil uji Chi-square menunjukkan adanya hubungan yang bermakna antara indeks massa tubuh (IMT) (p = 0,022) dan kekurangan energi kronik (KEK) (p = 0,011) pada ibu hamil dengan kejadian stunting. Hasil uji regresi logistik ordinal menunjukkan bahwa status gizi ibu hamil berpengaruh signifikan terhadap kejadian stunting pada anak, dengan nilai p = 0,025 (95% CI –4,875 hingga –0,328) pada variabel IMT dan p = 0,005 (95% CI –3,137 hingga –0,566) pada variabel KEK. Kesimpulan penelitian ini menunjukkan bahwa status gizi ibu selama kehamilan, khususnya kondisi berat badan kurang (underweight) dan KEK, berpengaruh signifikan terhadap kejadian stunting pada anak. Ibu dengan status gizi kurang memiliki risiko lebih tinggi untuk melahirkan anak yang mengalami stunting, terutama pada kategori stunting berat.

Kata Kunci: *ibu hamil, status gizi, stunting*

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Highlight:

- A substantial portion of pregnant women in Boneatiro Village faced nutritional vulnerabilities, with nearly half of them suffering from Chronic Energy Deficiency (CED) and the vast majority having a history of preterm births.
- Clear evidence demonstrates that a mother's physical condition during pregnancy directly shapes her child's growth, showing that both maternal Body Mass Index (BMI) and Chronic Energy Deficiency (CED) are closely tied to the occurrence of stunting.
- Maternal underweight conditions and energy deficits act as primary drivers that restrict fetal growth in the womb, ultimately leaving children highly vulnerable to falling into the most severe categories of stunting.

INTRODUCTION

Stunting is defined as a condition in which height is shorter than the standard height-for-age, with a z-score between –3 SD and < –2 SD, caused by chronic malnutrition during the critical period of growth and development in the first 1000 days of life (HPK) (Yuningsih, 2022). Stunting in children under five requires special attention as it may hinder both physical and mental development. This condition is

associated with an increased risk of illness, mortality, and delays in motor and cognitive development. Children experiencing stunting are at risk of reduced intelligence, lower productivity, and greater vulnerability to degenerative diseases later in life. In addition, stunted children are more susceptible to infections, which may negatively affect their learning capacity and contribute to higher school absenteeism. Stunting is also linked to the risk of obesity, as individuals with shorter stature typically have a lower ideal body weight. Consequently, a weight gain of only a few kilograms may cause their Body Mass Index (BMI) to exceed the normal threshold. If overweight and obesity persist over time, the risk of degenerative diseases will increase further (Perumal et al., 2023; Diniaty and Kadir, 2025).

Pregnancy is one of the most critical periods within the first 1000 days of life, requiring particular attention in stunting prevention (Helmyati et al., 2020). The 1000-day window is a crucial phase for child growth and development, especially in Indonesia, as it represents the period of highest vulnerability to growth disorders (Nyarko et al., 2024). Pregnant women frequently experience energy and protein deficits that may lead to chronic energy deficiency (CED) (Ilham et al., 2026). Approximately 48.9% of pregnant women suffer from anemia, while a considerable proportion also face CED. These conditions contribute to a relatively high prevalence of low birth weight (LBW) infants, estimated at around 6.2%, which is recognized as one of the main causes of stunting (Nyarko et al., 2024; Sari et al., 2024). Ruaida emphasized that maternal nutrition both before conception and during pregnancy plays an essential role in influencing the risk of stunting (Kadir et al., 2025).

Mothers with poor nutritional intake from the first trimester are at risk of delivering infants with low birth weight, which can subsequently lead to stunting in early childhood. A study conducted in Indramayu reported that birth characteristics strongly influence postnatal growth patterns. Infants who are small for gestational age already experience growth restrictions during pregnancy. Beyond maternal nutritional status, the weight and length of premature LBW infants also depend on gestational age. Such infants generally have smaller length, weight, and head circumference compared to normal standards. A cohort study in Brazil found that premature infants had a 2.35 times higher risk of stunting at 12 months and a 2.30 times higher risk at 24 months compared to full-term infants. Nevertheless, infants born with normal conditions remain at risk of stunting if their nutritional intake is inadequate (Garina et al., 2024; Anugraheni and Kartasurya, 2012; Ruaida, 2018).

The urgency of this study lies in the fact that stunting is a global problem, including in Indonesia. Undernutrition and stunting are interrelated issues that affect the quality of human resources and indirectly contribute to high maternal, infant, and child mortality rates, as well as low life expectancy. Poor maternal nutritional status during pregnancy hinders fetal growth and development, potentially leading to stunting and wasting.

Research on the relationship between maternal nutritional status during pregnancy and the incidence of stunting has been widely conducted in various regions of Indonesia. However, most previous studies have predominantly focused on urban settings or areas with relatively adequate access to healthcare services, thereby not fully representing the conditions experienced by populations living in remote areas. This study offers novelty as it was conducted in Boneatiro Village, a remote area characterized by limited access to healthcare services, nutritional education, and the availability of nutritious food for pregnant women. In addition, Buton Regency, where Boneatiro Village is located, is recognized as one of the regions with the highest stunting loci in Southeast Sulawesi,

making stunting a significant public health concern that requires special attention (Kemenkes, 2024).

The selection of Boneatiro Village as the study site was based on the importance of obtaining empirical evidence regarding maternal nutritional conditions and the incidence of stunting among communities with distinct geographical and social characteristics compared to other regions. Remote areas generally face various challenges, including limited healthcare personnel, low coverage of antenatal monitoring, inadequate access to health information, and suboptimal distribution of nutritious food. These conditions may increase the risk of maternal undernutrition during pregnancy, which can adversely affect fetal growth and subsequently contribute to a higher incidence of stunting among children. Therefore, this study is expected to provide a scientific contribution to the growing body of evidence on stunting prevention during the First 1,000 Days of Life, while also serving as a foundation for the development of more targeted health intervention programs and policies for communities residing in remote areas.

METHODS

This study is an observational analytic study employing a case-control design to examine the association between maternal nutritional status during pregnancy and the incidence of stunting in children. A retrospective approach was used to identify whether maternal nutritional status is associated with childhood stunting. This design enables the exploration of factors related to stunting within the specified period.

This study was conducted in Boneatiro Village, Kapontori Subdistrict, Buton Regency, which is categorized as a disadvantaged, frontier, and outermost (3T) area in Indonesia. The research was carried out from June to August 2025. The study population consisted of 123 children under five years of age, from which a sample of 40 respondents was selected using a purposive sampling technique. The sample was divided into two groups: 20 respondents in the case group (mothers with stunted infants/children who possessed a Maternal and Child Health [MCH] book/Growth Monitoring Card [KMS]) and 20 respondents in the control group (mothers with non-stunted infants/children who possessed a Maternal and Child Health [MCH] book/Growth Monitoring Card [KMS]). The inclusion criteria were children residing in Boneatiro Village and possessing a Maternal and Child Health (MCH) book, while the exclusion criteria included children with congenital anomalies, birth defects, and/or severe chronic illnesses, as well as mothers experiencing communication difficulties, such as visual impairment.

Data were collected using structured observation sheets designed to assess maternal and child nutritional status, along with reviews of the MCH book to obtain maternal and child health histories. Researchers conducted direct observations and interviews with respondents to ensure accurate responses and confidentiality. The collected data were analyzed using descriptive statistics, bivariate analysis with the *Chi-square* test, and multivariate analysis with ordinal logistic regression to determine the relationships between the studied variables. The findings were carefully interpreted to explain the main results concerning maternal nutritional status during pregnancy and the incidence of stunting. This study received ethical clearance from the Research Ethics Committee with approval number 171/STIKES-NH/KEPK/V/2025.

RESULTS AND DISCUSSIONS

Subject characteristics

The univariate analysis was performed using descriptive statistics or frequency distributions of respondent characteristics. Maternal characteristics included age, education, occupation, parity, delivery history, health insurance, body mass index (BMI) during pregnancy, and chronic energy deficiency (CED) during pregnancy. Child characteristics included age, sex, and stunting status. These are presented in Table 1.

Tabel 1. Subject characteristics (n=40)

Characteristics	n	%
Maternal Characteristics		
Maternal Age		
Not at risk	23	57.5
At risk	17	42.5
Educational Level		
Low	20	50
High	20	50
Employment Status		
Unemployed	38	95
Employed	2	5
Parity		
Primiparous	9	22.5
Multiparous/Grand multiparous	31	77.5
History of Delivery		
Preterm	35	87.5
Term	4	10
Post-term	1	2.5
Health Insurance		
Covered	38	95
Not covered	2	5
Body Mass Index (BMI) during Pregnancy		
Underweight	7	17.5
Normal	15	37.5
Overweight	12	30
Obese	6	15
Chronic Energy Deficiency (CED) during Pregnancy	22	55
Normal	18	45
CED		
Child Characteristics		
Child Age		
≤ 1 year	8	20
1-2 years	15	37.5
> 2 years	17	42.5
Sex		
Male	20	50
Female	20	50

Characteristics	n	%
Stunting		
Severely Stunted	10	25
Stunted	13	32.5
Normal	17	42.5

Source: Primary data, 2025

Based on Table 1, the majority of mothers were in the non-risk age group (57.5%), with education levels evenly distributed between low and high (50% each). Most respondents were unemployed (95%) and had health insurance (95%). In terms of parity, the majority of mothers belonged to the multipara/grand multipara category (77.5%).

Delivery history indicated that most respondents had preterm births (87.5%). Maternal nutritional status during pregnancy, as measured by body mass index (BMI), showed that most were in the normal category (37.5%), followed by overweight (30%), underweight (17.5%), and obese (15%). Regarding chronic energy deficiency (CED) during pregnancy, more respondents were in the normal category (55%) compared to those with CED (45%).

Child characteristics demonstrated a relatively diverse age distribution, with most being older than two years (42.5%). The sex distribution was equal, with 50% male and 50% female. Nutritional status based on stunting revealed that 42.5% of children were normal, while 32.5% were stunted and 25% were severely stunted.

Relationship between nutritional status of pregnant women and the incidence of stunting

The bivariate analysis aimed to examine the association between maternal nutritional status during pregnancy, specifically BMI and CED, and the incidence of stunting using the *Chi-square* k x k test, as presented in Table 2.

Table 2. Relationship between nutritional status of pregnant women and the incidence of stunting

Variabel	Stunting						Total		*p-value*
	Severely Stunted		Stunted		Normal				
	n	%	n	%	n	%	N	%	
BMI during Pregnancy									
Underweight	4	57.1	2	28.6	1	14.3	7	100	
Normal	4	26.7	8	53.3	3	20	15	100	
Overweight	1	8.3	2	16.7	9	75	12	100	0.022*
Obesity	1	16.7	1	16.7	4	66.7	6	100	
Total	**10**	**25**	**13**	**32.5**	**17**	**42.5**	**40**	**100**	
CED during Pregnancy									
Normal	3	13.6	5	22.7	14	63.6	22	100	
CED	7	38.9	8	44.4	3	16.7	18	100	0.011*
Total	**10**	**25**	**13**	**32.5**	**17**	**42.5**	**40**	**100**	

Note: *Chi-square test, significant if the p-value < 0.05

The analysis revealed a significant association between maternal nutritional status during pregnancy and the incidence of stunting in children. Based on BMI during pregnancy, the proportion of stunted children was higher among mothers with

underweight status (57.1% severely stunted) compared to mothers with normal or obese status. Conversely, children of obese mothers were more likely to be classified as normal (66.7%). The *Chi-square* test confirmed a significant relationship between maternal BMI during pregnancy and child stunting ($p = 0.022$).

For chronic energy deficiency (CED), it was found that children of mothers with a history of CED had higher rates of stunting (38.9% severely stunted and 44.4% stunted) compared to children of mothers without CED, where the majority were in normal nutritional status (63.6%). Statistical testing indicated a significant association between maternal CED during pregnancy and child stunting ($p = 0.011$).

Overall, these findings indicate that maternal nutritional status during pregnancy, whether assessed by BMI or CED, plays an important role in determining the risk of stunting in children.

Low maternal body mass index (BMI) or chronic energy deficiency (CED) during pregnancy may lead to fetal growth restriction due to inadequate reserves of energy, protein, and micronutrients required throughout gestation. Insufficient maternal nutritional intake contributes to intrauterine growth restriction (IUGR), resulting in infants being born with low birth weight and shorter birth length. These conditions subsequently increase the risk of stunting during childhood growth, as the process of linear growth impairment has already begun during the prenatal period (Louwen et al., 2024; Satterfield et al., 2021).

Biologically, the placenta functions as the primary organ responsible for the transfer of oxygen and nutrients from the mother to the fetus. In mothers with low BMI or CED, placental development and vascularization may become suboptimal, thereby reducing the capacity for nutrient transfer, including glucose, amino acids, and fatty acids. The placental nutrient transfer theory explains that maternal nutritional status substantially influences the activity of nutrient transporters within the placenta. Reduced nutrient transfer subsequently impairs fetal tissue and bone growth, increasing the likelihood of stunting after birth (Winterhager and Gellhaus, 2017).

In addition, energy deficiency during pregnancy may disrupt the regulation of fetal growth hormones, such as insulin-like growth factor-1 (IGF-1) and insulin, both of which play essential roles in cellular proliferation and bone growth. These hormonal disturbances trigger fetal metabolic adaptations aimed at maintaining vital organ function; however, such adaptations may compromise linear growth. If these conditions persist after birth without adequate nutritional improvement, the child is at increased risk of developing chronic stunting (Dimasuay et al., 2016; Winterhager and Gellhaus, 2017).

Analysis of the effect of maternal nutritional status on occurrence of stunting

Multivariate analysis was conducted using ordinal logistic regression to examine the association between child stunting and maternal nutritional status during pregnancy, specifically BMI and CED, as presented in Table 3.

Table 3. Analysis of the effect of maternal nutritional status on occurrence of stunting

Variabel		Estimated B	Standard Error	Wald	df	p-value	95% Confidence Interval	
							Lower	Upper
Stunting	Severely stunted	-2.373	0.928	6.534	1	0.011*	-4.192	-0.553

Variabel		Estimated B	Standard Error	Wald	df	p-value	95% Confidence Interval	
							Lower	Upper
	Stunted	-.550	0.834	0.435	1	0.510	-2.184	1.084
BMI during Pregnancy	Underweight	-2.602	1.160	5.032	1	0.025*	-4.875	-0.328
	Normal	-1.613	0.981	2.703	1	0.100	-3.536	0.310
	Overweight	0.505	1.059	.228	1	0.633	-1.570	2.581
	Obesity	0	.	.	0	.	.	.
Stunting	Severely stunted	-2.187	0.568	14.823	1	<0.001*	-3.300	-1.074
	Stunted	-0.496	0.434	1.304	1	0.254	-1.347	0.355
CED during Pregnancy	CED	-1.851	0.656	7.971	1	0.005*	-3.137	-0.566
	Normal	0	.	.	0	.	.	.

Note: *Chi-square test, significant if the p-value < 0.05

The regression analysis showed that maternal nutritional status significantly influenced stunting outcomes. For the BMI variable, underweight mothers had a significantly higher risk of giving birth to stunted children compared to obese mothers (p = 0.025; 95% CI: –4.875 to –0.328). In contrast, mothers with normal BMI (p = 0.100) and overweight (p = 0.633) did not show a significant association with child stunting. These findings suggest that maternal underweight status is a key risk factor for stunting.

Similarly, CED during pregnancy was also found to have a significant effect on stunting incidence (p = 0.005; 95% CI: –3.137 to –0.566). Mothers with CED were more likely to have children classified as stunted or severely stunted compared to mothers without CED. Thus, maternal CED can be considered an important determinant of stunting.

Further analysis of child nutritional categories indicated that the strongest association was observed in the severely stunted group (p = 0.011). This highlights that maternal nutritional factors, particularly during pregnancy, contribute more substantially to severe stunting than to mild stunting.

In summary, these findings confirm that maternal nutritional status during pregnancy, as reflected by both BMI and CED, plays a crucial role in determining child nutritional outcomes. Therefore, nutritional interventions for pregnant women, particularly to prevent underweight and CED, are essential in reducing the risk of stunting, especially severe stunting, in children.

Table 4. Test of parallel lines

Model	-2 Log Likelihood	*Chi-square*	df	*p-value*
Null Hypothesis	22.198	1.827	4	0.768
General	20.371			

Note: *Chi-square test, significant if the p-value < 0.05

Table 4 tested the assumption of the ordinal regression model. This assumption states that the relationship between predictors and the ordinal dependent variable is consistent across all categories of the dependent variable. The parallel lines test yielded a significance value (p = 0.768), which is greater than 0.05, indicating that the assumption was met. This result confirms that the ordinal regression model used in this study was appropriate for the data.

Maternal nutritional status during pregnancy is a critical determinant of fetal growth and the child's eventual height. Maternal undernutrition (underweight or chronic energy deficiency/CED) contributes to impaired intrauterine growth, particularly small for gestational age (SGA) and low birth weight (LBW), which are the primary biological pathways leading to stunting in infancy and early childhood. Large-scale studies have consistently shown that infants with LBW have approximately three times the risk of stunting compared with those born with normal birth weight (Tang et al., 2022).

This study found that maternal nutritional status during pregnancy significantly influences the occurrence of stunting in children. Logistic regression analysis demonstrated that mothers with underweight status were at greater risk of delivering stunted children compared with obese mothers (p = 0.025; 95% CI: -4.875 to -0.328).

Several studies support these findings. Fitriani et al. (2020) reported that children born to mothers with inadequate nutritional intake during pregnancy were 13.222 times more likely to experience stunting compared to children born to mothers with adequate nutritional intake. Similarly, Gokhale and Rao (2021) found that all anthropometric indicators reflecting maternal undernutrition during the first trimester of pregnancy, including intrauterine growth restriction manifested by smaller head circumference, were associated with an increased risk of low birth weight (LBW) and stunting at birth, particularly among young mothers living in rural areas (Fitriani et al., 2020; Gokhale and Rao, 2021).

At the population level, maternal undernutrition makes a substantial contribution to stunting prevalence. A multi-source review across 137 countries estimated that 14.4% of stunting among children under two years originates from maternal undernutrition, highlighting the importance of maternal nutrition interventions during pregnancy. The global evidence framework (The Lancet Maternal and Child Nutrition Series) also identifies maternal undernutrition, as indicated by low BMI or small mid-upper arm circumference (MUAC), as a key risk factor for impaired growth and adverse birth outcomes in low- and middle-income countries (Fitriani et al., 2024; Utami et al., 2025; Zewude et al., 2024).

From a mechanistic perspective, deficits in energy, protein, and micronutrients (e.g., iron, folate) compromise the supply of nutrients and oxygen to the fetus, triggering fetal growth restriction, LBW, and short birth length, all of which are strong predictors of stunting in both the short and long term. Cohort evidence shows a positive linear association between birth weight and child length/height, regardless of several confounders, indicating that improving birth outcomes is a central strategy for stunting prevention. These findings align with the Developmental Origins of Health and Disease (DOHaD) framework (Mertens et al., 2023; Qoni'ah et al., 2026) and are consistent with Siswati et al. (2023), who reported that maternal undernutrition with low BMI significantly contributes to severe stunting in children (p = 0,004).

Furthermore, a study conducted by Agustina and Fathur (2022), found that chronic energy deficiency during pregnancy was strongly associated with the incidence of stunting (OR = 14.2; 95% CI: 6.0–33.2). These findings indicate that maternal undernutrition is a critical determinant of stunting. The evidence further suggests that maternal CED and nutritional deficiencies increase the likelihood of severe stunting in children, while also elevating the risk of intrauterine growth restriction (IUGR), short birth length, and early-life stunting. The Indonesian Ministry of Health emphasizes that CED in pregnancy reduces the availability of essential nutrients for the fetus, thereby constraining optimal growth (Kemenkes, 2021).

In maternal health services in Indonesia, pregnant women are considered at risk of CED if MUAC is less than 23.5 cm or pre-pregnancy/first-trimester BMI is below 18.5 kg/m². These criteria are widely used in national technical guidelines. Low MUAC, a field proxy for CED, has repeatedly been shown to predict LBW and SGA. Several studies suggest MUAC thresholds around 23–24 cm for identifying maternal risk (Cardinal et al., 2025; Yunita et al., 2023). National health reports also indicate that the proportion of pregnant women at risk of CED, based on MUAC < 23.5 cm, remains a programmatic concern (Kemenkes, 2022).

Biologically, maternal undernutrition during pregnancy can disrupt fetal growth by limiting nutrient transfer and altering hormonal regulation of organ and tissue development. These conditions often result in LBW and short birth length, both of which are strong predictors of stunting.

Overall, evidence indicates that underweight or CED during pregnancy increases the risk of stunting through the LBW/SGA pathway and restricted fetal growth. Antenatal nutrition interventions, including BMI and MUAC monitoring, nutrition counseling, balanced energy-protein and multiple micronutrient (MMN) supplementation in at-risk populations, are effective strategies to disrupt this pathway. Consequently, stunting prevention programs must prioritize maternal nutrition improvement from preconception through pregnancy, combined with social protection and strengthened antenatal care services to enhance coverage of maternal nutrition interventions in the most vulnerable populations (Arizmendi et al., 2025; Fitriani et al., 2024).

Recent meta-analyses confirm that LBW significantly increases the odds of stunting in early childhood, while population-based analyses also show that LBW children are more vulnerable to stunting than those with normal birth weight. Thus, the pathway CED → LBW/SGA → stunting represents a consistent causal chain across diverse settings (Abbas et al., 2021; Putri et al., 2021; Vats et al., 2024).

Because CED is a modifiable risk factor, antenatal care approaches that emphasize early detection (BMI, MUAC), nutrition counseling, and targeted interventions are essential. The World Health Organization (WHO) recommends balanced energy-protein supplementation for pregnant women in undernourished populations to improve fetal growth and reduce the risk of LBW, SGA, and stillbirth. Nutrition education on increasing energy and protein intake is also advised. Recent evidence confirms the effectiveness of these interventions, and in many contexts, MMN supplementation during pregnancy has been shown to reduce LBW and SGA risks compared with iron–folic acid supplementation alone (Hunter et al., 2023; WHO, 2017). UNICEF programmatic guidelines also reinforce these recommendations and include them as part of integrated antenatal care package (Dalmiya et al., 2022).

Taken together, this study strengthens the evidence that maternal nutrition interventions are central to stunting prevention. Programs should prioritize routine monitoring of maternal nutritional status using BMI and MUAC, provision of supplementary food for pregnant women at risk of CED, and consistent delivery of nutrition education. These measures are essential to reducing stunting prevalence in Indonesia.

The findings also support the national target of reducing stunting prevalence to 14% by 2024. The evidence that maternal underweight and CED significantly influence stunting highlights the importance of interventions during the first 1000 days of life. Improving maternal nutrition from preconception through pregnancy is aligned with the National Movement to Accelerate Nutrition Improvement and with the specific stunting prevention strategies promoted by the Indonesian Ministry of Health.

CONCLUSIONS

This study demonstrates that maternal nutritional status during pregnancy, particularly underweight conditions and chronic energy deficiency (CED), significantly influences the occurrence of stunting in children. Mothers with inadequate nutritional status are more likely to give birth to children experiencing stunting, especially severe stunting. The findings of this study are expected to serve as a basis for strengthening nutrition education programs, supplementary feeding interventions, and systematic monitoring of maternal nutritional status within healthcare facilities. Consistent implementation at the individual, family, and community levels is expected to support the achievement of the national stunting reduction target and promote the development of a healthier and more productive generation in Indonesia. Health workers are encouraged to play a more active role in providing nutrition education for pregnant women, conducting routine nutritional screening, and delivering nutritional interventions such as balanced energy-protein and micronutrient supplementation, particularly for pregnant women at risk of chronic energy deficiency. In addition, local governments and primary healthcare centers are expected to strengthen early detection and nutritional intervention programs through routine monitoring of maternal BMI and MUAC, optimization of antenatal care services, and provision of supplementary nutritious foods, especially in remote areas with limited access to healthcare services. These interventions are expected to reduce the risk of low birth weight and contribute to stunting prevention during the first 1,000 days of life.

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CONFLICT OF INTEREST

The author(s) declare that they have no conflict of interest.

REFERENCES

Abbas, F., Kumar, R., Mahmood, T., Somrongthong, R., 2021. Impact of Children Born with Low Birth Weight on Stunting and Wasting in Sindh Province of Pakistan: A Propensity Score Matching Approach. Scientific Reports 11(1), 1–10. https://doi.org/10.1038/s41598-021-98924-7

Agustina, W., Fathur, F., 2022. Ibu Hamil KEK, Berat Bayi Lahir Rendah dan Tidak ASI Eksklusif sebagai Faktor Risiko Terjadinya Stunting. Jurnal Kesehatan Tambusai 3(1), 263–270. https://doi.org/10.31004/JKT.V3I1.4015

Anugraheni, H.A., Kartasurya, M., 2012. Faktor Risiko Kejadian Stunting pada Anak Usia 12-36 Bulan di Kecamatan Pati, Kabupaten Pati. Journal of Nutrition College 1(1), 30–37. https://doi.org/10.14710/jnc.v1i1.725

Arizmendi, L.F., Domingo, C.T., Rengifo, E.W., 2025. Anemia, Weight, and Height Among Children Under Five in Peru from 2007 to 2022: A Panel Data Analysis. Studies in Health Sciences 6(2), E15548. Https://Doi.Org/10.54022/Shsv6n2-005

Cardinal, A.M., Torres-Ticzon, V.M.F., Alesna-Llanto, M.E., 2025. Maternal Mid-Upper Arm Circumference As A Predictor of Low Birth Weight Outcome Among

Newborn Deliveries of Adolescents in A Tertiary Level Hospital. Acta Medica Philippina 59(2), 62-71. Https://Doi.Org/10.47895/AMP.VI0.9109

Dalmiya, N., Kupka, R., Tyler, V., Aguayo, V., Arts, M., Blankenship, J., Fox, E., Degefie Hailegebriel, T., Jha, S., Kavle, J., Mclean, E., Murira, Z., Nanema, S., Ntambi, J., Olson, R., Rudert, C., Sandalinas, F., Singh, S., Torlesse, H., Zvandaziva, C., 2022. Unicef Programming Guidance: Maternal Nutrition, Prevention of Malnutrition in Women Before and During Pregnancy and While Breastfeeding. United Nations Children's Fund. https://www.unicef.org/media/114561/file/Maternal

Dimasuay, K.G., Boeuf, P., Powell, T.L., Jansson, T., 2016. Placental Responses to Changes in The Maternal Environment Determine Fetal Growth. Frontiers in Physiology 7(12), 1-12. https://pubmed.ncbi.nlm.nih.gov/26858656/

Diniaty, I.Y., Kadir, A., 2022. Gerakan Pencegahan Stunting melalui Pemberdayaan Masyarakat dalam Mendukung Program 1000 HPK. Abdimas Polsaka 1(1), 35–38.

Fitriani, F., Yarmaliza, Y., Farisni, T.N., 2024. Analyzing The Level of Knowledge, Food Consumption Diversity, and Nutritional Intake on Chronic Energy Deficiency Among Pregnant Women in Stunting Prevention. European Journal of Medical and Health Sciences 6(2), 62–66. Https://Doi.Org/10.24018/EJMED.2024.6.2.1939

Fitriani, H., Setya, A., Nurdiana, P., 2020. Risk Factors of Maternal Nutrition Status During Pregnancy to Stunting in Toddlers Aged 12-59 Months. Jurnal Keperawatan Padjadjaran 8(2), 174–182. https://doi.org/10.24198/jkp.v8i2.1305

Garina, L.A., Dewi, M.K., Trusda, S.A.D., Purbaningsih, W., Muflihah, H., Tursina, A., Respati, T., Rahimah, S.B., 2024. Maternal, Child, and Household Risk Factors for Children with Stunting. The Open Public Health Journal 17(1), 1-11. Https://Doi.Org/10.2174/0118749445321448240823112908

Gokhale, D., Rao, S., 2021. Compromised Maternal Nutritional Status in Early Pregnancy and Its Relation to The Birth Size in Young Rural Indian Mothers. BMC Nutrition 7(73), 1-8. https://doi.org/10.1186/S40795-021-00478-4

Helmyati, S., Atmaka, D.R., Wisnusanti, S.U., Wigati, M., 2020. Stunting: Permasalahan dan Tantangannya. Gadjah Mada University Press, Yogyakarta.

Hunter, P.J., Muthiani, Y., Gilmore, P.K., Koivu, A.M., P€, P., Bastola, K., Vimpeli, R., Luoma, J., Ashorn, U., 2023. Sponsored Supplement Publication A Modular Systematic Review of Antenatal Interventions to Address Undernutrition During Pregnancy in The Prevention of Low Birth Weight. The American Journal of Clinical Nutrition 117, S134–S147. Https://Doi.Org/10.1016/J.Ajcnut.2023.01.024

Ilham, N.A., Artha, S.A., Fattah, A.M., Agusliani, A., 2026. The Relationship Between Nutritional Behavior and Dietary Patterns and The Incidence of Chronic Energy Deficiency in Pregnant Women in The Work Area of Sendana II Health Center in 2025. International Journal of Health Science 6(1), 24–34. https://journalshub.org/index.php/ijhs/article/view/6301

Kadir, A., Marbun, U., Rosidi, I., Dahniar, Arini, A., Firna, F., Wahid, W.O.P.A., Amin, H., Hasriati, W.O., Irnawati, I., 2025. Indonesia Waspada Stunting. Lakeisha Penerbit, Klaten.

[Kemenkes] Kementerian Kesehatan., 2021. Buku Saku Pemantauan Status Gizi dan Intervensi Gizi pada Ibu Hamil. Kementerian Kesehatan RI, Jakarta.

[Kemenkes] Kementerian Kesehatan., 2022. Buku Saku Hasil Survey Status Gizi Indonesia (SSGI) 2022. Kementerian Kesehatan RI, Jakarta.

[Kemenkes] Kementerian Kesehatan., 2024. Profil Kesehatan Indonesia 2023. Kementerian Kesehatan RI, Jakarta.

Louwen, F., Kreis, N.N., Ritter, A., Yuan, J., 2024. Maternal Obesity and Placental Function: Impaired Maternal–Fetal Axis. Archives of Gynecology and Obstetrics 309(6), 2279–2288. https://doi.org/10.1007/s00404-024-07462-w

Mertens, A., Benjamin-Chung, J., Colford, J.M., Coyle, J., Van Der Laan, M.J., Hubbard, A.E., Rosete, S., Malenica, I., Hejazi, N., Sofrygin, O., Cai, W., Li, H., Nguyen, A., Pokpongkiat, N.N., Djajadi, S., Seth, A., Jung, E., Chung, E.O., Jilek, W., Yori, P.P., 2023. Causes and Consequences of Child Growth Faltering in Low-Resource Settings. Nature 621(7979), 568–576. Https://Doi.Org/10.1038/S41586-023-06501-X

Nyarko, M.J., Ten Ham-Baloyi, W., Van Rooyen, D., 2024. Qualitative Exploration of Health Professionals' Perceptions of Addressing Malnutrition Within The First 1,000 Days. Journal of Nutrition Education and Behavior 56(7), 442–451. Https://Doi.Org/10.1016/J.JNEB.2024.03.010

Perumal, N., Bassani, D.G., Roth, D.E., 2023. Stunting: Prevalence and Prevention. Encyclopedia of Human Nutrition 230–240. Https://Doi.Org/10.1016/B978-0-12-821848-8.00016-0

Putri, T.A., Salsabilla, D.A., Saputra, R.K., 2021. The Effect of Low Birth Weight on Stunting in Children Under Five: A Meta Analysis. Journal of Maternal and Child Health 6(4), 496-506. https://thejmch.com/index.php/thejmch/article/view/639

Qoni'ah, N.K., Setiyani, A., Saadah, N., Sulikah, S., 2026. The Effect of Chronic Energy Deficiency on The Incidence of Stunting in Children Aged 24-59 Months. International Journal of Advanced Health Science and Technology 6(1), 32–38. https://ijahst.org/index.php/ijahst/article/view/495

Ruaida, N., 2018. Gerakan 1000 Hari Pertama Kehidupan Mencegah Terjadinya Stunting (Gizi Pendek) di Indonesia. Global Health Science 3(2), 139–151. https://jurnal.csdforum.com/index.php/GHS/article/view/245

Sari, L.P., Irnawati, I., Marbun, U., Rosidi, I.Y.D.R., 2024. Pendampingan Ibu Hamil terhadap Kekurangan Energi Kronik (KEK). Jurnal Pengabdian Masyarakat Gunung Sari 2(2), 9-15. Https://Doi.Org/10.58294/JPMGS.V2I2.161

Satterfield, M.C., Edwards, A.K., Bazer, F.W., Dunlap, K.A., Steinhauser, C.B., Wu, G., 2021. Placental Adaptation to Maternal Malnutrition. Reproduction 162(4), R73–R83. Https://Doi.Org/10.1530/REP-21-0179

Siswati, S., Setyatama, I.P., Masturoh, M., 2023. Hubungan antara Riwayat Status Gizi Ibu Hamil dengan Kejadian Balita Stunting. Jurnal Update Keperawatan 3(1), 45–49. https://doi.org/10.31983/JUK.V3I1.10234

Tang, X., Zhao, Y., Liu, Q., Hu, D., Li, G., Sun, J., Song, G., 2022. The Effect of Risk Accumulation on Childhood Stunting: A Matched Case-Control Study in China. Frontiers in Pediatrics 10, 1-11. https://www.frontiersin.org/journals/pediatrics/articles/10.3389/fped.2022.816870/full

Utami, C.T., Azrimaidaliza, A., Purnakarya, I., Dwinatrana, K., Habibi, N.A., 2025. Comparative Impact of Maternal Anemia and Chronic Energy Deficiency on Low Birth Weight: Meta-Analysis. Amerta Nutrition 9(1SP), 431–440. Https://Doi.Org/10.20473/AMNT.V9I1SP.2025.431-440

Vats, H., Walia, G.K., Saxena, R., Sachdeva, M.P., Gupta, V., 2024. Association of Low Birth Weight with The Risk of Childhood Stunting in Low- and Middle-Income Countries: A Systematic Review and Meta-Analysis. Neonatology 121(2), 244–257. Https://Doi.Org/10.1159/000532006

Winterhager, E., Gellhaus, A., 2017. Transplacental Nutrient Transport Mechanisms of

Intrauterine Growth Restriction in Rodent Models and Humans. Frontiers in Physiology 8, 1-19. Https://Doi.Org/10.3389/FPHYS.2017.00951/FUL

[WHO] World Health Organization., 2017. Guideline: Integrated Care for Older People (ICOPE). World Health Organization, Geneva.

Yuningsih, Y., 2022. Hubungan Status Gizi dengan Stunting pada Balita. Jurnal Ilmiah Kebidanan 9(2), 102–109. Https://Doi.Org/10.35316/OKSITOSIN.V9I2.1845

Yunita, Y., Pravita, A., Natan, O., Suryani, D., 2023. Analysis of Macronutrient Intake and The Incidence of Chronic Energy Deficiency (CED) in Pregnant Women in Stunting Village, Argamakmur Sub-District, North Bengkulu Regency, Bengkulu Province. International Journal of Medical Science and Clinical Research Studies 3(10), 2489–2493. Https://Doi.Org/10.47191/IJMSCRS/V3-I10-69

Zewude, S.B., Beshah, M.H., Ahunie, M.A., Arega, D.T., Addisu, D., 2024. Undernutrition and Associated Factors Among Pregnant Women in Ethiopia. A Systematic Review and Meta-Analysis. Frontiers in Nutrition 6(11), 1-12. https://doi.org/10.3389/fnut.2024.1347851