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Prenatal And Postnatal Risk Factors Associated with Stunting in Children Aged 0-24 Months Banyumas Regency Indonesia

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Abstract

Stunting remains a serious public health challenge in Indonesia. The prevalence of stunting in Banyumas Regency reached 20.9% in 2023. Determinants of stunting are related to many factors, both prenatal and postnatal. The purpose of this study was to analyze the risk factors for stunting in children aged 0-24 months during the prenatal and postnatal periods in Banyumas Regency in 2024. This is an observational cross-sectional study that included 100 children aged 0–24 months selected through cluster random sampling. Data analysis included univariate, bivariate with chi-square, and multivariate with multiple logistic regression. The results showed that prenatal factors associated with stunting were maternal MUAC (p=0.029), gestational weight gain (p=0.031), and postnatal factors were maternal nutritional knowledge (p=0.03), parental diet (p=0.042), and child factors were gender (p=0.034), birth weight (p=0.001), and protein adequacy (p=0.04). Multivariate analysis revealed that factors influencing stunting included maternal MUAC, gestational weight gain, parental diet, and birth weight. The most influential factor was birth weight (p=0.00; OR=12.5, meaning that babies with low birth weight are 12.5 times more likely to be stunted. The results of this study emphasize and then develop appropriate interventions during the prenatal and postnatal periods to reduce stunting.

Introduction

The In Indonesia, like in many other low- and middle-income nations, stunting, the retardation of physical and mental development due to prolonged lack of food, is a major public health concern (UNICEF, 2013). Pregnant women and children younger than five continue to face significant challenges when it comes to nutrition. Stunting affected 21.5% of Indonesian children, wasting 7.7%, being underweight 15.9%, having maternal chronic energy deficit (CED) 16.9%, and being anemic 27.7%, according to the 2023 Indonesian Health Survey. The following conditions were observed in Banyumas Regency: stunting (20.9%), wasting (4.1%), underweight (12.3%), overweight (2.9%), maternal CED (12.73%), and anemia (21.0%) (Kementerian Kesehatan RI, 2024).

Significant long-term effects, such as increased risks of mortality and morbidity, impaired cognitive development, decreased future productivity, and an increased likelihood of chronic disease onset in adulthood, are signaled by stunting, which is reflected in an inadequate Height-for-Age Z-score (Amadu *et al*., 2021; Black *et al*., 2013; Katoch, 2022). From the time of conception until the child reaches the age of two, there is a window of opportunity for nutritional and developmental interventions known as the First Thousand Days of Life (1000 HPK). This window sets the stage for the child's future physical and cognitive development (Black *et al*., 2008; Victora *et al*., 2010).

There is no one factor that produces stunting; rather, there are a number of

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interconnected and mutually reinforcing determinants of stunting in children less than two years old. There are many variables that influence both the prenatal and postnatal phases of life, and they all contribute to stunting (Alam *et al*., 2020; Sutrisna *et al*., 2025). Prenatal factors that contribute to stunting include the mother's nutritional status, her age, her height, the distance between her babies, and the fact that she is pregnant at a young age. These factors, along with the mother's education, income, socioeconomic status, physical and mental health, and access to prenatal care (ANC), all play a role in determining whether the fetus gets enough nutrients during pregnancy. There is strong evidence that stunting, also known as chronic childhood undernutrition, starts with insufficient nutrition during pregnancy and continues throughout childhood, with mainly permanent effects. (Karlsson *et al*., 2022; Paciorek *et al*., 2013; Ramos *et al*., 2015; Soliman *et al*., 2021; Svefors *et al*., 2019; World Health Organization, 2014)

According to postnatal variables are the product of a web of interrelated direct and indirect factors (Karlsson *et al*., 2022). Infections and food consumption, particularly breast milk and supplemental meals, are the main culprits behind stunting in children. Health care accessibility, parenting styles, food availability, environmental cleanliness, clean water, family traits, and socioeconomic position are all examples of indirect factors (Aguayo *et al*., 2016; Svefors *et al*., 2019). A significant public health concern, stunting is rampant in Indonesia; thus, effective prevention interventions, particularly early intervention to address risk factors, are urgently needed (Wicaksono *et al*., 2021).

To solve the stunting issue, we need a thorough knowledge of all the elements that might cause it. Including, but not limited to, maternal and infant characteristics, as well as larger familial and environmental influences. In an attempt to better nourish infants and toddlers in the first thousand days of life in Banyumas Regency, Central Java, this research aims to examine the prenatal and postnatal risk factors for stunting in children 0-24 months old. Unlike many other studies, this one included both prenatal and postnatal factors, and it ranked the importance of each prospective predictor and its relative contribution from a public health standpoint.

Methods

This study aimed to determine the causes of stunting in children 0-24 months in Banyumas Regency in 2024 using a cross-sectional observational design. The population comprised children attending integrated health posts (Posyandu) in Banyumas Regency. Cluster random sampling was applied. Initially, two community health centers (Puskesmas) with high stunting prevalence were randomly selected based on the Banyumas Regency Health Office. Subsequently, five Posyandu from each selected Puskesmas were randomly chosen as study sites. At each Posyandu, ten eligible children aged 0–24 months were randomly recruited, yielding a total sample of 100 participants. The inclusion criteria were age 0–24 months, complete maternal and child health records, and written approval to participate. Data collection was conducted from July to September 2024 using successive sampling.

Prenatal variables extracted from MCH records comprised maternal age, height, CED, pre-pregnancy BMI, antenatal care (ANC) visits, pregnancy interval, and parity. Gestational weight gain was classified according to IOM recommendations based on BMI category (Committee on Obstetric Practice, 2013). Postnatal factors included maternal education, employment, and nutritional knowledge (median score <11), as well as nutrition information exposure (median <3). Feeding practices were assessed using a median cutoff (≤10). Additional variables were Posyandu utilization, family size, and household income below the Banyumas minimum wage (Rp 2,195,690). Child variables included age, sex, gestational age, birth weight and length, immunization status, and history of infection, obtained from Maternal and Child Health (MCH) records. Low birth weight was defined as <2,500 g, and short birth length as <48 cm. Feeding variables collected during the study included breastfeeding, timely complementary feeding, and energy and protein adequacy, which were categorized as inadequate if

<100% of the Recommended Intake (RDA) (Kementerian Kesehatan RI, 2014). The dependent variable was stunting, defined as a Height-for-Age Z-score (HAZ) below –2 standard deviations (Kementerian Kesehatan RI, 2020; World Health Organization, 2006).

Data were analyzed using SPSS version 25. Univariate analysis described variable distributions, and normality was tested with the Kolmogorov–Smirnov test. Associations were examined using chi-square tests (95% CI; α=0.05). Variables with p<0.25 in bivariate analysis were included in multivariate analysis. Multiple logistic regression (enter method) was performed, sequentially removing variables with p>0.05 to obtain the final model and identify the main determinants of stunting in children aged 0–24 months. Ethical approval for this study was granted by the Health Research Ethics Committee of the Faculty of Health Sciences, Jenderal Soedirman University, Purwokerto (Certificate No. 1484/EC/KEPK/VI/2024). Written informed consent was obtained after explaining study procedures, voluntary participation, and data confidentiality.

Results and Discussion

Table 1 shows that whereas 63% of children between the ages of 0 and 24 months showed normal development, 37% were found to be stunted. According to the descriptive data, most of the moms (71.0%) were between the ages of 20 and 35, which is considered the reproductive age bracket. The majority of the women (78.0%) were taller than 145 cm, and a whopping 83% had a healthy diet during pregnancy (non-CED). Mothers who reported a normal BMI before pregnancy accounted for 78% of the total. But 62% failed to acquire the minimum amount of weight that the IOM recommends throughout pregnancy. Not only that, 95% of pregnancies occurred more than 2 years apart, 77% of moms had a parity of 1-2 children, and 77% of the mothers received ANC while they were pregnant.

In terms of postnatal maternal factors, 53% of mothers had a high school diploma or higher, 85% were unemployed, 61% had good knowledge, 51% were exposed to nutritional information, 53% had inadequate parenting patterns, 94% actively took their children to the integrated health post (posyandu), 51% had a small family size, and 55% had poor family income. In terms of postnatal factors, there are 53% of children aged 0-12 months, 54% of them are male, 78% have a history of a normal birth (term), 83% have a normal birth weight, 60% have Low Birth Length (LBW), 66% have had an infectious disease in the last month, 95.7% have received all of their recommended immunizations for their age, 60% are still breastfeeding, 65% receive their complementary foods on time, 53% have enough energy, and 84% have enough protein.

Table 1. Characteristics of Maternal and Child in Banyumas Regency

Variables	n	%
Prenatal Factors		
Maternal age during pregnancy		
< 20 or > 35 years	29	29.0
20 - 35 years	71	71.0
Maternal Short stature		
Less (< 145 cm)	22	22.0
More ((≥ 145 cm)	78	78.0
Maternal CED		
CED (MUAC < 23 cm)	22	22.0
Normal (MUAC ≥ 23 cm)	78	78.0
BMI Before Pregnancy		
Less (< 18.5 cm)	17	17.0
Normal (≥ 18.5 cm)	83	83.0

Variables	n	%
Gestational Weight Gain		
Not according to IOM	62	62.0
According to IOM	38	38.0
Pregnancy Interval		
Less (< 2 years)	5	5.0
More (≥ 2 years)	95	95.0
Parity		
More (> 2 children)	23	23.0
Less (≤ 2 children)	77	77.0
Antenatal Care		
No (< 6 ANC)	8	8.0
Yes (≥ 6 ANC)	92	92.0
Postnatal Factors		
Mother's Education		
Low (≤ Junior High School)	47	47.0
High (>Junior High School)	53	53.0
Mother's Employment Status		
Not Working	85	85
Working	15	15
Maternal nutritional knowledge		
Less (< 11 score)	39	39.0
Good (≥ 11 score)	61	61.0
Nutrition information exposure		
Less (< 3 score)	43	43.0
Good (≥ 3 score)	57	57.0
Parenting Eating Patterns		
Less (< 10 score)	53	53.0
Good (≥ 10 score)	47	47.0
Posyandu utilization		
No (< 6 times)	6	6.0
Yes (≥ 6 times)	94	94.0
Family Size		
> 4 individuals	51	51.0
≤ 4 individuals	49	49.0
Family Income		
Low (< Rp. 2,195,690)	55	55.0
High (≥ Rp. 2,195,690)	45	45.0
Child Factors		
Age		
0 – 12 months	53	53.0
13 - 24 months	47	47.0
Sex		
Male	47	47.0
Female	53	53.0

Variables	n	%
Gestational age		
Preterm	22	22.0
Aterm	78	78.0
Birth Weight		
LBW (< 2500 gram)	17	17.0
Normal (≥ 2500 gram)	83	83.0
Birth Length		
SBL (<48 cm)	60	60.0
Normal (≥ 48cm)	40	40.0
History of Infectious Diseases		
Yes	66	66.0
No	34	34.0
Basic Immunization Status		
Incomplete	3	3.0
Complete	97	97.0
Breastfeeding		
No	40	40.0
Yes	60	60.0
Timeliness of complementary foods		
Early (< 6 months	35	35.0
Appropriate (> 6 months)	65	65.0
Energy adequate level		
Low (< 100 % RDA)	47	47.0
Good (≥ 100 % RDA)	53	53.0
Protein adequacy Level		
Low (< 100 % RDA)	16	16.0
Good (≥ 100 % RDA)	84	84.0
Stunting		
Stunted	37	37.0
Normal	63	63.0

(Primary data, 2024)

Table 2 below shows that prenatal variables, especially maternal CED (p = 0.029), were associated with poor gestational weight increase (p = 0.031). In line with research in Gorontalo, shorter maternal height and high-risk pregnancy ages are associated with higher risks (Helmizar *et al*., 2024; Nurlaily Z *et al*., 2025). Maternal nutritional awareness is associated with postnatal factors and parental eating practices (0.042), with a beta coefficient of 0.031. Protein adequacy level (0.043), birth weight (0.001), length (0.025), and sex (0.034) are factors that are associated with children. There is a correlation between stunting and maternal nutritional knowledge (0.031), according to the research. In Indonesia, children under the age of two who suffer from stunting are more likely to have mothers with lower levels of education, according to previous studies. There is an elevated risk of stunting in this age group in children whose mothers have lower levels of education (Laksono *et al*., 2022; Rina & Meliati, 2020). The majority of moms showed a high degree of expertise, according to the report. To ensure that children's nutritional requirements are fulfilled and their development may continue effectively, good nutritional understanding is essential. Stunting prevention

activities, such as increasing awareness for early identification of the potential for stunting, rely on mothers with this level of knowledge, which in turn influences their behavior in order to preserve their children's health. In children 0-24 months old, there is a link between stunting and the child's sex (0.034). Stunting was more common in females (62.2%) than in boys (60.2%) in this research. Because they have bigger frames and greater energy needs, boys are more likely to suffer from stunting than girls. Their risk of stunted development is elevated, along with their higher nutritional needs, resulting from their larger bodies, which aren't always satisfied. The prevalence of stunting is greater in males and children living in rural regions compared to girls, according to studies conducted in many low- and middle-income nations (Dassie & Fantaye, 2024). Stunting and wasting are more common in males compared to girls (Khura *et al*., 2023).

Table 2. Relationship Between Prenatal, Postnatal and Stunting children aged 0-24 months in Banyumas Regency

Variables	Stunting Status				p-value
	Stunting		Non Stunting		
Prenatal Factors					
Maternal age during pregnancy					
< 20 or > 35 years	12	41.4	17	58,6	0,725
20 - 35 years	25	35.2	46	64.8	
Maternal Short Stature					
Less (< 145 cm)	10	45.5	12	54,5	0,497
More ((≥ 145 cm)	27	34.6	51	65.4	
Maternal CED					
CED (MUAC < 23 cm)	13	59.1	9	40.9	0.029*
Normal (MUAC ≥ 23 cm)	24	30.8	54	69.2	
BMI before Pregnancy					
Less (< 18.5 cm)	10	58.8	7	41.2	0.077
Normal (≥ 18.5 cm)	27	32.5	56	67.5	
Gestational Weight Gain					
Not according to IOM	28	45.2	34	54.8	0.031*
According to IOM	9	23.7	29	76.3	
Pregnancy Interval					
Less (< 2 years)	2	40.0	3	60.0	1.000
More (≥ 2 years)	35	36.8	60	63.2	
Parity					
More (> 2 children)	7	30.4	16	68.6	0.619
Less (≤ 2 children)	30	39.0	47	61.0	
Antenatal Care					
No (< 6 ANC)	3	37.5	5	62.5	1.000
Yes (≥ 6 ANC)	34	37.0	58	63.0	
Postnatal Factors					
Mother's education					
Low (≤ Junior High School)	21	44.7	26	55.3	0.197
High (≥Junior High School)	16	30.2	37	69.8	
Mother's Employment Status					
Not Working	32	37.6	53	62.4	0.977
Working	5	33.3	10	66.7	

Variables	Stunting Status				p-value
	Stunting		Non Stunting		
Maternal Nutritional Knowledge					
Less (< 11 score)	20	54.1	19	30,2	0.031*
Good (≥ 11 score)	17	45.9	44	69.8	
Nutrition Information Exposure					
Less (< 3 score)	21	56.8	22	34.9	0.055
Good (≥ 3 score)	16	43.2	41	65.1	
Parenting Eating Patterns					
Less (< 10 score)	25	67.6	28	44.4	0.042*
Good (≥10 score)	12	32.4	35	55.6	
Posyandu Utilization					
No (< 6 times)	8	21.6	8	12.7	0.372
Yes (≥ 6 times)	29	78.4	55	87.3	
Family Size					
> 4 individuals	19	51.4	32	50.8	1.000
≤ 4 individuals	18	48.6	31	49.2	
Family Income					
Low (< Rp. 2,195,690)	23	62.2	32	50.8	0.371
High (≥ Rp. 2,195,690)	14	37.8	31	49.2	
Child Factors					
Age group					
0 – 12 months	18	48.6	35	55.6	0.645
13 – 24 months	19	51.4	28	44.4	
Sex					
Male	23	62.2	24	38.1	0.034*
FeMale	14	37.8	39	61.9	
Gestational Age					
Preterm	7	18.9	15	23.8	0.749
Aterm	30	81.1	48	76.2	
Birth Weight					
LBW (< 2500 gram)	13	35.1	4	6.3	0.001*
Normal (≥ 2500 gram)	24	64.9	59	93.7	
Birth Length					
SBL (<48 cm)	28	75.7	32	50.8	0.025*
Normal (≥ 48cm)	9	24.3	31	49.2	
History of Infectious Diseases					
Yes	29	78.4	37	58.7	0,074
No	8	21.6	26	41.3	
Basic Imunization Status					
Incomplete	6	16.2	8	12.7	0.849
Complete	31	83.8	55	87.3	
Breastfeeding					
No	13	35.1	27	42.9	0.583
Yes	24	64.9	36	57.1	

Variables	Stunting Status				p-value
	Stunting		Non Stunting		
Timeliness of Complementary Foods					
Early (< 6 months	12	32.4	23	36.5	0.845
Appropriate (> 6 months)	25	67.6	40	63.5	
Energy Adequate Level					
Low (< 100 % RDA)	17	45.9	30	47.6	1.000
Sufficient (≥ 100% RDA)	29	54.1	33	52.4	
Protein Adequacy Level					
Low (< 100 % RDA)	10	27.0	8	9.5	0.043*
Good (≥ 100 % RDA)	27	73.0	57	90.5	

(Primary data, 2024)

The researchers found a statistically significant correlation between birth length and stunting in infants ranging from 0 to 24 months (p = 0.025). Similar to what was shown in the multi-country Women First randomized study, birth length outperformed a plethora of other prenatal and postnatal variables in predicting linear growth and stunting in the first two years of life. A greater risk of stunting in the first year is linked to a lower birth length (<48 cm) as stated in their study on the early route to stunting (Mwangome *et al*., 2024).

Stunting is linked to low protein adequacy levels in infants and toddlers (0-24 months) (0.043). This agrees with previous studies that found a correlation between stunting and children whose protein intake is lower than the recommended amount. Children whose protein intake is insufficient from animals are twice as likely to be stunted as those whose protein intake is enough (Haryani *et al*., 2023). A crucial dietary component in a child's linear development, particularly within the 0 to 24-month time frame, is protein consumption. Protein deficiencies, if left untreated, may prevent cells from dividing, slowing down linear development, and raise the likelihood of stunting. The need for treatments that promote protein-rich, diversified supplemental meals to support normal development is highlighted when comparing stunted children to their non-stunted classmates, who tend to have more varied diets, consume more meat, and less total protein. In addition, stunted children had a much lower median total protein consumption than non-stunted children, even though the multivariate analysis did not find a correlation between stunting and sufficient protein intake.

The most important of the four variables that affect stunting is birth weight; the other two are mother CED and weight increase during pregnancy, and postnatal factors include parental eating practices. Having a child that is very underweight is 5.84 times more likely for mothers who suffer from chronic energy deficiency (CED) (p=0.010; OR 5,843; 95% CI= 1.539-22.185). Infants whose mothers suffer from Chronic Energy Deficiency (CED) and have an upper arm circumference less than 23 cm during pregnancy are 1.6% more likely to be born with a short stature (stunted) compared to babies whose mothers do not have CED, and measures to prevent this condition should start during prenatal care (Kpewou *et al*., 2020;

Table 3. Multivariate Analysis Results

Variables	B	S.E	Sig	Exp (B)	CI 95%	
Maternal CED	1.765	0.681	0.010	5.843	1.539	22.185
Gestational Weight Gain	1.313	0.598	0.028	3.716	1.151	11.994
Parenting Eating Patterns	1.240	0.546	0.023	3.455	1.186	10.068
Birth Weight	2.526	0.702	0.000	12.501	3.161	49.442
Constant	-3.925	0.990	0.000	0.020		

Sutrisna *et al*., 2025; Wati *et al*., 2022).

There is a 5.843-fold increased probability of having a child born with stunting if the mother has gestational weight gain (p = 0.028; OR 3.716; 95% CI = 1.151-11.994). According to research conducted, the risk of stunting is largely determined by prenatal variables that impact birth length, such as the mother's nutritional health during pregnancy and gestational weight gain (GWG). This risk persists up to 24 months after delivery (Krebs *et al*., 2022). Children aged 6-23 months were shown to be at risk of stunting if their mothers gained weight during pregnancy that did not correspond to their pre-pregnancy body mass index (BMI) or if their mothers gained weight by less than 10 or more than 12.5 kilograms (Noviyanti *et al*., 2019). The growth and development of the fetus depend on the expectant mother getting sufficient energy and nutrients during pregnancy. Expectant women may tell whether they are getting enough nourishment to fulfill their nutritional demands by seeing typical gestational weight growth.

Parents whose eating habits are less structured are 3.455 times more likely to raise their children's risk of stunting compared to parents whose eating habits are more structured (p-value = 0.023; OR 3.455; 95% CI = 1.186-10.068). Linear growth trajectories and stunting at 2 years of age are tightly connected to postnatal circumstances and feeding habits (Svefors *et al*., 2019). Previous research has shown that stunting rates were 53% and 12.3%, respectively, due to poor parenting practices, which is 8.07 times larger than excellent parenting (Tobing *et al*., 2019). Stunting is most common between the ages of 6 and 24 months, when a child's development is most susceptible to the negative effects of inadequate feeding habits, such as delayed breastfeeding initiation, not nursing at all, incorrect supplemental feeding, and an inadequate variety of nutrients. There is a 12.501-fold increased risk of stunting in infants born with a low birth weight (OR 12.501; 95% CI = 3.161-49.442), which is statistically significant (p-value = 0.000). Children who weigh less than 2,500 g at birth are more likely to have stunting, and low birth weight is a predictor of stunting in general (Aini & Kurniawan, 2023; Sartika *et al*., 2021). According to studies conducted in Malaysia, the risk of stunting increases by around 26.47 times in the first month and 6.62 times in the sixth month when the birth weight is low (Ahmad *et al*., 2021).

Intrauterine growth retardation is a common occurrence in children who are born with a low birth weight (LBW), leading to inadequate energy and protein reserves as well as less-than-ideal organ maturation. Because of these underlying biological factors, children are at a higher risk of developing recurrent infections, low-grade chronic inflammation, and inefficient nutrition utilisation, and they are also less able to make up on their development after birth. Because of these variables, children who have a history of low birth weight are more likely to have stunting throughout the critical 0 – 24 months period, when their nutritional demands and organ development progress at a fast pace.

Conslusion

This study confirms that stunting in children under two years of age is the accumulation of continuous risks from the prenatal to postnatal periods. Prenatal factors such as maternal chronic energy deficiency (CED) and inadequate weight gain significantly increase children's vulnerability to growth disorders. This risk is exacerbated postnatally by poor parenting practices and protein intake deficits. Low birth weight (LBW) has been shown to be the strongest predictor of stunting in children. Therefore, stunting prevention requires a holistic and sustainable approach that integrates upstream interventions (improving pre-pregnancy and antenatal nutrition) and downstream interventions (providing animal protein-rich foods). Prioritising nutrition capacity building in the first 1000 days of life is key to breaking the intergenerational chain of stunting. This work would not have been possible without the BLU financing assistance provided by the Institute for Research and Community Service of Jenderal Soedirman University, Purwokerto, for which the author would like to acknowledge. Those responsible for authorizing and facilitating the research inside the Banyumas Regency, as well as any and all relevant institutions that helped keep

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