
RELATIONSHIP BETWEEN A HISTORY OF CHRONIC ENERGY DEFICIENCY DURING PREGNANCY AND THE OCCURRENCE OF STUNTING IN INFANTS AGED 6-24 MONTHS IN ACEH BESAR DISTRICT

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ABSTRACT

The first two years of life are a critical period characterized by rapid growth and development. One of the consequences of malnutrition during this period is stunting. There are several factors suspected to contribute to stunting in infants, and one of them is Chronic Energy Deficiency (CED), where pregnant women with CED lack adequate nutrient reserves for their fetus, leading to impaired growth and development and ultimately resulting in stunting. This study aims to determine the association between a history of CED during pregnancy and the occurrence of stunting in infants aged 6-24 months in Aceh Besar District. This study employed an observational research design with a case-control approach. The population consisted of mothers with infants aged 6-24 months. The sample size comprised 302 individuals (151 cases and 151 controls), and logistic regression analysis was performed to analyze the data. The results of the bivariate analysis showed a significant association between CED ($p=0.0001$), Maternal Body Mass Index (BMI) ($p=0.0001$), premature birth ($p=0.001$), Low Birth Weight (LBW) ($p=0.0001$), and birth length ($p=0.0001$) with the occurrence of stunting. However, there was no association between maternal age, maternal education, maternal occupation, family income, and the occurrence of stunting. The multivariate analysis revealed that CED was the most dominant predictor of stunting (OR=18.31; 95% CI: 9.73-34.45) with a p-value of 0.0001. In conclusion, there is a significant association between CED and the occurrence of stunting, and CED during pregnancy is the most influential risk factor. Therefore, it is crucial to monitor and implement preventive and management programs for stunting in Aceh Besar District.

Keywords: Chronic Energy Deficiency; infants; pregnancy; stunting

INTRODUCTION

According to the World Health Organization (WHO), stunting is a global issue that affects the growth and development

of children worldwide. Based on the latest data, approximately 149 million children under the age of five worldwide experience stunting. The global prevalence of stunting is

estimated to be around 21.9% (Black, Victora, et al., 2013; Jones et al., 2014). WHO also notes that the highest occurrence of stunting is found in the Sub-Saharan Africa region, with approximately 36% of children experiencing stunting. In South Asia, the prevalence of stunting reaches around 34.7%, while in East Asia and the Pacific, it is around 17.4% (Black, Alderman, et al., 2013). The high levels of stunting in these regions indicate serious challenges in achieving optimal growth and development for children. (Menon et al., 2015; Suchdev et al., 2015).

The latest data on the prevalence of stunting in Indonesia is obtained from the Riskesdas (Basic Health Research) survey conducted in 2018. According to that data, the prevalence of stunting in Indonesia reached 30.8%. (Survei Status Gizi Indonesia, 2022). That's correct. Approximately 8 million children in Indonesia experience stunting, which means that about one in three children in Indonesia face suboptimal growth. Furthermore, the data indicates that stunting in Indonesia is not evenly distributed across the country. Some regions in Indonesia have higher prevalence rates of stunting, such as East Nusa Tenggara Province with a rate of 51.9%, Papua with 48.4%, and Maluku with 44.8%.

The Riskesdas (2018) survey also shows a prevalence of stunting among infants and young children in Aceh Province at 37.9% (short stature 19% and very short stature 18.9%). According to the Profile of the Aceh Provincial Health Office (2019), the prevalence of stunting among toddlers is 36.5% (short stature 17.8% and very short stature 18.7%). The latest stunting data in Aceh Besar district obtained in 2020 until March revealed that out of the 28 health centers (Puskesmas) in the district and with a total of 20,619 toddlers, 4,979 children were affected by stunting (25.27%) (Dinkes Aceh Besar-Dinas Kesehatan.). This data reinforces

the fact that many children in Aceh Besar district face the risk of stunted growth and long-term consequences for their health and development.

The issue of stunting in Indonesia has long-lasting impacts on children's quality of life. Children who experience stunting are at a higher risk of health problems, physical and cognitive developmental disorders, and difficulties in reaching their optimal genetic potential. The government has taken steps to address the issue of stunting through child nutrition and health programs. These programs aim to improve access to good nutrition, enhance sanitation and hygiene, and increase public awareness of the importance of healthy caregiving and adequate nutrition for children.

One of the contributing factors to the high prevalence of stunting in toddlers is chronic energy deficiency (CED) in pregnant women, which is associated with stunting in children. Several recent studies have shown a link between chronic energy deficiency (CED) in pregnant women and the occurrence of stunting in children (Talarima et al., 2023). Research conducted by Adair et al., (2013) in Bangladesh found that pregnant women experiencing chronic energy deficiency have a higher risk of giving birth to children with stunting, emphasizing the importance of improving nutritional intake during pregnancy to prevent stunting. Similar studies have been conducted by Lowe et al., (2021) in Indonesia, De-Regil et al., (2013) in India, Lipoeto et al., (2020) in Nepal, and Akbarini et al., (2022) involving multiple countries including Indonesia, all of which found a relationship between chronic energy deficiency in pregnant women and an increased risk of stunting in children. These studies highlight the importance of special attention to maternal nutrition and comprehensive nutritional interventions

during pregnancy as a strategy to reduce the occurrence of stunting in children.

The high prevalence of chronic energy deficiency (CED) in Indonesia is a serious concern, particularly due to its significant impact on the nutrition of pregnant women and the growth of the fetus they carry. CED in pregnant women results in a lack of adequate nutrient reserves for fetal growth, leading to a decreased supply of essential nutrients to the fetus and ultimately contributing to the occurrence of stunting. For instance, in Aceh Besar district, the stunting rate is 25.27%, which is still above the maximum stunting threshold set by the WHO. Therefore, the issue addressed in this research is to explore the relationship between a history of CED during pregnancy and the occurrence of stunting in infants aged 6-24 months in Aceh Besar district. The objective of this study is to gain a better understanding of the impact of CED during pregnancy on infant stunting and to promote more effective prevention efforts.

RESEARCH METHOD

This study employs an observational research design, specifically a case-control design. In an observational case-control study, the measurement of independent and dependent variables occurs at different times. The research begins by measuring the dependent variable, which is stunting in infants, while the independent variables are traced retrospectively. The research location was selected in Aceh Besar Regency due to the high prevalence of stunting, which is 25.27%, a significant figure surpassing the maximum stunting rate set by the WHO. The study was conducted in 11 primary health care (puskesmas) areas with the highest number of cases in Aceh Besar Regency, namely: Lembah Seulawah Puskesmas, Seulimum Puskesmas, Kuta Cot Glie Puskesmas, Lamteuba Puskesmas, Piyeung Puskesmas, Ie Alang Puskesmas, Krueng Baroena Jaya

Puskesmas, Pulo Aceh Puskesmas, Mesjid Raya Puskesmas, Leupung Puskesmas, and Lhoong Puskesmas.

Data collection was performed through direct interviews with respondents and the observation of available secondary data, such as data from Maternal and Child Health (KIA) records, cohorts, and Maternal and Child Health Integrated Services (PWS KIA). Univariate analysis was conducted to obtain a descriptive overview of each variable under investigation, including the frequency distribution of both dependent and independent variables. Bivariate analysis was used to examine the relationship between the independent and dependent variables, followed by statistical tests using logistic regression as an approach to create a predictive model. Multivariate analysis was conducted to determine the partial and simultaneous relationships between independent and dependent variables using logistic regression tests with a stepwise method. Data analysis was performed using STATA version 14.

The logistic regression test with the stepwise method aimed to test hypotheses with the rejection criterion for H_0 if the significance value (P-value) $< \alpha$ (0.05). The initial step in the logistic regression test with the stepwise method is the selection of research variables that are deemed suitable for inclusion in the model based on a significance value (P-value) < 0.20 .

This study has undergone an ethics review process with registration number: 2379/VI/SP/2021. This number indicates that the study has obtained approval from the ethics committee after being assessed in accordance with applicable ethical standards.

RESULTS

In the descriptive analysis, both dependent and independent variables were tested using frequency distribution statistics.



This analysis was conducted for each factor group related to stunting. Maternal factors analyzed included Chronic Energy Deficiency, Maternal Body Mass Index

(BMI), and Premature Birth. Newborn Baby factors analyzed included Gender, Low Birth Weight (LBW), and Length at Birth.

Tabel 1. Decriptive Data Analysis

Variable	Frequency		Total
	Control	Case	
Maternal Factors			
Chronic Energy Deficiency			
Normal	136 (90,07)	50 (33,22)	186 (61,59)
CED	15 (9,93)	101 (66,89)	116 (38,41)
Mother's BMI			
Normal	111 (73,51)	78 (51,66)	189 (62,58)
Overweight	25 (16,56)	9 (5,96)	34 (11,26)
Obesity	11 (7,28)	4 (2,65)	15 (4,97)
Underweight	4 (2,65)	60 (39,74)	64 (21,19)
Premature Birth			
Mature	138 (91,39)	115 (76,16)	253 (83,77)
Premature	13 (8,61)	36 (23,64)	49 (16,23)
Infant Factors			
Gender			
Female	62 (41,06)	61 (40,40)	123 (40,73)
Male	89 (58,94)	90 (59,60)	179 (59,27)
History of LBW (Low Birth Weight)			
Normal	145 (96,03)	119 (78,81)	264 (87,42)
LBW	6 (3,97)	32 (21,19)	38 (12,58)
Length at Birth			
Normal	145 (96,03)	111 (73,51)	256 (84,77)
Short	6 (3,97)	40 (26,49)	46 (15,23)
Sosio-economic Factors			
Mother's Age			
20-35	114 (75,50)	114 (75,50)	228 (75,50)
>35	31 (20,53)	29 (19,21)	60 (19,87)
<20	6 (3,97)	8 (5,30)	14 (4,64)
Mother's Education			
High	29 (19,21)	23 (15,23)	52 (17,22)
Medium	108 (71,52)	113 (74,83)	221 (73,18)
Low	14 (9,27)	15 (9,93)	29 (9,60)
Income			
High	32 (21,19)	21 (13,91)	53 (17,55)
Low	119 (78,81)	130 (86,09)	249 (82,45)
Mother's Occupation			
Yes	36 (23,84)	28 (18,54)	64 (21,19)
No	115 (76,16)	123 (81,46)	238 (78,81)



Socioeconomic factors analyzed included Maternal Age, Education, Occupation, and Family Income. The descriptive analysis results for each factor can be seen in the Table 1.

Based on Table 1, maternal factors including Chronic Energy Deficiency (CED), Maternal Body Mass Index (BMI), and Premature Birth show an interesting pattern related to the occurrence of stunting in 2-year-old children in Aceh Besar District. Mothers who experienced CED during pregnancy had a higher percentage of stunted children (66.89%) compared to mothers with normal nutritional status (9.93%). The percentage of stunted children was also higher in mothers with low BMI (39.64%) compared to mothers with normal BMI (2.65%).

Additionally, children born prematurely had a higher risk of experiencing stunting (23.64%) compared to children born at term (8.61%). Newborn factors, including Gender, Low Birth Weight (LBW), and Birth Length (BL), also influenced the occurrence of stunting in children. Male children had a similar percentage of stunting compared to female children (59.60% vs. 58.64%). Children born with LBW had a significant percentage of stunting (21.19%) compared to children with normal birth weight (3.97%). Similarly, children with short BL had a higher risk of experiencing stunting (26.49%) compared to children with normal BL (3.97%).

In addition to maternal and infant factors, socioeconomic determinants also exerted influence on the prevalence of stunting among children. An examination of socioeconomic variables revealed compelling insights. For instance, mothers aged below 20 exhibited a higher proportion of stunted children (5.30%) in contrast to those with infants of normal nutritional status (3.97%). Likewise, mothers with only basic

education displayed a greater incidence of stunting among their offspring (9.93%) compared to counterparts with lower educational attainment and children with normal nutritional status (9.27%). Families characterized by low income levels also showed a higher prevalence of stunted children (86.09%) in comparison to those with higher incomes and children of normal nutritional status (78.81%). Conversely, mothers engaged in employment demonstrated a lower incidence of stunting among their children (18.54%) relative to working mothers with children of normal nutritional status (23.84%).

Through these findings, it becomes evident that maternal, newborn, and socioeconomic factors collectively contribute to the occurrence of stunting among 2-year-old children within the Aceh Besar District.

BIVARIATE ANALYSIS

Bivariate analysis seeks to explore the associations and correlations between Maternal, Infant, and Socioeconomic Factors and the Incidence of Stunting among Infants in Aceh Besar District.

This analytical approach involves examining the interplay between various factors and stunting occurrence to understand how maternal health, infant characteristics, and socioeconomic status relate to the prevalence of stunting in the study population comprising 302 infants.

Table 2 shows that variables in the maternal factor have a significant relationship with stunting. Chronic Energy Deficiency (CED) has a strong association with stunting (P-value 0.0001, OR 18.31), indicating that children born to mothers with CED have a 18.31 times higher risk of stunting compared to children born to mothers with normal nutrition status. Maternal low Body Mass Index (BMI) is also associated with stunting (P-value 0.0001, OR

Tabel 2. The Relationship Between Maternal and the Occurrence of Stunting Among Toddlers in Aceh Besar District (n=302)

Maternal Factors	Stunting				Total		OR (95% CI)	p-value
	Control		Case		n	%		
	n	%	n	%				
Chronic Energy Deficiency								
Normal	136	90,07	50	33,11	186	61,59	18,31	0,0001
Chronic Energy Deficiency	15	9,93	101	66,89	116	38,41	(9,73-34,45)	
Mother's Body Mass Index (BMI)								
Normal	111	73,51	78	51,66	189	62,58	0,51 (0,22-1,15)	0,108
Overweight	25	16,56	9	5,96	34	11,26	0,51 (0,15-1,68)	0,274
Obesity	11	7,28	4	2,65	15	4,97		
Thin	4	2,65	60	39,74	64	21,19	(7,44-61,16)	0,0001
Premature Birth								
Mature	138	91,39	115	76,16	253	83,77	3,32	0,001
Premature	13	8,61	36	23,84	49	16,23	(1,68-6,56)	

21.34), meaning that children born to mothers with low BMI have a 21.34 times higher risk of stunting compared to children born to mothers with normal, overweight, or obese BMI. Premature birth is also associated with

stunting (P-value 0.001, OR 3.32), indicating that premature infants have a 3.32 times higher risk of stunting compared to infants born at term. Variables in the newborn

Tabel 3. The Relationship Between Infant Factors and the Occurrence of Stunting Among Toddlers in Aceh Besar District (n=302)

Infant Factors	Stunting				Total		OR (95% CI)	p-value
	Control		Case		n	%		
	n	%	n	%				
Gender								
Female	62	41,06	61	40,40	123	40,73	0,97	0,907
Male	89	58,94	90	59,60	179	59,27	(0,61-1,53)	
History Low Birth Weight								
Normal	145	96,03	119	78,81	264	87,42	6,49	0,0001
Low Birth Weight (LBW)	6	3,97	32	21,19	38	12,58	(2,62-16,06)	
Birth Length								
Normal	145	96,03	111	73,51	256	84,77	8,70	0,0001
Short	6	3,97	40	26,49	46	15,23	(3,56-21,26)	



factor that are associated with stunting are Low Birth Weight (LBW) (P-value 0.0001, OR 6.49) and Birth Length (BL) (P-value 0.0001, OR 8.70).

Children born with Low Birth Weight (LBW) in Table 3, have a 6.49 times higher risk of stunting compared to children born

with normal birth weight. Similarly, children born with short Birth Length (BL) have an 8.70 times higher risk of stunting compared to children born with normal birth length. However, the variable of gender is not associated with stunting (P-value 0.907, OR 0.97).

Tabel 4. The Relationship Between Sosio-economic Factors and the Occurrence of Stunting Among Toddlers in Aceh Besar District (n=302)

Sosio-economic Factors	Stunting				Total		OR (95% CI)	p-value
	Control		Case		n	%		
	n	%	n	%				
Mother's Age								
20-35 years old	114	75,50	114	75,50	228	75,50	0,93 0,52-1,65)	0,818
Over 35 years old	31	20,53	29	19,21	60	19,87		
Under 20 years old	6	3,97	8	5,30	14	4,64	1,33 (0,44-3,96)	0,705
Mother's Education								
High School	29	19,21	23	15,23	52	17,22	1,31 (0,71-2,42)	0,371
Middle School	108	71,52	113	74,83	221	73,18		
Elementary School	14	9,27	15	9,93	29	9,60	1,35 (0,54-3,35)	0,518
Mother's Occupation								
Yes	36	23,84	28	18,54	64	21,19	1,35 (0, 78-2,69)	0,261
No	115	76,16	123	81,46	238	78,81		
Family Income								
High	32	21,19	21	13,91	53	17,55	1,66 (0,90-3,04)	0,098
Low	118	78,81	130	86,09	249	82,45		

Variables in the socioeconomic factor (Table 4) do not have a significant association with stunting. Maternal age <20 years (P-value 0.705, OR 1.33), maternal education with a basic/low category (P-value 0.518, OR 1.35), maternal occupation (P-value 0.261, OR 1.35), and family income (P-value 0.098, OR 1.66) are not significantly associated with the occurrence of stunting.

MULTIVARIATE ANALYSIS

Multivariate analysis was conducted to determine the partial and simultaneous relationships between independent and dependent variables using logistic regression

with the stepwise method. The results of the model's feasibility test using Logistic Regression with the Stepwise Method can be seen in the following Table 5. The analysis showed that all three variables in the maternal factor, namely Chronic Energy Deficiency (KEK), Maternal Body Mass Index (IMT ibu), and Premature Birth, are suitable for inclusion in the model. The obtained P-values are 0.0001 for KEK, 0.001 for Maternal BMI, and 0.077 for Premature Birth. This means that all three variables have a significant relationship with the occurrence of stunting in children.



Tabel 5. Model Feasibility Test Results of Maternal, Infant, and Economic Factors as Predictors of Stunting Incidence in Infants in Aceh Besar District

Variable	Predictors	OR	95% CI		P-value
			Lower	Upper	
Maternal Factor Variables	Chronic Energy Deficiency (KEK)	12,54	6,51	24,15	0,0001
	Mother's BMI Underweight	1,59	1,21	2,09	0,001
	Premature Birth	2,09	0,92	4,75	0,077
Infant Factor Variables	History of Low Birth Weight (BBLR)	2,98	1,09	8,12	0,033
	Short Body Length at Birth	5,66	2,17	14,72	0,0001
Maternal Factor Variables	Low Family Income	1,66	0,90	3,04	0,098

Next, among the two variables in the infant factor, namely Low Birth Weight (BBLR) and Birth Length, only these two variables are suitable for inclusion in the model. BBLR has a P-value of 0.033, while Birth Length has a highly significant P-value of 0.0001. This indicates that both BBLR and Birth Length have a significant influence on the occurrence of stunting in children.

Meanwhile, among the four variables in the socio-economic factor, only one variable, namely family income, is suitable for inclusion in the model, with a P-value of 0.098. Thus, the family income variable does not have a significant influence on the occurrence of stunting in children.

Based on these results, it can be concluded that among the maternal variables and socio-economic variables, three variables are suitable for inclusion in the model, namely KEK (P-value: 0.0001), Maternal BMI (P-value: 0.001), and Premature Birth (P-value: 0.077). Meanwhile, among the infant variables and socio-economic variables, two variables are suitable for inclusion in the model, namely a history of BBLR (P-value: 0.033) and Birth Length (P-

value: 0.0001). These findings provide important insights into the factors associated with stunting in children and can be used in the development of models to address the issue of stunting.

DISCUSSION

The research findings indicate that the percentage of mothers with Chronic Energy Deficiency (CED) and having stunted infants is 38.61%. There is a significant relationship between CED during pregnancy and stunting (P-value: 0.0001; OR: 18.31), implying that mothers with CED have an 18.31 times higher chance of delivering stunted infants. This finding is consistent with previous research by Fajrina (2016), which found that maternal upper arm circumference (MUAC) has a significant relationship with the occurrence of stunting in toddlers at Piyungan Primary Health Center, Bantul Regency. In that study, it was found that mothers with MUAC less than 23.5 cm had a 4.154 times higher risk of having children with stunting compared to mothers with MUAC greater than or equal to 23.5 cm.



Research by Victora et al. (2008) also highlights the long-term impact of early-life malnutrition on human health and development in adulthood. Similarly, the study by Black et al. (2008) revealed the global and regional consequences of maternal and child malnutrition, as well as the resulting health consequences. They found that maternal and child malnutrition increase the risk of disease and hinder healthy growth and development. After adjusting for other factors, the odds ratio (OR) in this study became 13.28. Additionally, the percentage of mothers with underweight Body Mass Index (BMI) and having stunted infants is 21.19%. There is a significant relationship between maternal BMI and stunting (P-value: 0.0001; OR: 21.34), indicating that mothers with lower BMI have a 21.34 times higher risk of having stunted infants.

This finding is in line with the research conducted by Pusparini (2016), which found a relationship between maternal body mass index in early pregnancy and linear growth disorders in infants. In that study, it was found that pregnant women with BMI less than 18.5 had a 2.374 times greater risk of giving birth to infants with linear growth disorders. Based on this research, it was also found that the percentage of premature births experiencing stunting is 16.23%. There is a significant relationship between premature birth and stunting (P-value: 0.001; OR: 3.32), meaning that premature babies have a 3.32 times higher risk of experiencing stunting compared to full-term babies. This finding is consistent with the research conducted by Pusparini, P. (2016), Friska Meyliasari (2014) which found a relationship between preterm gestational age and stunting in infants. In those studies, it was found that infants born prematurely have an 11.5 times higher risk of experiencing stunting compared to full-term babies.

Similarly Christian et al., (2013) conducted research on the risk of malnutrition in children born with low birth weight for gestational age (small-for-gestational age) and preterm birth in low- and middle-income countries. This study showed a relationship between malnutrition in children and the condition of low birth weight and preterm birth. In this study, no significant relationship was found between the baby's gender and stunting (P-value: 0.907; OR: 0.97). This indicates that gender does not affect the risk of stunting in infants. The percentage of Low Birth Weight (LBW) babies experiencing stunting is 12.58%. There is a significant relationship between LBW and stunting (P-value: 0.0001; OR: 6.49), meaning that LBW babies have a 6.49 times higher risk of experiencing stunting.

These research findings are in line with a study conducted in Vietnam, which found that a history of LBW is a major risk factor for stunting in children under three years of age (OR=4.4; 95% CI: 2.08-9.10) (Lowe et al., 2021). This finding is also consistent with research conducted by Nasution et al., (2014) There is a relationship between low birth weight (LBW) and the occurrence of stunting in children aged 6-24 months, with a 5.6 times higher risk of stunting in children with a history of LBW compared to those born with normal birth weight. The percentage of infants with short length (PB) experiencing stunting is 15.23%. There is a significant relationship between PB and stunting (P-value: 0.0001; OR: 6.49), which means that infants with short length have a 6.49 times higher risk of experiencing stunting.

A study conducted by Kartasurya MI (2012) revealed a relationship between the length of infants at birth and the height of parents with the occurrence of stunting in children aged 12-36 months in the Pati District, Pati Regency. This study highlights the importance of linear growth in infants

from birth as a factor that can influence the risk of stunting during child development. Another relevant study was conducted by (Campbell et al., 2018; Ramakrishnan et al., 2012; Zongrone et al., 2012) The study conducted in Uganda evaluated the prevalence of stunting in children aged 6-23 months in the Nakaseke and Nakasongola districts. Although it did not specifically mention a direct relationship between infant length and stunting, the study did not find a significant relationship between infant gender, maternal age, education, occupation, and family income with stunting.

CONCLUSION

There is a relationship between several maternal and infant factors with the occurrence of stunting. Maternal factors associated with stunting include chronic energy deficiency (P-value 0.0001), maternal body mass index (BMI) (P-value 0.0001), and premature birth (P-value 0.001). In addition, the infant factors that play a role are low birth weight (BBLR) (P-value 0.0001) and birth length (P-value 0.0001), while infant gender does not show a significant relationship (P-value 0.907). In terms of socio-economic factors, variables such as maternal age (P-value 0.705), maternal education (P-value 0.518), maternal occupation (P-value 0.261), and family income (P-value 0.098) do not have a significant relationship with stunting. The research findings also indicate that chronic energy deficiency is the most dominant factor associated with stunting, with a P-value of 0.0001 and an Odds Ratio of 18.31.

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