

Prenatal Factors Associated with the Risk of Stunting: A Multilevel Analysis Evidence from Nganjuk, East Java

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ABSTRACT

Background: Globally, one in four children under the age of five suffers from stunting. Stunting is associated with an underdeveloped brain, with long-lasting harmful consequences, including diminished mental ability and learning capacity, poor school performance in childhood, reduced earnings and increased risks of nutrition-related chronic diseases, such as diabetes, hypertension, and obesity in future. This study aimed to analyze prenatal factors associated with the risk of stunting in Nganjuk, East Java, using a multilevel analysis.

Subjects and Method: This was an analytic observational study with a case control design. The study was conducted at 25 posyandus (integrated health posts) in Nganjuk, East Java, from June 03 to July 07, 2018. Posyandu was selected by stratified random sampling. A sample of 225 children under five was selected by fixed disease sampling, consisting of 75 stunted children and 150 normal children. The dependent variable was stunting. The independent variables were birth length, maternal height, and family size. The data were collected by questionnaire and analyzed by a multilevel logistic regression run on Stata 13.

Results: The risk of stunting increased with maternal height <150 cm ($b= 2.59$; 95% CI= -0.75 to 4.42; $p= 0.006$), birth length <48 cm ($b=4.17$; 95% CI= 2.19 to 6.15; $p<0.001$), and large family size ($b= 2.31$; 95% CI= 0.34 to 4.29; $p= 0.022$). Posyandu had a contextual effect on stunting with ICC= 63.39%.

Conclusion: The risk of stunting increases with maternal height <150 cm, birth length <48 cm, and large family size. Posyandu has a sizeable contextual effect on stunting.

Keywords: stunting, birth length, maternal height, family size, posyandu, multilevel

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BACKGROUND

Malnutrition in children under five is a direct consequence of a large number of families, and lack of access to quality food and health services. Stunting is a form of malnutrition that is often faced by developing countries. Approximately 65% of the deaths of children under five are due to some forms of malnutrition and malnutrition representing one third of the burden of illness of children and mothers (Adeela and Seur, 2016). Indonesia is one of the developing countries that has a high prevalence

of stunting, from 88 countries in the world, Indonesia is at the top five of stunting cases (Unicef, 2013).

Basic Health Research (2013) shows that in Indonesia, the prevalence of stunting incidence increased from 2010 to 2013 from 35.6% to 37.2%. WHO recommends a stunting target of less than 20% so it would not cause problems. Nganjuk Regency is one of the provinces in East Java which has a stunting prevalence of more than 20%. Nganjuk regency has increased the prevalence of stunting events from 2016

to 2017 from 22.7% to 25.9% (Nganjuk Health Office).

Prenatal factors have an important role in the incidence of stunting. Biological factors become a strong foundation in the growth of children. Growth failure is the main manifestation of malnutrition during pregnancy and in childhood which is born with low birth weight (Kramer et al, 2016). Studies in developing countries have shown that stunting depends on the condition of the population of the region (Kinyoki et al, 2016). Stunting is more common at the individual level in men than in women. Family and community levels such as maternal education, employment, family income, and basic health services affect the incidence of stunting (Hagos et al., 2017).

Stunting increases the global public health burden of contributing 45% of all under-five mortality. More than two million children under five die each year from malnutrition worldwide (Cruz et al., 2017). The other effects of stunting are disease, lack of intelligence and productivity which are certainly very beneficial for future generations (Yisak et al, 2015).

Stunting is a very important issue, so community-based interventions should be formulated and implemented to improve children's health. At the individual level, interventions must focus on educating mothers on the right basics of nutrition and the need to utilize available health services. At the community level, health systems that facilitate public health intervention include maternal and child health programs that need to be made accessible to women in rural areas. This intervention will improve the nutritional status of children under five so that the WHO global target of 2025 can be achieved (Akombi, 2017).

The foundation of the long-term food and nutrition program policy in Law No. 17 of 2007 concerns the Long Term Develop-

ment Plan (RPJPN) for 2005-2025. The multi-sector approach in the development of food and nutrition includes production, processing, distribution to consumption of food with sufficient nutrition, balanced and guaranteed safety. The focus of the nutrition improvement movement is on the first 1000 days of life group at the global level called Scaling Up Nutrition (SUN) and in Indonesia, it is called the national nutrition awareness movement in order to accelerate nutritional improvement in the first 1000 days of life. Integrated health post (Posyandu) is one of the interventions in the 1000 days of life movement in monitoring the growth of children under five (Ministry of Health RI, 2012).

The researchers examined the prenatal factors that affect the incidence of Stunting in Nganjuk District, East Java Province. The purpose of this study to explain the influence of prenatal factors that affect the incidence of stunting in Nganjuk regency.

SUBJECTS AND METHOD

1. Study Design

This was an analytic observational study with a case control design. The study was conducted at 25 posyandus (integrated health posts) in Tanjunganom, Ngetos, Rejoso and Prambon sub-districts, Nganjuk district, East Java, from June 03 to July 07, 2018. Posyandu was selected by stratified random sampling.

2. Population and Samples

A sample of 225 children under five was selected by fixed disease sampling, comprising 75 stunted and 150 normal children.

3. Study Variables

The dependent variable was stunting. The independent variables were maternal height, birth length, family size, and posyandu.

4. Operational Definitions

Maternal height was defined as the height of the mother measured at the time of the study in centimeters measured by microtoise. The measurement scale was continuous, but for the purpose of data analysis, it was transformed into dichotomous, coded 0 for maternal height ≥ 150 cm and 1 for maternal height < 150 cm.

Birth length was defined as infant's body length measured (in cm) at the time of birth. The data were taken from the maternal and child monitoring book. The measurement scale was continuous, but for the purpose of data analysis, it was transformed into dichotomous, coded 0 for birth length ≥ 48 cm and 1 for birth length < 48 cm.

Family size was defined as the number of household members who live and live together which is the smallest unit in the community consisting of husband and wife and their children, wife and children or father and children. The data were collected by questionnaire. The measurement scale was continuous, but for the purpose of data analysis, it was transformed into dichotomous, coded 0 for < 5 and 1 for ≥ 5 .

Posyandu activities are defined as all activities carried out at the posyandu. The measuring tool used was a questionnaire. The categorical measurement scale is using parameter 0 for score ≥ 4 and 1 for score < 4 .

Stunting was defined as a short stature arising from the old malnutrition that is characterized by short and very short body circumstances by measuring height of age. The body length was measured by microtoise. The measurement scale was continuous, but for the purpose of data analysis, it was transformed into dichotomous, coded 0 for normal children and 1 for stunting.

5. Data Analysis

The data analysis included univariate, bivariate, and multivariate analysis. Multivariate analysis used a multilevel logistic regression run on Stata 13.

6. Research Ethics

The ethical clearance was obtained from the Research Ethics Committee at Dr. Moewardi Hospital, Surakarta, Central Java, Indonesia, with NO: 110 / UN27.6 / KEPK / 2018. Research ethics of this study including inform consent, anonymity, and confidentiality.

RESULTS

1. Univariate analysis

The results of univariate analysis were showed in Table 1. Table 1 shows that most of the stunted children was born with birth length < 48 cm (84%), maternal height < 150 cm (82.67%), and family size > 4 .

Table 1. Study subject characteristics

Variable	Stunting		Normal	
	n	%	n	%
Maternal Height				
< 150 cm	62	82.67	45	30
≥ 150 cm	13	17.33	105	70
Birth Length				
< 48 cm	63	84	37	24.67
≥ 48 cm	12	16	113	75.33
Family Size				
≤ 4	23	30.67	124	82.67
> 4	52	69.39	26	17.33

2. Bivariate analysis

The results of bivariate analysis on the effects of birth length, maternal height, and family size on stunting were showed in Table 2. Table 2 shows that the risk of stunting in child under five increased with birth length (OR= 16.03; 95% CI= 7.80 to 32.95; $p < 0.001$), maternal height (OR= 11.13; 95% CI= 5.57 to 22.24; $p < 0.001$), and family size (OR= 10.78; 95% CI= 5.64 to 20.61; $p < 0.001$).

Table 2. Chi-square analysis on the effects of maternal height, birth length, and family size on stunting

Independent Variables	Stunting status				OR	95% CI		p
	Yes (n=75)		No (n=150)			Lower limit	Upper limit	
	n	%	n	%				
Maternal Height								
< 150 cm	62	57.94	45	42.06	11.13	5.57	22.24	<0.001
≥ 150 cm	13	11.02	105	88.98				
Birth Length								
< 48 cm	63	63	37	37	16.03	7.80	32.95	<0.001
≥ 48 cm	12	9.6	113	90.4				
Family Size								
< 5	23	15.65	124	84.35	10.78	5.64	20.61	<0.001
≥ 5	52	66.67	26	33.33				

3. Multilevel analysis

The results of multilevel logistic regression was showed in Table 3. Table 3 showed that there was association between maternal height and stunting. Maternal height <150 cm increased the risk of stunting in children under five (b= 2.59; 95% CI= -0.75 to 4.42; p= 0.006). There was an association between birth length and

stunting. Birth length <48 cm increased the risk of stunting (b= 4.17; 95% CI= 2.19 to 6.15; p<0.001). There was an association between family size and stunting. Family size ≥5 increased the risk of stunting (b= 2.31; 95% CI= 0.34 to 4.29; p 0.022). Posyandu had strong contextual effect on stunting with ICC= 63.3%.

Table 3. The results of multilevel logistic regression analysis on the effects of prenatal factor on stunting

Independent Variable	b	95% CI		p
		Lower Limit	Upper Limit	
Fixed Effect				
Maternal Height (<150 cm)	2.59	0.75	4.42	0.006
Birth Length (<48 cm)	4.17	2.19	6.15	<0.001
Family Size (≥ 5)	2.31	0.34	4.29	0.022
Random Effect				
Posyandu Activeness				
N Observation = 225				
N Posyandu =25		Prob>chi2	<0.001	
Likelihood Ratio = -25.20		ICC=	63.39	

DISCUSSIONS

1. The effect of maternal height on stunting

The result of this analysis showed that there was an association between maternal height and stunting, and it was statistically significant. Maternal height <150 cm were more likely to have stunting than mother with normal height (≥150 cm) (b=2.59; 95% CI= -0.75 to 4.42; p= 0.006).

The result of this study is consistent with a study by Indriyani *et al.* (2018), which stated that there was a relationship between maternal height and birth length. Maternal height <150 cm was an indirect factor that increased the incidence of stunting. Maternal height <150 cm increased the likelihood of birth length <48 cm (b= 1.39; 95% CI= 0.55 to 2.24; p<0.001).

The result of this study supported a study of Aguayo *et al.* (2016), which stated that mothers who were <145 cm tall would increase the incidence of stunting in infants by 2.04 times than mothers who were ≥ 145 cm ($b = 2.04$; 95% CI = 1.46 to 2.81).

Maternal height was associated with children body height due to internal factors such as genetic which contributed greatly to other internal factors such as ethnicity, family, and gender (Ministry of Health RI, 2012). The result of this study was in line with a study done by Setyaningrum *et al.* (2017) which stated that every enhancement of 1 cm of maternal height, it would the growth of children nutritional status (height for age) ($b = 0.43$; CI 95% = 0.27 to 0.58; $p < 0.001$).

A study by Amin and Hadi (2015) conducted on 252 study subjects and analyzed by a multiple logistic regression showed that maternal height contributed significantly to stunting among children aged 6-23 months. This study illustrated that genetic factors, especially maternal height had a strong effect on the incidence of stunting.

2. The effect of birth length on stunting

The result of this analysis showed that there was an association between birth length and stunting, and it was statistically significant. Infants with birth length <48 cm increased the risk of stunting ($b = 4.17$; 95% CI = 2.19 to 6.15; $p < 0.001$). The result of this study is consistent with a study by Setyaningrum *et al.* (2017), which stated that birth length increased children nutritional status (height for age) ($b = 0.21$; 95% CI = 0.12 to 0.30; $p < 0.001$).

This study was in line with Rieger and Trommlerová (2016), which stated that children body height was affected by birth length that would always increase along with the children's age. The result of a study

by Amaliah *et al.* (2016) stated that birth length was one of the determinants of child growth and development. Children with short birth length were 3 times more likely to have stunting.

3. The effect of family size on stunting

The result of analysis showed that there was an association between family size and stunting, and it was statistically significant. Family size ≥ 5 increased the risk of stunting ($b = 2.31$; 95% CI = 0.34 to 4.29; $p = 0.022$). The result of this study was in line with a study by Wolde *et al.* (2015), which stated that the large number of family would increase the incidence of stunting ($b = 2.00$; 95% CI = 0.3 to 3.4).

Habyarimana *et al.* (2016) reported that malnutrition (stunting) determinants among children under five in Rwanda was affected by birth order. This findings showed that children who was born from large family size had higher risk to be stunted (OR = 1.65, $p = 0.002$).

The result of this study was in line with a study done by Cruz *et al.* (2017), which stated that children who live in a house with other family members ($b = 17.3$; 95% CI = 7.62 to 39.12; $p = 0.001$) and live in a house with other children for less than five years were more likely to have stunting ($b = 28.42$; 95% CI = 11.93 to 67.70; $p < 0.001$).

Children from large family size tend to get less nutrition intake, parental attention, and health care (Proverawati and Wati, 2011). Large family size would spend more money to fulfill their needs, and there would be competition and limitations in providing balanced nutritious food (Amin and Julia, 2014).

4. The effect of posyandu on stunting

The result of multilevel analysis showed the score of ICC = 63.39%. This indicator

showed that Posyandu had strong contextual effect on stunting.

The result of this study was in line with a study by Sinta *et al.* (2017), which stated that Posyandu had a contextual effect on exclusive breastfeeding with ICC= 28.87%. Posyandu with *mandiri* stratification increased the likelihood of exclusive breastfeeding rather than Posyandu with *purnama* and *madya* stratification.

Ministry of Health RI (2012), stated that Posyandu has two activities, namely main activities and optional or development activities. The main activities at the posyandu include maternal and child health, family planning, immunization, nutrition, and prevention and control of diarrhea, while the optional or development activities include the development of toddler families (DTF), Family Medicinal Plants (FMP), elderly family development (EFD), and early childhood education program (ECEP). With routine activities conducted at Posyandu, health personnel and health cadres could share information about stunting to the community, especially to the mothers.

Posyandu activities were closely related to Posyandu strata. Nganjuk has three Posyandu stratification namely *madya*, *purnama*, and *mandiri*. Posyandu was stratified by activeness of organization and program achievement level.

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