

Life Course Factors Associated with Stunting in Children Aged 2-5 Years: A Path Analysis

Ayu Rosita Dewi¹⁾, Yulia Lanti Retno Dewi²⁾, Bhisma Murti¹⁾

¹⁾Masters Program in Public Health, Universitas Sebelas Maret

²⁾Faculty of Medicine, Universitas Sebelas Maret

ABSTRACT

Background: Worldwide, in 2014, 23.8% of the children under-five years of age were stunted following the WHO definition, 7.5% were wasted but 6.1% had overweight or were obese. Developing countries host the bulk of the global stunting and child mortality rate. This study aimed to examine life course factors associated with stunting in children aged 2-5 years, using path analysis model.

Subjek dan Metode: A case control study was conducted in Tulungagung, East Java, from October to November 2018. A sample of 200 children under five was selected by fixed disease sampling. The dependent variable was stunting. The independent variables were maternal mid-upper arm circumference (MUAC), maternal height, exclusive breastfeeding, complementary feeding, birth weight, birth length, infection disease, and clean water supply and sanitation. Data on maternal height was measured by microtoise. The other data were collected by maternal and child health book and questionnaire. The data were analyzed by path analysis.

Results: Stunting directly decreased with maternal MUAC (b= 2.47; 95% CI= 0.33 to 2.86; p= 0.013), maternal height (b=3.10; 95% CI= 0.79 to 3.54; p= 0.002), exclusive breastfeeding (b= 4.78; 95% CI= 2.05 to 4.91; p<0.001), complementary feeding (b= 2.35; 95% CI= 0.25 to 2.83; p= 0.019), normal birth weight (b= 3.64; 95% CI= 1.26 to 4.21; p<0.001), normal birth length (b= 4.10; 95% CI= 1.63 to 4.62; p<0.001), no infection disease (b= 3.28; 95% CI= 0.87 to 3.47; p= 0.001), and clean water supply (b= 2.99; 95% CI= 0.72 to 3.49; p<0.001). Stunting indirectly affected with infection disease and birth weight.

Conclusion: Stunting directly decreases with maternal MUAC, maternal height, exclusive breastfeeding, complementary feeding, normal birth weight, normal birth length, no infection disease, and clean water supply. Stunting indirectly affects with infection disease and birth weight.

Keywords: stunting, determinants, path analysis

Correspondence:

Ayu Rosita Dewi. Masters Program in Public Health, Universitas Sebelas Maret, Jl. Ir. Sutami 36 A, Surakarta 57126, Central Java. Email: ayrost2014@gmail.com. Mobile: +6285856852680.

BACKGROUND

Child growth is a key indicator for assessing nutritional status in children under five (under five years) and is also one of the 6 global nutrition targets set by the World Health Assembly in 2012 and is a key indicator of the objectives of the Sustainable Development Goals (SDGs) in 2030 (Silva et al., 2017).

In this world, there are 165 million children under 5 in short conditions and 90% more in Africa and Asia, this is a

threat to the nutritional problems being experienced in the world. The World Health Assembly (WHA, 2012) targets a reduction of 40% in children under five in 2025, so that efforts are needed to reduce this condition by 3.9% per year. The global target achieved is to reduce stunting by 39.7% from 1990 to 26.7% in 2010. Within 20 years, it is expected to be reduced by 1.6% per year. A very small decline occurred in Africa (40% to 38%), a considerable decline occurred in Asia (from 49% to

28%), around 2.9% per year (Ministry of Health, 2016).

Indonesia is a country with a high prevalence of stunting, which is 30% -39%. Indonesia is in the 5th place in the world with the highest number of short children. Results from the South East Asian Nutrition Survey (SEANUTS) in 2010-2011 show that Indonesia is the country with the largest the number of children under five is above Malaysia, Thailand and Vietnam (Ministry of Health, 2016). Based on the results of the 2013 Basic Health Research, the percentage of nutritional status of short (short and very short) children in Indonesia in 2013 was 37.2%, compared to 2010 (35.6%) and in 2007 (36.8%) indicating that there was no decline/significant improvements (Ministry of Health, Republic of Indonesia, 2016).

Based on the results of monitoring nutritional status in 2017, in the province of East Java the prevalence of toddlers is very short at 7.9% and short toddlers at 18.8% (Ministry of Health, 2017). Prevalence of stunting (short and very short) in children under 5 years old in Tulungagung District was 7423 children from a total number of toddlers 58274 or 12.7% of children under five (Dinkung District, 2017).

The causes of stunting are multifactorial, which includes genetic, socio-demographic, economic status, as well as cultural and environmental factors and other health-related variables (Selamawit et al., 2018). The district / city analysis produced from the 2013 Community Health Development Index shows that short nutritional status among toddlers and school-aged children is influenced by environmental health factors, population services, reproductive health, economic status and education status (Ministry of Health, 2016).

Stunting is not only caused by malnutrition factors experienced by pregnant

women and children under five. Some of the factors that cause stunting include inadequate parenting practices, inadequate ANC and PNC, poor family access to nutritious food and lack of access to clean water and sanitation (National Team for the Acceleration of Poverty Reduction, 2017). Sanitation facilities in households also determine the incidence of stunting in Indonesia, toilets that are not maintained and drinking unprocessed water provide a three times greater chance of stunting (Harriet et al., 2016).

Toddlers (infants under the age of two years) who experience stunting will have a level of intelligence that is not optimal, making children more vulnerable to disease and in the future can be at risk of declining levels of productivity. Stunting will be able to hamper economic growth, increase poverty and widen inequality (National Team for the Acceleration of Poverty Reduction, 2017). International experience and evidence shows that stunting can hamper economic growth and reduce labor market productivity, resulting in a loss of 11% of GDP (Gross Domestic Products) and reducing the income of adult workers by 20%. Stunting can also contribute to widening inequality, thereby reducing 10% of total lifetime income and also causing intergenerational poverty (National Team for the Acceleration of Poverty Reduction, 2017).

Based on the description above, the researchers are interested in conducting research under the issue of "factors related to stunting in infants aged 2-5 years".

SUBJECTS AND METHOD

1. Study Design

This was an analytic observational study with a case control design. The study was conducted in Kauman community health center, Tulungagung Regency, East Java, Indonesia.

2. Population and Samples

The target population in this study was all children aged 2-5 years, while the source population was children aged 2-5 years at Kauman Health Center, Tulungagung, East Java, from October to November 2018. A sample of 200 children subjects was selected by fixed disease sampling, consisting of 50 stunted children and 150 normal children.

3. Study Variables

The dependent variable was stunting. The independent variables include maternal nutritional status, maternal height during pregnancy, exclusive breastfeeding, administration of breast milk, birth weight, birth length, infectious disease, and access to clean water and sanitation.

4. Operational Definition of Variables

Stunting was defined as child nutritional status based on length or height according to age and compared to the standard WHO-MGRS (Multicentre Growth Reference Study) in 2005, the z-score was less than -2SD and was categorized as very short if the z-score is less than -3SD. The measurement scale was continuous and transformed into a dichotomous, coded 0 for normal and 1 for stunting.

Maternal mid-upper arm circumference (MUAC) was defined as maternal body condition as a result of consumption of food and use of nutrients. Maternal MUAC was measured by MUAC tape. The data were obtained from maternal and child health books. The measurement scale was continuous and transformed into dichotomous, coded 0 for MUAC ≥ 23 cm and 1 for < 23.5 cm.

Maternal height was defined as the maximum distance from the vertex to the sole of the foot, measured when pregnant. The measurement scale was continuous and transformed into dichotomous, coded 0 for

0 for body height ≥ 150 cm and 1 for < 150 cm.

Exclusive breastfeeding was defined as only breastfeeding for infants to 6 months of age without additional fluids or other foods. The measurement scale was categorical, coded 0 for exclusive breastfeeding and 1 for exclusive breastfeeding.

Complementary feeding was defined as food that was given together with breastfeeding to a two-year-old child who fulfills 4 conditions, namely timely, adequate, safe and given in the right way. The measurement scale was continuous and transformed into dichotomous, coded 0 for appropriate and 1 for inappropriate.

Birth weight was defined as the weight of the baby weighed within the first 1 hour after birth. The measurement scale was continuous and transformed into dichotomous, coded 0 for $\geq 2,500$ g and 1 for $< 2,500$ g.

Birth length was defined as body length of child at birth. The measurement scale was continuous and transformed into dichotomous, coded 0 for ≥ 48 cm and 1 for < 48 cm.

An infectious disease was defined as an infectious disease (diarrhea or ARI) that the child has suffered in the past 6 months. The measurement scale was categorical, coded 0 for no and 1 for yes.

Sanitation was defined as a clean water and drinking water facility that must meet health requirements, both physical, biological and chemical requirements. The measurement scale was continuous and transformed into dichotomous, coded 0 for good and 1 for poor.

5. Study Instrument

The data were obtained from Tulungagung District Health Office and Kauman Health Center. Maternal height was measured by microtoise. Data on maternal MUAC were collected from maternal and child books.

The other data were collected by questionnaire.

6. Data Analysis

Sample characteristics were describe by univariate analysis. Bivariate analysis used Chi square. Multivariate analysis used path analysis to determine the direct and indirect effects of the relationships between study variables. Path analysis steps included model specification, model identification, model fit, parameter estimate, and model respecification.

7. Research Ethics

The research ethics include informed consent, anonymity, confidentiality, and ethical clearance. Ethical clearance in this study was obtained from Research Ethics Committee Faculty of Medicine, Universitas Sebelas Maret, Surakarta, Central Java, number 312/UN27.6/ KEPK/ 2018.

RESULTS

1. Sample Characteristics

Table 1 showed sample characteristics. Table 1 showed that most of the children were female 111 (55.5%), aged 24-36 months (54.0%). As many as 139 mothers (69.5%) had high education, 142 (71.0%) working at home, and 68.5% had family income \geq Rp 1,537,150.

Table 1. Sample Characteristics

Characteristics	N	%
Children age		
24-36 months	108	54.0
37-60 months	92	46.0
Gender		
Male	89	44.5
Female	111	55.5
Maternal Education		
High (<Senior high school)	139	69.5
Low (\geq Senior high school)	61	30.5
Maternal occupation		
Working	58	29.0
Not working	142	71.0
Family Income		
<Rp 1,537,150	63	31.5
\geq Rp 1,537,150	137	68.5

2. Univariate Analysis

Table 2 showed the results of univariate analysis. Table 2 showed that as many as 50 (75%) children were stunted, normal birth weight (76.5%), normal birth length (69.5%), received exclusive breastfeeding (74%), and good complementary feeding (71%).

3. Bivariate Analysis

Table 3 showed the results of bivariate analysis. Table 3 showed that maternal MUAC during pregnancy <23.5 cm (OR= 7.15; 95% CI= 3.53 to 14.49; $p<0.001$), maternal height <150 cm (OR= 4.00; 95% CI= 2.04 to 7.86; $p<0.001$), non-exclusive breastfeeding (OR= 5.87; 95% CI= 2.90 to 11.85; $p<0.001$), inappropriate complementary feeding (OR= 3.99; 95% CI= 2.07 to 7.87; $p<0.001$), birth weight (OR= 4.47; 95% CI= 2.20 to 9.06; $p<0.001$), birth length (OR= 3.56; 95% CI= 1.18 to 6.96; $p<0.001$), infectious disease (OR= 7.76; 95% CI= 3.82 to 15.77; $p<0.001$), and poor access to clean water and sanitation) (OR= 3.56; 95% CI= 1.82 to 6.97; $p<0.001$) increased the risk of stunting.

4. Path Analysis

Table 4 showed that there was a significant relationship between maternal MUAC, maternal height, exclusive breastfeeding, complementary feeding, birth weight, birth length, infectious disease, and access to clean water and sanitation, and stunting.

Stunting has a positive and direct relationship with maternal MUAC, maternal height, exclusive breastfeeding, complementary feeding, birth weight, birth length, infectious disease, and access to clean water and sanitation. Inappropriate complementary feeding has a positive relationship to infection. Maternal MUAC during pregnancy <23.5 has a direct relationship with birth weight.

Table 2. Univariate Analysis

Variable	n	%
Stunting		
Stunting	50	75.0
Normal	150	25.0
Maternal MUAC during pregnancy		
<23.5 cm	56	28.0
≥23.5 cm	144	72.0
Maternal height during pregnancy		
<150 cm	61	30.5
≥ 150 cm	139	69.5
Exclusive breastfeeding		
No	52	26.0
Yes	148	74.0
Complementary feeding		
Poor	58	29.0
Good	142	71.0
Birth weight		
Low birth weight	47	23.5
Normal birth weight	153	76.5
Birth length		
<48 cm	61	30.5
≥ 48 cm	139	69.5
Infection		
Yes	63	31.5
No	137	68.5
Access to clean water and sanitation		
Poor (<80%)	61	30.5
Good (≥ 80%)	139	69.5

Table 3. Bivariate Analysis

Variable Group	Stunting				OR	CI 95%		p
	Yes		No			Lower Limit	Upper Limit	
	n	%	n	%				
Maternal MUAC								
<23.5 cm	30	60.0	26	17.3	7.15	3.53	14.49	<0.001
≥23.5 cm	20	40.0	124	82.7				
Maternal height								
Short (<150 cm)	27	54.0	34	22.7	4.00	2.04	7.86	<0.001
Normal (≥ 150 cm)	23	46.0	116	77.3				
Exclusive breastfeeding								
No	27	54.0	25	16.7	5.87	2.90	11.85	<0.001
Yes	23	46.0	125	83.3				
Complementary feeding								
Appropriate	24	48.0	118	78.7	3.99	2.07	7.87	<0.001
Inappropriate	26	52.0	32	21.3				
Birth weight								
<2,500 g	23	46.0	24	16.0	4.47	2.20	9.06	<0.001
≥2,500 g	27	54.0	126	84.0				
Birth length								
<48 cm	26	52.0	35	23.3	3.56	1.18	6.96	<0.001
≥ 48 cm	24	48.0	115	76.7				
Infectious disease								
Yes	33	66.0	30	20.0	7.76	3.82	15.77	<0.001
No	17	34.0	120	80.0				
Clean water and sanitation								
Poor (<80%)	26	52.0	35	23.3	3.56	1.82	6.97	<0.001
Good (≥ 80%)	24	48.0	115	76.7				

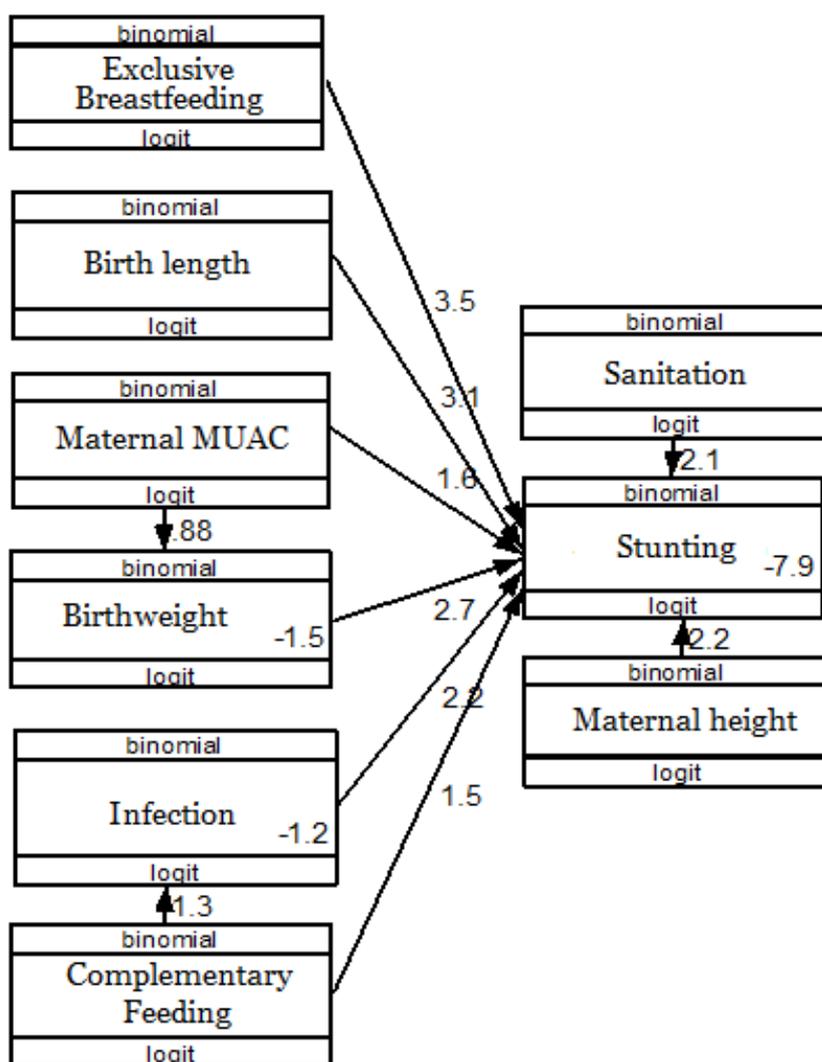


Figure 1. Structural Model with Estimation

Table 4. The Result of Path Analysis

Dependent variables	Independent Variables	b	CI 95%		p
			Lower Limit	Upper Limit	
Direct Effect					
Stunting	← Maternal MUAC <23.5 cm	2.47	0.33	2.86	0.013
	← Maternal height <150 cm	3.10	0.79	3.54	0.002
	← Non-exclusive breastfeeding	4.78	2.05	4.91	<0.001
	← Inappropriate complementary feeding	2.35	0.25	2.83	0.019
	← Birth weight <2,500 g	3.64	1.36	4.21	<0.001
	← Birth length <48 cm	3.10	1.63	4.64	<0.001
	← History of infectious disease	3.28	0.87	3.47	0.001
	← Poor access to clean water and sanitation	2.99	0.72	3.49	0.003
Indirect Effect					
Infectious disease	← Poor complementary feeding	3.84	0.61	1.90	<0.001
Birth weight	← Maternal MUAC <23.5	2.50	0.19	1.56	0.012

DISCUSSION

1. The relationship of maternal MUAC and Stunting

The result of analysis showed that there was an effect of maternal MUAC during pregnancy on the incidence of stunting. The results of this study showed the score of direct relationship with the path coefficient score of 2.47 and the score of $p = 0.013$ and it was statistically significant. Lack of maternal MUAC during pregnancy increased the risk of stunting by 2.47 units compared to good maternal nutritional status.

The result of this study was in line with Vir (2016), which stated that there was an effect of maternal MUAC during pregnancy on the incidence of stunting. Nutritional problems often faced by pregnant women were Chronic Energy Deficiency (CED) and nutritional anemia. Mothers who experienced CED had a state of malnutrition in a long time, if this happened, the nutritional needs for the growth process of the fetus become hampered so that the mother was at risk of delivering babies with LBW.

2. The relationship of maternal height during pregnancy on stunting

The result of analysis showed that there was an effect of maternal height during pregnancy on the incidence of stunting. The results of this study showed the score of direct relationship with the path coefficient score of 3.10 and the score of $p = 0.002$ and it was statistically significant. Lack of maternal height during pregnancy increased the risk of stunting by 3.10 units compared to normal maternal height.

The result of this study was in line with Zattorelly (2014) which stated that mothers who have a height of <150 cm were more at risk of having a stunting child compared to mothers who have a height of

≥ 150 cm. A study conducted by Geberselasie (2017) stated that stunting significantly correlated with maternal height. Parent's height was related to the child's physical growth. Parents have nature genes that can inherit to their children.

3. The relationship of exclusive breastfeeding and stunting

The result of analysis showed that there was an effect of exclusive breastfeeding on the incidence of stunting. The results of this study showed the score of direct relationship with the path coefficient score of 4.78 and the score of $p < 0.001$ and it was statistically significant. Toddlers who did not get exclusive breastfeeding increase the risk of stunting by 4.78 units compared to toddlers who get exclusive breastfeeding.

The result of this study was in line with a study by Fitri (2018) which stated that there was an effect of exclusive breastfeeding on the incidence of stunting. Breast milk was a nutritional intake that was suitable to the needs that would help the growth and development of children. Infants who did not get enough breast milk would have poor nutrition and can lead to malnutritions, one of them was stunting.

4. The relationship between complementary feeding on stunting

The result of analysis showed that there was an effect of complementary feeding on the incidence of stunting. The results of this study showed the score of direct relationship with the path coefficient score of 2.35 and the score of $p = 0.019$ and it was statistically significant. Inadequate complementary feeding increased the incidence of stunting by 2.35 units compared to good complementary feeding.

The result of this study was in line with Roba *et al.*, (2016), which stated that improper feeding can lead to malnutrition and overweight. Research conducted by Kusumawati (2015) stated that comple-

mentary feeding that was not statistically significant could increase the risk of stunting. At the age of 6 months old, physiologically, the baby was ready to receive additional food, because overall gastrointestinal function has developed. In addition, at that age the breast milk was no longer sufficient for the baby's needs for growth and development, so the provision of complementary food was needed.

5. The relationship between birth weight on stunting

The result of analysis showed that there was an effect of birth weight on the incidence of stunting. The results of this study showed the score of direct relationship with the path coefficient score of 3.64 and the score of $p < 0.001$ and it was statistically significant. Lack of birth weight increased the risk of stunting by 3.64 units compared to normal birth weight.

The result of this study was in line with a study by Fekadu *et al.*, (2015) which stated that baby's weight at birth affected the growth of the baby. Toddlers with a history of low birth weight were more likely to experience stunting. Babies who were born with LBW would find difficulty to experience early growth. The problem of growth could lead to stunting.

6. The relationship between birth length on stunting

The result of analysis showed that there was an effect of birth length on the incidence of stunting. The results of this study showed the score of direct relationship with the path coefficient score of 4.10 and the score of $p < 0.001$ and it was statistically significant. Lack of body length increased the incidence of stunting by 4.10 units compared to babies born with normal body lengths.

The result of this study was in line with a study done by Permatasari (2018), which stated that babies born with a body

length of < 48 cm have a risk of stunting compared to babies born with the length of ≥ 48 . Birth lengths that were less than normal have a risk of stunting at the age of 6-12 months old. Babies who were born with normal birth lengths got adequate nutrition during pregnancy so that the babies were not short. Babies were stated to be short if the birth length was < 48 cm.

7. The relationship between infectious disease on stunting

The result of analysis showed that there was an effect of infectious disease on the incidence of stunting. The results of this study showed the score of direct relationship with the path coefficient score of 3.28 and the score of $p = 0.001$ and it was statistically significant. Toddlers who suffered from infections increased the risk of stunting by 3.28 units compared to toddlers who did not suffer from infectious diseases.

The result of this study was in line with a study by Mgongo *et al.*, (2017), which stated that toddlers who suffer from infectious disease were more likely to have stunting. Infectious diseases have long-term consequences on growth, depending on the severity, duration, and time of recurrence.

8. The relationship between access to clean water and sanitation on stunting

The result of analysis showed that there was an effect of access to clean water and sanitation on the incidence of stunting. The results of this study showed the score of direct relationship with the path coefficient score of 2.99 and the score of $p = 0.003$ and it was statistically significant. Poor condition of access to clean water and sanitation increased the risk of stunting by 2.99 units compared to good condition of clean water and sanitation.

The result of this study was in line with a study by Correia *et al.*, (2014) which

stated that there was an effect of access to clean water and sanitation on the incidence of stunting. A study by Harriet Torlesse *et al* (2016), stated that the poor condition of toilets and drinking water that has not undergone a processing was associated with an increased likelihood of stunting in Indonesia compared to good conditions. Environmental sanitation was more visible to have a direct effect on the health development of toddlers. Unhealthy water would lead to diarrhea and various diseases.

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