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Research Article

Determinants of Stunting among Children in Urban Families in Palu, Indonesia

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Abstract

Background and Objective: The high incidence of stunting is a serious problem for the government of Palu. Thus, a study of the determinants of stunting in Palu is necessary. This study aimed to assess potential modifiable risk factors that lead to stunting among children. **Materials and Methods:** This study used a case-control research design with a 1:3 ratio of cases (children who were stunted) to controls (children who were not stunted) and conducted from September, 2016-March, 2017. The population included all stunted children aged 7-24 months in Petobo village, Palu. The number of cases was 36 as obtained by the total sampling method and the number of control children was 108, who were selected randomly. Univariate, bivariate and multivariate with logistic regression analyses were used. **Results:** The determinants of stunting were family income ($p = 0.000$), exclusive breast feeding ($p = 0.002$), immunization status ($p = 0.147$), environmental sanitation ($p = 0.001$) and maternal age during pregnancy ($p = 0.003$). The multivariate analysis results showed that family income [odds ratio(OR) = 6.24] was the highest risk factor for stunting. Exclusive breast feeding (OR = 4.33), environmental sanitation (OR = 4.60) and maternal age during pregnancy (OR = 3.05) were associated with the same risk of stunting. **Conclusion:** In Petobo village, Palu, the main modifiable risk factor that leads to stunting among children is family income, followed by environmental sanitation, exclusive breast feeding and maternal age during pregnancy.

Key words: Stunted children, urban area, family income, environmental sanitation, exclusive breast feeding, maternal age

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

A long period of inadequate food intake, infectious diseases and unhealthy living environments can cause stunting in children¹. Four main causes of stunting are factors related to the family and household, inadequate complementary food, failure to breastfeed exclusively and infection². A maternal age that is too young or too old during pregnancy may also lead to stunting in children, mainly because of the effects of psychological factors³. Family income may directly affect changes in a family's food consumption. Increased income may also increase opportunities to buy food of better quality, quantity and vice versa⁴. In addition, immunization in children is a cost-effective health effort towards protection against infectious diseases and infections, thus reducing the morbidity and mortality of children⁵. However, data have shown that as many as 47.4% of children still do not receive complete basic immunization and 10.9% of children do not receive basic immunizations⁶. According to Hidayat and Fuada⁷, socio-demographic factors, environmental sanitation and health services affect the nutritional status of children. Maternal age during pregnancy indicates the marriage age of the child's parents. A pregnant mother aged <18 years is at high risk of giving birth to a stunted child⁸.

Stunting is a global nutrition problem occurring mostly in children in the first 2 years of life⁹. The International Food Policy Research Institute (IFPRI)¹⁰ reported that there were 159 million (23.8%) children aged <5 years who had a short body. The prevalence of stunting in Indonesia is still relatively high. Data from Basic Health Research⁶ indicated that the prevalence of very short children was 18.0% and that of short children was 19.2%. In Central Sulawesi Province, chronic nutrition problems are very prominent and the prevalence of very short and short children is 17.7 and 23.3%, respectively⁶. The 2015 assessment results of the nutritional status in Central Sulawesi showed that the prevalence of the nutritional problems of stunting (short and very short) among children aged 0-23 months was higher (25.9%) than that of Indonesia (23.1%), while Palu, the capital city of Central Sulawesi Province, had a prevalence of 35.1% of stunted children aged 0-59 months¹¹. Stunting is a key indicator of long-term malnutrition and failure to achieve optimal growth. Thus, the height of a child with stunted growth is not appropriate (low) for his/her age¹².

Food intake and infectious diseases are the direct causes of nutritional problems, especially wasting and stunting¹². This study focused on indirect factors and the root of nutritional problems, namely, the economic condition of the family

(family income), environmental sanitation, health services (immunization), parenting (exclusive breast feeding) and maternal age during pregnancy. The high incidence of stunting in Palu is a serious problem for its government. Thus, this study was carried out to examine the determinants of stunting in Palu to enable the government of Palu to formulate policies based on the study's results. The government's support of the research is very important in its efforts to improve nutrition. The novelty of this study indicates that poverty is not only a major factor in stunting in rural areas but is also a major problem in urban areas in Central Sulawesi.

MATERIALS AND METHODS

A case-control research design was used, with a 1:3 ratio of cases (children who were stunted) to controls (children who were not stunted). The study was conducted over 6 months, from September, 2016-March, 2017.

Population and sample: The population was comprised of all stunted children aged 7-24 months (aged under 2 years) in Petobo village, Palu. The case group included 36 children, recruited using a total sampling method and the control group included 108 children, who were selected randomly.

The data collection was conducted through a series of measurements:

- Nutritional status, namely stunted and normal was determined by measuring the body length at a precision of nearly 0.1 cm using a body length measuring instrument (in cm) and the WHO Anthro Plus program application. The categories of nutritional status according to body length index for age (BL/A) or height for age (H/A) of children aged 0-60 months were divided into stunted and normal
- Information on family income was collected through a questionnaire regarding the income of all family members. Family income criteria were divided into sub-categories
- Exclusive breast feeding data were obtained using a questionnaire in which mothers were asked directly what foods were given to the child from 0-6 months of age
- Immunizations, which aim to make a person immune to specific diseases, need to be given to infants younger than 1 year of age and should consist of a complete set of basic immunizations [HB 0 (hepatitisB), BCG (Bacillus Calmette-Guérin), polio 1, DPT/HB 1 (diphtheria, tetanus, pertussis/hepatitisB), polio 2, DPT/HB 2, polio 3, DPT/HB 3, polio 4, measles]. The measuring instrument used was the growth chart

- Environmental sanitation includes basic sanitation covering toilets, garbage and household waste processing facilities. The measuring instrument used to examine environmental sanitation was a questionnaire
- Maternal age during pregnancy is the age at which women are prepared psychologically and physically to conceive, that is between the ages of 20-35 years. The measuring instrument used to examine maternal age during pregnancy was a questionnaire
- An incomplete immunization status was defined on the basis of whether an infant received all or one type of immunization (HB 0, BCG, polio 1, DPT/HB1, polio 2, DPT/HB2, polio 3, DPT/HB3, polio 4, measles) by 1 year of age
- Household environment sanitation was considered poor if it did not meet basic sanitary guidelines
- Maternal age was categorized at high risk if mothers were ≤ 20 years of age or ≥ 35 years of age during pregnancy. The dependent variable is stunting. The categories of stunting were as follows: Stunted if the height age z-score (HAZ) was < -2 standard deviations (SD) and normal if the HAZ was -2 SD-2 SD

Statistical analysis: Univariate data analysis was performed for all study variables. Chi-square tests were used to examine the correlation between independent variables and dependent variables (bivariate). The level of significance was $p < 0.05$. Multiple logistic regression tests were used to examine which independent variables were most influential on the dependent variable¹³.

RESULTS

A greater number of male children aged 13-24 months participated in this study, as shown in Table 1.

In this study, there were five independent variables and one dependent variable (Table 2).

- Family income was divided into different categories: Insufficient if the family income was $< \text{Rp } 1,675,000/\text{month}$ and sufficient if the family income was $\geq \text{Rp } 1,675,000/\text{month}$, a maximum income of Rp 1,675,000/month was the standard for the municipal minimum wage in Palu in 2016
- Children fed exclusively via breast feeding was defined as when the mother did not give the child any food/drink other than breast milk until 6 months of age

Cases of stunting were more common in children under two years of age from a family with an income $<$ the municipal minimum wage (69.4%), compared to those who were not stunted (30.6%) in these same categories. Chi-square tests showed that family income ($p = 0.000$), environmental sanitation ($p = 0.001$), maternal age during pregnancy ($p = 0.001$) and exclusive breast feeding ($p = 0.002$) had significant effects on stunting. Immunization status did not have a significant effect on stunting ($p = 0.147$), as shown in Table 2.

Multivariate analysis, using multiple logistic regression, showed that of the five variables included in the analysis that had $p < 0.25$ in the bivariate analysis, four variables made a significant contribution ($p < 0.05$) to predicting

Table 1: Distribution of respondents by characteristics of children

Characteristics	Category	N	%
Gender	Male	63	43.8
	Female	81	56.2
Age (in months)	7-12	40	27.8
	13-24	104	72.2
Total		144	100

Primary data of stunting in palu³⁴

Table 2: Variables associated with stunting, bivariate analysis

Variables	Category	Stunting		Normal		p-value
		n (36)	%	n (108)	%	
Family Income	$< \text{MMW}$	25	69.4	29	26.9	0.000*
	$\geq \text{MMW}$	11	30.6	79	73.1	
Exclusive breast feeding	Without exclusive breast feeding	22	61.1	35	32.4	0.002*
	With exclusive breast feeding	14	38.9	73	67.6	
Immunization Status	Incomplete	20	55.6	45	41.7	0.147
	Complete	16	44.4	63	58.3	
Environmental Sanitation	Poor	25	69.4	42	38.9	0.001*
	Good	11	30.6	66	61.1	
Maternal Age during Pregnancy	At Risk	21	58.3	33	30.6	0.003*
	Not at Risk	15	41.7	75	69.4	

* $p < 0.05$: Chi-square test, MMW: Municipal minimum wage Rp 1,675,000/month, Primary data of stunting in palu³⁴

Table 3: Variables associated with stunting, multivariate analysis

Variables	B	Wald	Df	p-value	Exp(B)	95% CI for EXP(B)	
						Lower	Upper
Family income (<MMW)	1.83	13.80	1	0.000*	6.24	2.37	16.39
Exclusive breast feeding (Without exclusive breast feeding)	1.46	9.07	1	0.003*	4.33	1.67	11.27
Environmental sanitation (Poor)	1.52	9.55	1	0.002*	4.60	1.74	12.21
Maternal age during pregnancy (at risk)	1.11	5.24	1	0.022*	3.05	1.17	7.95

B: Coefficient logistic regression, Df: Degrees of freedom, Exp(B): Odds ratio, CI: Confidence interval, *p<0.05, Primary data of stunting in palu³⁴

stunting, namely, family income, exclusive breast feeding, environmental sanitation and maternal age during pregnancy. Multivariate analysis showed that children under 2 years of age with a family income < the municipal minimum wage had a 6.24-fold higher risk of stunting compared to children under 2 years of age with a family income > the municipal minimum wage. Children under 2 years of age who were not exclusively breastfed had a 4.33-fold higher risk of stunting compared to children under 2 years of age who were exclusively breastfed. Children under 2 years of age living in a household with poor environmental sanitation had a 4.60-fold higher risk of stunting compared to those who lived in a household with good environmental sanitation. Furthermore, children under 2 years of age whose mothers were <20 years and >35 years of age during pregnancy had a 3.05-fold higher risk of stunting compared to children whose mothers were between 20 and 35 years of age during pregnancy, as shown in Table 3.

DISCUSSION

The results showed that the determinants related to stunting in children aged 7-24 months, with p<0.05, were family income, exclusive breast feeding, maternal age during pregnancy and immunization status. Stunting in children under 2 years of age is a chronic nutritional problem caused by inadequate nutrient intake and infectious disease, plus morbidity and environmental concerns, particularly family conditions and household sanitation¹⁴. Family conditions in this case, were family income and maternal age during pregnancy, which both had a significant contribution to stunting. Finlay *et al.*¹⁵ stated that the first-born child of a woman aged <27-29 years of age in low-to middle-income countries is at a higher risk of infant mortality, stunting, underweight, diarrhea and moderate-to-severe anemia but not wasting. Results of the present study were supported by Reyes *et al.*¹⁶, who stated that a family income of less than 25 USD per month had a significant relationship with stunting ($p = 0.03$, OR = 1.65).

Nutritionists and economists have agreed that the direct causes of stunting in early life are food intake and infectious diseases. These problems are reflections of the four underlying causes, namely household food insecurity, inadequate child care, poor health conditions and uneasy access to the health services¹⁴. These problems all stem from the family's economic condition. Thus, the family's economic condition is the root cause of the problems of stunting. This conclusion is in line with the findings of research conducted by Vitolo *et al.*¹⁷, who stated that there is a correlation between stunting and low socio-economic status, with a 2.36-fold higher risk of stunting (OR = 2.36, 95% CI 1.51-3.69) among children from families of low socio-economic status. Low-income families have a 1.46-fold (95% CI 0.79-2.67) higher risk of stunting¹⁸⁻²⁰.

Toddlers who are not exclusively breastfed can be stunted²¹. In infants, breast milk is instrumental in the fulfillment of nutritional needs. Breast milk consumption also strengthens the baby's immune system, thus reducing the risk of infectious diseases. It is alleged that the nutritional requirements of children who are breastfed exclusively for 6 months will be fulfilled for growth, while toddlers who were not breastfed exclusively tend to be stunted due to inadequate nutrient intake in the first 6 months²². Infants are more likely to have infectious diseases, such as diarrhea and respiratory diseases, if they are not exclusively breastfed or if they are given formula too early. The research conducted by Paudel *et al.*²³ suggested that children who are not breastfed exclusively have a 6.90-fold higher risk of stunting (95% CI 2.81-16.97).

Families that provide good parenting, especially with regard to fulfilling nutrient requirements, will affect the nutritional status of children. Appropriate complementary feeding in children 12-24 months of age will reduce the risk of malnutrition, because at that age, children's nutritional needs cannot be fulfilled by breast milk alone. In addition to parenting, environmental sanitation is one of the factors that affect nutritional status. Thus, children who live in places with poor sanitation are likely to be stunted²⁴.

Poor access to clean water and sanitation facilities may increase the likelihood of infectious diseases, which may cause the energy needed for growth to be diverted to the body's resistance to the infection, the necessary nutrients to be poorly absorbed by the body and stunting²⁵. According to Nadiyah *et al.*²⁶, poor environmental sanitation increases the risk of stunting by 1.46 times (95% CI 1.01-2.13). The evidence suggests that poor WASH (water, sanitation and hygiene) conditions have a significant detrimental effect on child growth and development, which results from not only sustained exposure to enteric pathogens but also wider social and economic mechanisms²⁷.

Maternal age is a factor that indirectly affects the nutritional status of toddlers. The findings showed that maternal age during pregnancy had a significant effect on stunting ($p = 0.003$, OR = 3.05). This finding was consistent with the research conducted by Esfarjani *et al.*²⁸. Stating that pregnant women older than 35 years of age have a 3.01-fold (95% CI 1.19-7.60) higher risk of having a stunted child. The case in India shows that children born to mothers married at <18 years of age have a higher risk of stunting and malnutrition compared to children born to mothers married at >18 years of age²⁹.

In Indonesia, the prevalence of child marriage has declined by more than 2-fold in the last three decades but it is still among the highest in East Asia and the Pacific³⁰. Babies born to mothers who married during childhood (<20 years) have a higher mortality risk and double the risk of dying before 1 year of age, compared to children born to mothers in their twenties³¹. This finding directly relates to the fact that married women who are very young during pregnancy and child birth have higher malnutrition rates themselves and their bodies are not yet fully grown^{32,33}. Thus, women's ages become a serious consideration in deciding when they should get married to prevent nutritional problems in their children, such as stunting and wasting.

The implication of this research is to provide recommendations to the governments of the Central Sulawesi region in formulating policies aimed at decreasing stunting through improvements in social welfare. This research can be applied in the synergy of sensitive programs for the reduction of stunting in the environmental health sector, as well as provide opportunities for the religious, economic and social empowerment of women.

The limitation of this research is the small sample area, because the study was only conducted in one village, which is considered quite representative. Additionally, the study was not designed using cohorts due to time, cost and labor constraints.

CONCLUSION AND RECOMMENDATIONS

It is concluded, the poverty characterized by low levels of family income has been a major factor contributing to stunting among children. The practice of exclusive breast feeding is still low, thus, nutrition in early life is not sufficient, which ultimately leads to stunting. Marriage in women <20 years of age suggests that the level of education of mothers is also low, thus, less nutrition is provided to children and the sanitation of the household environment is poor. Therefore, the accumulation of several factors contributes significantly to the incidence of stunting in urban areas.

This study suggests that stunting can be prevented by improvements in family income through the aid of government programs, such as the Indonesian Conditional Cash Transfer Programme (Program Keluarga Harapan), as well as through educating mothers and young brides about the importance of nutrition, family, exclusive breast feeding and environmental sanitation.

SIGNIFICANCE STATEMENT

The study discovered that the core problem of stunting in Central Sulawesi is still dominated by socio-economic factors, especially family income factors, thus, reducing the poverty rate in Central Sulawesi is considered the best solution to decrease the incidence of stunting, which can be beneficial for the government, especially the governments of the Central Sulawesi region, in formulating policies to decrease stunting through improvements in social welfare and more integrated cross-cutting cooperation. This study will help the government and researchers examine the critical issue of poverty, a problem related to stunting. Poverty and stunting are still major problems in urban areas that many researchers have not been able to explore. Thus, a new theory on low family income and a combination of other risk factors for stunting may be addressed at the policy level.

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