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Research

Multilevel Analysis Association of Soil Transmitted Helminths and Stunting in Children Aged 6-12 Years Old in Pinrang District, South Sulawesi

Putri Andini Muslimah[1)], Harsono Salimo[2)], Yulia Lanti Retno Dewi[3)]

[1)]Masters Program in Public Health, Universitas Sebelas Maret
[2)]Department of Pediatrics, Dr. Moewardi Hospital, Surakarta
[3)]Faculty of Medicine, Universitas Sebelas Maret

ABSTRACT

Background: Stunting in children is often associated with infectious diseases, one of which is Soil Transmitted Helminths (STH). Worms in children affect the intake, digestion, absorption and metabolism of food which has an impact on reducing the supply of nutrients to the body. This study aimed to determine the relationship between STH and the incidence of stunting in children aged 6-12 years in Pinrang, South Sulawesi.

Subjects and Method: This was an analytic observational with cross sectional design. The study was conducted in Pinrang Regency, South Sulawesi, from January to March 2020. A sample of 200 children aged 6-12 years was selected by random sampling. The dependent variable was stunting. The independent variables were worm disease, maternal education, family income, number of family members, maternal body height, low birth weight, length of birth, exclusive breastfeeding, and complementary feeding. The data were collected by questionnaire and analyzed by a multiple multilevel logistic regression run on STATA13.

Results: The risk of stunting increased with worms (b= 2.11; 95% CI= 1.11 to 3.10; p <0.001), low maternal education (b= 1.08; 95% CI= 0.13 to 2.03; p= 0.025), low income (b= 1.03; 95% CI= 0.05 to 2.02; p= 0.039), number of family (b= 2.13; 95% CI= 1.13 to 3.13; p< 0.001), short maternal height (b= 1.03; 95% CI= 0.10 to 1.96; p= 0.030), LBW (b= 1.45; 95% CI= 0.38 to 2.51; p= 0.007), short birth length (b= 1.91; 95% CI= 0.95 to 2.87; p< 0.001), and inappropriate complementary feeding (b= 1.11; 95% CI= 0.21 to 2.11; p= 0.029). The risk of stunting decreased with exclusive breastfeeding (b= 0.96; 95% CI= 0.23 to 1.91; p= 0.045). Village had negligible contextual effect on the stunting with ICC= 8.2%.

Conclusion: The risk of stunting increases with worms, low maternal education, low income, number of family, short maternal height, LBW, short birth length, and inappropriate complementary feeding. The risk of stunting decreases with exclusive breastfeeding. Village has negligible contextual effect on the stunting.

Keywords: stunting, soil transmitted helminths

Correspondence:
Putri Andini Muslimah. Masters Program in Public Health, Universitas Sebelas Maret, Jl. Ir. Sutami 36A, Surakarta 57126, Central Java. Email: ptriandn15@gmail.com. Mobile: +6285-331663133.

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BACKGROUND

Stunting is a measure of chronic malnutrition as the most common form of malnutrition in children in developing countries (Hagos et al. 2017). The prevalence of stunting according to UNICEF/WHO/-

World Bank Group (2019) affects around 21.9% or 149 million toddlers worldwide. There are approximately 9 million children aged 0-59 months old with the condition of continuing stunting until 6-18 years old.

This condition is more clear for Indonesia, which shows a trend (tendency) for non-communicable disease to increase from 2007 to 2013, where it is estimated that 70 million adult people (>18 years old) suffer from non-communicable disease (Ministry of Health of the Republic of Indonesia, 2018). In 2018, there was an increase from the previous year to 30.8% which made Indonesia got the the fourth rank in the world (Ministry of Health of the Republic of Indonesia, 2018b). The incidence of stunting in South Sulawesi also in the fourth rank in all of Indonesia. The prevalence of stunting in Pinrang Regency was 43.6% in 2017, this makes Pinrang Regency as the fifth largest stunting rate in South Sulawesi (South Sulawesi Provincial Health Office, 2018).

The incidence of stunting in children is influenced by various factors, one of them is infectious diseases, such as the incidence of worm infections. Worms can make children experience digestive disorders and protein absorption so that children experience growth problems and acute anemia due to malnutrition. Infectious disease has a significant relationship ($p < 0.05$) with the incidence of stunting (Fitria, 2017).

Another factor related to the incidence of stunting is maternal education, the level of mother's education will influence the mother's attitude and mindset in paying attention to food intake so that it will affect the choice of food that will determine the nutritional status of the child (Rozali, 2016) Family income is also related to the incidence of stunting, high family income can be a factor in fulfilling food needs, nutritional needs both in terms of quality and quantity as well as health care for all family members (Andriani M, 2014). Families who have a large number of children or family members, especially those with less economic conditions are the cause of stunting, this is due to the inability to fulfill food needs and the inability to pay attention to all children or family members they have (Candra, 2011). Height is a form of genetic expression and is a factor passed on to children and is associated with the incidence of stunting (Ibrahim et al. 2019).

In addition, babies born with low birth weight (LBW) will experience obstacles in their growth and development (Azriful et al. 2018), birth length (Swathma et al. 2016), history of exclusive breastfeeding (Kusumawardhani, 2017), History provision of complementary foods (Paramashanti et al. 2016) also has a direct relationship with the incidence of stunting which, if not improved, nutritional intake in the early stages of growth will lead to various kinds of diseases that are detrimental to children.

Therefore, researchers are interested in conducting study on "multilevel analysis of the relationship of soil transmitted helminths (sth) and the incidence of stunting in children aged 6-12 years in Pinrang Regency".

SUBJECTS AND METHOD

1. Study Design

This was an analytic observational study with a cross-sectional design. The study was conducted in Pinrang Regency from January to March 2020.

2. Population and Sample

The source population in this study were children aged 6-12 years in 25 sub-districts in Pinrang Regency. A sample of 200 children aged 6-12 years was selected by simple random sampling.

3. Study Variable

The dependent variable was stunting. The independent variables were worm disease, maternal education, family income, number of family members, height of the mother, low birth weight, length of birth, exclusive breastfeeding, complementary feeding, and village level.

4. Definition of Operational Variable

Worms is the finding of intestinal nematode eggs or larvae in children 6-12 years based on the results of examination of stool samples. Categorical data scale. Code 0: no worms, 1: worms.

Maternal education is the last type of formal education completed by mothers. Categorical data scale. Code 0: high school education to college, 1: elementary to junior high school.

Family income is the average income obtained in one family, adjusted to the MW Pinrang Regency (Rp. 2,860,000). Continous data scale, converted to categorical during data analysis. Code 0: ≥Minimum wage, 1: <Minimum wage.

Number of family is the number many family members in one household. Continous data scale, converted to categorical during data analysis. Code 0: number of family members ≥4, 1: number of family members> 4.

Maternal height is the mother's current height as measured at the time of data collection. Measured using microtoise. Continous data scale, converted to categorical during data analysis. Code 0: Height ≥150 cm, 1: Height <150 cm.

Low birth weight is the weight of the child at birth <2,500 grams (Ministry of Health of the Republic of Indonesia, 2013). Categorical data scale. Code 0: No LBW, code 1: LBW

Birth length is the length of the child's body at birth, the standard size of the child's birth length is 48 cm (Ministry of Health of the Republic of Indonesia, 2013). Categorical data scale. Code 0: Body length at birth ≥48 cm, 1: body length at birth <48 cm.

Exclusive breastfeeding is a history of breastfeeding from 0-6 months old without other food or drink. Categorical data scale. Code 0: exclusive breastfeeding, 1: non-exclusive breastfeeding.

Complementary feeding is a history of complementary feeding starting from 6 months old. Categorical data scale. Code 0: Getting complementary food, 1: Not getting complementary food.

Sub-district is the strata or level of the village with the topography in Pinrang Regency. Categorical data scale. Code 1: Altitude 0-100 masl, 2: altitude 100-400 masl, 3: altitude 400-1,000 masl, 4: altitude> 1,000 masl.

5. Study Instrument

The study instrument used for data collection was a questionnaire that had been tested for validity and reliability, medical records (KIA book), laboratory tests. The questionnaire was used to measure maternal education, family income, number of family members, maternal height, exclusive breastfeeding, complementary feeding. Medical records were used to measure LBW, birth length. Laboratory tests were used to measure the incidence of worms.

6. Data Analysis

Univariate analysis to find out the frequency distribution and percentage of characteristics of study subjects. Bivariate analysis to determine the relationship between the dependent variable and the independent variable using the chi-square test. Multivariate analysis using logistic regression analysis through a multilevel approach with Stata13 program to determine the effect of level 2 (sub-district) on child development.

7. Study Ethic

Ethical clearance in this study was obtained from the Health Research Ethics Commission of the Moewardi Hospital, Surakarta City with number 1,284/XII/HREC/2019 which was published on December 3, 2019.

RESULTS

1. Sample Characteristics

The characteristics studied included worm infection status, maternal education, family income, number of family members, maternal height, age, low birth weight, birth length, exclusive breastfeeding, complementary feeding and sub-districts. These characteristics can be shown in Table 1 and Table 2.

2. Bivariate Analysis

Bivariate analysis using the chi-square test. Bivariate analysis based on the results of this study can be seen in table 3.

3. Multilevel Analysis

Multilevel analysis explained the effect of more than one independent variable (worm disease, gender, maternal education, family income, number of family members, maternal height, LBW, birth length, exclusive breastfeeding and complementary feeding) with the dependent variable (stunting). The results of multivariate analysis of the incidence of stunting using multiple logistic regression with a multilevel approach can be seen in Table 4.

Table 4 shows that:

1. The Effect of Worms Infection Status on Stunting

Based on Table 4, it can be seen that there was an effect of infection status of worms on the incidence of stunting in children aged 6-12 years. Children with worms had a logodd probability of experiencing stunting by 2.11 units greater than children without worms. (b= 2.11; CI 95% = 1.11 to 3.10; p= <0.001

Table 1. The Characteristics of Study Subjects (Continous Data)

Variables	N	Mean	SD	Min.	Max.
Income (rupiah)	200	3,116,500	4392247	0	54,000,000
Number of family	200	4.635	1.435996	3	11
Maternal body height (cm)	200	153.24	7.061994	132	169
Age (years old)	200	8.99	2.319158	6	12
LBW (gram)	200	2.777	.4348754	2.1	4.3
Birth length (cm)	200	47.72	2.319158	39	53
Z-score (bh/a)	200	-1.67245	1.2778	-3.96	3.52

2. The effect of maternal education on stunting

There was an effect of maternal education on the incidence of stunting in children aged 6-12 years. Children with low-educated mothers had logodd of experiencing stunting by 1.08 units higher than children with highly educated mothers (b= 1.08; 95% CI= 0.13 to 2.03; p= 0.025).

3. The effect of family income on stunting

There was an effect of family income on the incidence of stunting in children aged 6-12 years. Children with low income families had logodd of experiencing stunting by 1.03 units greater than children with high-income families (b= 1.03; 95% CI= 0.05 to 2.02; p= 0.039).

4. The effect of number of family on stunting

There was an effect of the number of family members on the incidence of stunting in children aged 6-12 years. Children who have a number of family members ≥5 were more likely (logodd) to experience stunting by 2.13 units than children who have a number of family members of <5 (b= 2.13; 95% CI= 1.13 to 3.13; p<0.001).

Table 2. The Characteristics of Study Subjects (Dichotomy Data)

Variables	Category	n	%
Stunting	Normal	107	53.3
	Stunting	93	46.5
Worm infection status	No	118	59.0
	Yes	82	41.0
Gender	Male	99	49.5
	Female	101	50.5
Maternal education	<Senior high school	86	43.0
	≥ Senior high school	114	57.0
Family income	<Minimum wage	109	54.4
	≥ Minimum wage	91	45.5
Number of family member	<5	127	63.5
	≥5	73	36.5
Maternal height	<150 cm	70	35.0
	≥150 cm	130	65.0
Low birth weight	Not LBW	144	72.0
	LBW	56	28.0
Birth length	<48 cm	75	37.5
	≥48 cm	125	62.5
Exclusive breastfeeding	Not exclusive breastfeeding	73	36.5
	Exclusive breastfeeding	127	63.5
Complementary feeding	Not in time	77	38.5
	In time	123	61.5

Table 3. Bivariate Analysis

Independent Variables	Stunting				OR	p
	Normal		Stunting			
	n	%	n	%		
Worm infection status						
No	79	67.0	39	33.0	7.55	<0.001
Yes	28	34.1	54	65.9		
Maternal education						
< HS	37	43.1	49	56.9	2.73	0.026
≥HS	70	61.4	44	38.6		
Family income						
<MW	40	36.7	69	63.3	2.73	0.038
≥MW	67	73.6	24	26.4		
Number of family member						
<5	82	64.6	45	35.4	7.88	<0.001
≥5	25	34.2	48	65.8		
Maternal height						
<150 cm	23	32.9	47	67.1	2.66	0.030
≥150 cm	84	64.6	46	35.4		
Low birth weight						
Not LBW	92	63.9	52	36.1	3.75	0.008
LBW	15	26.8	41	73.2		
Birth length						
<48 cm	20	26.7	55	73.3	6.28	<0.001
≥48 cm	87	69.6	38	30.4		
Breastfeeding						
Not exclusive breastfeeding	28	38.4	45	61.6	2.57	0.041
Exclusive breastfeeding	79	62.2	48	37.8		
Complementary feeding						
Not in time	27	35.1	50	64.9	3.02	0.024
In time	80	65.0	43	35.0		

5. The effect of maternal height on stunting

There was an effect of maternal height on the incidence of stunting in children aged 6-12 years. Children with mothers who have a height <150 cm were more likely (logodd) to experience stunting by 1.03 units than children with maternal height of ≥150 cm (b= 1.03; 95% CI= 0.10 to 1.96; p= 0.030).

6. The effect of LBW on stunting

There was an effect of LBW on stunting in children aged 6-12 years. Children who have a history of LBW, the likelihood (log-odd) of experiencing stunting was 1.45 units higher than children with normal birth weight (b= 1.45; 95% CI= 0.38 to 2.51; p= 0.007).

7. The effect of birth length on stunting

There was an effect of body length at birth on the incidence of stunting in children aged 6-12 years. Children who had a history of body length at birth <48 cm were more likely (logodd) to experience stunting by 1.91 units higher than children who had a history of ≥48 cm (b= 1.91; 95% CI= 0.94 to 2.87; p<0.001).

8. The effect of exclusive breastfeeding on stunting

There was an effect of exclusive breastfeeding on stunting in aged children 6-12 years. Children who had a history of not being exclusively breastfed were more likely (logodd) to experience stunting by 0.96 units than children who had a history of exclusive breastfeeding (b= 0.96; 95% CI= 0.23 to 1.90; p= 0.045).

9. The effect of complementary feeding on stunting

There was an effect of complementary feeding on stunting in children aged 6-12 years. Children with inappropriate complementary feeding were more likely (logodd) to experience stunting by 1.11 higher than those with appropriate complementary feeding (b= 1.11; 95% CI= 0.12 to 2.11; p= 0.029).

Table 4. Multiple logistic regression analysis with a multilevel approach Association of Soil Transmitted Helminths and Stunting in Children Aged 6-12 Years Old

Independent Variables	Regression Coefficient (b)	95% CI		p
		Lower Limit	Upper Limit	
Fixed effect				
Worms infection status (yes)	2.11	1.11	3.10	<0.001
Education (low)	1.08	0.13	2.03	0.025
Income (low)	1.03	0.05	2.02	0.039
Number of family member (≥5)	2.13	1.13	3.13	<0.001
Maternal height (≥150 cm)	1.03	0.10	1.96	0.030
LBW (yes)	1.45	0.38	2.51	0.007
Birth length (≥48 cm)	1.91	0.94	2.87	<0.001
Exclusive breastfeeding (yes)	0.96	0.23	1.90	0.045
Complementary feeding (yes)	1.11	0.12	2.11	0.029
Constants	-5.16	-6.76	-3.56	<0.001
Random Effect				
Var (Constants)	0.294			
N observation= 200				
N group= 25				
Log Likelihood= -74.19				
Min= 8, max= 8				
p= <0.001				
ICC= 8.2%				

10. The effect of village on stunting

Village had a contextual effect on stunting (ICC= 8.2%). The variation in the incidence of stunting was 8.2% influenced by the sub-district. The ICC value in this study was in accordance with the rule of thumb (8-10%), so the contextual influence in this study was important.

DISCUSSION

1. The relationship between worms and stunting

The results in this study indicated that worms had a relationship with the incidence of stunting. In this study, it is known that children aged 6-12 years who have worms can cause stunting.

According to Susilowati and Quyumi, in 2017, infectious diseases that can cause malnutrition or stunting are worm infections. Worms can cause a decrease in children's appetite which results in loss of carbohydrates, protein and loss of blood and other nutrients needed by the body, thereby reducing the quality of human resources (Onis and Branca, 2016). In the long term, this can affect children's learning achievement, because the child's motor, cognitive and verbal development is impaired. Children with disabilities who are stunted may experience interference with the maturation process of brain neurons and changes in brain structure and function (Yadika *et al.* 2019).

2. The relationship between maternal education and stunting

The results in this study indicate that maternal education has a relationship with the incidence of stunting. In this study, it is known that children aged 6-12 years with mothers with low education cause the incidence of stunting.

This is in line with research conducted by Utami et al. (2017) which showed that there is an indirect effect of maternal education on the incidence of stunting, maternal education affects protein intake and energy intake which indirectly affects stunting status. The majority of mothers have tertiary education, namely high school and tertiary education, but mothers with higher education levels are not always knowledgeable, because knowledge is not only obtained from formal education but also from non-formal education (Senbanjo et al. 2011).

3. The relationship between family income and stunting

The results in this study indicated that family income has a relationship with the incidence of stunting. In this study, it is known that children aged 6-12 years with low-income families can cause stunting.

Families with sufficient or high income are able to buy food that is better in quality and quantity so that the family's nutritional needs can be fulfilled, this is a reflection of good nutritional behavior. According to Handini (2013), income and nutritional status have a significant relationship.

4. The relationship between number of family member and stunting

The results in this study indicated that the number of family members has a relationship with the incidence of stunting. In this study, it is known that children aged 6-12 years with a number of family members ≥5 can cause stunting.

There is an effect of the number of family members (≥4 family members) on the incidence of stunting (Sugiyanto et al. 2019). Having a large number of family members (≥5 family members) and low economic status can make family members have limitations and competition in terms of providing and getting food that is nutritionally balanced.

The large number of children in families with sufficient and stable economic

status can cause reduced love and attention from mothers to child development, but it is not absolutely a risk factor for the incidence of stunting, it is necessary to pay attention to various other risk factors (Suciningtyas et al. 2019).

5. The relationship between maternal height and stunting

The results in this study indicated that maternal height has a relationship with the incidence of stunting. In this study, it is known that children aged 6-12 years with mothers who are <150 cm can cause stunting.

Maternal height is a predictor factor in reducing the prevalence of stunting. Children with mothers who have a height of ≥154 cm have a prevalence of 78% lower than children whose mothers have a height of <154 cm (Dekker et al. 2010).

6. The relationship between LBW and stunting

The results in this study indicated that LBW has a relationship with the incidence of stunting. In this study, it is known that children aged 6-12 years with a history of LBW can cause stunting.

Ntenda (2019) stated that compared to children with normal birth weight, children who experience LBW have a higher chance of experiencing stunting in Malawi. Likewise what happened in Bangladesh, research done by Rahman et al. (2016) stated that there is a positive relationship between LBW and malnutrition in children, the percentage of malnourished children born with LBW is greater than children born with normal weight, although other variables have been controlled.

7. The relationship between birth length and stunting

The results in this study indicated that birth body length has a relationship with the incidence of stunting. In this study it was found that children aged 6-12 years with a history of birth length <48 cm caused the incidence of stunting.

The results of a study conducted in Pinrang Regency are in line with the results of research conducted by Ilma, Salimo and Pamungkasari (2019) in Kupang, which stated that children with a long history of normal birth weight reduce the risk of stunting. Child birth length significantly increases the risk of stunting by up to 2 years in an early life, which can increase the risk of various chronic diseases.

8. The relationship between exclusive breastfeeding and stunting

The results in this study indicated that exclusive breastfeeding has a relationship with the incidence of stunting. In this study it is known that children aged 6-12 years who do not have a history of exclusive breastfeeding can cause stunting.

Akombi et al. (2017) found that there was a relationship between the length of breastfeeding and the incidence of stunting. Children who were exclusively breastfed for more than 12 months were more likely to be stunted than children who were exclusively breastfed for 6 months.

Breastmilk given to children early in life can provide immediate and long-term protection against infection. The content of breast milk in the form of various immunity, anti-microbial, anti-inflammatory and nutritional properties can protect children from diseases that can be carried by fluids or other foods contaminated by infectious agents (Nigatu *et al.* 2019).

9. The relationship between complementary feeding and stunting

The results in this study indicate that complementary foods have a relationship with the incidence of stunting. In this study, it is known that children aged 6-12 years who do not have a history of complementary foods can cause stunting.

Hijra et al. (2016) stated that there is a relationship between complementary feeding and the incidence of stunting, children who do not get complementary foods have an increased risk of stunting by 8.26 times than children who get complementary foods on time.

Impaired growth in children is caused by malnutrition experienced since they were in the womb, inappropriate timing of complementary feeding, inadequate complementary solids and inappropriate complementary patterns according to the child's age. The provision of solid foods must fulfill the requirements for quantity, time, texture, variety of food, method of administration and adequate hygiene principles (Rakhmahayu et al. 2019).

10. The contextual effect of village on stunting

The results in this study indicated that the context of the sub-district has a relationship with the incidence of stunting. The value of the contextual influence of the sub-district with the regional topographic strata at the second level is shown by the ICC value of 8.2%.

A study Leo et al. (2018) stated that the risk factors for stunting in the highlands and lowlands areas have differences and this indirectly affects the incidence of stunting, while differences in risk factors in each region include the level of energy sufficiency and the level of protein adequacy and a history of exclusive breastfeeding. Children who live in the lowlands have a tendency to consume more carbohydrates, foods that contain carbohydrates are mostly obtained from large portions of rice and regular meals at all times. In addition, most children who live in the lowlands also eat snacks such as sponge cakes and various other snacks (Rahma et al., 2018).

This is in line with Indrastuty and Pujiyanto (2019), which showed that the place of residence as a child's domicile has a significant relationship with the opportunity for the incidence of stunting. Access to health facilities is one of the causes of the incidence of stunting under five, while the affordability of access to health services in the regions is one of the targets for stunting management interventions.

AUTHOR CONTRIBUTION

Putri Andini Muslimah as the main author has the role in collecting data, formulating data, designing study, conducting questionnaire reliability test and analyzing data. Harsono Salimo advised discussion of study and writing techniques. Yulia Lanti Retno Dewi examined the data, provided input on study discussions and writing techniques.

CONFLICT OF INTEREST

There was no conflict of interest in this study.

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