Determinant Characteristics of Stunting in Babies and Toddlers in Sungai Rengit Murni, South Sumatra, Indonesia

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Abstract. Stunting is a condition where a child fails to optimally grow and develop his/her bodily organs. Due to the high rate of stunting case in Indonesia, particularly in South Sumatra, this study aimed to determine the causes of stunting in children of 0 yr to 5 yr old as the dependent variable. Independent variables of infection, birth weight, gender, and age were studied accordingly. The purposive sampling method selected 100 babies and toddlers in Sungai Rengit Murni, Banyuasin, South Sumatra, Indonesia. The cross-sectional design applied univariate, bivariate (chi-

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square test), and multivariate (multiple logistic regression and backward regression tests) analyses. The result showed that while age was insignificant (0.649, $P > 0.25$) and infection was less significant (0.077, $P > 0.05$), low birth weight (0.044, $P < 0.05$) and gender (0.045, $P < 0.05$) are significant in affecting stunting.Being 61 % accurate, the independent variables of this study covered 15.1 % of known stunting cause.

Keywords: Infection, low birth weight, parenting, undernourishment.

1 Introduction

Fetal phase and the first two years of infancy are the most crucial stages of a child's life [1] for growth and development both physically and mentally. While nutrition is of the highest requirement during these periods, the latter becomes prone to undernourishment [2] due to scarce health access and inappropriate diet [3, 4]. Such a condition often leads to stunting – a condition when a child fails to optimally grow and develop bodily organs. Stunted children are expected to be shorter than average as grown-ups as they have lost their individual productivity up to 1.4 % [5]. Moreover, stunting dwindles one's intelligence between fivepoints and 11 points [6]. When occurring in an early age, the impact of stunting is likely more severe ($P < 0.000$) [7].

While undernutrition is often assumed as the outcome of failing food security, food is proven to be an insignificant cause – with famine as an exception. Various studies have discovered parents' knowledge, parenting pattern, health service access, water access, sanitation, and diet [8, 9] as some of more sizeable factors. Food-abundant countries have also been recorded to face household nutrition problems [10]. Despite high food productivity rates, Arsi, Ethiopia and Iringa, Tanzania have been dealing with stunting as high as 62 % and 66 % respectively [11].

The prevalence of stunting in Indonesia, particularly among children of 0 mo to 59 mo, is as high as 28.4 % [12, 13], and it is detrimental towards the national human resource quality [13, 14]. This situation had ranked the nation in 124th out of 187 regarding the 2011 International Human Development Index, which was lower than the neighboring countries Malaysia (61st), Thailand (103rd), and the Philippines (112th) [15]. Despite that, the rate of stunting cases in South Sumatra (3° 19' 9.973" S 103° 54' 51.836" E), a province in Indonesia, has been rising in 2017 to 2018 (17.2 %) compared to 2016 (14.58 %) [16]. Realizing the urgency of the matter, Indonesia government has responded by issuing Presidential Regulation No.72 of 2021 – applying in synergy with National Population and Family Planning Board Regulation No. 12 of 2021 – to accelerate the decline of stunting prevalence rate to the targeted 14 % by arranging a multisectoral collaboration.

2 Material and methods

Performed in Sungai Rengit Murni – a village in Banyuasin Residence, South Sumatra Province (38' 46.267" E, 50' 31.497" S) – with aimed to map out determinant characteristics of stunting occurrence in children of 0 mo to 59 mo old in South Sumatra due to its high-and-rising rate of stunting cases. This research was conducted with the description of Ethical Approval No. E.5.a/237/KEPKUUMM/VIII/2023, August 23, 2023, by the Faculty of Medicine, University of Muhammadiyah Malang

Fig.1. Length measuring in a local integrated healthcare center (*Posyandu*).

Amount of 100 children of 12 mo to 59 mo in the area who were not under any medical treatments, were free of infection within 1 m prior, and were of Z-scores ≤ 2SD were taken as samples [17, 18], thus purposive sampling. With stunting as the dependent variable, four independent variables of infection, birth weight, age, and age entails. Data were obtained by applying WHO-standard Anthropometry [19], interview, and 2010 National Basic Health Research.

Involving editing, coding, and scoring processes, the results were run through cross-sectional methods. All data were analyzed by employing Microsoft Excel 2007 and Statistical Packages for the Social Science (SPSS) ver. 24. T-test quantified the average Z-score of length by age [20]. Univariate analysis calculated distribution and proportion of all categories entailing the variable. Bivariate analysis through chi-square test evaluated the correlation between free variable and stunting variable. Multivariate analysis through Multiple Logistic Regression test determined the role of free variable towards stunting. Regression analysis of backward method was also included to tackle any sign of multi-colinearity [21].

3 Result and discussion

3.1 Univariate analysis

The categories that indicate potentials of stunting in young children were low birth weight, low height growth, and low weight growth. Comparing observation data on each category based to standard, a stunting child should be distinguishable from a normal one.

3.1.1 Birth weight

By computing birth weight, birth length, weight at measurement, and length at measurement, a child can be verified to have a normal or low one as detailed in Table 1.

Table 1. Data t-test on birth weight.

	Low birth weight				Normal birth weight			
	Mean	**Standard deviation**	**Min**	**Max**	**Mean**	**Standard deviation**	**Min**	**Max**
Birth weight (g)	2 345.45	96.06	2 150	2 450	2 967.30	236.38	2 500	3 800
Birth length (cm)	48.18	2.56	45	53	49.97	3.42	45	59
Weight at measurement (kg)	10.25	1.59	7.3	12.5	12.10	2.90	7	17.3
Length at measurement (cm)	85.91	8.47	73	98	89.52	11.01	66	117

A child is considered to have a normal birth weight when he/she is born with 2.5 kg to 3.8 kg of it. Although a birth length of 45 cm may be of either normal or low birth heights, below the number means low birth length that more likely goes along with low birth weight.

Weight and height growths vary widely considering the range of ages between 1 yr old and 5 yr old. Regarding the samples in this study, the weight rate of 12.10 kg and height rate of 89.52 cm are referred to as normal while the weight rate of 10.25 kg and height rate of 85.91 cm are low.

3.1.2 Height growth

The child characteristics of infection, birth weight, sex, and age were then cross-compared with height-at-measurement to conclude whether a child is very short, short, normal, or tall. The result is presented in Table 2.

Table 2. Child characteristics compared to height.

Independent variable		**Very short**		**Short**		**Normal**		**Tall**		**Total**
		n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	
Infection	None	8	12.5	20	31.3	33	51.6	3	4.7	64
	Helminthiasis	5	23.8	8	38.1	8	38.1	0	0.0	21
	Diarrhea	4	44.4	4	44.4	1	11.1	0	0.0	9
	Acute respiratory	1	16.7	2	33.3	2	33.3	1	16.7	6
Birth weight	Low	5	45.5	4	36.4	2	18.2	0	0.0	11
	Normal	13	14.6	30	33.7	42	47.2	4	4.5	89
Gender	Boy	13	23.6	20	36.4	22	40.0	0	0.0	55
	Girl	5	11.1	14	31.1	22	48.9	4	8.9	45
Age	1 yr	1	12.5	3	37.5	4	50.0	0	0.0	8
	2 yr	4	13.8	14	48.3	10	34.5	1	3.4	29
	3 yr	9	32.1	7	25.0	12	42.9	0	0.0	28
	4 yr	3	10.7	5	17.9	17	60.7	3	10.7	28
	5 yr	1	14.3	5	71.4	1	14.3	0	0.0	7

Out of 64 children with no infection, more than half of them were of normal height and some of them were even tall; yet 20 (31.3 %) were short. Meanwhile, only 8 (38.1 %) out of 21 children with worms were normal – the rest were either short or very short. One child with diarrhea was of normal height, while the other eight were short or very short. Out of six children with acute respiratory disease, half of them were normal and tall while the other half were short and very short.

In accordance with birth weight, 89 children with normal one mostly grew normally (47.2 %), even tall (4.2 %); however, the number of those who came out short (33.7 %) and

very short (14.6 %) was notable. As of 11 children with low birth weight, only 2 (18.2 %) were of normal height while the rest were short (36.4 %) or very short (45.5%).

Further, 22 out of 55 boys (40.0 %) were normal height, while 20 (36.4 %) were short and 12 (23.6 %) were very short. As for the girls, 22 (48.9 %) were of normal height and 4 (8.9 %) were tall while 14 (31.1 %) were short and 5 (11.1 %) were very short.

Regarding age, most children of 1 yr old, 2 yr old, 3 yr old, and 5 yr old were short to very short – rated50 %, 62.1 %, 57.1 %, and 85.7 %, respectively. Four years old children were in the best condition as most of them were normal and tall, leaving 28.6 % to be short or very short.

3.1.3 Weight growth

Low weight growth is the most perceptible factor in stunting. Contrasting birth weight and birth length to measured weight and length, the result should be able to indicate the parameters of normal children and stunting one. The data can be seen in table 3.

Table 3. Stunting determination based on birth weight and birth length compared to weight and length at measurement.

Independent variable	Stunting				Not stunting			
	Mean	Standard deviation	Min	Max	Mean	Standard deviation	Min	Max
Birth weight (g)	2 833.08	301.78	2 150	3 700	2 970.21	279.87	2 250	3 800
Birth length (cm)	49.42	3.31	45	57	50.15	3.44	45	59
Weight at measurement (kg)	10.99	2.55	7	17	12.88	2.82	7	17.3
Length at measurement (cm)	83.62	8.21	66	98	95.08	10.09	73	117

Normal children were 2 970.21 g weight and 50.15 cm height when born and grew up to 12.88 kg weight and 95.08 cm height when measured for this study. Meanwhile, children with stunting were generally born with 2.8 kg weight and 49.42 cm length, and when measured they grew only up to 10.99 kg weight and 83.62 cm height. Studies [22–24] have explained how children with low birth weights and birth lengths are prone to diseases and fatality, particularly when undernourished during their growing period. When such children survive, they have a tendency to suffer from stunting.

3.2 Bivariate analysis

A bivariate analysis employing Chi-square test was established to find out whether demographywas affective towards stunting cases among children in the study site. The result is as listed in Table 4.

Tabel 4. Child characteristics compared to demography regarding stunting cases.

		Stunting		Non-stunting		Total	*P* value
		Frequency	%	Frequency	%		
Infection	None	28	43.8	36	56.3	64	0.058
	Helminthiasis	13	61.9	8	38.1	21	
	Diarrhea	8	88.9	1	11.1	9	
	Acute respiratory	3	50.0	3	50.0	6	
Birth weight	Low	9	81.8	2	18.2	11	0.036
	Normal	43	48.3	46	51.7	89	

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Table 4. Continued.

		Stunting		Non-stunting		Total	*P* value
		Frequency	%	Frequency	%		
Gender	Boy	33	60.0	22	40.0	55	0.077
	Girl	19	42.2	26	57.8	45	
Age	1 yr	4	50.0	4	50.0	8	0.029
	2 yr	18	62.1	11	37.9	29	
	3 yr	16	57.1	12	42.9	28	
	4 yr	8	28.6	20	71.4	28	
	5 yr	6	85.7	1	14.3	7	

Note: Chi-square test result is significant when$P< 0.05$

While most children with no infection grew up normally in height, almost half of them (43.8 %) were stunted. Stunting also appeared in most children with worms (61.8 %) and with diarrhea (88.9 %) as well as in exactly half of the children with acute respiratory infection. Seeing the *P* value of 0.058 ($P > 0.05$), it is conclusive that infection is insignificant in triggering stunting among babies and toddlers in the study area. This result differs from a number of research stating that infectious diseases – proportionate to hygiene – is substantial in causing stunting [25–28].

Nine out of eleven children born with low weight and nearly half of the ones born with normal height (48.3 %) were indicated for stunting. With the *P* value of 0.036 ($P < 0.05$), low birth weight has higher risk of stunting.

From 55 boys observed, 33 of them (60 %) showed signs of stunting in their height growths. The same thing appeared in 19 out of 45 girls (42.2 %). Since the *P* value came out with 0.077 ($P > 0.05$), gender is therefore insignificant in instigating a stunting case.

Referring to ages, indications of stunting occurred by 50.0 %, 62.1 %, 57.1 %, 28.6 %, and 85.7 % in children of 1 yr old, 2 yr old, 3 yr old, 4 yr old, and 5 yr old, respectively. The *P* value of 0.029 ($P < 0.05$) affirms the significance of age in the presence of stunting, thus in agreement with research articulating that the risk of stunting heightens when a child is older [29, 30]. Despite the vacillation, this study has proven that 5 yr old children with stunting are of the highest rate.

3.3 Multivariate analysis

Run to ascertain characteristic factor towards stunting cases in the study area, the multivariate analysis was simultaneously performed with the logistic regression test to discover the most influential independent variable towards stunting as the dependent one. Independent variables with $P < 0.25$ as per bivariate analysis – listed in Table 5 – were made candidates for the purpose.

Table 5. Significant independent variablesin stunting among children in Sungai Rengit Murni, Banyuasin, South Sumatra, Indonesia.

Independent variable	*P*value	Remark
Infection	0.058	Candidate
Birth weight	0.036	Candidate
Gender	0.077	Candidate
Age	0.029	Candidate

The logistic regression test operated LR Backward method, where the aforementioned independent variables were taken account on before removed in accordance with certain statistical significance. The outcome of the first stage is as detailed in Table 6.

Table 6. Logistic regression test – stage 1.

Independent variable	B	Sig.	Exp(B)	95.0% C.I. for EXP(B)	
				Lower	Upper
Infection	-0.423	0.118	0.655	0.386	1.113
Birth weight	1.742	0.041	5.710	1.071	30.451
Gender	0.870	0.045	2.386	1.018	5.594
Age	0.094	0.649	1.098	0.734	1.644
Constant	-3.846	0.041	0.021		

Notes: EXP (B) = Odds Ratio (OR).

With *P* value of 0.649 – much higher than the limit of 0.25 – the independent variable of age was pronounced as insignificant and therefore eliminated. The second stage calculated the three remaining independent variables, and the answers are presented in Table 7.

Table 7. Logistic regression test – stage 2.

Independent variable	B	Sig.	Exp(B)	95.0% C.I. for EXP(B)	
				Lower	Upper
Infection	-0.459	0.077	0.632	0.380	1.051
Birth weight	1.708	0.044	5.519	1.045	29.151
Gender	0.872	0.045	2.392	1.020	5.605
Constant	-3.483	0.040	0.031		

Notes: EXP (B) = Odds Ratio (OR), overall percentage= 61.0%, Nagelkerke R square = 0.151.

As all independent variables are of $P < 0.25$, no further removal was required. With a negative regressive coefficient rate (-0.459) and *P* value of 0.077 ($P > 0.05$), infection is less significant in stunting towards babies and toddlers in the study area. However, the highrisk rate (CI 95 %) indicates that children with infections – particularly helminthiasis, diarrhea, and acute respiratory – are 0.632 times more prone to stunting than those with no infection.

The positive regressive coefficient rate (1.708) and *P* value of 0.044 ($P < 0.05$) conclude that birth weight is significant in stunting. Often found in children with low birth weight (< 2500 g), they have tendency to stunting 5.519 times more than children with normal birth weight.

Gender also has a positive regressive coefficient rate (0.872), with *P* value of 0.045 ($P < 0.05$). In the study area, signs of stunting are shown in boys as they are 2.392 times more liable to it than are girls.

An accuracy rate – represented by overall percentage – of 61.0 % is established on infection, low birth weight, and gender as significant causes of stunting, with low birth weight – having the highest odds ratio – as the most significant independent variable. However, the three independent variables appointed cover only 15.1 % of stunting foundation in the study area.

4 Conclusion and recommendation

This study has discovered that in Sungai Rengit Murni Village, Banyuasin Residence, South Sumatea Province, Indonesia, boys of 5 yr old and younger who were born with below-normal weight and have experienced infection are most likely impaired in their height growth. An early response to the conditions should be advantageous to diminish the rate of stunting in the area.

While relatively accurate, the coverage of the study needs to be broadened in the future researches on the matter of stunting in babies and toddlers in the hope of keeping the next generation healthy and productive.

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