Low Birth-Body Weight as Wasting Predictor over Children Aged 6-59 Months in Indonesia

Berat Badan Lahir Rendah sebagai Prediktor Wasting pada Anak Usia 6-59 bulan di Indonesia

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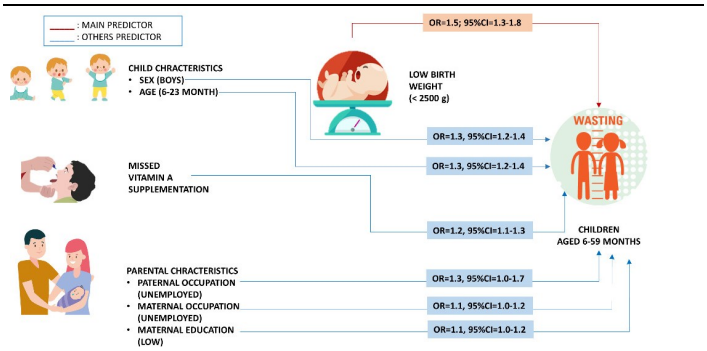
ABSTRACT

Approximately ten percent of children under five in Indonesia have suffered from wasting. Children with low birth body weight are considerably more at risk of suffering such disease. This current study aimed to analyze the relationship between low birth body weight and other risk factors of wasting among Indonesian children. This study utilized data from the 2018 Indonesian National Basic Health Research (Riskesdas). In total, 60,451 children aged 6-59 months were included. The data were analyzed using bivariate and logistic regressions. According to the data analysis, children with low birth-body weight had significantly higher odds of being wasted compared to children with normal birth-body weight (OR=1.5, 95%CI=1.3-1.8). In addition, boys and younger children (6-23 months) were 1.3 times more susceptible to wasting (OR=1.3, 95%CI=1.2-1.4). Unemployed fathers and mothers comprised of 1.3 and 1.1 times, respectively, to increase the risk of child wasting (OR=1.3, 95%CI=1-1.7; OR=1.1, 95%CI=1-1.2). Mothers with a low education level contributed to an increase in wasting prevalence 1.1 times (OR=1.1, 95%CI=1-1.2). Children who were lack of vitamin A supplements had a 1.2 times more chance of being wasted (OR=1.2, 95%CI=1.1-1.3). This research eventually suggested that low birth-body weight was the dominant factor in child wasting in Indonesia. Programs for improving the nutritional status of pregnant women and children with low birth-body weight should therefore be implemented intensively and comprehensively.

ABSTRAK

Prevalensi *wasting* pada anak balita di Indonesia mencapai 10 persen. Anak yang memiliki Berat Badan Lahir Rendah (BBLR) lebih berisiko mengalami *wasting*. Penelitian ini bertujuan untuk menganalisis hubungan antara BBLR dan faktor risiko lainnya terhadap kejadian *wasting* pada anak Indonesia. Penelitian ini menggunakan data Riset Kesehatan Dasar (Riskesdas) 2018. Sebanyak 60.451 anak usia 6-59 bulan masuk dalam kriteria penelitian ini. Analisis data secara bivariat dan multivariat menggunakan uji regresi logistik. Hasil analisis menunjukkan bahwa, dibandingkan dengan anak dengan berat badan lahir normal, anak dengan BBLR memiliki kemungkinan yang jauh lebih tinggi untuk mengalami *wasting* (OR=1,5; 95%CI=1,3-1,8). Anak laki-laki dan anak yang berusia lebih muda (6-23 bulan) 1,3 kali lebih rentan mengalami *wasting* (OR=1,3, 95%CI=1,2-1,4). Ayah dan ibu yang tidak bekerja meningkatkan risiko *wasting* pada anak sebesar 1,3 dan 1,1 kali (OR=1,3; 95%CI=1-1,7; OR=1,1; 95%CI=1-1,2). Ibu dengan tingkat pendidikan rendah meningkatkan prevalensi *wasting* sebesar 1,1 kali (OR=1,1; 95%CI=1-1.2). Anak yang tidak mendapatkan suplementasi vitamin A memiliki peluang 1,2 kali lebih besar untuk mengalami *wasting* (OR=1,2; 95%CI=1,1-1,3). Penelitian ini menunjukkan bahwa BBLR merupakan faktor risiko dominan *wasting* pada anak di Indonesia, jika dibandingkan dengan faktor risiko lainnya. Program peningkatan status gizi ibu hamil dan anak dengan BBLR harus dilaksanakan secara intensif dan komprehensif.

GRAPHICAL ABSTRACT



Keyword
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Wasting is regarded as a major public health problem worldwide, particularly among children under five years old. In 2020, the WHO revealed that 47 million children under five years suffered from wasting. Around 45% of the under-five child deaths, in addition, were linked to undernutrition and mostly occurred in low- and middle-income countries. Wasting or low body weight indicates a situation of undernutrition as a consequence of severe weight loss and poor dietary intake (World Health Organization, 2020). Wasting is a major health problem in children due to increased morbidity risk. Some reasons underline why wasting becomes an urgent condition for policy making and program implementation. First, about 4.5% of infant mortalities have been associated with wasting. It increases the risk of infant death from infectious diseases such as diarrhea, pneumonia, and measles.

Moreover, children with severe wasting are at 11 times higher to have risk of death than well-nourished children. Wasting children, furthermore, tend to have growth and development disorders throughout their lives (Olofin et al., 2013). Second, the measurement of body weight is closely related to linear growth restrictions. Children with episodes of wasting have lower linear growth. This association suggests that wasting can redouble the mortality risk associated with stunting. For this reason, it is important to understand that wasting is an emergency that gradually increases each year (Khara & Dolan, 2014).

Indonesia is counted has the fourth-highest burden of acute undernutrition in the world. It is estimated that one in ten Indonesian children suffers from wasting (Ministry of Health of Indonesia, 2018). Although there is a trend of decreasing cases, this figure is classified as high risk because the prevalence is still slightly above 10%. The government's political commitment to handling nutrition cases is consistently associated with achieving the target of the World Health Assembly in 2025 and SDG by 2030. Indonesia still faces some obstacles about lacking dietary intake in half of the population. About 46% of the Indonesian population lack energy intake, 36% of them have protein intake inadequacy, and 38% of the population is unable to purchase nutritious foods. This condition contributes to the decline of the nutritional status among Indonesian children and pregnant mothers, resulting in undernutrition in children and mother which give birth to an infant with low birth body weight (National Development Planning Agency of Indonesia, 2019).

Some previous studies revealed that low birth body weight is closely linked to wasting (Abbas et al., 2021; Ntenda, 2019; Rahman et al., 2016). LBW is a condition of a newborn with a birth body weight lower than 2,500 grams regardless of gestational age. Nearly about 15-20% of children around the world are born with low birth body weight (UNICEF & WHO, 2019). Birth body weight represents the nutritional and health status of the fetus and mother during pregnancy. Some studies have even figured out that children having LBW were more at risk of wasting, lower IQ, and death. Furthermore, once they were in

adulthood, they would have a higher risk of obesity/overweight and suffering from non-communicable diseases such as heart disease and diabetes (Ali et al., 2017; Khan et al., 2019). The majority of LBW cases occurred in both low and middle-income countries, and 95.6% occurred in developing countries (UNICEF & WHO, 2019). Moreover, wasting also is related to other risk factors such as low maternal body mass index, household wealth, poor nutritional status, and poor immunological status (Schaefer et al., 2021; Wali et al., 2021).

Reducing the prevalence of wasting is one of the major concerns of the Indonesian government. Therefore, identification of the main risk factor becomes the government's effort to implement an evidence-based policy to prevent new wasting cases and improve child nutritional status. Given that LBW contributes to child wasting, it is essential to assess the correlation strength of these variables and adjust it to other related risk factors. This present study determined the correlation between LBW and other risk factors for wasting among Indonesian children aged 6-59 months.

METHODS

This study used secondary data from the 2018 Indonesian Basic Health Research, which was conducted longitudinally by the National Institute of Health Research and Development (NIHRD) of the Indonesian Ministry of Health. The research was a cross-sectional community-based survey that aimed to describe the prevalence or incidence of health problems and to assess public health problem indicators as references for health policy-making in Indonesia. This survey involved individuals and households in 34 provinces chosen using a stratified and multi-stage random sampling technique. The data collection was conducted during the course duration of April to June 2018.

This study involved 60,451 children aged 6-59 months. This preliminary number could be different in each variable due to the completeness of the data, although it had been equalized in the multivariate analysis. The child's weight (kg) was measured using a digital scale with 0.1 kg precision. The supine length (cm) of the children aged 6-24 months was measured using length box measurement, while the height of children aged 25-59 months was measured using a microtome with 0.1 cm precision. Wasting status was converted using the Z-score of the WHO's 2005 anthropometric standard. Children with Z-scores below minus two of median standard deviation (-2SD) according to the standard would be categorized as suffering from wasting. Birth body weight is the initial weight of a live newborn and is recorded soon after delivery. In the survey, birth body weight was obtained from written records of child health cards. Birth body weight was, in addition, expressed in grams (g). Newborns with a birth body weight less than 2,500 g were categorized as having LBW, while those with a birth body weight greater than or equal to 2,500 g were categorized as having normal birth body weight.

Outcome variables were categorized as binary variables: wasting (a Z-

score of weight for height at < 2) and normal (a Z-score of weight for height at ≥ 2), LBW (birth body weight at < 2,500 gr), and normal (birth body weight at ≥ 2,500 gr). Other independent risk factors included in the analysis were region, sex, age, paternal and maternal education, paternal and maternal occupation, vitamin A supplement, prematurity, weaning time, and exclusive breastfeeding. The 2018 Indonesian Basic Health Research had obtained ethical permission approved by the National Ethics Committee of NIHRD, No: LB.02.01/2/KE.024/2018.

All data were inputted and analyzed in SPSS for Windows (version 21.0). All data were adjusted by weights to represent data nationally. Respondent's characteristics were shown in a total amount (n) and percentage (%). Differences in proportions (bivariate analysis) were analyzed using Chi-square. A P-value less than 0.25 as a result of the bivariate analysis was included in the multivariable logistic regression model. The correlation strength was analyzed by calculating the odds ratio (OR) with 95% of confidence intervals (CIs). A P-value less than 0.05 is considered statistically significant. A multi-collinearly analysis was performed at first, and the final model used a Variance Inflation Factor (VIF).

RESULTS

The total number of respondents involved was 60,451 children whose ages were 6-59 months. Respondent's characteristics are then described in the following table 1. Fifty-four percent of the respondents lived in urban areas. There were proportionally more boys (50.9%) than girls (49.1%). About 5.8% of the respondents were in the category of LBW, 3.5% suffered from severe wasting, and 6.6% were classified as wasting disease. Most of the respondents were infants aged 12-23 months (24.5%). The majority of parental education was secondary education (junior and senior high school). Half of the children's mothers were housewives, while their fathers worked in various sectors. The majority of their fathers were traders and farmers.

Table 2 depicts that low birth body weight was strongly correlated to wasting (OR=1.54, 95%CI=1.35-1.76), and other eleven variables were also closely correlated to wasting. These factors included residence in rural areas (OR=1.13, 95%CI=1.07-1.19), sex (male) (OR=1.24, 95%CI=1.18-1.31), younger age (OR=1.28, 95%CI=1.21-1.35), paternal low education (OR=1.11, 95%CI=1.05-1.17), maternal low education (OR=1.10, 95%CI=1.04-1.16), unemployed fathers (OR=1.32, 95%CI=1.10-1.59), and children lacking of vitamin A supplement (OR=1.17, 95%CI=1.09-1.25).

Table 2 shows ten selected variables with P values <0.25 to be further processed in the logistic regression analysis. The results of the multivariate analysis are presented in table 3. The final model of multivariate analysis suggested that children with LBW were 1.5 times more likely to be wasted (OR=1.5, 95%CI=1.3-1.8). Boys and younger children (aged 6-23 months) were 1.3 times more susceptible to wasting (OR=1.3, 95%CI=1.2-1.4). Unemployed fathers and mothers accounted for 1.3 and 1.1 times, respectively, to increase the risk

Table 1

The Characteristics of Children Aged 6-59 months

Variables	N	%
Region (60,451)		
Urban	32,648	54
Rural	27,803	46
Age (60,451)		
6 - 11 months	8119	13.5
12 - 23 months	14,716	24.3
24 – 35 months	14,054	23.2
36 – 47 months	12,399	20.5
48 – 59 months	11,163	18.5
Sex (60,451)		
Boys	30,790	50.9
Girls	29,662	49.1
Birth-body weight (34,940)		
<2,500	2,001	5.8
2,500-3,999	31,669	90.6
>=4,000	1,271	3.6
Weight for height (60,451)		
Severe wasting	2,088	3.5
Wasting	3,971	6.6
Normal	49,921	82.5
Fat	4,471	7.4
Paternal education (56,036)		
No education	4,667	8.3
Primary school	12,082	21.6
Secondary school	33,030	58.9
Higher school	6,256	11.2
Maternal education (59,890)		
No education	4,410	7.4
Primary school	12,466	20.8
Secondary school	35,682	59.6
Higher school	7,332	12.2
Paternal occupation (56,036)		
Unemployed	923	1.6
Student	124	0.3
Government employee	2,595	4.6
Private employee	10,874	19.4
Trader	14,105	25.2
Farmer, fisher	13,127	23,4
Housekeeper, domestic and related helper	11,573	20.7
Others	2,714	4.8
Maternal occupation (59,890)		
Housewife	35,186	58.7
Student	401	0.7
Government employee	1,523	2.5
Private employee	4,890	8.2
Trader	5,816	9.7
Farmer, fisher	5,061	8.5
Housekeeper, domestic and related helper	2,251	3.8
Others	4,760	7.9

Table 2
Bivariate Analysis

Variables	Wasting (n)		P	OR (95% CI)
	Yes	No		
Low Birth-body weight (n=34,940)				
Yes	289 (14.5)	1,711 (85.5)	0.000*[a]	1.54
No	3,253 (9.9)	29,687 (90.1)		(1.35-1.76)
Region (n=60,451)				
Rural	2,951 (10.6)	24,852 (89.4)	0.000*[a]	1.13
Urban	3,109 (9.5)	29,539 (90.5)		(1.07-1.19)
Sex (n=60,451)				
Male	3,378 (11)	27,412 (89)	0.000*[a]	1.24
Female	2,681 (9)	26,890 (91)		(1.18-1.31)
Age (n=60,451)				
6 - 23 months	2,759 (11.4)	21,504 (88.6)	0.000*[a]	1.28
24 - 59 months	3,300 (9.1)	32,888 (90.9)		(1.21-1.35)
Paternal education (n=56,036)				
Low	3,025 (10.4)	26,003 (89.6)	0.000*[a]	1.11
High	2,569 (9.5)	24,439 (90.5)		(1.05-1.17)
Maternal education (n=59,890)				
Low	3,360 (10.4)	28,877 (89.6)	0.000*[a]	1.1
High	2,645 (9.6)	25,008 (90.4)		(1.04-1.16)
Paternal occupation (n= 56,036)				
Unemployed	133 (12.7)	914 (87.3)	0.004*[a]	1.32
Employed	5,461 (9.9)	49,528 (90.1)		(1.1-1.59)
Maternal occupation (n= 59,890)				
Unemployed	3,631 (10.2)	31,956 (89.8)	0.081[a]	1.05
Employed	2,374 (9.8)	21,929 (90.2)		(0.99-1.11)
Vitamin A supplement (n=60,451)				
No	1,106 (11.2)	8,742 (88.8)	0.000*[a]	1.17
Yes	4,953 (9.8)	45,650 (90.2)		(1.09-1.25)
Prematurity (n=60,451)				
Yes	350 (10.7)	2,921 (89.3)	0.187[a]	1.08
No	5,710 (10.0)	51,470 (90.0)		(0.96-1.21)
Weaning time (n=4,507)				
≤ 6 months	236 (9.6)	2,222 (90.4)	1	1
> 6 months	196 (9.6)	1,853 (90.4)		(0.82-1.22)
Exclusive breastfeeding (n=21,385)				
No	870 (11.6)	6,628 (88.4)	0.981	0.99
Yes	1,614 (11.6)	12,273 (88.4)		(0.91-1.09)

Note: * = P values < 0.05 will be considered significant; [a] = P values < 0.25 will be included in the multivariate analysis; OR = Odds Ratio, CI = Confident Interval.

of child wasting (OR=1.3, 95%CI=1-1.7; OR=1.1, 95%CI=1-1.2). Meanwhile, mothers with low education contributed to an increase in the prevalence of child wasting 1.1 times (OR=1.1, 95%CI=1-1.2). Children who lacked vitamin A supplements had 1.2 times more chances to be wasted (OR=1.2, 95%CI=1.1-1.3).

DISCUSSION

The correlation between wasting and LBW in Indonesia has not been comprehensively studied yet. The national secondary data analysis conducted in this study investigated whether LBW was related to the acute poor nutritional status of children under five years old or not while adjusting for other known risk factors. This study concluded that there was a strong correlation between LBW and wasting. The risk of wasting in LBW children under five was 1.5 times higher than in normal-birth body

Table 3
Multivariate analysis

Variables (N=32,482)	First Model			Final Model		
	OR	P-value	95%CI	OR	P-value	95%CI
Low birth-body weight	1.6	0	1.4 - 1.8	1.5	0.000*	1.3 - 1.8
Age	1.3	0	1.2 - 1.4	1.3	0.000*	1.2 - 1.4
Sex	1.3	0	1.2 - 1.4	1.3	0.000*	1.2 - 1.4
Paternal occupation	1.3	0.025	1 - 1.7	1.3	0.028*	1 - 1.7
Vitamin A supplement	1.2	0.001	1.1 - 1.3	1.2	0.001*	1.1 - 1.3
Maternal education	1.1	0.124	1 - 1.2	1.1	0.004*	1 - 1.2
Maternal occupation	1.1	0.039	1 - 1.2	1.1	0.043*	1 - 1.2
Paternal education	1.1	0.285	1 - 1.1	-	-	-
Prematurity	0.9	0.172	0.7 - 1	-	-	-
Region	1	0.34	1 - 1.1	-	-	-

Note: * = P values < 0.05 will be considered significant; OR = Odds Ratio, CI = Confident Interval. Models were adjusted to covariates.

weight children, even after it was adjusted to other risk factors in a multivariable model. This finding is consistent with some previous studies that had also discovered a correlation between birth body weight and nutritional status. Infants with LBW were hard to achieve expected body weight as compared to infants with normal birth body weight through 5 years of age. Therefore, LBW was a strong predictor of wasting and severe wasting (Olson et al., 2015; Rahman et al., 2016). Studies held in Ghana also reported that LBW increased the risk of morbidity and mortality due to undernutrition (Ali et al., 2017)

A study in Malawi showed that wasting in preschool children was found higher in children with LBW history. Children with LBW commonly remain undernourished in the early years of childhood (Ntenda, 2019). Children with low birth body weight were more vulnerable to infectious diseases. Children with infectious diseases were mostly accompanied by loss of appetite and nutrition absorption, inducing catabolism, and increased excretion due to vomiting and diarrhea. As a result, children lost energy and were at the risk of wasting. Wasting itself has been observed to be the major cause of immunodeficiency that increases susceptibility to infections (Ibama et al., 2020; Ntenda, 2019).

LBW with premature birth is mostly caused by intrauterine growth restriction (IUGR) in developing countries. They also have a high risk of fever and diarrhea (Rahman et al., 2016). Half of IUGR cases are correlated to the mother's condition, which is under-nutrition, low weight gain during pregnancy, low maternal weight, and anemia. LBW has long-term consequences on postnatal growth. In developing countries, infant girls with LBW tend to have growth restrictions from early infancy until adolescence. Health disruption is caused by LBW, including food intake dysfunction, respiratory distress, and hypoglycemia. Later in life, this can develop maternal complications, cardiovascular disease, and diabetes (Abbas et al., 2021)

The Indonesian government launched a national program to accelerate

children's nutritional status, focusing on the first 1,000 days of child's lives. This period consists of sensitive and specific interventions. Sensitive interventions are related to indirect causes of undernutrition, such as clean water supply and sanitation, nutritional and health services, better awareness of parenting, and improvements in access to nutritious food. Meanwhile, specific interventions are associated with direct causes of undernutrition, such as food supplements for pregnant women and malnourished toddlers, iron supplements for pregnant women and young girls, education, and counseling on early breastfeeding initiation and exclusive breastfeeding, vitamin A supplements, and improvement in the environmental health (National Development Planning Agency of Indonesia, 2019). The main obstacle in the implementation of this program is disparities in resources at the district level. Indonesia, the biggest archipelagic country in the world, has consequently prepared more efforts and time to deliver these interventions comprehensively and adequately. Despite its challenges, this program has been accepted and implemented gradually.

Meanwhile, this study also revealed that younger children (6-23 months) had a higher risk of wasting. In line with studies conducted in Senegal, wasting most commonly occurred in younger children aged 6-29 months (Garenne et al., 2019). Children throughout 24 months of age were in the golden period, having rapid growth and development. Poor nutrition and exposure to infectious diseases during this period were critical and might affect the supine length and weight negatively, resulting in an increased risk of wasting at a younger age (Derso et al., 2017). Children with low birth body weight are at higher risk of growth retardation and nutritional deficits during the first year of life. This condition makes them more susceptible to postnatal wasting (Zoleko-Manego et al., 2021)

Furthermore, this present study showed that boys were more likely to be wasted than girls. This finding is consistent with earlier studies conducted in Sub-Saharan Africa and Northern Ghana (Akombi et al., 2017; Ali et al., 2017). Boys were more susceptible to suffering from wasting because they have higher birth-body weight and supine length at birth and during infancy compared to girls, and thus they need more calorie intakes for growth and development (Wells et al., 2020). In contrast to this finding, a study in Tanzania and southwest rural Ethiopia has discovered that girls had a higher risk of wasting (Mgongo et al., 2017). However, these current findings need to be further explored for more conclusive results.

In addition to sex, this study also suggested that children who missed vitamin A supplements were more at risk of wasting. Similarly, another study in Ethiopia points out that the absence of postnatal vitamin A supplement was 1.55 times higher correlated with wasted children (Tariku et al., 2017). Otherwise, a cross-sectional study in Uganda shows different ideas that children with Vitamin A deficiency had a 43% higher risk of stunting, but this variable had no correlation with wasting or underweight (Ssentongo et al., 2020). Vitamin A plays a role in some biological functions,

including vision development, maintenance of mucosal immunity homeostasis, and intestinal barrier control (de Medeiros et al., 2018). Vitamin A level in children is influenced by the amounts and dietary intakes of breast milk. Mothers who have a low level of vitamin A during pregnancy and postnatal possibly have produced poor vitamin A levels in breast milk (Fernandes et al., 2014).

Other risk factors related to child wasting in Indonesia were low education and unemployed parents. Parental education levels, especially mothers', may influence a child's nutritional status. This study has found that mothers with low education had children at higher risk of wasting. These results are in line with a study conducted by Das & Gulshan in Bangladesh. High maternal education greatly affected the quality of child nutrition care, health services, and sanitation. Meanwhile, a father's education could influence income and decisions to supply basic family needs (Das & Gulshan, 2017). A study in Nepal shows that children whose mothers had no income were three times more likely to be underweight than children whose mothers had monthly income (Sigdel et al., 2020). A systematic review conducted by Ghosh (2020) shows the effect of maternal occupation on a child under nutrition was debatable. Employed mothers can make better decisions to provide healthy food and medical care. However, it is not always true that employed mothers will have well-nourished children. The high demands of work hours possibly make mothers have less time to take care of their children and contribute to poor nutrition in children (Ghosh, 2020). Fathers, who are mainly responsible for providing for family needs, have a significant direct impact on individuals' health. Employed fathers could increase the socioeconomic level of the family. The higher the socioeconomic level of the family, the healthier the individuals (Pinilla et al., 2017). Above all, this study has some limitations. As it used cross-sectional data, in consequence, the researchers could not present a causality association. However, this present study provides more information about the main significant factors predicting wasting in Indonesian children under five.

CONCLUSIONS

In this present study, low birth-body weight was the most dominant risk factor for wasting, even after being adjusted with other risk factors. Maternal health programs to prevent low birth-body weight neonates can be directed towards improving communication, education, and motivation of pregnant mothers to maintain adequate nutritious dietary intake during the pregnancy period. Furthermore, it is important to accelerate nutritional status immediately for neonates born with low birth-body weight and give them intensive care and intervention to prevent acute nutrition. Moreover, integrated support from family, health workers, and governments are required to increase the growth, health, and survival of both children and mothers.

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