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Determinants of Low Birth Weight in Indonesia

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Abstract

Low birth weight (LBW) is one of the main factors influencing the development of chronic disease in adulthood in surviving or surviving infants. This study aims to determine the determinants of the incidence of LBW in toddlers (infants aged 0-5 years) in Indonesia. This study uses a data set from the 2017 Indonesian Demographic and Health Survey (IDHS). The dependent variable is the child's LBW status, while the independent variable consists of 3 variable blocks, namely; distal, intermediate and proximal variables. The number of samples in this study was 14,372 people. Data analysis was done descriptively and inferentially. The results showed that, of the 14,262 samples analyzed, 7% showed LBW. The highest probability of LBW was associated with the type of birth of twins (AOR: 22,087; 95%CI: 18,344-26,194), the order of birth of the 4th child or more (AOR: 2,231; 95%CI: 1,887-2.598), experiencing pregnancy complications (AOR: 1.887; 95% CI: 1.543-2.134), number of ANC visits less than 4 times (AOR: 1.763; 95% CI: 1.411-2.202), low maternal education (AOR: 1.711; 95% CI: 1.344-2.143), no consumption of iron tablets during pregnancy (AOR: 1.316; 95% CI:1.109-1.623), and households with low wealth quintiles (AOR: 1.301; 95% CI: 1.197-1.324. Various aspects have been associated with LBW which is expected to contribute on elaborating health and family policies and promoting better living conditions for mothers and children in Indonesia.

Introduction

Although the prevalence continues to decline, the stunting rate among children under five in Indonesia is still above the global average prevalence of 27.7% compared to 22.0%. (UNICEF/WHO/World Bank, 2021). The low level of intelligence and child productivity as a result of stunting and other nutritional disorders affects economic growth and the provision of quality Human Resources (HR) (McGovern et al., 2017). This has prompted the government to target reducing stunting to become one of the National Priority Programs.

One of the biggest risks of stunting in Indonesia is due to low birth weight (LBW) (Aryastami et al., 2017; Lestari, Hasanah and Nugroho, 2018; Utami et al., 2018). Although children's physical development is more influenced by postnatal conditions, a study in Pakistan found LBW is the main cause of failure to thrive in infants less than three years old. (Avana, Razab and Kirkwoodc, 2014). In line with that, research in Wuhan, China also showed that babies with low birth weight were at risk of experiencing delays in gross motor development, fine motor skills, and adaptability (Zhang et al., 2020). This situation worsens if LBW infants do not receive adequate energy and nutrient intake. Babies with LBW also have a higher risk of experiencing neonatal jaundice or jaundice and causing death (Puspita, 2018). This shows that birth weight is an important indicator of vulnerability to disease risk and child survival (Mulu et al., 2020; Sabbaghchi, Jalali and Mohammadi, 2020).

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Data from the 2012 Indonesian Demographic and Health Survey (IDHS) noted that the prevalence of LBW in Indonesia reached 12%, while the prevalence of extreme LBW (with a baby weighing less than 1,500 grams) was 0.7%. Basic Health Research Results (Riskesdas), 2018 shows that around 6% of children under five in Indonesia have low birth weight, where in general this figure has increased from previous years, although not too big (Ministry of Health of the Republic of Indonesia (Kemenkes, 2018). This condition indicates that LBW is still an important problem that requires special attention and must be resolved immediately because it will affect the quality of Indonesia's next generation of human resources.

Various studies have shown that the incidence of LBW is influenced by internal and external factors of the mother (Falcão et al., 2020; Trerotoli et al., 2021). Indoor air pollution, lack of iron intake during pregnancy, insignificant weight gain during the second and third trimesters of pregnancy, comorbidities during pregnancy, and preterm delivery were found to be risk factors associated with LBW (Anil, Basel and Singh, 2020). In addition, short mother, occurrence of pregnancy complications, gestational hypertension, incomplete antenatal visits, and low maternal education are also predictors of LBW (Mulu et al., 2020).

Although there have been many similar studies, research related to the determinants of LBW is still interesting to continue. The prevalence of LBW which tends to increase and the varying socio-economic conditions of the community, which are thought to have contributed differently to the number of LBW cases in Indonesia, are problems that still require solutions. This study aims to determine the determinants of LBW in children under five in Indonesia using the 2017 IDHS data. This study analyses not only the proximate causes of LBW but also the distal and intermediate variables that influence it, namely social demographics and characteristics of prenatal care. With the information generated from this study, it is hoped that the risk of LBW can be prevented, making it easier for policy makers to formulate strategies to intervene to prevent stunting and other child development disorders due to LBW..

Method

This study uses the 2017 IDHS data which is a cross sectional study. The unit of analysis in this study were women who gave birth in the last five years and their children were weighed at birth. In accordance with these criteria, the number of samples obtained was 14,372 women (Figure 1). The dependent variable in this study is the child's birth weight status, which is categorized into two, namely normal (baby birth weight 2,500 grams) and LBW (baby birth weight <2500 grams). The independent variable used is a modification of the research (Belfort et al., 2018) and (Falcão et al., 2020) which consists of 3 blocks of variables, namely distal variables, intermediate variables (intermediate) and proximal variables. The distal variable is a sociodemographics characteristic consisting of area of residence, source of drinking water, sanitation, fuel for cooking, availability of hand washing facilities, number of members in the household, mother's marital status, mother's education, mother's ownership of health insurance, wealth quintile and last pregnancy status. The intermediate variable is the characteristic variable of prenatal care, namely the number of ANC visits. Proximal variables are biological and obstetrical characteristics variables consisting of maternal age at delivery, pregnancy complications, consumption of iron tablets during pregnancy, maternal smoking status, sex of newborn, birth order of newborns, and type of birth.

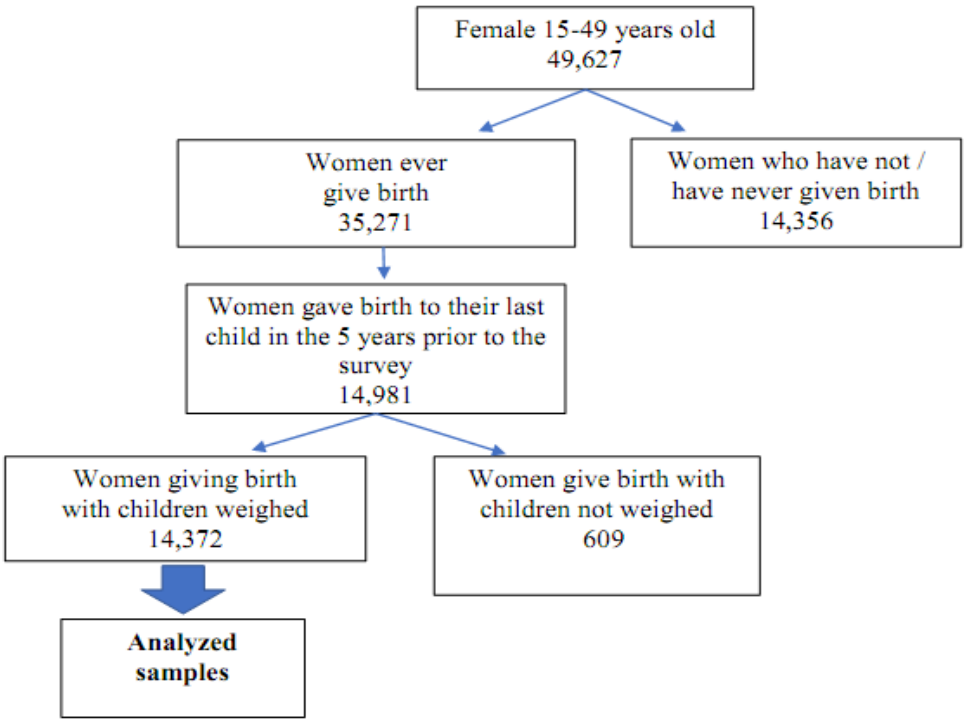

Figure 1. Flowchart Description Detailing the Acquisition of the Unit of Analysis/Research Sample

Data analysis was done descriptively, bivariately, and multivariately. Bivariate analysis was carried out through the Chi Square Test which aims to examine the relationship of each independent variable with the dependent variable, namely the baby's birth weight status. Meanwhile, to analyze the relationship between the independent variables and the baby's birth weight status multivariately (simultaneously with several variables), binary logistic regression analysis was used.

The limitations of this study are: 1) This study is limited to data from the 2017 IDHS processing for WUS (15-49 years) who had given birth to their last child in the 5 years prior to the survey with children being weighed. 2) The lack of data on LBW babies is very dependent on the respondent's memory (recall bias), because this question occurred before the survey and allowed respondents to forget and not remember for sure.

Results and Discussion

Among the 14,372 samples investigated, 6.7% found LBW. Table 1 lists the characteristics of newborns with LBW. About sociodemographic characteristics (distal), 50.1% live in urban areas, 88.0% have proper drinking water sources, 82.7% have proper sanitation, 78.9% cook using electricity/gas fuel, have proper hand washing facilities (88.9%), the number of household members is 5-7 people (48.4%), the mother's marital status is married/living together (97.1%), secondary education (59.4%), has health insurance (59%), high wealth quintile (40.9%), and desired last pregnancy status (83.6%). Regarding the characteristics of prenatal care (intermediate), 92.8% had complete ANC visits (>4 times).

According to biological and obstetric characteristics (proximal), 77.0% maternal age at delivery was 20-35 years, did not experience pregnancy complications (82.1%), consumed iron tablets during pregnancy (87.6%), maternal status did not smoke (98.5%), the sex of the boy (51.1%), the order of birth of the last 2-3 children (53.8%), and the type of single birth (99.3%).

Table 1. Distribution of Sample Characteristics

Variable		Frequency	%
Baby's weight			
Baby's weight at birth	Normal (>=2500gr)	13,403	93.3
	LBW (< 2500gr)	968	6.7
Sociodemography (Distal)			
Residential area	Urban	7,196	50.1
	Rural	7,176	49.9
drinking water source	Worthy	12,646	88.0
	Not worthy	1,726	12.0
Sanitation	Worthy	11,887	82.7
	Not worthy	2,485	17.3
Cooking fuel	Electric/gas	11,343	78.9
	Non-electric/gas	3,029	21.1
Hand washing facilities	Worthy	12,775	88.9
	Not worthy	1,597	11.1
Number of members in Ruta	<= 4	5,965	41.5
	5-7	6,963	48.4
	>7	1,444	10.1
Mother's marital status	Married/live together	13,950	97.1
	Not married (divorced/separated)	422	2.9
Mother's education	Low (<=Elementary School)	3,641	25.3
	Middle School (Junior High School-High School)	8,543	59.4
	College (Academy/College)	2,188	15.3
Mother's ownership of health insurance	No	5,894	41.0
	Yes	8,477	59.0
Wealth quintile	Low	5,450	37.9
	Medium	3,039	21.2
	High	5,883	40.9
Recent pregnancy status	Yes, wanted	12,009	83.6
	Wanted later	1,188	8.3
	Unwanted	1,175	8.1
Prenatal care (intermediate)			
Number of ANC visits	Never	207	1.4
	1-3 times	830	5.8
	≥4 times	13.335	92.8
Biological and midwifery (proximal)			
Mother's age at birth	<20	886	6.2
	20-35	11,069	77.0
	>35	2,417	16.8
Pregnancy complications	No	11,804	82.1
	Yes	2,568	17.9
Consumption of iron tablets during pregnancy	No	1,780	12.4
	Yes	12,592	87.6
Mother's smoking status	No	14,152	98.5
	Yes	220	1.5
Gender of child	Male	7,339	51.1
	Female	7,033	48.9
Birth order	1	4,872	33.9
	2-3	7,739	53.8
	≥4	1,769	12,3
Birth type	Single	14,270	99.3
	Twins(>1)	101	0.7
	Total	14,372	100.0

Source: IDHS, 2017

Table 2 illustrates the results of our bivariate and multivariate analyses. After analyzing simultaneously (multivariate) it was seen that not all variables statistically related to LBW in the bivariate analysis had an effect on LBW, after being controlled by other variables. In the adjusted model for multivariate analysis, the likelihood of LBW was higher among infants born to women who self-proclaimed multiple births (AOR: 22,087; 95% CI: 18,344-26,194), birth order of children to 4 or more (AOR: 2,231; 95% CI: 1.887-2.598), experienced pregnancy complications (AOR: 1.887; 95% CI: 1.543-2.134), the number of ANC visits was less than 4 times (AOR: 1.763; 95% CI: 1.411-2.202), low maternal education (AOR: 1.711; 95% CI: 1.344-2.143), did not take iron tablets during pregnancy (AOR: 1.316; 95% CI: 1.109-1.623), and households with low wealth quintiles (AOR: 1,301; 95% CI: 1,197-1,324).

Table 2. Tendency Ratio (Odds Ratio) Effect of Independent Variables on Infant Weight Status at Birth, 2017 IDHS

Variable/Category		Baby Weight Status at Birth				Bivariate		Multivariate			
		Normal (>=2500gr)		LBW (< 2500gr)		OR	P-value	AOR	P-value	CI 95%	
		N	%	n	%						
Sociodemography (Distal)											
Residential area	Urban*	6,707	93.2	489	6.8	1.00	0.799				
	Rural	6,696	93.3	480	6.7	0.98					
Source of drinking water	Worthy*	11,814	93.4	832	6.6	1.00	0.035				
	Not worthy	1,589	92.1	137	7.9	1.22					
Sanitation	Worthy*	11,133	93.7	755	6.3	1.00	0.000				
	Not worthy	2,271	91.4	214	8.6	1.39					
cooking fuel	Electric/gas*	10,611	93.5	732	6.5	1.00	0.008				
	Non-electric/gas	2,792	92.2	237	7.8	1.23					
Hand washing facilities	Worthy*	11,945	93.5	830	6.5	1.00	0.001				
	Not worthy	1,458	91.3	139	8.7	1.37					
Number of members in Home	<= 4*	5,603	93.9	361	6.1	1.00	0.015				
	5-7	6,467	92.9	496	7.1	1.19					
	>7	1,333	92.3	112	7.7	1.30					
Marital status	Married/live together *	13,024	93.4	926	6.6	1.00	0.007				
	Not married (divorce/separate)	380	90.0	42	10.0	1.56					
Education	Low (<=Elementary School)	3,326	91.4	315	8.6	1.69	0.000	1,711	0.000	1.344 -	2,143
	Middle School (Junior High School-High School)	8,005	93.7	538	6.3	1.20		1,269	0,021	1,096 -	1.443
	Higher education (Academy/ College)*	2,072	94.7	116	5.3	1.00		1.000			
Health insurance ownership	No	5,503	93.4	391	6.6	0.97	0.666				
	Yes*	7,900	93.2	578	6.8	1.00					
Wealth quintile	Low	5,024	92.2	426	7.8	1.35	0.000	1,301	0,002	1,197 -	1,324

	Medium	2,843	93.6	196	6.4	1.10		1,193	0,010	1,091 -	1,203
	High*	5,536	94.1	347	5.9	1.00		1,000			
Recent pregnancy status	Yes, wanted*	11,185	93.1	824	6.9	1.00	0.365				
	Wanted later	1,113	93.7	75	6.3	0.91					
	Unwanted	1,105	94.1	69	5.9	0.85					
Prenatal Care *Intermediate*)											
Number of ANC visits	< 4 kali	916	88,2	121	11,8	1,96	0,000	1,763	0,000	1,411 -	2,202
	≥4 kali *	12.488	93,6	847	6,3	1,00		1,000			
Biological and Midwifery (*Proximal*)											
Age of woman/mother	<20	815	92.0	71	8.0	1.23	0.292				
	20-35*	10,335	93.4	735	6.6	1.00					
	>35	2,254	93.3	163	6.7	1.01					
Pregnancy complications	No*	11,102	94.1	702	5.9	1.00	0.000	1,000			
	Yes	2,302	89.6	267	10.4	1.83		1,887	0,000	1,543 -	2,134
Consumption of iron tablets during pregnancy	No	1,619	91.0	161	9.0	1.45	0.000	1,316	0,008	1,109 -	1,623
	Yes*	11,784	93.6	808	6.4	1.00		1,000			
Smoking status of woman/mother	No*	13,195	93.2	957	6.8	1.00	0.301				
	Yes	209	95.0	11	5.0	0.73					
Child gender	Male*	6,868	93.6	471	6.4	1.00	0.113				
	Female	6,535	92.9	498	7.1	1.11					
Birth order	1	4,512	92.6	361	7.4	1.22	0.013	1.113	0,020	1,041 -	1,334
	2-3*	7,262	93.8	477	6.2	1.00		1.000			
	≥4	1,354	92.4	111	7.6	4.45		2.231	0,000	1,887 -	2,598
Birth type	Single*	13,372	93.7	898	6.3	1.00	0.000	1.000			
	Twins(>1)	31	31.0	70	69.0	33.16		22.087	0,000	18,344 -	26,194

Source: IDHS, 2017

This study evaluates the factors associated with low birth weight (LBW) infants in Indonesia. Our findings show that LBW is associated with babies born to mothers who self-declared the type of birth of twins, birth order of children 4 or more, experiencing pregnancy complications, number of incomplete ANC visits 1-3 times, low maternal education, households with low wealth quintile and did not take iron tablets during pregnancy. Twin pregnancy is the most risky variable for LBW in this study. The results showed that twin pregnancies had 22,087 times the chance of developing LBW compared to singleton pregnancies. In addition to being at risk for LBW, twins are at risk for neonatal death. The results of research conducted by (Bintang et al., 2018) showed that there was a significant relationship between multiple births and neonatal mortality, where multiple births had a 2.39 times chance of experiencing neonatal death compared to singleton births after controlling for parity factors and birth weight.

Another significant factor influencing the incidence of LBW is birth order. In the order of birth of children, the greater the number of birth orders of children, the greater the possibility of LBW. The chance of LBW births decreases in birth order 2-3, but in birth order 4 or more it can increase the chance of LBW birth 4.45 times greater than birth order 2-3 children. Children with the first birth order also have a greater chance of experiencing LBW than those in the 2-3 birth order (Zaveri et al., 2020). This may happen because mothers who are pregnant for the first time are not experienced in caring for their pregnancies. This condition is the same as what happened in India, the order of birth of more than two children actually reduces the risk of LBW (Khan, Mozumdar and Kaur, 2020). Testosterone levels are thought to affect LBW in the first child, while in the second child it will increase by 115 grams, but this trend decreases in the third and fourth order. The higher the age of the mother and the greater the number of children, the lower the testosterone level (Ghaemmaghami et al., 2013).

Another important predictor of low birth weight in this study is the occurrence of pregnancy complications. The results of the multivariate analysis in this study showed that there was a relationship between a history of complications during pregnancy and the incidence of LBW with p-value = 0.000 (<0.05), which was statistically significant. The adjusted odds ratio or AOR value obtained is 1.887 (95% CI: 1.543 - 2.134), meaning that mothers who have a history of complications during pregnancy are at 1.887 times greater risk than mothers who do not have a history of complications during pregnancy to give birth to children with low birth weight. This finding strengthens previous research that women who experience complications during pregnancy will increase the incidence of LBW (Mulu et al., 2020).

The estimated OR for LBW was found to increase with a decrease in the number of prenatal visits, indicating the importance of prenatal care. Less provision of prenatal care, characterized by a lower number of visits, has been associated with negative perinatal outcomes, such as low birth weight (Mahumud, Sultana and Sarker, 2017; Belfort et al., 2018; Falcão et al., 2020; Mulu et al., 2020; Bekalo et al., 2021). Mothers who perform ANC at least 4 times, tend to be less likely to experience LBW births. Research in India states that the incidence of women giving birth to LBW babies is lower in mothers who perform ANC 4 times (Zaveri et al., 2020). Furthermore, it is stated that routine pregnancy check-ups will affect the practice of maternal health for the fetus so that incomplete ANC visits have a significant effect on the incidence of LBW. Even incomplete ANC increases the risk of LBW up to 7 times greater (Mulu et al., 2020). This happens in several developing countries, inadequate ANC increases the risk of LBW occurrences than those who perform ANC according to standards, but this is greatly influenced by the frequency of standard ANC visits in each country (Mahumud, Sultana and Sarker, 2017) . Mothers who perform ANC will monitor hemoglobin levels more closely from the beginning of pregnancy until delivery, besides that the clinic can also monitor the condition of anemia, height and weight so that the mother's actual BMI is measured during pregnancy (Adam et al., 2019).

Our analysis shows that the incidence of LBW babies is inversely related to the mother's

level of education, i.e. the lower the mother's education level leads to a greater chance of giving birth to LBW babies. This finding corroborates other studies investigating factors associated with LBW, highlighting the importance of socioeconomic conditions, especially with regard to the education level of mothers or their families (Trisnawati, Salimo and Murti, 2018; Falcão et al., 2020; Mulu et al., 2020; Bekalo et al., 2021). Maternal education level is associated with better knowledge of nutrition and generally understanding and adhering to health professional recommendations during pregnancy (Falcão et al., 2020). Educational factors and good wealth quintiles are protective factors against the incidence of LBW. Other studies also show that educated women generally have more access to health facilities and are more exposed to information about the risks of inadequate health service utilization (Adam et al., 2019). Another finding also states that illiterate mothers have a high risk of experiencing LBW when compared to educated mothers, even mothers with low education have a 4 times greater risk of experiencing LBW than mothers with higher education (Mahumud, Sultana and Sarker, 2017; Mulu et al., 2020).

The proportion of LBW decreased along with the increasing level of household wealth of respondents. This finding is in line with other studies that the incidence of LBW is inversely related to wealth quintiles (Trisnawati, Salimo and Murti, 2018; Bekalo et al., 2021). In addition, it is stated that economically well-off families will go to better quality health facilities and be exposed to as much information as possible regarding adequate health during pregnancy, because rich women are easier to educate. In addition, rich families are able to consume appropriate and nutritious food during pregnancy so that the risk of experiencing low birth weight is lower than poor women (Adam et al., 2019). The richer the economic level, the lower the chance of experiencing LBW, one of the reasons is that mothers with poor economic conditions experience a greater level of stress which affects the condition of their pregnancy (Ghaemmaghami et al., 2013; Mahumud, Sultana and Sarker, 2017; Zaveri et al., 2020).

The incidence of LBW decreases along with behavior during pregnancy, namely the consumption of iron tablets. Prevention of LBW also depends on the fulfillment of nutrition and lifestyle during pregnancy, including the use of multivitamin supplements containing calcium, iron and folic acid, all essential micronutrients for proper fetal growth, in addition to preventing risky behaviors, for example: tobacco use (cigarettes), alcohol and drugs (Falcão et al., 2020). This finding is similar to a previous study which stated that not taking the required daily iron supplementation and mothers with first trimester hemoglobin below 11 g/dl were determinants of low birth weight (Adam et al., 2019). Another finding states that iron intake of less than 180 tablets during pregnancy is at risk of developing low birth weight (Anil, Basel and Singh, 2020).

Conclusion

Although the percentage is low, the continuous increase in the prevalence of babies born with low body weight must be watched out for. The closest variable (proximal) was statistically proven to have the greatest influence on low birth weight babies. However, the influence of other factors cannot be ignored, especially in the formulation of intervention strategies. The influence of distal variables, namely education and wealth status, on the knowledge and attitudes of the mother then greatly determines the mother's behavior in an effort to prevent her baby from being born with low weight. Therefore, policies to improve women's education are still very important. Not only affecting the level of knowledge about nutrition, pregnancy care, and reproductive health including family planning, improving women's education is also an effort to improve their welfare in the future. With a good level of welfare, it is hoped that nutritional fulfillment can be carried out in a sustainable manner in all phases of life. In addition, there needs to be a strategy for providing integrated communication, information, and education between the Family Planning Program (KB) and nutrition improvement that targets not only EFA but also teenagers..

The provision of communication, information, and education, family planning programs and nutrition education as early as possible is expected to prevent malnutrition

experienced by pregnant women which has an impact not only on the health of the mother but also the baby born. Improving health facilities that meet the ideal ANC examination standards supported by adequate resources, equipment, and affordable prices so that pregnant women can get quality ANC services. In addition, for health workers to provide counselling for pregnant women and their husbands on a regular basis to increase the knowledge of pregnant women about the importance of the ideal ANC examination so that mothers and babies are born healthy. Health facilities should be more active in providing counselling or communication, information, and education, putting up media posters, and providing leaflets related to iron (Fe) tablets and anemia to pregnant women and their husbands, so that they can motivate pregnant women to consume iron tablets. (Fe).

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