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Research Article

Keywords: low birth weight, disparities, socioeconomic, wealth status, antenatal care, maternal health, nutrition

Posted Date: October 23rd, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-96360/v1>

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ABSTRACT

Background: Poverty is estimated to increase a mother's chances of giving birth to a low birth weight baby (LBW).

Objective: This study aimed to analyze the socioeconomic disparities of LBW in rural Indonesia.

Methods: Mother aged 15-49 years old who had given birth in the last 5 years in rural Indonesia was used as the unit of analysis. With stratification and multistage random sampling found 19,283 mothers were sampled. The variables analyzed included LBW, socioeconomic, age, marital, education, employment, and antenatal care (ANC). The binary logistic regression test was used at the final stage to determine the existence of disparities.

Results: The results show that the mother with the poorer wealth status was 0.686 times more likely than the poorest mother to give birth to an LBW baby. Mothers with middle wealth status were 0.688 times more likely than the poorest mothers to give birth to LBW babies. Mothers with richer wealth status were 0.621 times more likely than the poorest mothers to give birth to LBW babies. Finally, the richest mothers were 0.452 times more likely than the poorest mothers to give birth to LBW babies. The results of this analysis inform that the better the socioeconomic of mothers, the lower the likelihood of giving birth to LBW babies. Apart from socioeconomics, the analysis also found two other predictors of LBW in rural Indonesia, namely education level and ANC visits.

Conclusion: It was concluded that there were socioeconomic disparities of LBW in rural Indonesia.

Keywords: low birth weight, disparities, socioeconomic, wealth status, antenatal care, maternal health, nutrition.

Introduction

Low birth weight (LBW) is a condition where the baby's body weight is less than 2500 grams. This condition can be caused by genetic elements or premature birth signs.¹ LBW is found in 15.5% of births in the world and 90% occurs in developing countries^{2,3}. The prevalence of LBW in Indonesia has increased from 2002 to 2013, namely 9.30% to 10.2%. This is linear with the situation of infant mortality due to LBW in Indonesia is still high, namely 29%⁴.

LBW is responsible for infant mortality as much as 75% of total infant mortality. This often occurs in the first week of birth because of the conditions of asphyxia and prematurity⁵. LBW is an important matter for health workers, policymakers, and parents to pay attention to because it can inhibit the baby's brain growth, mental retardation, and the risk of several other infectious diseases. The risk of LBW will be more complex when entering adolescence which can affect the increased risk of coronary heart disease, diabetes, immune system disorders and metabolism⁶.

In general, LBW describes maternal health conditions, maternal malnutrition, irregular access to ANC services, and the mother's low socioeconomic status^{5,7,8}. Several studies explain that the factors that cause LBW include maternal factors, nutritional factors, social factors, medical factors, environmental factors, and socio-cultural factors⁵. Indonesia as a country that has a diversity of socio-cultural values and adheres to a patriarchal ideology, which places men as family leaders, who have power and control rights over women⁹⁻¹¹. In the end, the gender ideological context attaches the position of women as companions to husbands, household regulators and the primary caregivers of children, thereby weakening the bargaining position of wives towards husbands in making decisions in the household. This condition ultimately makes women not economically independent so that it can have consequences on access to health services during pregnancy and childbirth^{12,13}. This situation is still very strong, especially in rural areas.

Poor households have limitations in providing food for all family members, including the food needs of pregnant women. Insufficient food availability does not only apply in quantity but also quality^{14,15}. This condition is a challenge in itself for poor households related to the increased need for macro and micronutrition in pregnant women due to nutritional needs for mothers and fetuses¹⁶.

In general, the health status of people living in rural areas is often lower than those in urban areas, including access to health service facilities, both for basic and referral services^{17,18}. Previous research in Italy and Ethiopia informed that mothers living in rural areas have a higher likelihood of giving birth to LBW babies¹⁹⁻²¹. Neighborhood socioeconomic status, wealth index, toilet types, and sources of drinking water were the most significant contributors to pro-rural inequalities in malnutrition²². Based on the background description, the study aimed to analyze the socioeconomic disparities of LBW in rural Indonesia.

Methods

Data Source

The study employed secondary data from the 2017 Indonesian Demographic Data Survey (IDHS) as material for analysis. The unit of analysis in this study was mother aged 15-49 years old who had given birth in the last 5 years in rural Indonesia. By using the sampling method stratification and multistage random sampling obtained 19,283 mothers as respondents.

Data Analysis

In this study, LBW was defined according to WHO terminology, namely a birth weight of fewer than 2,500 grams (or 5.5 pounds), regardless of gestational age. Birth weight was the newborn's first bodyweight measured after birth and should be measured within the first hour of life before significant postnatal weight loss occurs².

Socioeconomic status was based on the wealth quintile owned by a household. Households were scored based on the numbers and types of items they had, from televisions to bicycles or cars, and housing characteristics, such as drinking water sources, toilet facilities, and main building materials for the floor of the house. This score was calculated using principal component analysis. National wealth quintiles were arranged based on household scores for each person in the household and then divided by the distribution into the same five categories, with each accounting for 20% of the population, namely quintile 1 (poorest), quintile 2 (poorer), quintile 3 (middle), quintile 4 (richer), and quintile 5 (richest)²³.

Apart from socioeconomic, other independent variables analyzed in this study were age group, marital status, education level, employment status, and antenatal care (ANC) visits. The age group was divided 5 years into 7 categories, namely 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, and 45-49. Marital status was divided into 2 categories, namely never in union/divorced/widowed and married/living with a partner. Education level was divided into 4 categories, namely no education, primary, secondary, and higher. Employment status was divided into 2 categories, namely unemployed and employed. Meanwhile, the ANC visits were divided into 2 categories, namely incomplete ANC visits (<4 times) and complete ANC visits (≥ 4 times). The distribution of ANC visits was based on recommendations from the Ministry of Health of the Republic of Indonesia that recommends ANC visits during pregnancy be performed at least 4 times, namely, 1 time in the first trimester, 1 time in the second trimester, and 2 times in the third trimester²⁴.

In this study, all the variables analyzed were dichotomous variables, so the Chi-Square test was used to see the relationship between ANC visits and other variables. The binary logistic regression was used in the final stage to determine predictors and see their odds ratios. All statistical analyzes were carried out using SPSS 22 software.

Procedure

The national ethics committee has approved ethical clearance from the 2017 IDHS. The respondents' identities have all been deleted from the dataset. Respondents have provided written approval for their involvement in the study. The author has obtained permission to use the 2017 IDHS data from ICF International through its website: <https://dhsprogram.com/data/new-user-registration.cfm>.

Results

Figure 1 shows the distribution map of LBW by the province in rural Indonesia. The distribution looks random. There is no certain pattern spatially, either in the western, central, or eastern regions.

Figure 1. Distribution of LBW by the province in rural Indonesia, the 2017 IDHS

Figure 2. Interaction diagram between 3 variables (LBW, socioeconomic, and ANC visits) in rural Indonesia, the 2017 IDHS

Figure 2 shows a diagram of the interaction between 3 variables, namely LBW, socioeconomic, and ANC visits in rural Indonesia. It can be seen that for mothers who make complete ANC visits (≥ 4 times) the percentage of LBW tends to be lower following the better socioeconomic status.

Table 1 shows the descriptive statistics of the socioeconomic status of respondents in rural Indonesia. It can be seen that in all socioeconomic categories are dominated by mothers who give birth to LBW babies. Based on the age group, two socioeconomic groups are

dominated by the 35-39 age group (the poorest and the richer), the remaining three groups are dominated by the 30-34 age group.

Based on marital status, all socioeconomic categories are dominated by married/living with partner mothers. Based on education level, the poorest and the poorer are dominated by mothers with primary education, meanwhile, the remaining three groups are dominated by mothers with secondary education.

Furthermore, based on employment status, it can be seen that the employed mothers dominate all socioeconomic categories, except for the poorer and the middle who are dominated by unemployed mothers. Based on ANC visits, all socioeconomic categories are dominated by mothers who make complete ANC visits during pregnancy.

Information on the results of the binary logistic regression test of LBW in rural Indonesia can be seen in Table 2. It can be seen that socioeconomics is one of the strong predictors of LBW in rural Indonesia. Mothers with poorer wealth status were 0.686 times more likely than the poorest mothers to give birth to LBW babies (OR 0.686; 95% CI 0.585-0.805). Mothers with middle wealth status were 0.688 times more likely than the poorest mothers to give birth to LBW babies (OR 0.688; 95% CI 0.571-0.829). Mothers with richer wealth status were 0.621 times more likely than the poorest mothers to give birth to LBW babies (OR 0.621; 95% CI 0.489-0.788). Finally, the richest mothers were 0.452 times more likely than the poorest mothers to give birth to LBW babies (OR 0.452; 95% CI 0.314-0.651). The results of this analysis inform that the better the socioeconomic of a mother, the lower the likelihood of giving birth to LBW babies. The socioeconomics is a barrier from LBW in rural Indonesia.

Apart from socioeconomic, the analysis also found two other variables as predictors of LBW in rural Indonesia. First, education level. Mothers with secondary education have a probability of 0.608 times compared to no education mothers to give birth to LBW babies (OR 0.608; 95% CI 0.425-0.870). Mothers with higher education have 0.483 times the chance of having no education mothers to give birth to LBW babies (OR 0.321; 95% CI 0.321-0.726). Meanwhile, there is no difference between mothers with primary education compared to mothers with no education. The results of this analysis inform that a better level of education is an inhibiting factor for LBW in rural Indonesia.

Second, ANC visits. Mothers who made complete ANC visits (≥ 4 times) during pregnancy were 0.620 times more likely than mothers who did not complete ANC visits (< 4 times) (OR 0.620; 95% CI 0.530-0.724). This information shows that complete ANC visits are a protective factor for mothers to deliver LBW babies in rural Indonesia.

Tabel 1. The descriptive statistics of the socioeconomic status of respondents in rural Indonesia (n=19,283)

Variables	Socioeconomic Status										P
	Poorest		Poorer		Middle		Richer		Richest		
	n	%	n	%	n	%	n	%	n	%	
Low Birth Weight											***0.000
• No	3231	34.5%	1794	42.1%	1218	43.7%	836	44.8%	463	45.8%	
• Yes	6133	65.5%	2466	57.9%	1567	56.3%	1028	55.2%	547	54.2%	
Age group											***0.000
• 15-19	161	1.7%	50	1.2%	33	1.2%	11	0.6%	10	1.0%	
• 20-24	898	9.6%	448	10.5%	278	10.0%	128	6.9%	67	6.6%	
• 25-29	1726	18.4%	798	18.7%	537	19.3%	390	20.9%	181	17.9%	
• 30-34	2307	24.6%	1172	27.5%	769	27.6%	508	27.3%	285	28.2%	
• 35-39	2429	25.9%	1043	24.5%	623	22.4%	526	28.2%	278	27.5%	
• 40-44	1374	14.7%	588	13.8%	455	16.3%	247	13.3%	145	14.4%	
• 45-49	469	5.0%	161	3.8%	90	3.2%	54	2.9%	44	4.4%	
Marital status											***0.000
• Never in union/ Divorced/Widowed	321	3.4%	112	2.6%	73	2.6%	28	1.5%	17	1.7%	
• Married/Living with partner	9043	96.6%	4148	97.4%	2712	97.4%	1836	98.5%	993	98.3%	
Education Level											***0.000
• No education	617	6.6%	65	1.5%	14	0.5%	4	0.2%	0	0.0%	
• Primary	4880	52.1%	1623	38.1%	825	29.6%	312	16.7%	133	13.2%	
• Secondary	3558	38.0%	2202	51.7%	1575	56.6%	1097	58.9%	444	44.0%	
• Higher	309	3.3%	370	8.7%	371	13.3%	451	24.2%	433	42.9%	
Employment status											***0.000
• Unemployed	4632	49.5%	2307	54.2%	1455	52.2%	801	43.0%	398	39.4%	
• Employed	4721	50.5%	1949	45.8%	1330	47.8%	1060	57.0%	612	60.6%	
ANC visits											***0.000
• < 4 times	749	22.1%	204	11.1%	110	8.6%	57	6.8%	22	5.0%	
• ≥ 4 times	2638	77.9%	1632	88.9%	1173	91.4%	780	93.2%	421	95.0%	

Note: * p < 0.05; ** p < 0.01; *** p < 0.001.

Table 2. Results of binary logistic regression of LBW in rural Indonesia (n=19,283)

Predictor	Low Birth Weight			
	P	OR	Lower Bound	Upper Bound
Socioeconomic status: Poorest	-	-	-	-
Socioeconomic status: Poorer	***0.000	0.686	0.585	0.805
Socioeconomic status: Middle	***0.000	0.688	0.571	0.829
Socioeconomic status: Richer	***0.000	0.621	0.489	0.788
Socioeconomic status: Richest	***0.000	0.452	0.314	0.651
Age group of respondents: 15-19	-	-	-	-
Age group of respondents: 20-24	0.959	0.991	0.709	1.386
Age group of respondents: 25-29	0.201	0.805	0.577	1.123
Age group of respondents: 30-34	0.112	0.762	0.545	1.066
Age group of respondents: 35-39	0.095	0.746	0.529	1.052
Age group of respondents: 40-44	0.225	0.792	0.543	1.155
Age group of respondents: 45-49	0.265	0.742	0.438	1.255
Marital status: Never in union/Divorced/Widowed	-	-	-	-
Marital status: Married/Living with partner	0.572	0.912	0.662	1.256
Education Level: No education	-	-	-	-
Education Level: Primary	0.067	0.719	0.505	1.024
Education Level: Secondary	**0.006	0.608	0.425	0.870
Education Level: Higher	***0.000	0.483	0.321	0.726
Employment status: Not employed	-	-	-	-
Employment status: Employed	0.291	0.933	0.821	1.061
ANC visits: < 4 times	-	-	-	-
ANC visits: $\geq$ 4 times	***0.000	0.620	0.530	0.724

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Discussion

The findings of the study indicate that the better a mother's socioeconomic level, the lower the chances of having an LBW baby. This means that socioeconomic status is a strong protective factor for LBW in rural Indonesia. LBW can be caused by poor maternal nutritional intake in mothers with low socioeconomic status as found in other previous studies. This information indicates that the poverty inherent in a family affects the availability and diversification of food consumed by pregnant women in the family so that it has an impact on babies born LBW²⁵.

Socioeconomic disparities of LBW have also been reported in several studies in various low-income countries. Among them in India, Ethiopia, Bangladesh, and Pakistan^{8,26-28}. This finding reinforces the results of a previous systematic review analyzing publications in three electronic databases (PubMed, Scopus and Science Direct), which found that the socioeconomic disparities of LBW existed in 11 studies published in English²⁹.

Meanwhile, another study in India found different findings. The results of the analysis in this study found that the relationship between socioeconomics and LBW was not significant. It can occur if a poor pregnant woman can maintain a good nutritional status and avoid potential medical complications during pregnancy so that giving birth to a normal weight baby is

possible³⁰. This information can also be one of the government's strategies to reduce the prevalence of LBW with food interventions for poor pregnant women.

The results showed that a better level of education is an inhibiting factor for LBW in rural Indonesia. Better education levels are proven to provide a better understanding to mothers so that they can manage their needs and fulfillment efforts. Better education levels are closely related to women's empowerment, which also impacts maternal nutrition and reduces the incidence of LBW^{16,31}.

A study in Brazil informed that there was a significant decrease in LBW in neonates born to mothers with higher education levels, and there was a slight increase in mothers with poor education³². The results of this study are in line with several previous studies in various countries, which found that a better level of maternal education is a protective factor for LBW^{16,26,33}. In several previous studies, it has often been found that a better level of education results in better output on health outcomes³⁴⁻³⁷. On the other hand, poor education is a barrier to achieving health status to become more qualified^{38,39}.

Meanwhile, complete ANC visits are proven to be a protective factor for mothers to deliver LBW babies in rural Indonesia. This finding reaffirms the importance of monitoring the pregnancy to health workers²⁴. ANC is considered beneficial for the health of pregnant women. Good ANC quality can reduce the incidence of LBW⁴⁰. ANC provides routine monitoring of height and weight gain, identification of maternal or fetal medical problems, counseling on tobacco or substance use, providing psychosocial support, nutritional advice, and early intervention that can reduce adverse pregnancy output including LBW. Access to high-quality ANC should be emphasized as it not only improves maternal health but also provides opportunities for counseling and other risk assessment related to pregnancy⁷.

Unlike Indonesia, in Ghana, the local government recommends ANC visits during pregnancy for 8 times. It was informed that mothers who make ANC visits as recommended by the government (at least 8 visits) are significantly less likely to have LBW babies than mothers who make fewer visits⁴¹. Similar information was also found in the Indian study. Mothers who have complete ANC visits, mothers who take IFA tablets during pregnancy, mothers with normal BMI, and mothers who are over 20 years of age, are shown to have a lower chance of giving birth to LBW babies⁸. Similar information is also informed in a study by taking samples in several developing countries³.

The results of this study provide a clear target for the government in its efforts to reduce the prevalence of LBW in Indonesia. Pregnant women with poor socioeconomic and poor education are the main targets. A policy is needed to encourage poor pregnant women with poor education to routinely make ANC visits according to government recommendations. On the other hand, a food intervention for these specific targets must also be prepared.

Strengths and Limitations

This study has at least 2 strengths. First, the 2017 IDHS used a validated and standardized survey tool to interview survey participants. Second, this study uses logged-verified LBW data, eliminating the possibility of recall bias. Meanwhile, the limitation is that because this is a cross-sectional study, the authors cannot confirm a temporal relationship between exposure and outcome variables. Another limitation is that it did not investigate some of the known risk factors from previous studies for LBW, including dietary and nutritional factors^{42,43}, genetic factors, and⁴⁴⁻⁴⁶, as well as pollution and environmental factors^{47,48}. This limitation is more due to limited secondary data from the 2017 IDHS.

Conclusions

Based on the research results, it can be concluded that there were socioeconomic disparities of LBW in rural Indonesia. Besides, two other variables were found that also significantly influence the incidence of LBW in rural Indonesia, namely education level and ANC visits.

Acknowledgments

The author would like to thank the Inner City Fund for allowing the use of the 2017 IDHS.

References

1. Aryastami NK, Shankar A, Kusumawardani N, Besral B, Jahari AB, Achadi E. Low birth weight was the most dominant predictor associated with stunting among children aged 12–23 months in Indonesia. *BMC Nutr.* 2017;3(1).
2. World Health Organization. Global Nutrition Targets 2025: Low birth weight policy brief [Internet]. Geneva; 2014. Available from: https://www.who.int/nutrition/publications/globaltargets2025_policybrief_lbw/en/
3. Mahumud RA, Sultana M, Sarker AR. Distribution and determinants of low birth weight in developing countries. *J Prev Med Public Heal.* 2017;50(1):18–28.
4. Astria Y, Suwita CS, Suwita BM, Widjaya FF, Rohsiswatmo R. Low Birth Weight Profiles at H.Boejasin Hospital, South Borneo, Indonesia in 2010-2012. *Paediatr Indones.* 2016;56(3):155–61.
5. Sutan R, Berkat S. Does cultural practice affects neonatal survival- a case control study among low birth weight babies in Aceh Province, Indonesia. *BMC Pregnancy Childbirth.* 2014;14(1):1–13.
6. Hutagalung L. ANEMIA AND NUTRITIONAL STATUS AS DOMINANT FACTOR OF THE EVENT LOW BIRTH WEIGHT IN INDONESIA: A SYSTEMATIC REVIEW. *LIFE Int J Heal Life-Sciences.* 2017 Jan;3(1):29–38.
7. Siramaneerat I, Agushyvana F, Meebunmak Y. Maternal risk factors associated with low birth weight in Indonesia. *Open Public Health J.* 2018 Aug;11(1):376–83.
8. Banerjee A, Singh AK, Chaurasia H. An exploratory spatial analysis of low birth weight and its determinants in India. *Clin Epidemiol Glob Heal.* 2020;8(3):702–11.
9. Beal T, Tumilowicz A, Sutrisna A, Izwardy D, Neufeld LM. A review of child stunting determinants in Indonesia. *Matern Child Nutr.* 2018;14(4):1–10.
10. Pratiwi NL, Fitrianti Y, Nuraini S, Rachmawati T, Laksono AD, Afreni M, et al. Concealed Pregnant Women or Kemel of Gayo Ethnic in Blang Pegayon District, Gayo Lues District, Aceh. *Bull Heal Syst Res.* 2019;22(2):81–90.
11. Laksono AD, Soerachman R, Angkasawati TJ. Case Study of Muyu Ethnic's Maternal Health in Mindiptara District-Boven Digoel (Studi Kasus Kesehatan Maternal Suku Muyu di Distrik Mindiptana, Kabupaten Boven Digoel). *J Reprod Heal.* 2016;07/03:145–55.
12. Vaezghasemi M, Öhman A, Ng N, Hakimi M, Eriksson M. Concerned and Conscious, but DefenselessThe intersection of gender and generation in child malnutrition in Indonesia: a qualitative grounded theory study: The intersection of gender and generation in child malnutrition in Indonesia: a qualitative grounded. *Glob Health Action.* 2020;13(1).
13. Hidayat AAA, Uliyah M. The effect of the nursing care model based on culture to

- improve the care of malnourished madurese children in Indonesia. *Open Access Maced J Med Sci.* 2019;7(7):1220–5.
14. Patel R, Srivastava S, Kumar P, Chauhan S. Factors associated with double burden of malnutrition among mother-child pairs in India: A study based on National Family Health Survey 2015–16. *Child Youth Serv Rev.* 2020;116:Article number 105256.
 15. Durao S, Visser ME, Ramokolo V, Oliveira JM, Schmidt B-M, Balakrishna Y, et al. Community-level interventions for improving access to food in low- and middle-income countries. *Cochrane Database Syst Rev.* 2020;2020(6):Article number CD011504.
 16. Shome S, Pal M, Bharati P. Influence of maternal autonomy and socioeconomic factors on birth weight of infants in India. *Malays J Nutr.* 2018;24(1):35–46.
 17. Laksono AD, Wulandari RD, Soedirham O. Urban and Rural Disparities in Hospital Utilization among Indonesian Adults. *Iran J Public Health.* 2019;48(2):247–55.
 18. Laksono AD, Wulandari RD. Determinant of the Puskesmas Utilization in Madura Island. *Indian J Public Heal Res Dev.* 2019;10(11):576–81.
 19. Mekie M, Taklual W. Magnitude of low birth weight and maternal risk factors among women who delivered in Debre Tabor Hospital, Amhara Region, Ethiopia: A facility based cross-sectional study. *Ital J Pediatr.* 2019;45(1):Article number 86.
 20. Bekela MB, Shimbire MS, Gebabo TF, Geta MB, Tonga AT, Zeleke EA, et al. Determinants of Low Birth Weight among Newborns Delivered at Public Hospitals in Sidama Zone, South Ethiopia: Unmatched Case-Control Study. *J Pregnancy.* 2020;2020:Article number 4675701.
 21. Alebel A, Wagnew F, Tesema C, Gebrie A, Ketema DB, Asmare G, et al. Factors associated with low birth weight at Debre Markos Referral Hospital, Northwest Ethiopia: A hospital based cross-sectional study. *BMC Res Notes.* 2019;12(1):Article number 105.
 22. Fagbamigbe AF, Kandala NB, Uthman AO. Demystifying the factors associated with rural–urban gaps in severe acute malnutrition among under-five children in low- and middle-income countries: a decomposition analysis. *Sci Rep.* 2020;10(1):Article number 11172.
 23. Wulandari RD, Putri NK, Laksono AD. Socioeconomic Disparities in Antenatal Care Utilisation in Urban Indonesia. *Int J Innov Creat Chang.* 2020;14(2):498–514.
 24. Laksono AD, Rukmini R, Wulandari RD. Regional disparities in antenatal care utilization in Indonesia. *PLoS One.* 2020;15(2):e0224006.
 25. Manyeh AK, Kukula V, Odonkor G, Ekey RA, Adjei A, Narh-Bana S, et al. Socioeconomic and demographic determinants of birth weight in southern rural Ghana: evidence from Dodowa Health and Demographic Surveillance System. *BMC Pregnancy Childbirth.* 2016;16(1):Article number 160.
 26. Alemayehu GM, Chernnet AG, Dumga KT. Determinants of child size at birth and associated maternal factor in gurage zone. *J Reprod Infertil.* 2020;21(2):138–45.
 27. Karim MR, Mondal MNI, Rana MM, Karmaker H, Bharati P, Hossain MG. Maternal factors are important predictors of low birth weight: Evidence from Bangladesh demographic & health survey-2011. *Malays J Nutr.* 2016;22(2):257–65.
 28. Khan A, Nasrullah FD, Jaleel R. Frequency and risk factors of low birth weight in term pregnancy. *Pakistan J Med Sci.* 2016;32(1):138–42.
 29. Ngandu CB, Momberg D, Magan A, Chola L, Norris SA, Said-Mohamed R. The association between household socio-economic status, maternal socio-demographic characteristics and adverse birth and infant growth outcomes in sub-Saharan Africa: A systematic review. *J Dev Orig Health Dis.* 2020;11(4):317–34.
 30. Kader M, Perera NKPP. Socio-Economic and Nutritional Determinants of Low Birth

- Weight in India. *North Am J Med Sci.* 2014;6(7):302–308.
31. Kabir A, Rashid MM, Hossain K, Khan A, Sikder SS, Gidding HF. Women's empowerment is associated with maternal nutrition and low birth weight: Evidence from Bangladesh Demographic Health Survey. *BMC Womens Health.* 2020;20(1):Article number 93.
 32. Silvestrin S, Hirakata VN, da Silva CH, Goldani MZ. Inequalities in birth weight and maternal education: a time-series study from 1996 to 2013 in Brazil. *Sci Rep.* 2020;10(1):Article number 8707.
 33. Apte A, Patil R, Lele P, Choudhari B, Bhattacharjee T, Bavdekar A, et al. Demographic surveillance over 12 years helps elicit determinants of low birth weights in India. *PLoS One.* 2019;14(7):Article number e0218587.
 34. Wulandari RD, Laksono AD. Education as predictor of the knowledge of pregnancy danger signs in Rural Indonesia. *Int J Innov Creat Chang.* 2020;13(1):1037–51.
 35. Ipa M, Widawati M, Laksono AD, Kusriani I, Dhewantara PW. Variation of preventive practices and its association with malaria infection in eastern Indonesia: Findings from community-based survey. *PLoS One.* 2020;15(5):e0232909.
 36. Wulandari RD, Laksono AD. Determinants of knowledge of pregnancy danger signs in Indonesia. *PLoS One.* 2020;15(5):Article number e0232550.
 37. Megatsari H, Laksono AD, Ibad M, Herwanto YT, Sarweni KP, Geno RAP, et al. The community psychosocial burden during the COVID-19 pandemic in Indonesia. *Heliyon.* 2020;6(10):Article number e05136.
 38. Rohmah N, Yusuf A, Hargono R, Laksono AD, Masrurroh, Ibrahim I, et al. Determinants of teenage pregnancy in Indonesia. *Indian J Forensic Med Toxicol.* 2020;14(3):2080–5.
 39. Laksono AD, Wulandari RD. The Barrier to Maternity Care in Rural Indonesia. *J Public Heal From Theory to Pract.* 2020;Online First.
 40. Abeywickrama G, Padmadas S, Hinde A. Social inequalities in low birthweight outcomes in Sri Lanka: Evidence from the Demographic and Health Survey 2016. *BMJ Open.* 2020;10(5):Article number e037223.
 41. Banchani E, Tenkorang EY. Determinants of Low Birth Weight in Ghana: Does Quality of Antenatal Care Matter? *Matern Child Health J.* 2020;24(5):668–77.
 42. Ancira-Moreno M, O'Neill MS, Rivera-Dommarco JÁ, Batis C, Rodríguez Ramírez S, Sánchez BN, et al. Dietary patterns and diet quality during pregnancy and low birthweight: The PRINCESA cohort. *Matern Child Nutr.* 2020;16(3):Article number e12972.
 43. Raghavan R, Dreifelbis C, Kingshipp BL, Wong YP, Abrams B, Gernand AD, et al. Dietary patterns before and during pregnancy and birth outcomes: A systematic review. *Am J Clin Nutr.* 2019;109:729S-756S.
 44. Desorcy-Scherer K, Bendixen MM, Parker LA. Determinants of the Very Low-Birth-Weight Infant's Intestinal Microbiome: A Systematic Review. *J Perinat Neonatal Nurs.* 2020;34(3):257–75.
 45. Nakimuli A, Starling JE, Nakubulwa S, Namagembe I, Sekikubo M, Nakabembe E, et al. Relative impact of pre-eclampsia on birth weight in a low resource setting: A prospective cohort study. *Pregnancy Hypertens.* 2020;21:1–6.
 46. Payton A, Clark J, Eaves L, Santos, H.P. J, Smeester L, Bangma JT, et al. Placental genomic and epigenomic signatures associated with infant birth weight highlight mechanisms involved in collagen and growth factor signaling. *Reprod Toxicol.* 2020;96:221–30.
 47. Li C, Yang M, Zhu Z, Sun S, Zhang Q, Cao J, et al. Maternal exposure to air pollution and the risk of low birth weight: A meta-analysis of cohort studies. *Environ Res.*

- 2020;190:Article number 109970.
48. Lamichhane DK, Lee S-Y, Ahn K, Kim KW, Shin YH, Suh DI, et al. Quantile regression analysis of the socioeconomic inequalities in air pollution and birth weight. *Environ Int.* 2020;142:Article number 105875.

Figures

Figure 1

Distribution of LBW by the province in rural Indonesia, the 2017 IDHS. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

Figure 2

Interaction diagram between 3 variables (LBW, socioeconomic, and ANC visits) in rural Indonesia, the 2017 IDHS