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Maternal Weight Gain During the Third Trimester as a Risk Factor for Low Birth Weight: A Case–Control Study in Solok, West Sumatera

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ABSTRACT

Background: Low birth weight (LBW) remains a significant public health concern, contributing to increased neonatal morbidity and mortality. Maternal nutritional status and gestational weight gain are key determinants of fetal growth. This study aimed to analyze the relationship between maternal weight gain during the third trimester and the incidence of low birth weight among pregnant women in Solok, West Sumatera.
Methods: This analytical observational study employed a retrospective case–control design. The study involved 78 respondents consisting of 26 mothers who delivered LBW infants (<2500 g) and 52 mothers who delivered normal-birth-weight infants (≥2500 g). Data on maternal weight gain were collected from maternal and child health records (KIA books) and analyzed using the Spearman correlation test. Statistical significance was set at $p < 0.05$.
Results: The median maternal weight gain during the third trimester was 4 kg (range: 3–6 kg) in the case group and 7 kg (range: 4–11 kg) in the control group. A significant positive correlation was found between maternal weight gain and infant birth weight in both the case group ($r = 0.625$; $p = 0.001$) and the control group ($r = 0.325$; $p = 0.019$). These findings indicate that greater maternal weight gain during the third trimester is associated with higher infant birth weight.
Conclusion: Maternal weight gain during the third trimester plays a crucial role in determining infant birth weight. Adequate gestational weight gain reflects sufficient maternal nutrient intake, which supports optimal fetal growth and reduces the risk of LBW. Strengthening maternal nutrition programs and regular antenatal monitoring are essential strategies to improve pregnancy outcomes and lower the incidence of LBW.

Keywords: Low Birth Weight, Maternal Weight Gain, Pregnancy, Solok, Third Trimester

A. BACKGROUND

Reducing child mortality has been one of the major global health priorities, as reflected in the *Millennium Development Goals (MDGs)*, which targeted a two-thirds reduction in under-five mortality between 1990 and 2015[1]. In Indonesia, this goal aligns with the *First 1000 Days of Life (1000 HPK)* program, which aims to improve human quality from conception to two years of age[2]. The program incorporates both specific interventions led by the health sector and sensitive interventions implemented by non-health sectors, with the main objective of improving maternal and child nutrition and reducing malnutrition across the country[2].

One of the key indicators of the success of the 1000 HPK movement is infant birth weight. Babies born weighing ≥2500 grams are classified as having normal birth weight, whereas those born weighing <2500 grams are categorized as low birth weight (LBW), often reflecting inadequate maternal nutrition during pregnancy[3]. LBW is a major determinant of neonatal morbidity and mortality and may have long-term consequences for physical growth and development[3].

According to Indonesia's *Basic Health Research* (*Riskesdas*) 2018, the prevalence of LBW was 6.2%[4], showing a decline compared to 2007 (11.5%)[5], 2010 (11.1%)[6], and 2013 (10.2%)[7]. However, the *Indonesia Health Profile* 2019 reported that among 69.3% of newborns weighed at birth, 3.4% were identified as LBW, a slight decrease from the previous year[8]. In West Sumatera Province, the LBW prevalence was 3.3% in 2019, representing 2,887 cases among 109,431 live births[8]. In Solok City, 60 out of 1,425 births (4.2%) were recorded as LBW, a proportion higher than the provincial average[8].

Maternal nutritional status plays a critical role in determining fetal growth and birth outcomes. Inadequate intake of essential nutrients, particularly energy and protein, has been identified as a major contributing factor to LBW[9,10]. According to Indonesia's *Recommended Dietary Allowances* (*Angka Kecukupan Gizi*, AKG) 2019, pregnant women require an additional 180 kcal during the first trimester and 300 kcal during the second and third trimesters to support optimal fetal development[11]. Previous studies have demonstrated a significant association between maternal weight gain during pregnancy and infant birth weight. Women who gain less weight than the recommended range are more likely to deliver LBW infants compared to those with adequate gestational weight gain[12]. Similarly, another study reported that maternal weight gain has a significant effect on the incidence of LBW[13].

Given these findings, the present study aims to analyze the relationship between maternal weight gain during the third trimester and the incidence of low birth weight among pregnant women in Solok, West Sumatera. The results of this study are expected to contribute to the

evidence base for improving maternal nutrition programs and reducing the risk of LBW in both local and national contexts.

B. METHODS

This study applied a quantitative, observational analytic design with a retrospective case–control approach[14]. The purpose of the research was to examine the relationship between maternal weight gain during the third trimester of pregnancy and infant birth weight. Data on maternal weight gain were obtained from maternal and child health records (*Kartu Ibu dan Anak*, KIA), and additional information was collected through structured interviews using a standardized questionnaire.

The study was conducted in Solok, West Sumatera, Indonesia, from December 2021 to January 2022, across several public health centers (*puskesmas*) within the Solok region. The study population included all infants born between January and June 2021, as recorded by the Solok City Health Office. Based on health records, there were 625 births in Solok City and 101 births from Tanjung Bingkung Public Health Center in Solok Regency, resulting in a total population of 726 respondents.

The minimum sample size was determined based on a previous study by Sharma et al. (2021), titled *"Association between Maternal Dietary Diversity and Low Birth Weight in Central India: A Case–Control Study"*[15]. The sample size was calculated using the following formula:

$$n = 2\left[\frac{\left(Z_{1-\alpha/2} + Z_{1-\beta/2}\right)S}{(X_1 - X_2)}\right]^2$$

where n represents the minimum sample size per group, $Z_{1-\alpha/2} = 1.96$ for a significance level of 0.05, $Z_{1-\beta} = 0.84$ for 80% statistical power, $S = 2.35$ (standard deviation), and $(X_1 - X_2) = 2$ (minimum meaningful difference between groups). Based on this calculation, a minimum of 22 respondents was required. To anticipate potential dropouts, an additional 10% was added, resulting in a total of 25 respondents for the case group. The control group was determined using a 1:2 ratio to the case group, resulting in 50 respondents. A simple random sampling technique was used to select participants.

The case group consisted of mothers who gave birth to infants weighing less than 2500 grams between January and June 2021, while the control group included mothers who gave birth to infants weighing 2500 grams or more during the same period. The inclusion criteria for both groups were as follows: mothers who gave birth in Solok during the study period, resided

in Solok, were willing to participate, and could be contacted directly. The exclusion criteria included multiple pregnancies, preterm births, and mothers who could not be contacted after three attempts.

Data collection was carried out through document review and structured interviews. Maternal weight gain during the third trimester was determined by calculating the difference between the mother's body weight at the end and at the beginning of the third trimester. Infant birth weight data were obtained from birth records at health facilities.

All collected data were analyzed using the Data Analyzer. Descriptive statistics were used to describe respondent characteristics. The normality of continuous variables was tested using the Shapiro–Wilk test for the case group ($n \leq 50$) and the Kolmogorov–Smirnov test for the control group ($n > 50$). Since most variables were not normally distributed, the Spearman rank correlation test was applied to determine the association between maternal third-trimester weight gain and infant birth weight. Statistical significance was defined at $p < 0.05$.

C. RESULT AND DISCUSSION

1. Respondent Characteristics

A total of 78 respondents participated in this study, consisting of 26 mothers in the case group who delivered infants with a birth weight below 2500 grams and 52 mothers in the control group who delivered infants weighing 2500 grams or more. The sample ratio between the case and control groups was set at 1:2, following the case–control study design to increase analytical accuracy.

The study was conducted in five community health centers (*puskesmas*) across Solok. The median age of respondents in the case group was 27.5 years, with a minimum of 21 years and a maximum of 35 years, while the control group had a median age of 30 years, ranging from 18 to 43 years. These results indicate that most respondents were within the productive reproductive age, which is considered an optimal period for pregnancy.

In terms of educational background, the largest proportion of respondents in the case group were senior high school graduates (50%), while the majority of respondents in the control group had completed higher education (61.5%). Regarding occupation, most respondents in both groups were housewives—42.3% in the case group and 32.7% in the control group—followed by private employees and civil servants. This pattern suggests that the majority of participants were non-working or informally employed mothers, which could potentially affect their dietary intake, nutritional status, and adherence to antenatal care recommendations during pregnancy.

The median birth weight of infants in the case group was 2100 grams, with a minimum of 1200 grams and a maximum of 2400 grams, while in the control group, the median was 3100 grams, ranging from 2500 to 4000 grams. According to the World Health Organization (WHO), infants with a birth weight below 2500 grams are classified as having low birth weight (LBW), a key indicator linked to increased neonatal morbidity and mortality[16]. Hughes et al. (2017) emphasized that maintaining a birth weight above 2500 grams is essential to reduce infant mortality rates[16].

Furthermore, Turhayati (2006) reported that several factors can influence infant birth weight, including maternal age, parity, pre-pregnancy body mass index, placental condition, socioeconomic status, dietary intake, health service utilization, and maternal weight gain during pregnancy[17]. Infants born with LBW face significantly higher health risks in both the short and long term [18]. Perinatal mortality, for instance, is reported to be up to eight times higher among LBW infants compared to those born with normal weight [18].

In summary, the demographic and socioeconomic characteristics of respondents—particularly maternal age, education, and occupation—provide essential background information for understanding the potential factors contributing to low birth weight. These characteristics also help contextualize the relationship between maternal weight gain during the third trimester and infant birth outcomes observed in this study.

2. Association Between Maternal Weight Gain and Infant Birth Weight

The median maternal weight gain during the third trimester in Solok, West Sumatera, was 4 kg (range: 3–6 kg) among the case group and 7 kg (range: 4–11 kg) among the control group. These findings suggest that mothers who delivered low-birth-weight infants generally experienced lower weight gain compared to those who delivered normal-weight infants. According to Shiddiq et al. (2015), the recommended maternal weight gain is approximately 2–4 kg during the first trimester, 0.4 kg per week (equivalent to 4.8 kg) during the second trimester, and 0.5 kg per week (around 6 kg) during the third trimester[18]. Similarly, Durie et al. (2013) emphasized that appropriate weight gain during the second and third trimesters should range between 0.8–1 pound (0.4–0.5 kg) per week[19].

The statistical analysis using the Spearman correlation test revealed a significant association between maternal weight gain during the third trimester and infant birth weight. The case group showed a correlation coefficient (r) of 0.625 with a p-value of 0.001, indicating a strong positive correlation. In the control group, the correlation coefficient was $r = 0.325$ with a p-value of 0.019, suggesting a moderate positive correlation. These findings demonstrate that

greater maternal weight gain during the third trimester is associated with higher infant birth weight.

This result aligns with previous research by Pathirathna et al. (2017), which identified a moderate positive correlation between maternal weight gain and birth weight ($p = 0.002$; $r = 0.302$)[20]. Similarly, Diemert et al. (2016) reported a significant relationship between maternal gestational weight gain and infant birth weight ($p = 0.02$), noting that each kilogram increase in maternal weight was associated with an approximate 20-gram increase in infant birth weight[21]. Furthermore, Wardsworth et al. (1986) in *Nutrition Concepts and Controversies* stated that, based on a study of 409 mothers in Scotland, those who experienced greater gestational weight gain delivered infants with an average of 500 grams higher birth weight compared to mothers with lower weight gain[22].

Maternal weight gain during pregnancy is one of the most influential factors determining fetal growth and birth outcomes. Insufficient weight gain may reflect inadequate caloric or nutrient intake, leading to intrauterine growth restriction and low birth weight, while excessive gain may predispose mothers to complications such as gestational diabetes or macrosomia. Therefore, maintaining adequate maternal weight gain within recommended ranges is crucial for optimizing pregnancy outcomes and reducing the risk of low birth weight.

D. CONCLUSION

This study demonstrated a significant association between maternal weight gain during the third trimester and infant birth weight among pregnant women in Solok, West Sumatera. Mothers who experienced inadequate weight gain during the third trimester were more likely to deliver infants with low birth weight compared to those who achieved adequate gestational weight gain. The statistical analysis revealed a strong positive correlation in the case group and a moderate positive correlation in the control group, indicating that higher maternal weight gain is associated with increased infant birth weight.

These findings underscore the critical role of maternal nutrition and gestational weight monitoring in improving pregnancy outcomes. Adequate maternal weight gain, consistent with established recommendations, reflects optimal energy and nutrient intake that supports fetal growth and development. Conversely, insufficient weight gain during pregnancy may indicate nutritional deficiencies that contribute to intrauterine growth restriction and low birth weight, both of which have short- and long-term health implications for the infant.

Strengthening maternal nutrition education, regular antenatal care, and early detection of inadequate weight gain during pregnancy are essential strategies for preventing low birth

weight and reducing neonatal morbidity and mortality. Further research with larger sample sizes and prospective designs is recommended to explore other contributing factors and to develop evidence-based guidelines for gestational weight management in Indonesian populations.

REFERENCES

1. AbouZahr C. Millennium development goals. Pharma Times. 2009;41(6):15–7.
2. Djauhari T. Gizi Dan 1000 Hpk. Saintika Medika. 2017;13(2):125.
3. Ruaida N. Gerakan 1000 Hari Pertama Kehidupan Mencegah Terjadinya Stunting (Gizi Pendek) Di Indonesia. Global Health Science [Internet]. 2018;3(2):139–51. Available from: http://jurnal.csdforum.com/index.php/ghs%0D
4. Kemenkes. Hasil Utama Riset Kesehatan Dasar. Kementrian Kesehatan Republik Indonesia [Internet]. 2018;1–100. Available from: http://www.depkes.go.id/resources/download/info-terkini/hasil-riskesdas-2018.pdf
5. Penelitian B, Pengantar K. Riset Kesehatan Dasar. 2008;
6. Riskesdas. Riset Kesehatan Dasar; Badan Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan RI Tahun2010. Laporan Nasional 2010. 2010;1–446.
7. Kemenkes RI. Profil Kesehatan Indonesia Tahun 2019. Vol. 42, Kementrian Kesehatan Repoblik Indonesia. 2019. 97–119 p.
8. Ramakrishnan U. Nutrition and low birth weight: From research to practice. American Journal of Clinical Nutrition. 2004;79(1):17–21.
9. Puspitaningrum EM. Hubungan Status Gizi Ibu Hamil dengan kejadian berat Badan Lahir Rendah (BBLR) di RSIA Annisa Jambi Tahun 2018. Scientia Journal. 2018;7(2):1–7.
10. Kementerian Kesehatan Republik Indonesia. Peraturan Kementarian Kesehatan Republik Indonesia Nomor 28 Tahun 2019. Jakarta Jakarta; 2019 p. 149–200.
11. Nurhayati E. Indeks Massa Tubuh (IMT) Pra Hamil dan Kenaikan Berat Badan Ibu Selama Hamil Berhubungan dengan Berat Badan Bayi Lahir. Jurnal Ners dan Kebidanan Indonesia. 2016;4(1):1.
12. Trisnawati Y, Utami T. Hubungan Kenaikan Berat Badan Ibu Selama Hamil dengan Kejadian Berat Badan Lahir Rendah (Bblr) Di Rsud Kota Tanjungpinang Tahun 2017. Jurnal Cakrawala Kesehatan. 2017;VIII(01):69–78.
13. Sharma S, Maheshwari S, Mehra S. Association between Maternal Dietary Diversity and Low Birth Weight in Central India: A Case-Control Study. J Nutr Metab. 2021;2021.
14. Diemert A, Lezius S, Pagenkemper M, Hansen G, Drozdowska A, Hecher K, et al. Maternal nutrition, inadequate gestational weight gain and birth weight: Results from a

prospective birth cohort. BMC Pregnancy Childbirth [Internet]. 2016;16(1):1–9. Available from: http://dx.doi.org/10.1186/s12884-016-1012-y

15. Fikawati S, Syafiq A, Karisma K. Gizi Ibu dan Bayi. Jakarta: Rajawali Pers; 2015. 270 p.

16. Callahan ML, Schneider-Worthington CR, Martin SL, Gower BA, Catalano PM, Chandler-Laney P. Association of weight status and carbohydrate intake with gestational weight gain. Clin Obes. 2021;11(4):1–7.

17. Fathonah S. Gizi & Kesehatan untuk Ibu Hamil. Jakarta: Erlangga; 2016. 216 p.

18. Mousa A, Naqash A, Lim S. Macronutrient and micronutrient intake during pregnancy: An overview of recent evidence. Nutrients. 2019;11(2):1–20.

19. Kaseva N, Wehkalampi K, Hemiö K, Hovi P, Järvenpää AL, Andersson S, et al. Diet and nutrient intake in young adults born preterm at very low birth weight. Journal of Pediatrics. 2013;163(1):43–8.

20. Ariana AP. Ilmu Gizi. Yogyakarta: Nuha Medika; 2017.

21. Proverawati A, Asfuah S. Buku Ajar Gizi Untuk Kebidanan. Yogyakarta: Nuha Medika; 2009. 148 p.

22. Amrang M, Nurmadilla N, Pramono SD, Ananda F, Rasfayanah. Hubungan Asupan Protein Ibu Hamil Trimester III dengan BB Lahir Bayi RSIA Kota Makassar. Wal'afiat Hospital Journal [Internet]. 2020;1(2):14–22. Available from: https://whj.umi.ac.id/index.php/whj/article/view/45