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Frequency and quality of antenatal care with the incidence of low birth weight: analysis of Indonesian Demographic and Health Survey Data (SDKI) 2017

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Abstract

Purpose: Efforts to reduce low birth weight (LBW) cases can be made by regularly conducting antenatal care (ANC) during pregnancy. The aim is to improve the quality of ANCs and the quality of mothers, fetuses, and newborns associated with ANC. The World Health Organization (WHO) recommends reducing perinatal mortality and increasing the ability of care of pregnant women to make at least eight visits during pregnancy. This study aims to prove WHO's recommendation of at least 8 times the effect of ANC on LBW events in Indonesia. **Methods:** This study used a retrospective cohort and observational study design. The sample in this study were all women of childbearing age who were respondents to the 2017 IDHS. Data testing was performed using univariable, bivariable, and multivariable analysis. The analysis was performed by logistic regression. **Results:** ANC frequency was 8 times proven to reduce LBW risk; the lower the ANC contact, the greater the LBW risk. The incidence of LBW is lower in mothers who get quality ANC services. Exposure to cigarette smoke, the area of residence in Sulawesi, NTT, and NTB, and the distance of pregnancy affect the incidence of LBW without changing the relationship of the ANC frequency with LBW. **Conclusions:** Mothers who regularly perform pregnancy checks at least 8 times in accordance with the standards become protection for LBW.

Keywords: antenatal care; IDHS 2017; low birth weight

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INTRODUCTION

Low birth weight (LBW) is still a public health problem because it causes mortality, morbidity, and neonatal disability in the future. In the neonatal period, LBW is the leading cause of death. LBW is also an important indicator in assessing the health status of the mother and fetus, predicting death, stunted growth, and chronic conditions that arise in adults. The risk of death will increase in very low birth weight (VLBW) babies and preterm gestational age [1,2]. Statistically, 90% of LBW cases occur in developing countries, and the risk of death is 35 times higher than in babies with a birth weight of more than 2500 grams [3].

Efforts are made to reduce these cases by conducting regular antenatal care (ANC) during pregnancy. ANC aims to increase care coverage during pregnancy and improve the quality of care for the mother, fetus, and newborn. Regular contact by pregnant women with doctors, midwives, or nurses during pregnancy allows women to receive services that are important for the health of their mothers and children in the future so that if problems are encountered from the beginning of pregnancy, it is easier for health workers to intervene so that pregnancy outcomes are better.

The World Health Organization (WHO) recommends a minimum of eight visits to reduce perinatal mortality and improve the care capacity of pregnant women. The first visit is scheduled in the first trimester (up to 12 weeks of pregnancy), two visits a trip planned in the second trimester at 20 and 26 weeks of pregnancy, and five visits a trip scheduled in the third trimester at 30, 34, 36, 38 and 40 weeks of pregnancy [4]. Global, regional, and country-reported data are only available for the previous recommendation of a minimum of four visits. In addition, the ANC can also help the World Health Assembly (WHA) to reduce LBW by 30 percent between 2012 and 2025 [5].

Zhou, Wang [6] has researched factors that can reduce cases of LBW. Steps to take include ANC visits at least 5 to 8 times during pregnancy, conducting ANC in the first trimester, consuming folic acid supplements, and getting quality ANC services [1]. These services include weighing, blood pressure checks, blood tests to check for anemia, urine tests, and a B-scan ultrasound or USG. Inaccuracy of ANC care can cause LBW. This inaccuracy can be caused by educational status, maternal knowledge, unwanted pregnancy, problems in the current pregnancy, perception of ANC care time, and advice from others [7]. The quality of services received by pregnant women, such as tetanus toxoid immunization, iron tablets (Fe), frequency of nutritional advice, age, educational status, and parity, also contribute to the increase in the incidence of LBW [8].

United Nations Children's Fund (UNICEF) estimates that globally, the birth of LBW babies in 2015 was 20.5 million (14.6%). The prevalence of LBW is estimated to be a minimum limit of 3.3 to 28%. LBW is more common in developing or low socio-economic countries, including Indonesia. The proportion of LBW 16 years (2000-2015) last showed a marginal reduction worldwide [9]. The incidence of LBW in Indonesia varies significantly from one region to another, ranging from 9% to 30%. The results of a study in 7 *multicenter regions* obtained LBW figures ranging from 2.1% to 17.2%. Based on further analysis of the 2017 Indonesian Demographic Health Survey (SDKI), the prevalence of LBW was 7.1%. Meanwhile, according to UNICEF, in 2015, the estimate of LBW in Indonesia was 10%. This figure is greater than the LBW target set by the 2015-2019 medium-term development plan (RPJMN) of 8% [1].

The causes of LBW are generally multifactorial. Factors associated with LBW typically include ANC visits, socioeconomic factors (family income, education, and presence of a partner), physical activity, maternal behavior during pregnancy (caffeine consumption, sexual activity during pregnancy, alcohol consumption, and work), maternal morbidity including (hypertension, anemia, nutritional status, multiple pregnancies, too close pregnancy spacing, history of LBW, urinary tract infection (UTI), premature rupture of membranes (PROM), bleeding and depression [10]. Demographic factors include age, marital status, and parity [11]. Other factors include fetal factors of chromosomal abnormalities, chronic fetal infection, radiation, pancreatic aplasia, hydramnios, villous placentitis, infarction, tumors, placental abruption, parabiotic syndrome, residence in the highlands, and exposure to toxic substances [12].

The government has carried out safe motherhood programs to improve the welfare of mothers and babies. One of the program's goals is to reduce the number of LBW cases. First, cross-professionals carry out integrated ANC activities during the first pregnancy visit to find a comprehensive assessment. Second, iron tablets (Fe) should be provided to prevent anemia, and third, additional food should be provided for pregnant women who experience chronic energy deficiency (KEK). Fourth, the birth planning and complication prevention (P4K) program and local area monitoring management (PWS) KIA for risk detection. Fifth, *making pregnancy saver* (M to reduce the burden of illness, disability, and death due to pregnancy.

This study uses SDKI data to obtain a general picture of ANC services in Indonesia so that program managers and policymakers can use it to improve ANC policies. SDKI's advantage is playing basic data that can be compared internationally. Based on the background above and the still limited research on WHO ANC recommendations with LBW incidence, further research is needed on the frequency and quality of ANC with LBW incidence in Indonesia using data SDKI 201SDKI 2017 data method in this study is a type of research with a cohort retrospective design using 2017 SDKI data. The independent variable in this study is antenatal care. The dependent variable in this study is LBW, which considers external variables such as parity, age, education, exposure to cigarette smoke, and economic status. The subjects in this study were

mothers who gave birth in 2013-2017 (during the survey) who met the inclusion and exclusion criteria. The number of samples in this study was 4530 weighted data and 4223 unweighted data with a sampling technique for using BS selection in rural and urban areas in each province using multi-stage stratified sampling.

The first stage is in each regency; several census blocks are selected systematically using PPS (probability proportional to size), where size is the number of households listed in the 2010 population census and an implicit stratification process by sorting census blocks based on urban, rural, and welfare index categories. The second stage is to systematically select 25 ordinary households in each census block chosen from the results of household updates. This study uses descriptive and inferential analysis. Descriptive analysis uses the chi-square test, and multivariate analysis uses the logistic regression test.

RESULTS

Most mothers gave birth in a non-risk age group, which is in accordance with the government's program to reduce childbirth in at-risk groups. Upper-middle economic status shows almost the same percentage, while lower-middle status has the lowest rate. Most mothers have even completed secondary education. This education category shows that most respondents have completed secondary education. Mothers who live in urban areas are greater than those who live in rural areas. Most of the respondents taken in this study came from the Java-Bali region.

The parity of respondents is mainly in the non-risk group, which has a small number of boys and girls. The percentage of LBW births in Indonesia based on the 2017 SDKI is 6%. Most respondents are in the non-risk group, with a total of ANC visits mostly more than 8 times. Most pregnant women have not received quality ANC services. The quality of ANC is not in accordance with the minimum standard of ANC services that every pregnant woman is required to receive quality service standards. In addition, mothers still make their first ANC visit in the second and third trimesters.

The birth spacing of most children is more than 5 years. This is in accordance with the government's recommendation to space pregnancies for at least 2 years. However, mothers who consume Fe <90 tablets are still large, and exposure to cigarette smoke from family members shows a large percentage. The coverage of Fe consumption is significant compared to the standard target of the Fe consumption program for pregnant women during pregnancy.

Bivariable analysis was conducted to see the relationship between the frequency and quality of ANC with BBLR. Analysis was used to determine the differences in BBLR according to the frequency and quality of ANC. Bivariable analysis of the influence of external variables, namely gender, first visit, amount of Fe consumption, exposure to cigarette smoke, maternal age, parity, socioeconomic, education level, and area of residence with independent variables using the *chi-square test*. Table 1 shows that the incidence of LBW in the age group 20-34 years is higher than in the age group <20 years and >35 years; no statistically significant relationship was found. The highest incidence of LBW was at the lowest economic level, and no statistically significant relationship was found. The highest incidence of LBW was at the elementary education level; no statistically significant relationship was found. The incidence of LBW was higher in mothers living in rural areas than in urban areas and statistically did not have a significant relationship. The highest incidence of LBW occurred in the Sulawesi, NTT, and NTB regions. The chances of mothers living in Sulawesi, NTT, and NTB increased by 15% and 21% to experience LBW compared to mothers residing in Java-Bali and were statistically related. The following is the incidence of LBW based on the characteristics of children, mothers, and ANC.

Bivariate tests showed that the highest incidence of LBW occurred in mothers who performed ANC 1-3 times. The chance of mothers who performed ANC 1-3 times to experience LBW was 2.8 times compared to mothers who performed ANC 8 times. While the chance of mothers who performed ANC 4-7 times to experience LBW was 1.4 times compared to mothers who performed ANC 8 times. The highest incidence of LBW occurred in the low-quality ANC service group, and the chance of mothers who received ANC services <75% was likely to reduce the risk by 5% compared to mothers who received ANC services>=75%. However, statistics showed there was now a significant relationship. The incidence of LBW in the high-risk parity group was higher than in the non-risk parity group and did not show a statistically significant relationship. The incidence of LBW was higher in female children than male children, and statistically, it did not show a significant relationship. The highest incidence of LBW occurred in mothers who did not consume Fe, and no statistically significant relationship was found. The incidence of LBW is higher in mothers who are exposed to cigarette smoke compared to those who are not exposed to cigarette smoke, and the chance of mothers who are exposed to cigarette smoke is 52% to experience LBW compared to mothers who are not exposed to cigarette smoke during pregnancy.

Multivariable analysis was conducted to assess the incidence of LBW and to determine the influence of frequency and quality of ANC, maternal age, first visit, pregnancy interval, Fe consumption, age, exposure to cigarettes, place of residence, education, region residence, and economic status. The results approach is interpreted by looking at the results of the 95% CI and a significance level of p<0.05. The results of the analysis are presented in Table 2.

Table 1. Incidence of LBW based on demographic and mother-child characteristics

Variables	Birth Weight				n	%	RR	CI 95%	*p-value*
	No LBW		LBW						
	N	%	n	%					
Mother's Age									
20-34 years	3116	93.7	208	6.3	3324	100.0	1.00		
<20 years	224	95.1	12	4.9	236	100.0	0.79	0.433-1.430	0.433
>=35 years	916	94.4	54	5.6	970	100.0	0.89	0.625-1.272	0.53
Economic Status									
Top	1000	94.4	59	5.6	1059	100.0	1.00		
Bottom	537	91.1	52	8.9	589	100.0	1.60	1,048-2,429	0.029
Lower Middle	808	93.6	56	6.4	863	100.0	1.16	0.755-1.772	0.501
Intermediate	955	93.8	63	6.2	1019	100.0	1.12	0.727-1.728	0.605
Upper Middle School	956	95.6	44	4.4	1000	100.0	0.80	0.505-1.255	0.327
Mother's Education									
Tall	721	94.1	46	5.9	767	100.0	1.00		
No school	20	94.2	1	5.8	21	100.0	0.98	0.322-2.980	0.972
Base	862	92.5	70	7.5	931	100.0	1.26	0.818-1.929	0.298
Intermediate	2653	94.4	158	5.6	2811	100.0	0.94	0.645-1.378	0.762
Residence									
Urban	2334	94	150	6	2484	100.0	1.00		
Rural	1922	93.9	124	6.1	2046	100.0	1.00	0.759-1.326	0.983
Area of residence									
Java_Bali	2796	94.4	165	5.6	2961	100.0	1.00		
Sumatra	767	94.9	41	5.1	808	100.0	0.92	0.640-1.321	0.65
Kalimantan	199	92.8	16	7.2	215	100.0	1.29	0.778-2.153	0.32
Sulawesi	271	89.7	31	10.3	302	100.0	1.85	1,240-2,581	0.001
NTT & NTB	178	90	20	10	198	100.0	1.79	1,240-2,581	0.002
Maluku & Papua	45	97.4	1	2.6	46	100.0	0.43	0.185-0.984	0.069
ANC Frequency									
8+	316	94.8	174	5.2	3341	100	1.00		
1-3	11	85.2	20	14.8	136	100	2.84	1,678-4,5813	0.001
4-7	97	92.4	80	7.6	1053	100	1.37	1,086-1,974	0.012
ANC Quality									
Quality	116	94.2	72	5.8	1234	100	1.00		
Lack of Quality	309	93.9	202	6.1	3296	100	0.95	0.689-1.307	0.747
Parity									
No Risk	269	94.5	157	5.5	2856	100	1.00		
At risk	155	93	117	7	1675	100	1.27	0.965-1.679	0.088
Gender									
Man	212	94	135	6	2263	100	1.00		
Woman	212	93.9	139	6.1	2267	100	1.03	0.777-1.351	0.862
Birth spacing									
6+ Years	134	93.7	91	6.3	1440	100	1.00		
<2 years	19	96	8	4	206	100	0.62	0.287-1.358	0.235
2-5 years	130	95.3	65	4.7	1368	100	0.75	0.511-1.109	0.125
The first child	140	92.7	110	7.3	1516	100	1.15	0.826-1.592	0.413
First Visit									
Trimester 1	377	94.1	239	5.9	4018	100	1.00		
Trimester 2	42	93.7	29	6.3	458	100	1.07	0.674-1.688	0.782
Trimester 3	4	88.1	7	11.9	55	100	2.01	0.857-4.693	0.108
FE Consumption									
>180	1347	94.2	83	5.8	1431	100	1.00		
No consumption	23	91	2	9	26	100	1.55	0.372-6.449	0.547
1-89	1743	93	131	7	1874	100	1.20	0.868-1.665	0.269
90-189	1143	95.2	58	4.8	1201	100	0.83	0.560-1.216	0.331
Cigarette Exposure									
Not Exposed	1144	95.5	54	4.5	1198	100	1.00		
Exposed	3112	93.4	221	6.6	3332	100	1.48	1,033-2,114	0.032

Table 2. Multivariable analysis: logistic regression of the relationship between frequency and quality of ANC and the incidence of LBW by considering demographic and mother-child characteristics

Variables	Model 1 Crude OR (CI 95%)	Model 2 Adj-OR (CI 95%)	Model 3 Adj-OR(CI 95%)	Model 4 Adj-OR(CI 95%)	Model 5 Adj-OR(CI 95%)
ANC Frequency					
8+	1	1	1	1	1
1-3	2.29 ** 1.39,3.77]	2.76 *** [1.70,4.49]	2.43 *** [1.50,3.93]	2.38 ** [1.33,4.27]	2.33 ** [1.30,4.17]
4-7	1.33 * [1.01,1.75]	1.58 *** [1.22,2.05]	1.48 ** [1.14,1.91]	1.49 ** [1.12,1.99]	1.48 ** [1.11,1.98]
ANC Quality					
Quality	1	1	1	1	1
<Quality	0.86 [0.65,1.15]	0.83 [0.63,1.11]	0.81 [0.61,1.08]	0.90 [0.67,1.20]	0.87 [0.65,1.18]
Economic Status					
Top	1				1
Bottom	1.28[0.86,1.93]				1.31[0.81,2.13]
Lower Middle	1.02[0.68,1.52]				1.04[0.67,1.64]
Intermediate	0.97[0.65,1.44]				0.95[0.62,1.46]
Upper Middle School	0.84[0.56,1.28]				0.82[0.53,1.25]
Cigarette Exposure					
Not Exposed	1		1	1	1
Exposed	1.40 * [1.01,1.94]		1.49 * [1.08,2.06]	1.42 * [1.03,1.97]	1.39[0.99,1.93]
Residential Area					
Java_Bali	1			1	1
Sumatra	0.84[0.59,1.20]			0.87[0.61,1.25]	0.90[0.63,1.30]
Kalimantan	0.99[0.61,1.60]			1.06[0.66,1.71]	1.05[0.65,1.70]
Sulawesi	1.43[1.00,2.05]			1.56 * [1.08,2.25]	1.57 * [1.07,2.30]
NTT & NTB	1.69 * [1.11,2.56]			2.02 *** [1.37,2.98]	1.80 ** [1.17,2.77]
Maluku & Papua	0.50[0.21,1.17]			0.57[0.24,1.33]	0.57[0.24,1.35]
Mother's Age					
20-34 years			1		1
<20 years			1.18[0.71,1.95]		0.91[0.53,1.56]
>=35 years			0.87[0.64,1.19]		0.89[0.64,1.25]
Birth Spacing					
6+ years		1		1	1
<2 years		0.69[0.38,1.26]		0.69[0.38,1.28]	0.67[0.36,1.25]
2-5 years		0.71 * [0.51,0.98]		0.69 * [0.50,0.96]	0.66 * [0.47,0.93]
The first child		1.24[0.92,1.66]		1.21[0.90,1.62]	1.22[0.87,1.72]
First Visit					
Trimester I				1	1
Trimester II				0.71[0.47,1.06]	0.69[0.46,1.03]
Trimester III				1.89[0.81,4.42]	1.79[0.76,4.22]
FE Consumption					
>180				1	1
No consumption				1.03[0.24,4.54]	1.04[0.24,4.57]
1-89				1.09[0.80,1.49]	1.08[0.79,1.49]
90-189				0.87[0.61,1.25]	0.88[0.61,1.25]
Education Status					
Tall					1
No school					1.90[0.59,6.10]
Base					1.23[0.79,1.92]
Intermediate					1.02[0.71,1.47]
Residence					
Urban					1
Rural					0.77[0.58,1.02]
Pseudo R^2	0.026	0.017	0.013	0.035	0.040
AIC	2065.2	2071.5	2078.3	2055.5	2065.4
Observations	4223	4223	4223	4223	4223

exponential coefficients; 95% confidence intervals in brackets * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

DISCUSSION

This study explores the frequency and quality of ANC during pregnancy and its effect on the incidence of LBW. The analysis conducted in this study includes descriptive analysis to determine the characteristics of respondents, bivariable analysis to determine the significance and strength of the relationship between independent and dependent variables, and multivariable analysis to determine the difference in risk by considering variables that are likely to be

confounding as a basis for building a model.

Based on the results of bivariate analysis, it is known that variables that show a statistically significant relationship are the frequency of ANC, area of residence, economic status, and exposure to cigarette smoke to the risk of LBW. Other variables, namely ANC quality, gender, birth spacing, first visit, parity, and place of residence, show no statistically significant relationship.

Antenatal care is a good promotional effort for mothers and children or fetuses that is useful for identifying risk factors that can harm the fetus and also efforts to prevent the occurrence of LBW births and even infant deaths due to LBW. Pregnancy checks are carried out at health facilities and by competent health workers.

The results of bivariable and multivariable analysis showed a significant relationship between pregnancy examinations and the risk of LBW. This study proves that the WHO recommendation of 8 times can provide an opportunity to reduce the risk of LBW. Mothers who do ANC >8 times consistently reduce the incidence of LBW. This is because the risk of LBW will decrease if the mother does ANC examinations at least 8 times. The possibility of LBW risk in mothers who do ANC 1-3 times and 4-7 times increases even though it has been adjusted for economic status, area of residence, and exposure to cigarette smoke.

New guidelines recommend ANC [4] at least eight ANC visits during pregnancy. The maximum recommended first contact schedule is in the first 12 weeks of pregnancy (Trimester I), the second contact in the 20th week and the third in the 26th week (Trimester II), the fifth to 8 contacts in the third trimester, namely at 30, 34, 36, 38 and 40 weeks of pregnancy. The purpose of this new ANC guideline is to reduce the risk of increased morbidity and mortality in mothers and babies and to improve the coverage of ANC services carried out in health facilities for maternal and infant deaths.

In this study, frequency has a relationship with the incidence of LBW. The same study conducted by [12] LBW was significantly lower among children whose mothers had adequate ANC services among mothers who did not receive such services even after accounting for important socioeconomic and demographic factors. Gebresilassie *et al.* (2019), research results showed that mothers who had an ANC frequency <4 times reduced the percentage of LBW births [13].

The quality of ANC in this study did not have a significant relationship with the incidence of LBW. ANC is considered good quality if women receive a percentile of essential ANC services during pregnancy, reducing the risk 8 times greater than those who do not receive services (Tafere *et al.*, 2018) [14]. In this study, most mothers have received quality ANC services despite no significant relationship between ANC quality and the incidence of LBW. This study is not in line with that conducted by [13] that mothers who receive ANC services ≥75% of all services can reduce the incidence of LBW. Infant birth weight will increase along with the increase in the quality of ANC during pregnancy [14]. This study is in line with that conducted by [15], which states that the quality of prenatal care is not associated with LBW in the adjusted model but is a factor with a more significant association in the adjusted (OR). When pregnancy, child, mother, and context characteristics are considered, complete prenatal care (education, physical examination, testing, and immunization) is important to ensure good pregnancy outcomes.

Similar research on ANC quality was conducted in Indonesia using 2017 SDKI data. Research [16] showed significant correlations between ANC quality and LBW incidence. The difference lies in the inclusion criteria, service components received (the previous study did not consider blood pressure, case management, or determination of fetal presentation through abdominal examination), and categorization of the ANC services received.

The variables of economic status, pregnancy spacing, exposure to cigarette smoke, and area of residence in this study provide evidence that does not consistently affect the relationship between ANC frequency and the incidence of LBW. Economic status in descriptive analysis has almost the same percentage. The bivariate analysis showed that the lowest economic status can increase the risk of experiencing LBW by 40%. Still, after further study, the mother's economic status did not significantly correlate with LBW. It did not affect the possibility of LBW risk in mothers who did ANC <8 times. This is not in line with the research conducted [17], which states that the wealthiest level reduces the incidence of LBW will be greater. In this study, upper-middle economic status showed a significant relationship with the incidence of LBW. This study aligns with the results [18] of 21 studies of socioeconomic relationships and the incidence of LBW; three studies did not show a significant relationship because LBW can be found in all wealth quintiles. Other studies show a different relationship conducted by [19], showing that only the economic status of women in the top richest quintile can reduce the risk of LBW births by 32%. [20] mothers strengthen this influence in the top wealth quintile, reducing the risk of LBW by 10%.

In the descriptive analysis results, most mothers have a birth interval of more than 6 years, while in the

bivariate analysis, the birth interval did not show a significant relationship with LBW. In the logistic regression analysis, the 2-5 years birth interval decreased the risk of LBW births after being controlled with other variables. It did not affect the relationship between the frequency and quality of ANC variables and the incidence of LBW. Birth intervals of less than or equal to two years were twice as likely to have low birth weight babies as those of three years or more. Pregnancy intervals that are too short may increase the risk of life for mothers associated with pregnancy and childbirth complications. This may directly or indirectly affect the mother's health and economic, and social status during pregnancy [21]. Based on this study, pregnancy intervals did not show a significant relationship.

Exposure to cigarettes during pregnancy in this study showed a significant relationship. In the descriptive analysis, most mothers in this study were exposed to cigarette smoke during pregnancy, and the incidence of LBW was greater in mothers exposed to cigarettes than in mothers who were not exposed to cigarettes during pregnancy. Hence, mothers who smoke increased the risk of experiencing LBW. Logistic regression analysis showed that mothers who were exposed to cigarettes during pregnancy had a constant risk of experiencing LBW and did not affect the relationship between the frequency and quality of LBW and the incidence of LBW. Smoking in pregnant women is known to have teratogenic effects on the fetus, especially the effects that cause stunted growth. Low birth weight (LBW) in mothers who smoke is caused by vasoconstriction of the uterine blood vessels, limiting the blood supply to the fetus. Prenatal exposure to cigarette smoke is independently associated with LBW [22]. Exposure to tobacco smoke during pregnancy can reduce birth weight. The birth weight of babies from passive smoking mothers is lower than mothers who are not exposed to cigarette smoke [23].

The descriptive analysis of respondents mostly lives in the Java-Bali region. The regions where they live, NTT, NTB, and Sulawesi, have the highest incidences, so the risk will likely increase in these two regional areas. Logistic regression analysis shows a significant relationship with the incidence of LBW. After entering the variable of birth spacing, the risk of mothers living in the NTT and NTB regions increased by 10% compared to the previous regression model. Still, it did not affect the relationship between the frequency and quality of ANC and the incidence of LBW. Several factors influencing this relationship are quality of service, distance from residence to other health service locations,availability of health facilities,skilled, medical personnel, different facilities, and infrastructure. In general, maternal and child health programs apply the same in every region of Indonesia.

Maternal age, gender, parity, amount of Fe consumption, first visit, place of residence, and education in this study did not show a statistically significant relationship. Practically, the gender of the female child, no Fe consumption, parity at risk, and the first ANC visit in the third trimester provide information on the increase in the incidence of LBW. The later the first ANC visit is started, the greater the possibility of an increase in the incidence of LBW. Gebresilassie *et al.* (2019) mothers who undergo the first ANC in the third trimester are 2.7 times more at risk of giving birth to LBW than mothers who give birth in the second trimester. Zhou *et al.* (2019) stated that pregnancy check-ups at least 5 times or even 8 times during pregnancy and undergoing ANC in the first trimester could prevent mothers from giving birth to LBW babies.

In this study, the relationship between maternal age was not shown to be significant. This result is not in line with research [24] that the age that increases the risk of LBW pregnancy occurs in the age group more significant than 40 years and does not occur in the younger age group. Analysis of gender did not show a significant relationship. This is in contrast to research conducted by [20] that girls are at risk of experiencing LBW.

Maternal parity in this study did not show a significant relationship. The study does not align with that conducted by [25], which states that primiparous and multiparous pregnancies do not contribute to LBW, while grand multiparous pregnancies do. Fe consumption during pregnancy does not provide statistical evidence, but in practice, the amount of consumption affects the incidence of LBW. Fe consumption of more than 90 during pregnancy has been shown to reduce the risk of LBW births, and not consuming Fe and folic acid during pregnancy increases the incidence of LBW by 24% [26]. Because mothers who do not consume Fe can increase the risk of anemia, further research shows that anemia in pregnant women is a risk factor for experiencing LBW [27]. Place of residence in this study did not show a significant relationship with the incidence of LBW. This study is not in line with research [26], which shows that the risk of LBW increases in people living in rural areas compared to urban areas. The results of the analysis of education levels are not in line with research [20] that secondary education and above will contribute to reducing the risk of giving birth to mothers.

CONCLUSION

Based on the findings of this study, it is evident that adhering to the WHO recommendation of attending at least eight ANC contacts significantly reduces the risk of LBW. The incidence of LBW was lower among mothers who completed eight or more ANC visits than those who attended only 1–3 or 4–7 times. Even after adjusting for other variables, the increased risk of LBW among mothers with fewer than eight ANC visits remained consistent. This highlights the importance of frequent and comprehensive ANC in mitigating the risk of adverse birth outcomes.

Additionally, mothers who received high-quality ANC services exhibited a lower incidence of LBW compared to those who did not, although the statistical analysis did not confirm a significant reduction in LBW occurrence. Specifically, mothers who attended only 1–3 ANC visits had a 9.6% higher incidence of LBW than those with eight or more visits, making them more likely to experience LBW. Similarly, mothers who attended 4–7 ANC visits had a 2.4% higher incidence of LBW, with a 63% greater likelihood of delivering an LBW infant compared to those who met the WHO-recommended ANC frequency. These findings underscore the crucial role of adequate and high-quality ANC in promoting better birth outcomes.

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