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Determinants for Low Birth Weight in Mothers Giving Birth during the Covid-19 Pandemic

Determinan Kejadian Berat Badan Lahir Rendah pada Ibu Melahirkan Selama Pandemi Covid-19

Lia Kurniasari[1]*, Martha Irene Kartasurya[2], Sri Achadi Nugraheni[2], Farid Agushybana[2]

[1]Student Doctoral of Public Health, Faculty of Public Health, Diponegoro University, Kota Semarang, Indonesia
[2]Faculty Of Public Health, Diponegoro University, Kota Semarang, Indonesia

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Correspondent:
Lia Kurniasari
liakesmas86@students.undip.ac.id

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ABSTRACT

Background: Low birth weight (LBW) remains a significant global health issue, leading to higher rates of infant and child morbidity and mortality. In 2022, Indonesia had a 12.58% rate, while in Kutai Kartanegara Regency, East Kalimantan, the rate was higher at 16.30%. The Covid-19 pandemic, which severely impacted East Kalimantan also influenced LBW rates.
Objectives: Analyzed the determinants of LBW incidence during the Covid-19 pandemic in Kutai Kartanegara.
Methods: This population of 1265 mothers delivered in four public health centers with the highest cases of BBLR. This study used a case control design for 240 mothers, including 120 mothers who gave birth to babies with low birth weight and 120 mothers who gave birth to babies with LBW. Data were obtained from e-cohort data according to specific inclusion and exclusion criteria. Data collection occurred from August until October 2022 through interviews with structured questionnaires and maternal child handbooks. Data analysis was performed with logistic regression.
Results: Determinant factors LBW were maternal nutritional risk (upper arm circumference <23.5 cm) (OR=2.800, 95% CI=1.237-6.340), history of anemia (OR=3.156, 95% CI=1.716-5.804), history of Covid-19 (OR=4.357, 95% CI=2.355-8.063), living with a smoker (OR=2.505, 95% CI=1.716-2.804), and not having health insurance (OR=2.744, 95% CI=1.435-5.247).
Conclusions: Internal factors such as age, under arm circumference, anemia, Covid-19, birth spacing, and parity and external factors (such as living with smokers, not having insurance) were interconnected in contributing to the risk of LBW, the pandemic further influenced these determinant factors.

INTRODUCTION

Low birth weight (LBW) becomes still a major concern as a health program in infants. Birth weight is a sensitive indicator of fetal development in the womb. Data from the World Health Organization (WHO) and the United Nation Children Fund (UNICEF) states that around 22 million babies are born worldwide with LBW and an increase of 7%[1,2]. LBW is an important indicator of maternal health throughout the period before and during pregnancy. It has a significant impact on neonatal, infant and childhood mortality and morbidity[2–4]. LBW is the leading cause of infant mortality and is associated with high morbidity and mortality of children under 5 years of age, increased infectious disease, growth deficits, and development delays[3].

As a developing country and in the Southeast Asia region, Indonesia has the second highest LBW rate after the Philippines with a proportion of 21.2%[5] . This proportion value has also increased since the Covid-19 Pandemic situation two years ago. In 2022, the percentage of LBW in Indonesia is still high at 12.58%[6]. At the time this research was conducted, the Covid-19 pandemic was still occurring. Covid-19 has an impact on increasing the risk of fetal health complications, including LBW[7]. According to the literature review, Covid-19 infection can worsen pregnancy when compared to uninfected women in pregnancies of the same age[8]. Research indicates that the risk factors for LBW include low income, low iron intake, low vitamin D consumption, anemic mothers, maternal age <20 years and ≥35 years, Covid-19 infection, food supply during the Covid-19 pandemic, and exposure to cigarette smoke[9,10].

East Kalimantan (Kaltim) is one of the regions that also has a record of cases infected with the Covid-19 Virus, the number of cases in 2021 had reached 37,089 cases with a mortality rate of 25.3% per 1000 cases, while in Indonesia itself, and the number of cases at the same time also reached 977,474 cases with a mortality rate of 28% per 1000 cases, but so far there is no data related to the number of pregnant women infected with the Covid-

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19 virus. Data from the East Kalimantan Provincial Health Office Profile in 2020 showed that the percentage of LBW in East Kalimantan was 5.2%. In East Kalimantan Province, the highest LBW rate occurred in Kutai Kartanegara Regency (KuKar), which is 7.79%[10]. This case control study determined various risk factors for LBW during the Covid-19 pandemic, starting from the smallest sub-region and become the basis for being able to provide input as an effort to prevent LBW if emergency conditions, such as a pandemic occur again.

METHODS

This study used a case control design in the population of mothers who gave birth in 2021 to 2022 (during the Covid-19 pandemic), the population is 1265. The sample size calculation was carried out with a 95% test strength with a ratio of 1: 1 between the LBW and non-LBW groups. The results of the sample calculation obtained research subjects totaling 240 mothers from the case group and control group, each group of 120 subjects. The case group was mothers who gave birth to babies with a birth weight of <2500 grams, and the control group was mothers who had given birth to babies with a birth weight of 2500 to 4500 grams. Case subjects were obtained through data taken from the cohort book, control subjects were obtained in the same location as case subjects, and a search for the mother's address was carried out through cellular contacts, and asked for the mother's consent by filling out informed consent.

Subjects were selected purposively from the list of mothers giving birth at the public health center based on the case inclusion criteria, namely those who gave birth to babies weighing <2500 grams in 2021 to 2022 in the KuKar region, and have a Maternal Child Health (MCH book). The control group inclusion criteria were mothers who gave birth to babies >2500 grams. Exclusion criteria for cases and controls were mothers who gave birth and had died, mothers who had cancer or were in legal proceedings. The list of respondents' names was obtained from the cohort book of the community health center in the four areas with the highest LBW cases in Kutai Kartanegara, namely Loa Kulu, Loa Janan, Separi and Mangkurawang health centers.

The main variable of this study was the incidence of LBW. The independent variables consist of internal and external factors. Internal variables include everything related to the condition of the mother and her health that cannot be changed such as reproductive age of risk, namely mothers who are pregnant with (age <20 years and ≥35 years), age not at risk, namely pregnant women aged 20-35 years. Safe parity is mothers with parity 2 and 3, while unsafe parity is mothers with the first pregnancy and more than 3. History of anemia is the Haemoglobin (Hb) level of pregnant women in the final trimester less than 11 mg/dl. Height is the height of the mother (<150 cm and ≥150 cm), Upper Arm Circumference <23.5 cm and ≥23.5 cm) is the size of the upper arm circumference of the mother during Antenatal Care (ANC) examination. Birth spacing (<2 years and ≥2 years) is the birth distance between the current child and the previous child. Number of Antenatal Care (ANC) visits is the number of ANC check-ups the mother had during pregnancy (<4 times and >4 times). Weight Gain (BW) is the mother's weight gain during pregnancy in accordance with the recommendations, and the history of Covid-19 is the mother's history of Covid-19 infection during pregnancy. External variables are factors that exist in the mother in the form of things that can be changed or cannot be changed, such as the level of education is the last education graduated by the respondent. Income is the regular money earned by the family every month. Health insurance ownership is the ownership of insurance both private and BPJS (social health insurance body) owned by pregnant women. Living with a smoker is the presence of family members who have a smoking habit. Participation in pregnant women's classes is whether or not the mother has attended pregnant women's classes during pregnancy either once until completion. Access to health services is the distance to the public health centers with a distance of >5 KM or a distance of >15 minutes.

Data were collected by interview using a structured questionnaire and by looking at records in the MCH book. Data were analyzed using Chi Square test with a significance level of 0.05 and logistic regression was performed on variables with a p-value of 0.25 as a condition for entering the regression model to determine the potential risk factors of each variable with OR values and 95% CI, all statistical analysis tests using Statistic Packager for Social Science (SPSS). This study was approved by the Research Ethics Commission of the Faculty of Public Health, Diponegoro University No.281/EA/KEPK-FKM/2022.

RESULTS AND DISCUSSIONS

The total number of mothers giving birth as research subjects was 240 respondents, consisting of 120 cases and 120 controls. The babies who were born less than 50% in the case group (LBW) were 43 (89.6%), most of the mothers' occupations were not working / housewives as many as 195 mothers. Meanwhile, related to the husband's occupation, six (100%) respondents had the husbands who were unemployed after the Covid-19 pandemic occurred. Besides, the location of the respondent's residence is mostly in the centre of the district, as many as 134 respondents, living on the edge of the district, and on the riverbank as many as 106 respondents.

Tabel 1. Social demographics and characteristics of respondent's mother delivered have baby with low birth weight and normal birth weight in Kutai Kartanegara

Characteristics	LBW n (%)	Normal Birth Weight n (%)	Total n (%)	p-value
Gestational age of Birth				
Full term	77 (40.1)	115 (59.5)	192 (100)	0.001*
Preterm	43 (89.6)	5 (10.4)	48 (100)	
Living Location				1.000

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Characteristics	LBW n (%)	Normal Birth Weight n (%)	Total n (%)	p-value
City Center	67 (50)	67 (50)	134 (100)	
Regional Periphery/Riverside	53 (50)	53 (50)	106 (100)	
Mother Occupation				
Unemployed/Housewife	100 (51.3)	95 (48.7)	195 (100)	0.408
Employed	20 (71.4)	25 (55.6)	45 (100)	
Husband's Occupation				
Unemployed	6 (100)	0 (0)	6 (100)	0.029
Employed	114 (48.7)	120 (51.3)	234(100)	
Total	120	120		

*chi-square (significant if p-value <0.05), LBW (Low Birth Weight), OR (Odds Ratio)

Table 2 sheds light on internal factors that significantly influence the risk of LBW. Maternal age appears to play a role, with an odds ratio (OR) of 0.521 and a 95% confidence interval (CI) of 0.310-0.875. This suggests that mothers on either end of the age spectrum might be at higher risk. Nutritional status also emerged as a significant factor. A low maternal upper arm circumference (OR=2.390, CI=1.166-4.898) indicates that malnutrition potentially increases the likelihood of LBW deliveries. The study also found a connection between short birth intervals (OR=1.694, CI=0.942-3.036) and LBW, suggesting that mothers who conceive too soon after a previous birth may be at risk. Finally, a history of both anemia (OR=2.843, CI=1.657-4.880) and Covid-19 infection (OR=4.071, CI=2.327-7.120) were identified as significant risk factors for LBW.

Tabel 2. Internal and external risk factor for low-birth-weight incidence in Kutai Kartanegara

Variable	Case LBW n (%)	Control Normal Birth Weight n (%)	Total n (%)	OR	CI (95%)	p-value
Internal Factor						
Age						
Reproduction at Risk (<20 & ≥35 years old) (Ref)	59 (43.1)	78 (56.9)	137 (100)	0.521	0.310-0.875	0.013*
Reproductively Healthy (20-35 years old)	61 (59.2)	42 (40.8)	103 (100)			
Upper Arm Circumference						
<23,5 cm (Ref)	27 (67.5)	13 (32.5)	40 (100)	2.390	1.166-4.898	0.015*
≥23,5 cm	93 (46.5)	107 (53.5)	200 (100)			
Height						
<150 cm (Ref)	33 (55.9)	26 (44.1)	59 (100)	1.371	0.759-2.476	0.294
≥150 cm	87 (48)	94 (52)	181 (100)			
Parity						
Unsafe Parity (1 and >3) (Ref)	66 (50)	64 (49.2)	130 (100)	1.069	0.644-1.777	0.796
Safe Parity (2 and 3)	54 (49.1)	56 (50.9)	110 (100)			
Birth Interval						
Risk (<2 years) (Ref)	37 (59.7)	25 (40.3)	62 (100)	1.694	0.942-3.046	0.077*
Not Risk (≥2 years)	83 (46.6)	95 (53.4)	178 (100)			
History of Anemia						
Anemia (Ref)	61 (65.6)	32 (34.4)	93 (100)	2.843	1.657-4.880	0.001*
Not Anemia	59 (40.1)	88 (59.9)	147 (100)			
History of Covid-19 Infection						
Covid (Ref)	65 (70.7)	27 (29.3)	92 (100)	4.071	2.327 -7.120	0.001*
No Covid	55 (37.2)	93 (62.8)	148 (100)			
ANC Visit History						
<4 (four) (Ref)	10 (50)	10 (50)	220 (100)	1.000	0.400-2.498	1.001
≥4 (four)	110 (50)	110 (50)	20 (100)			
Weight Gain Compliance with Recommendation						
Not Recommended (Ref)	29 (53.7)	25 (46.3)	54 (100)	1.211	0.660-2.223	0.536
As Recommended	91 (48.9)	95 (51.1)	186 (100)			
Education Level						
Less Education (Ref)	26 (50)	26 (50)	52 (100)	1.000	0.541-1.848	1.000
Higher Education	94 (50)	94 (50)	188 (100)			

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Variable	Case LBW n (%)	Control Normal Birth Weight n (%)	Total n (%)	OR	CI (95%)	p-value
External Factor						
Income Level						
<Regional Minimum Wage (Ref)	42 (57.5)	31 (42.5)	73 (100)	1.546	0.888-2.692	0.123*
≥Regional Minimum Wage	78 (46.7)	89 (53.3)	167 (100)			
Exposure to Active Cigarette Smoke						
Yes (Ref)	104 (54.5)	87 (45.5)	191 (100)	2.466	1.272-4.777	0.006*
No	16 (32.7)	33 (67.3)	49 (100)			
Health Service Distance						
Far (Ref)	37(43)	49 (57)	86 (100)	0.646	0.380-1.099	0.106*
Near	83(53.9)	71 (46.1)	154 (100)			
Participation in Maternity Class						
Not Participating (Ref)	10 (52.6)	9 (47.4)	19 (100)	0.892	0.349-2.279	0.811
Follow	110 (49.8)	111(50.2)	221(100)			
Health Insurance Ownership						
Do not Have (Ref)	52 (70)	22 (30)	74 (100)	3.406	1.895-6.125	0.001*
Have Health Insurance	68 (41)	98 (59)	166(100)			

*Included in regression analysis if p-value <0.25, LBW (Low Birth Weight), OR (Odds Ratio), CI (Confident Interval) 95%.

Table 2 explores not only internal factors but also external influences on LBW risk. It highlights several external factors with significant associations. Low income, specifically below the minimum wage, appears to be a contributing factor. Furthermore, limited access to healthcare facilities, potentially due to geographical distance, is another concern. Exposure to cigarette smoke by family members within the household environment also emerged as a risk factor. Finally, lacking health insurance may limit access to proper prenatal care, potentially increasing the risk of LBW.

Tabel 3. Final regression of risk factor for low-birth-weight incidence in Kutai Kartanegara

Variable	OR	CI	p-value
Upper Arm Circumference <23.5 cm	2.800	1.237-6.340	0.014*
History of Anemia	3.156	1.716-5.804	0.001*
History of Covid-19 Infection	4.357	2.355-8.063	0.001*
Exposure to Cigarette Smoke	2.505	1.716-2.804	0.001*
No Health Insurance	2.744	1.435-5.247	0.002*
Constant	0.602		

OR (Odds ratio), CI (Confident Interval), *chi-square (significant if p-value <0.05)

A multivariate logistic regression analysis, detailed in Table 3, identified several key risk factors associated with low birth weight (LBW) in mothers delivering at public health facilities in Kutai Kartanegara, Indonesia. Mothers with low upper arm circumference, indicating malnutrition (OR=2.800, 95% CI=1.237-6.340), and those with a history of anemia (OR=3.156, 95% CI=1.716-5.804) were found to be at significantly higher risk. The study also revealed a concerning association between a past Covid-19 infection and LBW, with mothers having had the disease exhibiting a fourfold increase in risk (OR=4.357, 95% CI=2.355-8.063). Furthermore, exposure to cigarette smoke at home (OR=2.505, 95% CI=1.716-2.804) and lacking health insurance (BPJS) (OR=2.744, 95% CI=1.435-5.247) were identified as additional significant risk factors for LBW deliveries.

Tabel 4. Internal and external risk factors for LBW in covid-19 patients in Kutai Kartanegara

Variabel	Case LBW n (%)	Control Normal Birth Weight n (%)	Total n (%)	OR	CI (95%)	p-value
Internal Factor						
Age				0.156	0.055-0.443	0.001*
Reproduction at Risk	23 (52.3)	21 (47.7)	44 (100)			

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Variabel	Case LBW n (%)	Control Normal Birth Weight n (%)	Total n (%)	OR	CI (95%)	p-value
(<20 & ≥35 years old) (Ref)						
Reproductively Healthy (20-35 years old)	42 (87.5)	6 (12.5)	48 (100)			
Upper Arm Circumference				1.563	1.319-1.852	0.002*
<23,5 cm (Ref)	17 (100)	0 (0)	17 (100)			
≥23,5 cm	48 (64)	27 (36)	75 (100)			
Height						
<150 cm (Ref)	21 (67.7)	10 (32.3)	31 (100)	0.811	0.317-2.073	0.662
≥150 cm	44 (72.1)	17 (72.1)	61 (100)			
Parity				1.393	0.564-3.438	0.471
Unsafe Parity (1 and >3) (Ref)	39 (73.6)	14 (26.4)	53 (100)			
Safe Parity (2 and 3)	26 (66.7)	13 (33.3)	39 (100)			
Birth Interval				3.818	1.032-14.122	0.035
Risk (<2 years) (Ref)	21 (87.5)	3 (12.5)	24 (100)			
Not Risk (≥2 years)	44 (64.7)	24 (35.3)	68 (100)			
History of Anemia				2.605	0.969-7.002	0.054
Anemia	31 (81.6)	7 (18.4)	38 (100)			
Not Anemia	34 (63)	20 (37)	54 (100)			
ANC Visit History				1.429	1.248-1.635	0.357
<4 (four)	2 (100)	0(0)	2 (100)			
≥4 (four)	63 (70)	27 (30)	90 (100)			
Weight Gain Compliance with Recommendation				1.212	0.492-2.986	0.676
Not Recommended (Ref)	13 (65)	7 (35)	20 (100)			
As Recommended	52 (68.8)	20 (31.2)	72 (100)			
External Factor						
Education Level				0.407	0.145-1.141	0.082
Less Education (Ref)	11 (55)	9 (45)	20 (100)			
Higher Education	54 (75)	18 (25)	72 (100)			
Income Level				1.134	0.427- 3.008	0.801
<Regional Minimum Wage (Ref)	21 (72.4)	8 (27.6)	29 (100)			
≥Regional Minimum Wage	44 (69.8)	19 (30.2)	63 (100)			
Exposure to Active Cigarette Smoke				5.784	1.837-18.212	0.001*
Yes (Ref)	59 (77.6)	17 (22.4)	76 (100)			
No	6 (37.5)	10 (62.5)	16 (100)			
Health Service Distance				0.343	0.131-0.898	0.026*
Far (Ref)	14 (53.8)	12 (46.2)	26 (100)			
Near	51 (77.3)	15 (22.7)	66(100)			
Participation in Maternity Class				0.319	0.037-2.274	0.273
Not Participating (Ref)	58(69)	26 (31)	84 (100)			
Follow	7 (87.5)	1 (12.5)	8 (100)			
Health Insurance Ownership				4.351	1.351-14.017	0.010*
Do not Have (Ref)	28 (87.5)	4 (12.5)	32 (100)			
Have Health Insurance	37 (61.7)	23 (38.3)	60 (100)			

LBW (Low Birth Weight), OR (Odds Ratio), * chi-square (significant if p-value <0.05), CI (Confident Interval) 95%.

Table 4 delves deeper by analyzing risk factors for LBW within two separate groups: mothers with and without a history of Covid-19. Interestingly, the factors influencing LBW risk differed between the groups. For mothers who had previously contracted Covid-19, factors like maternal age, upper arm circumference (indicating nutritional status), short birth intervals (less than 2 years between pregnancies), educational level, and exposure to cigarette smoke emerged as significant contributors to LBW risk. In contrast, Table 5 highlights the risk factors for LBW in mothers who did not have Covid-19. Here, a history of anemia and lacking health insurance were identified as the key factors associated with an increased risk of delivering a low-birth-weight baby.

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Tabel 5. Internal and external risk factors for LBW in non-Covid-19 patients

Variabel	Case LBW n (%)	Control BBLN n (%)	Total n (%)	OR	CI (95%)	p-value
Internal Factor						
Age						
Reproduction at Risk (<20 & ≥35 years) (Ref)	36 (38.7)	57 (61.3)	93 (100)	1.197	0.597-2.398	0.612
Reproductively Healthy (20-35 years)	19 (34.5)	36 (65.5)	55 (100)			
Upper Arm Circumference						
<23,5 cm (Ref)	10 (43.5)	13 (56.5)	23 (100)	1.368	0.555-3.369	0.495
≥23,5 cm	45 (36)	80 (64)	125 (100)			
Height						
<150 cm (Ref)	12 (42.9)	16 (57.1)	28 (100)	1.343	0.582-3.100	0.489
≥150 cm	43 (35.8)	77 (64.2)	120 (100)			
Parity						
Unsafe Parity (1 and >3) (Ref)	27 (35.1)	50 (64.9)	77 (100)	0.829	0.425-1.617	0.582
Safe Parity (2 and 3)	28 (39.4)	43 (60.6)	71 (100)			
Birth Interval						
Risk (<2 years) (Ref)	16 (42.1)	22 (57.9)	38 (100)	1.324	0.623-2.812	0.465
Not Risk (>2 years)	39 (35.5)	71 (64.5)	110 (100)			
History of Anemia						
Anemia (Ref)	30 (54.5)	25 (45.5)	55 (100)	3.264	1.619-6.582	0.001*
Not anemia	25 (26.9)	68 (73.1)	93 (100)			
ANC Visit History						
<4 (four) (Ref)	8 (44.4)	10 (55.6)	18 (100)	1.413	0.522-3.826	0.495
≥4 (four)	47 (36.2)	83 (63.8)	130 (100)			
Weight Gain Compliance with Recommendation						
Not Recommended (Ref)	29 (42.6)	39 (57.4)	68 (100)	1.544	0.790-3.020	0.203
As Recommended	26 (32.5)	54 (67.5)	80 (100)			
External Factor						
Education Level						
Less Education (Ref)	15 (46.9)	17 (53.1)	32 (100)	1.676	0.759-3.705	0.199
Higher Education	40 (34.5)	76 (65.5)	116 (100)			
Income Level						
<Regional Minimum Wage (Ref)	21 (47.7)	23 (52.3)	44 (100)	1.880	0.915-3.860	0.084
≥Regional Minimum Wage	34 (32.7)	70 (67.3)	104 (100)			
Exposure to Active Cigarette Smoke						
Yes (Ref)	45 (39.1)	70 (60.9)	115 (100)	1.479	0.644-3.396	0.355
No	10 (30.3)	23 (69.7)	33 (100)			
Health Service Distance						
Far (Ref)	23 (38.3)	37 (61.7)	60 (100)	1.088	0.552-2.143	0.808
Near	32 (36.4)	56 (63.6)	88 (100)			
Participation in Maternity Class						
Not Participating	52 (38)	85 (62)	137 (100)	1.631	1.414-6.427	0.481
Follow	3 (27.3)	8(72.7)	11 (100)			
Health Insurance Ownership						
Do not Have (Ref)	22 (56.4)	17 (43.6)	39 (100)	2.433	1.170-5.059	0.016*
Have Health Insurance	33 (30.3)	76 (69.7)	109 (100)			

LBW (Low Birth Weight), OR (Odds Ratio), *chi-square (significant if p-value <0.05), CI (Confident Interval) 95%.

The causes of LBW during the Covid-19 pandemic in Kutai Kartanegara in this study were found to be several factors, Upper arm circumference size <23.5 cm, history of anemia, history of Covid-19 infection, exposure to cigarette smoke and not having health insurance. The purpose of this study can be the basis for efforts to prevent LBW. This study was conducted when the respondents experienced pregnancy during the Covid-19 pandemic, so that the correlation between Covid-19 virus infection and the incidence of LBW was obtained. The Covid-19 pandemic situation as an emergency situation that has an influence on many things, in addition to the sharp increase in cases, it also has a lot of influence on the birth of premature babies, which increases the birth rate of babies with LBW. This is in accordance with research in Wuhan and Nanjing, China, which obtained the results of the birth of babies with lower weight more than the pre-pandemic period in full-term births. Mothers infected with Covid-19 increase the risk of caesarean delivery due to premature rupture of

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membranes, and fetal distress, thus increasing premature birth[7,11,12]. Pregnant women infected with Covid-19 experience limitations in the fulfillment of oxygen supply, the caesarean section rate of 46% has increased 1.5 times compared to before the pandemic[13]. The Covid-19 virus attacks the mother's respiratory tract so that the supply of food intake is also hampered due to respiratory problems experienced by the mother[11,14] . Research in Pakistan states that another thing that increases the risk of mothers experiencing low birth weight is the stressful conditions experienced by mothers during the Covid-19 pandemic[15].

The Covid-19 condition in this study increases LBW births because it occurs with other factors that also increase the risk of LBW, such as exposure to cigarette smoke. In this study, more than 80% of pregnant women lived with smokers, who smoked in the house so that during the pandemic the exposure of pregnant women to cigarette smoke increased even more. In this study, mothers have a risk of 2.505 times giving birth to LBW babies when there are family members as smokers, and in mothers infected with Covid-19 the risk of giving birth to LBW is even greater to 5.784 times, in mothers who are not affected by Covid-19 and are at home with smokers, have a risk of giving birth to LBW babies 1.479 times. The impact of exposure to cigarette smoke was greater on mothers affected by Covid-19, in Schiliro research mentioned that exposure to cigarettes for one hour has an adverse effect on lung membranes and increases symptoms of respiratory infections. This is also the case for pregnant women who are continuously exposed to cigarette smoke during pregnancy, increasing the risk of respiratory infections during pregnancy[16].

These results further strengthen Covid-19 infection during pregnancy, increasing the risk of LBW birth which is influenced by external maternal variables[17]. This study is similar to research on pregnant women in Surabaya which shows that mothers exposed to cigarette smoke are at risk of 3.04 times giving birth to LBW babies. Another study from Turkey mentioned that mothers who are exposed to secondhand smoke during pregnancy have the possibility of giving birth to LBW (OR=2.405, 95% CI=2.570-47.741)[18].

In this study, maternal age <20 years or ≥35 years was a protective factor for the incidence of LBW just positive in pregnant mother with Covid-19. Most of the subjects in this study were ≥35 years old (22.2%) this occurred due to limited access to health services to obtain family planning services, so that during the Covid-19 pandemic at the research location there were many unplanned pregnancies. Research in Finland states that mothers who delivered at the age of over 30 years have more mature socio-economic characteristics, which are closely related to a more stable household income, so that the fulfilment of nutrition during pregnancy is more easily obtained. In addition, the education of mothers above the age of 30-40 years is considered to have reached the highest level of education. This also identifies that age has become a measurement of a person's maturity, and mothers who become pregnant above the age of 30 years are considered to have a higher maturity trait. Thus, they are considered to be able to go through pregnancy more maturely than those under the age of 30 years[19].

At the Kutai Kartanegara, mothers aged 20-35 years who experienced LBW were due to more pregnant women at that age being exposed to Covid-19. When mothers experience Covid-19, they are at risk of experiencing a cytokine storm. This cytokine storm damages organs in younger people, as the immune system at that age seems stronger and has better recovery capabilities than older ages[20]. In pregnancy conditions, this cytokine storm causes serious pregnancy complications, such as preeclampsia and other organ damage. There is also dysregulation of the immune system resulting in inflammation that affects the placenta and contributes to LBW[21]. Babies born to mothers who have experienced a cytokine storm during pregnancy have a higher risk of LBW due to the non-optimal intrauterine environment due to inflammation[22–24].

Based on a brief interview conducted by the researcher regarding pregnancy during the pandemic and previous pregnancy experiences, the researcher can conclude that age above 35 years is a protective factor in the incidence of LBW, due to the mother's previous experience, the mother has better knowledge from previous pregnancies, the mother becomes more attentive to pregnancy during the pandemic because the mother knows that unfavorable conditions will affect the health of her pregnancy, so the mother tries to improve nutrition during pregnancy. This reason same with literature research which states that older mother has greater emotional maturity and feel more prepared for motherhood. In addition, advanced maternal age appears to exert a protective influence on children behavioral, social and emotional functioning, thus offsetting biological risks and during the Covid-19 pandemic present challenges for women with risk pregnancies, which negatively impacts psychological conditions and health seeking behaviours[25,26].

In this study, there was a correlation between maternal upper arm circumference and the incidence of LBW. Mothers with upper arm circumference less than 23.5 cm have a risk of giving birth to babies with LBW by 2.390 times compared to those with upper arm circumference > 23.5 cm. In the conditions of the Covid-19 pandemic, access to animal protein is limited due to lack of availability or increased prices.

Research in India also shows that upper arm circumference < 23.5 cm is a determinant of LBW incidence (OR 0.57, 95%CI 0.52-0.60), the Odds Ratio obtained in this study is greater at 2.39 times. mentioned the taboo on certain foods makes pregnant women have Upper arm circumference < 23.5 cm, Different things happen at the research location, taboo foods are not well known by pregnant women. Upper arm circumference has a relationship with Chronic Energy Deficiency (CED) in pregnant women, the results of the study mentioned the cause of LBW in West Kutai is the high rate of CED in pregnant women. Kutai Barat and KuKar have similar characteristics [27]. In this study, mothers who suffered from Covid-19 had a greater risk of giving birth to LBW when they had Upper arm circumference <23.5 cm, the risk was 0.811.

Iron requirements during pregnancy increase by 1.25 mg/dl compared to non-pregnant conditions[28]. The

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incidence of LBW is also still strongly related to the incidence of anemia in pregnant women. This study also proved that anemic mothers have a 2,843 times risk of giving birth to LBW babies, compared to mothers who do not have a history of anemia. This is also in accordance with research in India, which states that LBW is 1.5 (OR=1.27-1.9) times more likely to occur in women with severe anemia and 1.14 (1.06-1.22) in women with moderate anemia[29] . Study meta-analysis maternal anemia was associated with low birth weight with an adjusted OR=1.23 (95% CI=1.06–1.43)[30]. The findings of this study are similar to studies reported in China[31], India[32], and Brazil[33]. This is due to intrauterine growth restriction. When maternal hemoglobin levels drop, oxygen circulation in the fetal body is limited. Thus, the fetal placenta is exposed to an oxidative stress environment (chronic hypoxia), which disrupts the transfer of oxygen/nutrient supply, resulting in fetal growth restriction and low birth weight due to placental angiogenesis[34] . Holistic assistance is required to ensure that blood supplement tablets are properly consumed by pregnant women every day, so that the existing program runs effectively and efficiently.

Insurance ownership affects the birth of LBW in the study mentioned that there are still several subjects who do not have health insurance, and the risk of giving birth to a baby with LBW is 2.570. This is in line with the results of research in Indonesia, which states that babies from families participating in Non-ASKESKIN (social health insurance for the poor) health insurance are protected from LBW (OR; 95% CI =0.61; 0.43-0.88)[35]. This is also in accordance with Laksono's research that mothers who have health insurance showed a 1.416 times greater chance of understanding the danger signs of pregnancy compared to those who do not have health insurance[36]. The results of the Crescent study in Simbolon showed that healthcare social secure net program/*Jaring Pengaman Sosial Bidang Kesehatan* (JPS-BK) services for poor families participating in JPS-BK were very beneficial for pregnant women, postpartum women, breastfeeding mothers and other family members, in utilizing antenatal, delivery, post-natal, immunization, and other health services[35]. Another study mentioned that the ownership of health insurance in Indonesia shows an increasing trend although the coverage is still very low, and this low coverage will have an impact on the persistence of nutrition and maternal health problems in Indonesia[37]. Laksono's research states that the determinants of health insurance ownership in Indonesia are the level of education, wealth status, parity (multiparity), and knowledge of pregnancy danger signs, which will lead to greater efforts to have health insurance[37].s

This study found that there was a correlation between the birth spacing and the incidence of LBW. The best distance between pregnancy and the next pregnancy is above 24 month or two years, because with this distance the mother was considered to be better prepared to carry pout pregnancy with the fulfillment of better nutrition. Devagurudi study in India states that mothers with short pregnancies increase the risk of LBW, this occurs due to deteriorating nutritional status during pregnancy[38]. In this study, the Covid-19 situation in Indonesia provided limitations in the fulfillment of daily nutrition due to the unavailability old many foods as before the Covid-19 pandemic[39]. In addition, Covid-19 patient there was a decrease in appetite when they are sick, making it difficult to eat and further increasing pregnant women suffering from Covid-19 experience a decrease in appetite and fulfillment of nutrition during pregnancy[40].

CONCLUSIONS

This study concludes that the internal risk factors for LBW during the Covid-19 pandemic are safe reproductive age, Upper arm circumference <23.5 cm, history of anemia, history of Covid-19 infection, and birth spacing <2 years, and external risk factors are living with smokers, not having health insurance are factors that significantly increase the incidence of LBW during the Covid-19 pandemic. Further studies regarding the internal and external risk factors of low birth weight can be conducted in longitudinal studies.

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE

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AUTHOR CONTRIBUTIONS

LK: conceptualization, investigation, methodology, writing–original draft, and editing; MIK: supervision, methodology; SAN: writing–review, methodology, formal analysis; FA: statistical analysis, writing–review, formal analysis, resources.

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