



## Anemia in Pregnancy and Low Birth Weight Before and During the COVID-19 Pandemic in Kalijambe

### *Anemia pada Kehamilan dan Berat Bayi Lahir Rendah Sebelum dan Selama Pandemi COVID-19 di Kalijambe*

Sang Sanggita Surya<sup>1</sup>, Nur Aisyah Jamil<sup>2\*</sup>, Dwi Cahyanti<sup>3</sup>, Aulia Rahma<sup>1</sup>, Amalia Adityas D. S<sup>1</sup>, Tika Minawati Dewi<sup>1</sup>

<sup>1</sup>Student at Faculty of Medicine, Universitas Islam Indonesia

<sup>2</sup>Department of Public Health, Faculty of Medicine, Universitas Islam Indonesia

<sup>3</sup>Public Health Centre Kalijambe, Sragen Regency, Jawa Tengah Province, Indonesia

\*Email korespondensi: [n.aisyah.j@uii.ac.id](mailto:n.aisyah.j@uii.ac.id)

#### ARTICLE INFO

eISSN: 2356-4067

DOI:10.30597/mkmi.v17i4.18206

Published online Des, 2021

#### Keywords:

Anemia;  
pregnancy;  
low birth weight;

#### Kata Kunci:

Anemia;  
kehamilan;  
berat badan lahir rendah;

#### ABSTRACT

Pregnant women and infants were a vulnerable group during the COVID-19 pandemic. This research aimed to determine anemia in pregnancy and Low Birth Weight (LBW) before and during the COVID-19 pandemic and analyze their associated factors. This was a cross-sectional study used secondary data from maternal and child health records in Kalijambe Public health center, Sragen. A total of 1169 birth records from the period of 2019-2020 were collected. The chi-square and logistic regression were used to analyze the differences and significant associated factors. The prevalence of anemia in pregnancy increased from 38.33% in 2019 to 49.21% in 2020 ( $p=0.013$ ). However, the LBW proportion decreased from 7.26% in 2019 to 6.02% in 2020 ( $p=0.415$ ). Mother who suffered from chronic energy deficiency marked by Mid-Upper Arm Circumference (MUAC) < 23.5 cm was higher risk of anemia (aOR 1.86;95%CI 1.13-3.08). Considering the gestational age when the hemoglobin (Hb) test, anemia was more likely to be found at the second (aOR 2.59;95%CI 1.37-4.86) and third trimester (aOR 6.97;95%CI 3.98-12.20). High-risk pregnancy had higher odds of LBW (aOR 8.57;95%CI 1.65-44.37), while anemia showed no effect on LBW (aOR 1.80;95% CI 0.34-9.45). These results were adjusted for mothers' age, parity, abortus, infection during pregnancy, high-risk pregnancy, MUAC, preterm birth, and gestational age. COVID-19 pandemic increased the prevalence of anemia in pregnancy but had no impact on LBW. Several factors for anemia and LBW were significantly associated. This finding suggests the need for early risk detection and routine, standardized, and comprehensive antenatal care.

#### ABSTRAK

Wanita hamil dan bayi merupakan kelompok rentan selama pandemi COVID-19. Penelitian ini bertujuan untuk mengetahui anemia pada kehamilan dan Berat Bayi Lahir Rendah (BBLR) sebelum dan selama pandemi serta menganalisis faktor yang memengaruhinya. Penelitian ini merupakan penelitian potong lintang dengan menggunakan data sekunder Kesehatan Ibu dan Anak (KIA) di Puskesmas Kalijambe, Sragen. Sebanyak 1169 catatan kelahiran pada tahun 2019 dan 2020 diikutkan dalam penelitian. Data dianalisis menggunakan uji chi square dan regresi logistik untuk mengetahui perbedaan dan faktor yang memengaruhinya. Prevalensi anemia meningkat dari 38,33% pada tahun 2019 menjadi 49,21% pada tahun 2020 ( $p=0,013$ ). Namun, prevalensi BBLR menurun dari 7,26% pada 2019 menjadi 6,02% pada tahun 2020 ( $p=0,415$ ). Ibu hamil yang mengalami kurang energi kronis dengan Lingkar Lengan Atas (LILA) < 23,5 cm berisiko lebih tinggi mengalami anemia (aOR 1.86;95%CI 1.13-3.08). Dilihat dari usia kehamilan saat pemeriksaan hemoglobin (Hb), anemia lebih banyak ditemukan pada trimester kedua (aOR 2.59;95%CI 1.37-4.86) dan ketiga (aOR 6.97;95%CI 3.98-12.20). Kehamilan risiko tinggi cenderung melahirkan bayi dengan BBLR (aOR 8.57;95%CI 1.65-44.37), sedangkan anemia tidak berhubungan dengan BBLR (aOR 1.80;95%CI 0.34-9.45). Hasil ini disesuaikan dengan usia ibu, paritas, riwayat abortus, infeksi selama kehamilan, kehamilan risiko tinggi, LILA, kelahiran prematur, dan usia kehamilan. Pandemi COVID-19 meningkatkan prevalensi anemia pada kehamilan tetapi tidak berdampak pada

---

*BBLR. Beberapa faktor yang memengaruhinya telah teridentifikasi. Hasil penelitian ini, menunjukkan perlunya deteksi dini risiko dan perawatan antenatal care secara rutin, terstandarisasi dan komprehensif.*

---

## INTRODUCTION

The COVID-19 pandemic has impacted vulnerable groups such as pregnant women and infants. Several factors may associate with the increased severity of COVID-19 in pregnancy. There are Physiological and anatomic changes, hormonal imbalance, alterations in immune systems, and increased expression of ACE2.<sup>1</sup> A previous study reported the increase in severe maternal morbidity, mortality, and neonatal complications, especially for those who had comorbid before the pregnancy.<sup>2</sup> The COVID-19 confirmed that mother with high-risk pregnancies (either preexisting chronic medical conditions in pregnancy or obstetrical disorders occurring in pregnancy) was found to have more adverse maternal outcomes such as severe respiratory symptoms, invasive mechanical ventilation, and admission to ICU.<sup>3</sup> Even though no major complications, severe maternal morbidity, and perinatal deaths were reported in a systematic review with 108 pregnancies.<sup>4</sup>

Another concern is the COVID-19 pandemic created a stressful environment that prevented pregnant mothers from getting routine Antenatal Care (ANC). There were fourteen deaths of women during pregnancy and postpartum in West Sumatra province in only two months (March to May 2020). This maternal mortality occurred due to the inability to access proper health care, such as suspicion of being infected from COVID-19, and limited healthcare personnel and facility.<sup>5</sup> Similar findings were reported in two midwife clinics in 2020; 26.67% of pregnant women did not get their routine ANC in Jakarta,<sup>6</sup> and 20.00% did not access the 4<sup>th</sup> ANC in andung.<sup>7</sup> A previous study that used demographic and health survey data from 10 countries showed inadequate ANC, delayed conception, and maternal age had greater potential effect on birth weight.<sup>8</sup> Despite being stressed during the COVID-19 pandemic, the lockdown phases in Austria seems to have no significant negative effect on extremely preterm birth rates and newborn weight among non-infected mothers.<sup>9</sup> During the period of January-April 2020, where Ireland applied lockdown due to COVID-

19, the number of Very Low Birth Weight (VLBW) and Extremely Low Birth Weight (ELBW) decreased compared to the same periods for the last two decades.<sup>10</sup> However, the pathway was still poorly understood rather than socio-environmental and behavior modifiers in pregnancy.<sup>10</sup>

Anemia in pregnancy and Low Birth Weight (LBW) are major indicators for maternal and infant outcomes. A study of 66 confirmed pregnant women showed laboratory changes that included increased levels of Lactate Dehydrogenase (LDH), creatinine, D-dimer, and C-Reactive Protein (CRP), anemia, and leukopenia. Low erythrocytes and lymphocytes levels were the main predictors of severe COVID-19 in pregnant women.<sup>11</sup> Anemia was found as a maternal adverse outcome due to COVID-19 as well as decreased fetal movement, intrauterine fetal distress, Premature Rupture of Membrane (PROM), preterm labor, and Multiple Organ Dysfunction Syndrome (MODS). Meanwhile, the neonatal outcomes were still birth, prematurity, asphyxia, fetal distress, LBW, Small for Gestational Age (SGA), Large for Gestational Age (LGA), MODS, disseminated intravascular coagulation, and neonatal death.<sup>12</sup> A previous study revealed that maternal anemia was more likely to have LBW than non-anemic mothers.<sup>13,14</sup>

Anemia in pregnancy is an indirect cause of maternal death in Indonesia, reaching 305/100.000 live births,<sup>15</sup> and determinant for LBW.<sup>15,16</sup> However, there is still limited evidence investigating the impact of the COVID-19 pandemic on these indicators in this country, and their associated factor has not been clarified. Therefore, this study aimed to examine the anemia in pregnancy and LBW before and during the first year of COVID-19 pandemic and analyze their significant associated factors.

## MATERIAL AND METHOD

A cross-sectional study used secondary data from maternal and child records at the Kalijambe Public Health Centre, a primary government owned the health care facility that provided personal and public health programs. The

District of Kalijambe is inhabited by 48.693 residents,<sup>17</sup> located in the southwest area of Sragen Regency, Central Java Province, Indonesia. The prevalence of LBW in Sragen Regency in 2019 was 677 from 14.056 births (4.81%) and 704 from 13.426 births (5.24%) in 2020.<sup>18</sup> A total of 1169 births from 2019 (before pandemic) to 2020 (pandemic) were collected. Since Indonesia had officially declared the first COVID-19 case in March 2020, a previous study showed the possibility of an undetected case at the beginning of the year 2020.<sup>19</sup> Anemia in pregnancy was defined as hemoglobin (Hb) level below 11 g/dl (analyzed using hemato analyzer from venous blood sample at any gestational age). In addition, LBW was recorded if the baby's birth weight was less than 2500 grams (babies' birth weight was recorded by a midwife/health worker, defined as the first weight measured within hours after delivery). The mother's age was then categorized based on optimal pregnancy and delivery age (20-35 years old). Parity showed the number of child delivered, assigned as primipara, second para, and multipara (3 or more children). Preterm birth/PTB was defined as birth at gestational age less than 37 weeks. Mid Upper Arm Circumference (MUAC) was suitable for macro nutritional status for pregnant women, divided into less than 23.5 cm that indicated chronic energy deficiency.<sup>20</sup> History of abortion represented the number of Mothers' Abortion. In addition, being infected during pregnancy was recorded as well as a high-risk pregnancy. High-risk pregnancy was defined as pregnancy with at least one of the following conditions; such as severe preeclampsia, PROM, head-pelvic disproportion, PTB, placental abruption, ever Caesarean section, poor obstetrical history, proteinuria, hyperthyroid, butt or foot presentation, hypertension, placenta previa, vacuum extraction, Gemelli, and less than two years of pregnancy interval.

This study used the chi-squared test and fisher exact test to analyze the proportional difference of anemia in pregnancy, LBW, and related factors before and during the first year in pandemic. This analysis included all collected data. However, due to incomplete data, several variables had different total cases included in the analysis, such as mother ages (1140 cases), PTB (494 cases), parity (1154 cases), MUAC (532 cases), anemia in pregnancy (509 cases),

gestational age (484 cases), and baby's birth weight (1090 cases). Furthermore, this study involved 401 cases to analyze the characteristic of anemia in pregnancy and 221 cases for LBW. In order to investigate which factors influenced anemia in pregnancy and LBW, a binomial logistic regression was applied. This study was ethically approved by the Committee of Ethics for Health Research, Faculty of Medicine Universitas Islam Indonesia No. 24/Ka.Kom.Et/70/KE/VI/2021.

## RESULTS

From 1169 births data collected in the Kalijambe district, 623 were born in 2019 (before the pandemic) and 546 babies in 2020 (first year of the pandemic). Table 1 showed the characteristic of birth in those years based on maternal demography and reproductive health conditions, and the infant's characteristics.

Based on Table 1, the majority of babies were delivered from mothers at optimal productive ages at 20-35 years old (83.68%), and a similar proportion was found between two years ( $p=0.861$ ). Majority of babies were delivered a term (93.12%). Even though PTB increased during the pandemic, there was no significant different ( $p=0.920$ ). In terms of parity, it was distributed equally in two years ( $p=0.963$ ). Almost one-third of pregnant women who delivered babies were multipara, and there were no significant differences between the two years. Most of the mothers (74.25%) had adequate nutritional status marked by  $MUAC \geq 23.5$  cm, and there were no differences in maternal nutritional status before and after pandemic ( $p=0.791$ ).

On the other hand, the prevalence of anemia in pregnancy increased from 38.33% (97 of 253) in 2019 to 49.21% (126 of 256) in 2020, and it was a significant difference ( $p=0.013$ ). A statistical difference was found following the gestational age when the blood test was taken ( $p=0.000$ ). The majority of blood test was taken in the third trimester (44.83%), which the highest proportion (27.27%) was in 2020. Even though 93.30% of babies were born at the normal birth weight ( $\geq 2500$ grams), the prevalence of LBW in Kalijambe was 7.26% (43 of 592) in 2019 and 6.02% (30 of 498) in 2020. However, there were no significant differences in their proportion ( $p=0.415$ ). The majority of Mothers had no history of Abortion (91.27%) and no

high-risk pregnancy (89.56%), and there were no significant differences before and during the pandemic. However, even though almost no

mother was reported infection during pregnancy, there were 2 cases of COVID-19 infection in pregnant women in 2020 (Table 1).

**Table 1. Characteristic of Birth Before and During the First Year of COVID-19 Pandemic**

Characteristic	Year of Birth						p-value
	2019 (Before Pandemic)		2020 (First Year of the Pandemic)		Total		
	n	%	n	%	n	%	
<b>Mother's Age (Years)</b>							
< 20	17	1.49	12	1.05	29	2.54	0.861
20-35	511	44.82	443	38.86	954	83.68	
> 35	85	7.46	72	6.32	157	13.77	
<b>Total</b>	<b>613</b>	<b>53.77</b>	<b>527</b>	<b>46.23</b>	<b>1140</b>	<b>100</b>	
<b>Pre-Term Birth</b>							
Yes (< 37 weeks)	15	3.04	19	3.85	34	6.88	0.920
No (≥ 37 weeks)	207	41.90	253	51.21	460	93.12	
<b>Total</b>	<b>222</b>	<b>44.94</b>	<b>272</b>	<b>55.06</b>	<b>494</b>	<b>100</b>	
<b>Parity</b>							
Primipara	189	16.38	165	14.30	354	30.68	0.963
Second para	232	20.10	209	18.11	441	38.21	
Multipara	192	16.64	167	14.47	359	31.11	
<b>Total</b>	<b>613</b>	<b>53.12</b>	<b>541</b>	<b>46.88</b>	<b>1154</b>	<b>100</b>	
<b>Mid Upper Arm Circumference</b>							
< 23.5 cm	70	13.16	67	12.59	137	25.75	0.791
≥ 23.5 cm	207	38.91	188	35.34	395	74.25	
<b>Total</b>	<b>277</b>	<b>52.07</b>	<b>255</b>	<b>47.93</b>	<b>532</b>	<b>100</b>	
<b>Anemia in pregnancy</b>							
Yes (Hb < 11 g/dl)	97	19.06	126	24.75	223	43.81	0.013
No (Hb ≥ 11 g/dl)	156	30.65	130	25.54	286	56.19	
<b>Total</b>	<b>253</b>	<b>49.71</b>	<b>256</b>	<b>50.29</b>	<b>509</b>	<b>100</b>	
<b>Gestational Age When Took Blood Test</b>							
1 <sup>st</sup> trimester	85	17.56	61	12.60	146	30.17	0.000
2 <sup>nd</sup> trimester	68	14.05	53	10.95	121	25.00	
3 <sup>rd</sup> trimester	85	17.56	132	27.27	217	44.83	
<b>Total</b>	<b>238</b>	<b>49.17</b>	<b>246</b>	<b>50.83</b>	<b>484</b>	<b>100</b>	
<b>Baby's Birth Weight</b>							
Low Birth Weight (< 2500 gram)	43	3.94	30	2.52	73	6.70	0.415
Normal Birth Weight (≥ 2500 gram)	549	50.37	468	39.33	1017	93.30	
<b>Total</b>	<b>592</b>	<b>54.31</b>	<b>498</b>	<b>41.85</b>	<b>1090</b>	<b>100</b>	
<b>Ever Abortus</b>							
Never	567	48.50	500	42.77	1067	91.27	0.301
1x	39	3.34	38	3.25	77	6.59	
2x and more	17	1.45	8	0.68	25	2.14	
<b>Total</b>	<b>623</b>	<b>53.29</b>	<b>546</b>	<b>46.71</b>	<b>1169</b>	<b>100</b>	
<b>Infection During Pregnancy</b>							
No infection	620	53.04	538	46.02	1158	99.06	N/A
HbsAg+	3	0.26	3	0.26	6	0.51	
HIV+	0	0.00	3	0.26	3	0.26	
COVID-19+	0	0.00	2	0.17	2	0.17	
<b>Total</b>	<b>623</b>	<b>53.29</b>	<b>546</b>	<b>46.71</b>	<b>1169</b>	<b>100</b>	
<b>High-Risk Pregnancy</b>							
Yes	73	6.24	49	4.19	122	10.44	0.126
No	550	47.05	497	42.51	1047	89.56	
<b>Total</b>	<b>623</b>	<b>53.29</b>	<b>546</b>	<b>46.71</b>	<b>1169</b>	<b>100</b>	

Source: Secondary Data of Public Health Centre Kalijambe, 2019-2020

### Anemia in Pregnancy, Low Birth Weight and Their Characteristics

Table 2 showed cross tabulation among maternal demography, productive characteristic with anemia in pregnancy and LBW. There were 401 cases included in the analysis of anemia in pregnancy; 172 (42.89%) had anemia. The proportion of anemia in pregnancy was higher for mothers who took a blood test in the third trimester (60.86%, 112 of 184) and was associated significantly with anemia in pregnancy ( $p=0.000$ ). The other factors, such as mothers' age, parity, MUAC, abortus, high-risk pregnancy,

and infection during pregnancy, did not associate with anemia in pregnancy.

Based on table 2, total of 221 cases were included in the analysis; 11 (4.98%) babies had LBW. There were significant differences in the proportion of high-risk pregnancy ( $p=0.007$ ), gestational age when taking a blood test for Hb ( $p=0.041$ ), and PTB ( $p=0.007$ ) among babies with low and normal birth weight. In contrast, mothers' age, parity, MUAC, infection during pregnancy, abortus, and anemia showed no association with LBW.

Table 2. Anemia in Pregnancy, Low Birth Weight and Their Characteristics

Characteristic	Anemia in Pregnancy			<i>p-value</i>	Birth Weight			<i>p-value</i>
	Yes n = 172	No n = 229	Total n = 401		Low n = 11	Normal n = 210	Total n = 221	
<b>Mother's Age (Years)<sup>3</sup></b>								
< 20	7	4	11		3	40	43	
20-35	134	189	323	0.286 <sup>1</sup>	8	170	178	0.451 <sup>2</sup>
> 35	31	36	67					
<b>Parity<sup>3</sup></b>								
Primipara	53	61	114		6	59	65	
Second para	71	92	163	0.468 <sup>1</sup>	5	151	156	0.086 <sup>2</sup>
Multipara	48	76	124					
<b>Mid Upper Arm Circumference (Cm)</b>								
< 23.5 Cm	53	52	105		4	48	52	
≥ 23.5 Cm	119	177	296	0.068 <sup>1</sup>	7	162	169	0.291 <sup>2</sup>
<b>Infection During Pregnancy</b>								
Yes	2	1	3		1	0	1	
No	170	228	398	0.404 <sup>1</sup>	10	210	220	0.050 <sup>2</sup>
<b>High-Risk Pregnancy</b>								
Yes	21	25	46		5	24	29	
No	151	204	355	0.688 <sup>1</sup>	6	186	192	0.007 <sup>2</sup>
<b>Ever Abortus<sup>3</sup></b>								
Never	159	208	367		11	191	202	
1 x	10	19	29	0.481 <sup>1</sup>	0	19	19	0.605 <sup>2</sup>
2 x and more	3	2	5					
<b>Gestational Age When Took Blood Test<sup>3</sup></b>								
1 <sup>st</sup> trimester	24	97	121		5	38	43	
2 <sup>nd</sup> trimester	36	60	96	0.000 <sup>1</sup>	6	172	178	0.041 <sup>2</sup>
3 <sup>rd</sup> trimester	112	72	184					
<b>Anemia in Pregnancy</b>								
Yes (Hb <11 g/dl)					4	93	97	
No (Hb ≥ 11 gr/dl)					7	117	124	0.759 <sup>2</sup>
<b>Pre-Term Birth</b>								
Yes (< 37 weeks)					3	6	9	
No (≥ 37 weeks)					8	204	212	0.007 <sup>2</sup>

Source: Secondary Data of Public Health Centre Kalijambe, 2019-2020

<sup>1</sup>Chi squared test

<sup>2</sup>Fisher Exact test

<sup>3</sup>for birth weight analysis, there are only two group for mother's age (non optimum < 20 years & > 35 years vs optimum 20-35 years); parity (primipara vs second & multipara); ever abortus (never vs 1 x & more); and gestational age (1<sup>st</sup> trimester vs 2<sup>nd</sup> & 3<sup>rd</sup> trimester)

### Factor Influencing Anemia in Pregnancy and Low Birth Weight

Table 3 provided binomial logistic regression analysis of anemia in pregnancy and LBW. Based on table 3, pregnant women with smaller MUAC were more likely to have anemia than their counterparts (aOR 1.86; 95% CI 1.13-3.08).

Mothers who took a blood test in the third trimester were 6.9 times (95% CI 3.98-12.20) higher to have anemia in pregnancy compared to those who took in the first trimester. This was consistent for the second trimester (aOR 2.59 with 95% CI 1.37-4.86). Whereas mothers' age, parity, abortus, high-risk pregnancy, and infection during pregnancy were not significantly influenced on anemia in pregnancy.

A baby with LBW was more likely to be born from a mother with high-risk pregnancy (aOR 8.57 with 95%CI 1.65-44.37). In addition, mothers who took a blood test for Hb at second and third trimesters had lower odds of LBW than the first trimester (aOR 0.15 with 95% CI 0.02-0.86). Meanwhile, anemia in pregnancy had 1.8 times more risk of having LBW, with no statistically significant (95% CI 0.34-9.45). Furthermore, mothers' age, parity, abortus, infection during pregnancy, MUAC, and PTB did not significantly influence baby's birth weight.

**Table 3. Factor Influencing Anemia in Pregnancy and Low Birth Weight**

Factor Predictor	Anemia in Pregnancy (n=401)			Low Birth Weight (n=221)		
	Adjusted Odd Ratio	95% C.I.for aOR		Adjusted Odd Ratio	95% C.I.for aOR	
		Lower	Upper		Lower	Upper
<b>Mother's Age (Years)<sup>3</sup></b>						
< 20 <sup>1</sup>						
20-35 <sup>2</sup>	0.401	0.101	1.590			
> 35	0.546	0.123	2.416	2.010	0.410	9.856
<b>Parity<sup>3</sup></b>						
Primipara <sup>1</sup>						
Second para	1.261	0.730	2.177	0.219 <sup>†</sup>	0.041	1.180
Multipara	0.928	0.492	1.748			
<b>Ever Abortus<sup>3</sup></b>						
Never <sup>1</sup>						
1 x	0.877	0.359	2.141	0.000	0.000	-
2 x and more	1.842	0.236	14.392			
<b>High-Risk Pregnancy</b>						
Yes	1.062	0.536	2.105	8.573*	1.656	44.371
No <sup>1</sup>						
<b>Infection During Pregnancy</b>						
Yes	3.661	0.292	45.947	N/A	0.000	
No <sup>1</sup>						
<b>Mid-Upper Arm Circumference (Cm)</b>						
< 23.5 Cm	1.866*	1.130	3.080	2.053	0.434	9.700
≥ 23.5 Cm <sup>1</sup>						
<b>Gestational Age When Took Blood Test<sup>3</sup></b>						
1 <sup>st</sup> trimester <sup>1</sup>						
2 <sup>nd</sup> trimester	2.590**	1.379	4.863	0.158*	0.029	0.869
3 <sup>rd</sup> trimester	6.978***	3.989	12.204			
<b>Pre-Term Birth</b>						
Yes (< 37 weeks)				5.427 <sup>†</sup>	0.889	33.123
No (≥ 37 weeks) <sup>1</sup>						
<b>Anemia in Pregnancy</b>						
Yes (Hb < 11 g/dl)				1.804	0.344	9.457
No (Hb ≥ 11 g/dl) <sup>1</sup>						

Source: Secondary Data of Public Health Centre Kalijambe, 2019-2020

<sup>1</sup>Reference group for binomial logistic regression analysis for anemia in pregnancy and LBW

<sup>2</sup>Reference group for Mother's age at LBW analysis was optimum age (20-35 yr)

<sup>3</sup>For LBW analysis, there are only two group for mother's age (non optimum < 20 years & > 35 years vs optimum 20-35 years); parity (primipara vs second & multipara); ever abortus (never vs 1x & more); and gestational age (1<sup>st</sup> trimester vs 2<sup>nd</sup> trimester & 3<sup>rd</sup> trimester)

<sup>†</sup>p<0.1, \*p<0.05, \*\*p<0.01, \*\*\*p<0.001

## DISCUSSION

### Anemia in Pregnancy and Low Birth Weight Before and After Pandemic COVID-19

A total of 509 cases included in the analysis showed that the prevalence of anemia in pregnancy was 38.33% in 2019 and 49.21% in 2020. According to WHO, this prevalence indicates moderate to severe public health problems.<sup>21</sup> This prevalence was similar to Indonesia Basic Health Research Report in 2018 (48.90%).<sup>22</sup> However, this result was higher than global prevalence (36.90%).<sup>23</sup> Prevalence of anemia in pregnancy increased significantly during the COVID-19 pandemic ( $p=0.013$ ). This condition was related to gestational age when taking a blood test for Hb. There was a higher proportion of Hb test at third trimester during pandemic (27.27%) than a year before (17.56%) with  $p=0.000$ . At the beginning of the pandemic, Kalijambe Public health center provided online classes for pregnant women (after being stopped for a while) and ANC services by preparing PPE for health workers, hand hygiene facilities and normal working hours. However, due to limited PPE, delivery is only served at public health center which used to be partially performed at the midwife clinic. The first ANC visit (K1) in 2019 and 2020 was similar (100%) but slightly decreased in the fourth ANC visit (K4) in 2020 (87.74%) compared to 2019 (88.61%). The government issued guidelines for the care of pregnant women during the COVID-19 pandemic, such as 6 times ANC, iron tablets as needed and online classes for pregnant women, especially in the red zone.<sup>24</sup> However, it has not been well-implemented due to lack of socialization. Disruption in maternal services during pandemic were reported worldwide, such as declining the first ANC and facilities-based deliveries.<sup>25</sup> Two models from UNICEF in South Asian countries revealed the direct and indirect impact of COVID-19 on health, economic and food security. Therefore, the provision of basic health services and nutritional intervention during pregnancy and infancy is urgently needed.<sup>26</sup> Rapid and massive socialization of the new guidelines through online and offline platforms is required to minimize information gaps.

### Factors Influencing Anemia in Pregnancy

Regardless of the year of birth, 401 cases were

included in further analysis. Gestational age when taking blood tests was consistently associated with anemia. The second and third trimesters were more likely to have Hb levels less than 11 g/dl with aOR and 95% CI were 2.59; 1.37-4.86 and 6.97; 3.98-12.2 respectively. Similar findings in Ethiopia revealed second trimester (aOR 3.09, 95%CI 1.41–6.79) and third trimester (aOR 3.68, 95% CI 1.67–8.08) had higher odds to have anemia in pregnancy.<sup>27</sup> A Nation wide cross-sectional study in China showed the prevalence of anemia and Iron Deficiency Anemia (IDA) increased by gestational month, peaking at the eighth gestational month (24.00% for anemia and 17.80% for IDA).<sup>28</sup> According to WHO, mostly pregnant women suffered from IDA.<sup>23</sup> During pregnancy, the iron intake necessity is 0.8 mg/day in the first trimester and 3-6mg/day in the third trimester. This increasing is required for oxygen consumption for mother and fetal metabolism, fetal growth, expand the plasma volume, produce a greater quantity of red blood cells, and compensate for blood loss at delivery.<sup>29</sup>

Indonesia, every pregnant woman is tested for hemoglobin (Hb) level at least 1x during pregnancy, usually at the first trimester. However, it varies in terms of gestational age. There will be an evaluation test in the third trimester if the previous showed anemia. Despite Hb level, every pregnant woman is given 90 Iron-Folic Acids (IFA) tablets during the pregnancy. However, considering the numerous gastrointestinal side effects that often lead to poor compliance.<sup>29</sup> Education and monitoring through interaction with health care staff increase the compliance of IFA in Kediri,<sup>30</sup> and reduce the prevalence of anemia toward pregnancy in Aceh.<sup>31</sup> To these findings, it is necessary to have an early blood test in the first trimester and Re-evaluation in the third trimester. This procedure should become a nationwide standard; otherwise, there would be an underestimated prevalence of anemia if only done in the first trimester. Stewart T *et al.* recommends initial measurement of Hb and serum ferritin in the first trimester; to start oral tablets when Hb < 12 mg/dl and Normal serum ferritin or low (<30 mcg/dl); recheck in 28 weeks, unless initial Hb <10 mg/dl; and consider intravenous iron administration because of intolerance to oral tablet or persistent iron deficie-

ncy in 34 weeks and Hb < 7 mg/dl.<sup>32</sup> Another strategy is needed to combat anemia, such as education, IFA supplements, modify dietary and iron-rich food fortification.

After being adjusted for several factors, maternal nutritional status had a significant effect on anemia. Mothers, who suffered from chronic energy deficiency marked by MUAC below 23.5 cm, was a higher risk of anemia (aOR 1.86; 95%CI 1.13-3.08). A previous study in Ethiopia found a similarity that mothers with anemia had a higher odds of low MUAC with OR 1.28(1.09-1.49).<sup>33</sup> This result reinforces the importance of early detection and early intervention with health education and a specific nutrition program before becoming pregnant.

### Factors Influencing Low Birth Weight

Out of 1090 cases included in the analysis, the prevalence of LBW in Kalijambe was 7.26% in 2019 and 6.02% in 2020. However, this proportion was lower than the overall percentage globally (15.00-20.00%) and in South Asia countries (28.00%).<sup>34</sup> Compared to national data from 25 provinces (111.827 babies), the proportion of LBW was 3.40%. Moreover, according to Indonesia Basic Health Research in 2018, reported 6.2% LBW, from only 56.6% of babies that had birth weight recorded.<sup>22</sup> The prevalence of LBW varied based on geographical area. For example, a hospital-based survey that involved 91 respondents in Palu, Central Sulawesi Province found 40.70% LBW and 72.50% maternal anemia.<sup>35</sup>

The Prevalence of LBW reduced during the pandemic as well as PTB (n=494). However, it was not statistically significant with  $p=0.415$  and  $p=0.920$ . the previous study showed similar findings in Austria,<sup>9</sup> and Ireland.<sup>10</sup> In addition, a study from the United States reported a significant (25%) lower odds of PTB during the COVID-19 pandemic compared with a similar pre-pandemic period in the peer-reviewed literature. Several hypotheses are declared for the positive effect of COVID-19 as a consequence of work from home such as less stress and anxiety, no shift work, no long hours, and less physical work, better support from partner and family, better nutrition, more exercise, better hygiene, fewer social interaction, fewer infection, less smoking,

fewer car accident, less air pollution, government financial assistance, and fewer medical intervention.<sup>36</sup>

There were 221 cases regardless of the year of birth included in further analysis of LBW. Pre-term birth ( $p=0.007$ ) was associated with LBW in bivariate analysis. However, after adjusting other factors, this variable became not significant. High-risk pregnancy was consistent and had a higher odd of LBW with aOR 8.57 and 95% CI 1.65-44.37. A previous case control. Study in Nepal found comorbidity during pregnancy was a risk factor for LBW (aOR 2.4 and 95% CI 1.3-4.5).<sup>37</sup> In addition, there was multi factorial nature of LBW such as PTB and SGA.<sup>34</sup> Since high-risk pregnancy was a determinant for maternal and infant morbidity and mortality especially during the COVID-19 pandemic, it is necessary to increase awareness of high-risk pregnancy through routine ANC and provide adequate care.

Anemia in pregnancy had a higher odd of LBW; however, it was not statistically significant (aOR 1.8; 95% CI 0.34-9.45). At the same time, mothers who had a blood test in the second and third trimester were less likely to have LBW (aOR 0.15; 95% CI 0.029-0.86). This result was similar to previous study in Tanzania that involved 442 participants, it is found that there was no association between anemia and LBW, PTB, or stillbirths.<sup>21</sup> A prospective cohort study of 164 pregnant women who had their 4<sup>th</sup> ANC in Lampung showed no relationship between anemia and LBW.<sup>38</sup> Moreover, mothers' age, parity, abortus, MUAC, and infection during pregnancy showed no association with LBW.

To the best of our knowledge, this research is one of the limited studies examining the pandemic's impact on anemia in pregnancy and LBW and their related factors. All births recorded were analyzed. In this research, factors influencing anemia and LBW have been identified with adjustment for mothers' age, parity, abortus, infection during pregnancy, high-risk pregnancy, MUAC, PTB, and gestational age. However, there were several limitations, such as the variation of gestational age at the Hb test. Therefore, gestational age was included in the model. The completeness of data was a big obstacle in this research since several variables have miss-



ed. Consequently, only certain data were included in further analysis (as shown as quite wide of 95% CI for aOR in LBW). Reducing the number of MMR and IMR are the indicators of Sustainable Development Goals, and good quality MCH data are required. Since there is limited healthcare staff in public health center and, increasing burden during the COVID-19 pandemic (tracing, testing, treatment, and vaccination), it is necessary to have a friendly user and Innovative database management based on IT.

## CONCLUSION AND RECOMMENDATION

The prevalence of anemia in pregnancy increased during the COVID-19 pandemic and becomes severe public health concern. However, the pandemic has no effect on LBW. Older gestational age and low MUAC were more likely to have anemia in pregnancy. In addition, High-risk pregnancy had a higher odd of LBW. Anemia in pregnancy showed no effect on LBW since gestational age had confounded this relationship. This finding suggests the need for early risk detection (first trimester) and a routine, standardized, comprehensive antenatal care. Several strategies should be implemented from health education (using online platforms and social media), supporting compliance of IFA supplementation and iron-rich food fortification, specific nutritional program, providing adequate care, and strengthening MCH database managerial to achieve the desired outcome for mother and infant.

## ACKNOWLEDGMENTS

We would like to thank all staff from Kalijambe Public Health Center that gave valuable support during data collection. This study was funded by the Faculty of Medicine, Islam Indonesia University.

## REFERENCES

1. Kumar R, Yeni CM, Utami NA, Masand R, Asrani RK, Patel SK, et al. SARS-CoV-2 Infection During Pregnancy and Pregnancy-Related Conditions: Concerns, Challenges, Management and Mitigation Strategies - A Narrative Review. *Journal of Infection and Public Health*. 2021;14(1):863-875.
2. Villar J, Ariff S, Gunier RB, Thiruvengadam R, Rauch S, Kholin A, et al. Maternal and Neonatal Morbidity and Mortality Among Pregnant Women with and Without COVID-19 Infection: The INTERCOVID Multinational Cohort Study. *JAMA Pediatrics*. 2021;175(8):817-826.
3. D'Antonio F, Sen C, Mascio D Di, Galindo A, Villalain C, Herraiz I. Maternal and Perinatal Outcomes in High Compared to Low Risk Pregnancies Complicated by Severe Acute Respiratory Syndrome Coronavirus 2 Infection (Phase 2): The World Association of Perinatal Medicine Working Group on Coronavirus Disease 2019. *American Journal of Obstetrics & Gynecology MFM*. 2020:1-7.
4. Zaigham M, Andersson O. Maternal and Perinatal Outcomes with COVID-19: A Systematic Review of 108 Pregnancies. *Acta Obstetrica et Gynecologica Scandinavica*. 2020;99(7):823-829.
5. Ifdil I, Fadli RP, Gusmaliza B, Putri YE. Mortality and Psychological Stress in Pregnant and Postnatal Women During COVID-19 Outbreak in West Sumatra, Indonesia. *Journal of Psychosomatic Obstetrics and Gynecology*. 2020;41(4):251-252.
6. Ariestanti Y, Widayati T, Sulistyowati Y. Determinan Perilaku Ibu Hamil Melakukan Pemeriksaan Kehamilan (Antenatal Care) pada Masa Pandemi Covid-19. *Jurnal Bidang Ilmu Kesehatan*. 2020;10(2):203-216.
7. Rofiasari L, Noprianty R, Yusita I, Mulyani Y, Suryanah A. Assistance for Pregnant Women Class in Providing Antenatal Care Motivation as an Effort to Improve Maternal and Fetal Health in the Pandemic Covid-19. *Jurnal Peduli Masyarakat*. 2020;2(4):197-204.
8. Mahumud RA, Sultana M, Sarker AR. Distribution and Determinants of Low Birth Weight in Developing Countries. *Journal of Preventive Medicine & Public Health*. 2017;50(1):18-28.
9. Kirchengast S, Hartmann B. Pregnancy Outcome During the First Covid 19 Lockdown in Vienna, Austria. *International Journal of Environmental Research and Public Health*. 2021;18(7):1-14.
10. Philip RK, Purtill H, Reidy E, Daly M, Imcha M, McGrath D, et al. Unprecedented

- Reduction in Births of Very Low Birth Weight (VLBW) and Extremely Low Birth Weight (ELBW) Infants During the COVID-19 Lockdown in Ireland: A 'Natural Experiment' Allowing Analysis of Data From the Prior Two Decades. *BMJ Global Health*. 2020;5(9):1-10.
11. Shmakov RG, Prikhodko A, Polushkina E, Shmakova E, Pyregov A, Bychenko V, et al. Clinical Course of Novel COVID-19 Infection in Pregnant Women. *The Journal of Maternal-Fetal & Neonatal Medicine*. 2020:1-7.
  12. Banaei M, Ghasemi V, Saei Ghare Naz M, Kiani Z, Rashidi-Fakari F, Banaei S, et al. Obstetrics and Neonatal Outcomes in Pregnant Women with Covid-19: A Systematic Review. *Iranian Journal of Public Health*. 2020;49:38-47.
  13. Figueiredo ACMG, Gomes-Filho IS, Silva RB, Pereira PPS, Da Mata FAF, Lyrio AO, et al. Maternal Anemia and Low Birth Weight: A Systematic Review and Meta-Analysis. *Nutrients*. 2018;10(5):1-17.
  14. Aditianti A, Djaiman SPH. Meta Analisis: Pengaruh Anemia Ibu Hamil Terhadap Berat Bayi Lahir Rendah. *Jurnal Kesehatan Reproduksi*. 2020;11(2):163-177.
  15. Nainggolan S, Siagian FE. The Prevalence of Anemia in Pregnant Women in the 10 Priority Villages for Stunting Control in Sumedang District, West Java: A Community-Based Survey. *International Journal of Community Medicine and Public Health*. 2019;6(9):3760-3767.
  16. Kemenkes RI. Profil Kesehatan Indonesia 2018. Jakarta: Kementerian Kesehatan RI; 2019.
  17. Kecamatan Kalijambe. Profil Kalijambe. [Internet]. Jawa Tengah: Kecamatan Kalijambe; 2021 [Cited 2021 Sep 7]. Available from: <http://kalijambe.sragenkab.go.id/index.php/penduduk/>.
  18. BPS Provinsi Jawa Tengah. Jumlah Bayi Lahir, Bayi Berat Badan Lahir Rendah (BBLR), dan Bergizi Kurang Menurut Kabupaten/Kota di Provinsi Jawa Tengah (Jiwa), 2019-2021. [Internet]. Jawa Tengah: Badan Pusat Statistik Provinsi Jawa Tengah; 2021 [Cited 2021 Sep 7]. Available from: <https://jateng.bps.go.id/indicator/30/378/1/jumlah-bayi-lahir-bayi-berat-badan-lahir-rendah-bblr-bblr-dirujuk-dan-bergizi-buruk-menurut-kabupaten-kota-di-provinsi-jawa-tengah.html>.
  19. Bisanzio D, Kraemer MUG, Bogoch II, Brewer T, Brownstein JS, Reithinger R. Use of Twitter Social Media Activity as A Proxy for Human Mobility to Predict the Spatiotemporal Spread of COVID-19 at Global Scale. *Geospatial Health*. 2020;15(882):19-24.
  20. Ricalde AE, Velásquez-Meléndez G, Tanaka AC d'A., Siqueira AAF de. Mid-Upper Arm Circumference in Pregnant Women and Its Relation to Birth Weight. *Revista de Saude Publica*. 1998;32(2):112-117.
  21. Stephen G, Mgongo M, Hussein Hashim T, Katanga J, Stray-Pedersen B, Msuya SE. Anaemia in Pregnancy: Prevalence, Risk Factors, and Adverse Perinatal Outcomes in Northern Tanzania. *Hindawi Anemia*. 2018: 1-9.
  22. Kemenkes RI. Profil Kesehatan Indonesia 2019. Jakarta: Kementerian Kesehatan RI. 2020.
  23. WHO. WHO Global Anaemia Estimates, 2021 Edition. [Internet]. World Health Organization: The Global Health Observatory; 2021 [Cited 2022 May 13]. Available from: [https://www.who.int/data/gho/data/themes/topics/anaemia\\_in\\_women\\_and\\_children#:~:text=In 2019%2C global anaemia prevalence,39.1%25\) in pregnant women](https://www.who.int/data/gho/data/themes/topics/anaemia_in_women_and_children#:~:text=In 2019%2C global anaemia prevalence,39.1%25) in pregnant women).
  24. Kemenkes RI. Pedoman Pelayanan Antenatal, Persalinan, Nifas, dan Bayi Baru Lahir di Era Adaptasi Baru. Jakarta: Kementerian Kesehatan RI; 2020.
  25. Aranda Z, Binde T, Tashman K, Tadikonda A, Mawindo B, Maweu D, et al. Disruptions in Maternal Health Service Use During the COVID-19 Pandemic in 2020: Experiences from 37 Health Facilities in Low-Income and Middle-Income Countries. *BMJ Global Health*. 2022;7(1):1-10.
  26. UNICEF, UNFPA, WHO and SickKids' Center

- for Global Child Health. Direct and Indirect Effects of the COVID-19 Pandemic and Response in South Asia; 2021. [Internet]. 2021;57. Available from: <https://www.unicef.org/rosa/reports/direct-and-indirect-effects-covid-19-pandemic-and-response-south-asia>
27. Lebasis M, Anato A, Loha E. Prevalence of Anemia and Associated Factors Among Pregnant Women in Southern Ethiopia: A Community Based Cross-Sectional Study. *PLoS One*. 2017;12(12):1–11.
  28. Tan J, He G, Qi Y, Yang H, Xiong Y, Liu C, et al. Prevalence of Anemia and Iron Deficiency Anemia in Chinese Pregnant Women (IRON WOMEN): A National Cross-Sectional Survey. *BMC Pregnancy and Childbirth*. 2020;20(670):1–12.
  29. Garzon S, Cacciato PM, Certelli C, Salvaggio C, Magliarditi M, Rizzo G. Iron Deficiency Anemia in Pregnancy: Novel Approaches for An Old Problem. *Oman Medical Journal*. 2020;35(5):1–9.
  30. Anggraini DD, Purnomo W, Trijanto B. Interaksi Ibu Hamil dengan Tenaga Kesehatan dan Pengaruhnya terhadap Kepatuhan Ibu Hamil Mengonsumsi Tablet Besi (Fe) dan Anemia di Puskesmas Kota Wilayah Selatan Kota Kediri. *Buletin Penelitian Sistem Kesehatan*. 2018;21(2):82–89.
  31. Ahmad A, Wagustina S, Dwiriani CM, Estuti W, Salfiyadi T, Arnisam A, et al. The Efficacy of Nutrition Education on Anemia and Upper Arm Circumference among Pregnant Women in Aceh Besar District of Indonesia during the Covid-19 Pandemic. *Jurnal Gizi dan Pangan*. 2022;17(1):27–36.
  32. Stewart T, Lambourne J, Thorp-jones D, Thomas DW. Implementation of Early Management of Iron Deficiency Pregnancy During the SARS-Cov-2 Pandemic. *European Journal of Obstetrics and Gynecology and Reproductive Biology*. 2020;258:60–62.
  33. Ghosh S, Spielman K, Kershaw M, Ayele K, Kidane Y, Zillmer K, et al. Nutrition-Specific and Nutrition-Sensitive Factors Associated with Mid-Upper Arm Circumference as A Measure of Nutritional Status in Pregnant Ethiopian Women: Implications for Programming in the First 1000 Days. *PLoS One*. 2019;14(3):1–14.
  34. WHO. WHA Global Nutrition Targets 2025 : Low Birth Weight Policy Brief [Internet]. Vol. 28. World Health Organization 2014. Available from: [https://www.who.int/nutrition/topics/globaltargets\\_lowbirthweight\\_policybrief.pdf](https://www.who.int/nutrition/topics/globaltargets_lowbirthweight_policybrief.pdf).
  35. Nur AF. Anemia dan Kejadian Berat Badan Lahir Rendah di Rumah Sakit Umum Anutapura Palu. *Ghidza: Jurnal Gizi dan Kesehatan*. 2018;2(2):63–66.
  36. Berghella V, Boelig R, Roman A, Burd J, Anderson K. Decreased Incidence of Preterm Birth During Coronavirus Disease 2019 Pandemic. *American Journal of Obstetrics & Gynecology MFM*. 2020;2(4):1-3.
  37. Anil KC, Basel PL, Singh S. Low Birth Weight and Its Associated Risk Factors: Health Facility-Based Case-Control Study. *PLoS One*. 2020;15(6):1–10.
  38. Islamiyanti, Katharina K, Oktaviani I. Hubungan Anemia Ibu Hamil dengan Bayi Berat Lahir Rendah. *Jurnal Kesehatan Metro Sai Wawai*. 2012;V(2):9–16.