

# Weight gain during pregnancy and low birth weight babies: a retrospective cohort study in Gianyar District, Bali

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## ABSTRACT

**Background and purpose:** Low birth weight (LBW) is a major causal factor for neonatal and perinatal mortality. The aim of this study is to determine the risk of LBW incidence in pregnant women with weight gain not in accordance with the Institute of Medicine (IOM) standards.

**Methods:** This study used a retrospective cohort design with data obtained from three Public Health Centres (PHCs) in Gianyar District over the period of January-December 2017. Samples in this study were 186 pregnant women with the following criteria: complete data on the mother's medical record, had an antenatal care visit in the first trimester and at the end of the third trimester, at term delivery, not giving birth to twins and no complications during pregnancy. The sample size was determined with 95% confidence level, 80% power, the proportion of LBW in the group of inadequate weight gain of 26%, the proportion of LBW in the group of adequate weight gain of 9% and a relative risk (RR) estimate of 3.0. Data extracted from medical record consisted of weight gain, pre-pregnancy weight, height, upper arm circumference,

hemoglobin level, employment, age, parity and birth weight. The cumulative incidence of LBW was calculated to determine the RR. Multivariate analysis with binary logistic regression was conducted to determine the adjusted RR (ARR).

**Results:** The incidence of LBW in the group whose weight gain during pregnancy not in accordance with IOM standards was 59%, while those in accordance with the standards were 8.2% with RR=7.22 (95%CI: 3.96-13.19). The ARR for those with weight gain during pregnancy not in accordance with IOM standards was 15.33 (95%CI: 5.82-40.38). The incidence of LBW in the anemia group was 49% and not anemia group was 10%. The RR and ARR values for LBW in the anemia group were 4.72 (95%CI: 2.66-8.36) and 6.66 (95%CI: 2.53-17.53) respectively.

**Conclusion:** Mothers experiencing weight gain during pregnancy that was not in accordance with IOM standards and anemia were found to increase the risk of LBW. Monitoring of weight gain during pregnancy should be implemented using the IOM standards and anemia prevention among pregnant mothers should be enhanced.

**Keywords:** Low birth weight, IOM, weight gain, anemia

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## INTRODUCTION

Low birth weight (LBW) is a major causal factor of neonatal and perinatal mortality with a risk of death 40 times greater than those born with a normal weight.<sup>1</sup> The proportion of babies born with LBW in Indonesia was reported at 7.1% based on data from the 2017 Indonesian Demographic and Health Survey (DHS)<sup>2</sup> and 6.2% based on the 2018 Indonesia Basic Health Research (*Riskesdas*).<sup>3</sup> Proportion of LBW in children aged 0-59 month based on data from *Riskesdas* has increased from 5.7% in 2013<sup>4</sup> to 6.2% in 2018.<sup>3</sup>

Infant weight at birth is reported to be positively correlated with total maternal weight gain during pregnancy.<sup>5</sup> Adequate maternal weight gain during pregnancy is the main way to ensure adequate fetal growth as well as additional birth weight.<sup>5</sup> One of the factors causing LBW is the inadequate increase in maternal body weight during pregnancy due to poor nutritional status which can cause impaired fetal growth.<sup>6</sup> Weight gain in pregnant women

during pregnancy based on the 2010 Ministry of Health of Indonesia standard is 9-12 kg, but this standard does not take into consideration maternal pre-pregnancy body mass index (BMI),<sup>7</sup> while the IOM in 2009 provided standards for weight gain during pregnancy based on BMI before pregnancy.<sup>8</sup> Therefore adequate maternal weight gain during pregnancy would be different for each individual, and to date the standards for weight gain based on IOM standards have not been mainstreamed into the health services for pregnant women in Indonesia.

Studies related to risk factors of LBW have been carried out but with inconsistent results and require further studies.<sup>9-11</sup> A cross-sectional study conducted in Lebanon, found that weight gain that is not in accordance with IOM standards significantly increases the incidence of LBW.<sup>12</sup> A retrospective cohort study in Taiwan showed that weight gain during pregnancy under IOM cut off point had

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a higher risk of giving birth to LBW babies, while weight gain above IOM cut off point had a higher risk for cesarean delivery, overweight babies and macrosomia.<sup>13</sup> A case control study in Indonesia indicates that pregnant women have 3 times higher risk of giving birth to babies with low birth weight if they experience weight gain not in accordance with IOM standards.<sup>14</sup> Studies in several other countries examining weight gain during pregnancy using IOM standards have been carried out, but studies conducted in Indonesia remain limited and only few have used a cohort design. This study aims to determine the risk of LBW incidence in pregnant women with weight gain that is not in accordance with IOM standards.

## METHODS

This study employed a retrospective cohort design with data from January to December 2017 obtained from three PHCs in Gianyar District namely PHC I Ubud, I Gianyar and I Sukawati. PHCs were selected purposively from 13 PHCs in Gianyar District, Bali Province by considering the number of post-partum mothers in 2016 that higher compared to the other PHCs. Eligible subjects were post-partum mothers who had given birth in January to December 2017, had complete data on the mother's medical record, had an antenatal care visit in the first trimester and at the end of the third trimester, at term delivery, did not give birth to twins and had no complications during pregnancy. The number of samples was 186 mothers determined with 95% confidence level, 80% power, proportion of LBW in the group of inadequate weight gain of 26%, proportion of LBW in the adequate weight gain of 9%<sup>11</sup> and an RR estimate of 3.0.

Data collection was carried out in July 2018 by extracting data from the mother's medical record, which consisted of: weight gain during pregnancy, weight before pregnancy, height at first ANC visit, upper arm circumference, trimester I hemoglobin level, employment, age, parity, number of ANC visits, blood pressure and baby's birth weight. Weight gain during pregnancy was categorized to be "accordance" and "not accordance" with IOM standards. Those with weight gain not accordance with IOM standards were those with weight gain below and above the IOM standards. In the analysis, age was grouped into "<20 and >35" and "20-35" years old. Mothers were categorized as having hypertension during pregnancy when their blood pressure was  $\geq 140/90$  mmHg while those with blood pressure  $<140/90$  mmHg were categorized as "no hypertension". The cumulative incidence of LBW was calculated to determine the RR values. Multivariate analysis with binary logistic regression was conducted to determine the adjusted RR (ARR). This study has been approved by the Ethics Committee of the Faculty of Medicine, Udayana University/Sanglah General Hospital in Denpasar on June 21, 2018.

## RESULTS

Of the 186 subjects, 39 mothers were included in the at risk group (weight gain was not in accordance with IOM standards) and as many as 147 mothers included in the non-risk group (weight gain in accordance with IOM standards). Table 1 shows characteristics of mothers by age, employment, parity, number of ANC visits, weight gain, history of hypertension during pregnancy, BMI before pregnancy, status of anemia

**Table 1** Characteristics of mothers

Characteristics	n	%
<b>Age (years)</b>		
<20 dan >35	22	11.8
20-35	164	88.2
<b>Employment</b>		
Unemployed	69	32.8
Employed	117	67.2
<b>Parity</b>		
$\leq 1$ and $> 3$	94	50.5
2 or 3	92	49.5
<b>Number of ANC visits</b>		
<4	8	4.3
$\geq 4$	178	95.7
<b>Weight gain</b>		
Not accordance with IOM standards	39	21.0
Accordance with IOM standards	147	79.0
<b>Hypertension during pregnancy</b>		
Hypertension	5	2.7
No hypertension	181	97.3
<b>Pre pregnancy BMI</b>		
Low	8	4.3
Normal	178	95.7
<b>Anemia status</b>		
Anemia	41	22.0
No anemia	145	78.0
<b>CED status</b>		
CED	21	11.3
No CED	165	88.7
<b>Birth weight of baby</b>		
Low	35	18.8
Normal	151	81.2
<b>Total</b>	186	100.0

**Table 2** Incidence of low birth weight and the RR of several variables

	Low birth weight (n=35)	Normal birth weight (n=151)					
Variables	n (%)	n (%)	Total	Incidence (%)	RR	95% CI	p
Weight gain during pregnancy							
Not in accordance with IOM standards	23 (59.0)	16 (41.0)	39	59.0	7.22	3.95-13.19	<0.01
In accordance with IOM standards	12 (8.0)	135 (92.0)	147	8.2			
Anemia status							
Anemia	20 (49.0)	21 (51.0)	41	49	4.71	2.66-8.36	<0.01
No anemia	15 (10)	130 (90)	145	10			
Pre-pregnancy BMI							
Low	4 (50)	4 (50)	8	50	2.87	1.34-6.16	0.04
Normal	31 (17)	147 (83)	178	17			
CED Status							
CED	8 (38)	13 (62)	21	38	2.33	1.22-4.44	0.03
No CED	27 (16)	138 (84)	165	16			
Age (years)							
<20 and >35	2 (9)	20 (91)	22	9.1	0.45	0.12-1.75	0.38
20-35	33 (20)	131 (80)	164	20			
Employment							
Unemployed	11 (16)	58 (84)	69	16	0.78	0.41-1.49	0.44
Employed	24 (21)	93 (79)	117	20.5			
Number of ANC visits							
<4	3 (37.5)	5 (62.5)	8	37.5	2.09	0.81-5.38	0.17
≥4	32 (18)	146 (82)	178	18			
Parity							
≤1 and >3	21 (22)	73 (78)	94	22	1.47	0.80-2.71	0.21
2 or 3	14 (15)	78 (85)	92	15			
Hypertension during pregnancy							
Hypertension	2 (40)	3 (60)	5	40	2.19	0.72-6.70	0.24
No hypertension	33 (18)	148 (82)	181	18			

and chronic energy deficiency (CED) and birth weight of baby. Most (88.2%) of mothers were 20-35 years old, 67.2% were employed and 50.5% had fewer than one or more than three children. Almost all mothers had the number of ANC visits in accordance with the minimum standard (four visits) and most experienced weight gain in accordance with IOM standards (79.0%), did not experience anemia (78.0%) nor CED (88.7%). Most subjects (95.7%) had a normal pre-pregnancy BMI, 97.3% did not have hypertension and 81.2% had a baby with normal weight.

Table 2 presents the incidence of LBW in the at risk group (not in accordance with IOM standards) that is 23 out of 39 babies (59.0%) and in the non-risk group that is 12 of 147 babies (8.2%), with crude RR of 7.22 (95%CI: 3.95-13.19). This finding

shows a reduction in the incidence of LBW in the non-risk group by 86.0%. Variables that were found to significantly increase the incidence of LBW were experiencing anemia with crude RR of 4.71 (95%CI: 2.66-8.36), pre-pregnancy low BMI with crude RR of 2.87 (95%CI: 1.34-6.16) and CED with crude RR of 2.33 (95%CI: 1.22-4.44).

Table 3 presents the ARR of weight gain during pregnancy that is 15.33 (95%CI: 5.82-40.38). Another variable that also significantly increases LBW is anemia with ARR=6.66 (95%CI: 2.53-17.53).

## DISCUSSION

Our study shows that weight gain during pregnancy in accordance with IOM standards decreased the

**Table 3** ARR of weight gain during pregnancy and other variables

Variables	ARR	(95%CI)
<b>Weight gain during pregnancy</b>		
In accordance with IOM standards	1.00	
Not in accordance with IOM standards	15.33	5.82-40.38
<b>ANC Visits</b>		
≥4	1.00	
<4	5.63	0.98-32.38
<b>Parity</b>		
2 & 3	1.00	
≤1 & >3	1.90	0.72-4.99
<b>Pre-pregnancy BMI</b>		
Normal	1.00	
Low	1.68	0.17-16.24
<b>Hypertension during pregnancy</b>		
Hypertension	1.00	
No Hypertension	2.55	0.26-24.91
<b>Anemia status</b>		
No anemia	1.00	
Anemia	6.66	2.53-17.53
<b>CED status</b>		
CED	0.92	
No CED	1.00	0.21-4.04

incidence of LBW by 86.0% while weight gain that is not in accordance with IOM standards significantly increased the risk of LBW incidence. Other studies have also shown similar results, wherein mothers whose weight gain during pregnancy is not in accordance with IOM standards were at risk for LBW incidence. A study conducted at the PHC Sewon Bantul, Yogyakarta showed that mothers with weight gain not in accordance with IOM standards had 3.3 times higher risk of giving birth to LBW babies.<sup>14</sup> Another study conducted at Taipei Chang Gung Memorial Hospital showed that women whose weight gain was under IOM standards were 2.17 times more at risk of giving birth to LBW infants, but in this study there were three groups, namely, groups under IOM standards, in accordance with IOM standards and above IOM standards.<sup>13</sup> Weight gain less than IOM standards could increase the risk of LBW incidence likely because poor weight gain during pregnancy causes malnutrition which leads to intrauterine fetal growth disorders.<sup>15,16</sup>

Our study also shows that anemia increases the risk of LBW, but with a smaller risk compared to weight gain that not in accordance with IOM standards. Another study conducted in the Aceh Besar District showed similar results that anemia

increased the risk of LBW.<sup>17</sup> A systematic review of the risk factors for LBW in Indonesia found that within eight of the nine studies anemia increased the risk of LBW.<sup>9</sup> Biomedically, this is likely due to the fact that a decrease in iron in pregnant women disrupts the growth of the fetus in the womb.<sup>18</sup>

Our study shows that age, employment, number of ANC visits, pre-pregnancy BMI, CED status, parity and hypertension were not found to increase the risk of LBW. In another study conducted in Kudus District, it was shown that CED and parity were not a risk factor for LBW.<sup>19</sup> A study conducted in Aceh District also showed that CED status was not a risk factor for LBW.<sup>17</sup> Other study conducted at PHC II Gianyar showed different results, where parity, number of ANC visits and maternal age were reported to increase the risk of LBW.<sup>20</sup> A study conducted at the PHC Sewon Bantul showed that pre-pregnancy BMI is a risk risk for the incidence of LBW.<sup>14</sup>

The limitation of our study is that the samples were only mothers whose data in the medical records were complete while the others were not selected as samples, which might have led to bias. In this study, we defined mothers with weight gain below and above the IOM standards as “not accordance with the standards” while they likely

to have different risks for low birth weight babies. In addition, there was a possibility of errors in the mother's medical record and the scales used at the PHCs were not regularly calibrated. The pre-pregnancy weight listed on the mother's medical record was obtained by PHC officers through interviews so that the data obtained was less accurate and this data was used to calculate BMI before pregnancy in this study. Finally, the other factors that might be related to LBW could not be measured in our study.

## CONCLUSION

Weight gain during pregnancy that is not in accordance with IOM standards and anemia are the risk factors for LBW. Monitoring of weight gain during pregnancy should be implemented using the IOM standards as a modification of 2010 Ministry of Health of Indonesia recommendation. Anemia prevention among pregnant mothers should also be enhanced to prevent the incidence of low birth weight babies.

## ACKNOWLEDGEMENT

We would like to thank the Head of PHC I Gianyar, I Ubud and I Sukawati along with the coordinating midwives and other stakeholders who have facilitated the implementation of this study.

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