

## Gestational weight gain is a risk factor of stunting among children aged 6-23 months in Bangli District, Bali, Indonesia

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### ABSTRACT

**Background and purpose:** Stunting in children is a chronic nutritional concern that has short-term and long-term health effects. Several studies have shown inconsistent results related to the association between stunting and anemia and increased maternal weight during pregnancy. This study aims to determine anemia during pregnancy, increased body weight and weight gain during pregnancy based on body mass index (BMI) before pregnancy as the risk factors of stunting.

**Methods:** A case control study was carried out using the baseline data of an intervention study conducted from April to September to prevent stunting in children aged 6-23 months in nine villages in Bangli District, Bali Province. Baseline data collection was conducted from December 2017-February 2018 by interviewing 330 mothers of the children and observation of their ANC records. The number of samples for the case control study was 156 children aged 6-23 months consisting of 78 cases and 78 controls (1:1). Cases were selected by systematic random sampling from 82 children with stunting and controls were selected in the same way from 248 children without stunting. Data

analyzed were maternal age at pregnancy, education, employment, number of children, family income, height, hemoglobin level and maternal body weight during pregnancy. Multivariate analysis with logistic regression was conducted to determine the adjusted odds ratio (AOR) of each risk factor.

**Results:** The increase in maternal weight during pregnancy which is not in accordance with maternal BMI before pregnancy and an increase in maternal weight of <10 or >12.5 kilograms are significantly associated with stunting with AOR=3.53 (95%CI: 1.55-8.07) and AOR=3.31 (95%CI: 1.24-8.85). Hemoglobin <11gr/dL during pregnancy was not found to be significantly associated with stunting (AOR=5.02; 95%CI: 0.80-31.71).

**Conclusion:** The increase of maternal weight during pregnancy which is not suitable with BMI before pregnancy and an increase in maternal weight of <10 or >12.5 kilograms are risk factors for stunting in children aged 6-23 months. In addition to monitoring the increase of maternal weight during pregnancy, it is important to consider the mother's BMI before pregnancy in order to reduce the risk of stunting.

**Keywords:** stunting, children aged 6-23 months, anemia, increased body weight of pregnant women, Bali

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### INTRODUCTION

Stunting in children under the age of five is a chronic nutritional concern that occurs globally, including in Indonesia.<sup>1</sup> In 2016, 22.9% of children under five years of age around the world were recorded as stunted.<sup>2</sup> The proportion of stunting among under five children in Indonesia is increasing, started from 18.0% in 2007, 19.2% in 2013 and 19.3% in 2018.<sup>3</sup> The nutritional status monitoring survey conducted in Bali Province in 2016 showed that 19.7% of children under five experienced stunting.<sup>4</sup>

Stunting that occurs in the first 1000 days of life, which is from conception to two years old, will cause short-term and long-term health effects.<sup>5</sup> According to the WHO conceptual framework on childhood stunting, the stunting-related factors in children are community and societal, household and family factors, inadequate complementary feeding, breastfeeding and infection.<sup>6</sup> Maternal

factors include household and family factors consisting of poor nutrition during pre-conception, pregnancy and lactation, short maternal stature, infection, adolescent pregnancy, mental health, intra uterine growth retardation and preterm birth, short birth spacing and hypertension.<sup>6</sup>

Some studies indicate that the incidence of stunting is influenced by maternal factors including a lack of maternal nutrition before pregnancy, during pregnancy and lactation, inadequate antenatal care (ANC), maternal age, maternal height, infectious disease, maternal mental health, hypertension, anemia, low body mass index (BMI) and weight gain during pregnancy.<sup>5,7-9</sup> Several studies have shown inconsistent results regarding the association between stunting in infants with anemia and increased maternal weight gain during pregnancy.<sup>8-15,26</sup> This study aims to determine anemia

during pregnancy, increased body weight and weight gain during pregnancy based on body mass index (BMI) before pregnancy as the risk factors of stunting in children aged 6-23 months.

## METHODS

This is a case control study that used the baseline data of an intervention study conducted in April to October 2018 to prevent malnutrition in children aged 6-23 months in nine villages of Susut Sub-District, Bangli District, Bali Province. Bangli District is ranked second of the highest prevalence (25.7%) of stunting among children aged under five in Bali Province after Karangasem District (26%).<sup>4</sup> The nutritional status monitoring survey conducted in Bangli District in 2016 indicated that the proportion of children under five with stunting (9%) in Susut Sub-District was higher than the proportion of underweight (8%) and wasted under-fives (2.7%).

Baseline data collection of the intervention study was conducted from December 2017–February 2018 by interviewing 330 mothers of the children and observing their ANC records. The number of samples for the case control study was 156 children aged 6-23 months consisting of 78 cases and 78 controls (1:1). The number of samples was determined based on the confidence level of 95%, power of 80%, the proportion of anemia during pregnancy in non-stunting children at 25%<sup>11</sup> and anticipated odd ratio of 2.5. Case definition of stunting is if the z-score was <-2SD based on indicators of length-for-age. Of 330 children aged 6-23 months at the time of baseline data collection there were 82 stunted children and 78 children selected as cases by systematic random sampling. The number of controls was 78 children whom also selected in the same way from 248 children who were not stunted.

Data analyzed were maternal age at pregnancy, education, employment, number of children, family income, height, hemoglobin level and maternal

body weight gain during pregnancy. Hemoglobin levels recorded in the MCH books were grouped into <11 gr/dL (anemia) and ≥11 gr/dL (not anemia).<sup>17</sup> Weight gain during pregnancy was obtained from the difference between pre-pregnancy weight and pre-birthing weight recorded in the ANC book and confirmed by interview. The increase of body weight was grouped into two, namely 10-12.5 kg and <10 or >12.5 kg. The suitability of increasing maternal weight during pregnancy with BMI before pregnancy was grouped into “not suitable” if during pregnancy the increase in body weight is less or exceeds the standard range of the Institute of Medicine (IOM) and “suitable” if during pregnancy the weight gain is in the standard range IOM.<sup>18</sup> Increased weight categorized as “suitable with” the IOM standard is 12.5-18 kg in mothers who are underweight (BMI<18.5), 11.5-16 kg in women with a normal BMI (BMI=18, 5-22.9), 7-11.5 kg in mothers who were overweight (BMI=23.0-27.4) and 5-9 kg in obese mothers (BMI≥27.5).<sup>18</sup> Family income was grouped according to Bangli District’s minimum wage which is <IDR 2,128,253 and ≥IDR 2,128,253.<sup>19</sup>

Bivariate analysis was conducted to obtain crude odd ratios (OR) and multivariate analysis was conducted using binomial logistic regression using STATA 12.1 to obtain the adjusted odd ratio (AOR) of each variable. This study has been approved by the Ethics Committee of the Faculty of Medicine, Udayana University/Sanglah General Hospital in Denpasar on May 14, 2018.

## RESULTS

Table 1 shows that the characteristics of cases and controls did not differ by sex ( $p=0.08$ ) and age ( $p=0.74$ ). Table 2 shows the crude OR of maternal age at pregnancy, ANC visit frequency, maternal height, maternal nutritional status before pregnancy, maternal education, maternal occupation, family income, body weight increase and its suitability with BMI, hemoglobin level and number

**Table 1** Characteristics of children aged 6-23 months

Characteristics	Cases n (%)	Controls n (%)	p*
Sex			
Male	45 (57.7)	34 (43.6)	0.08
Female	33 (42.3)	44 (56.4)	
Age (months)			
12-23	32 (41.0)	30 (38.5)	0.74
6-11	46 (59.0)	48 (61.5)	

\*) Chi-Square test

**Table 2** Crude odd ratio of maternal factors for stunting among children aged 6-23 months

Variables	Cases	Controls	Crude OR	95% CI	p
	n (%)	n (%)			
Maternal age at pregnancy (years)					
<20 or >35	17 (21.8)	16 (20.5)	1.08	0.50-2.33	0.85
20-35	61 (78.2)	62 (79.5)			
ANC visit frequency (times)					
<9	45 (57.7)	49 (62.8)	0.81	0.43-1.53	0.51
≥9	33 (42.3)	29 (37.2)			
Maternal height					
<150 cm	19 (24.4)	11 (14.1)	1.96	0.86-4.46	0.10
≥150 cm	59 (75.6)	67 (85.9)			
BMI before pregnancy					
Underweight	9 (11.5)	6 (7.7)	1.49	0.76-2.93	0.25
Overweight	25 (32.1)	33 (42.3)	0.75	0.25-2.30	0.62
Normal weight	44 (56.4)	39 (50.0)			
Maternal education					
Junior high school	48 (61.5)	35 (44.9)	1.97	1.04-3.72	0.04
Senior high school and above	30 (38.5)	43 (55.1)			
Maternal employment					
Employed	42 (53.8)	38 (48.7)	1.23	0.66-2.30	0.52
Unemployed	36 (46.2)	40 (51.3)			
Family income					
Below minimum wage	52 (66.7)	40 (51.3)	1.90	1.00-3.63	0.05
Minimum wage and above	26 (33.3)	38 (48.7)			
Increase in body weight					
<10 kg or >12,5 kg	64 (82.1)	50 (64.1)	2.56	1.22-5.37	0.01
10-12,5 kg	14 (17.9)	28 (35.9)			
Body weight increase with BMI					
Unsuitable	49 (62.8)	24 (30.8)	3.80	1.96-7.39	<0.01
Suitable	29 (37.2)	54 (69.2)			
Hemoglobin level*					
<11 gr/dL (anemia)	5 (8.9)	2 (3.1)	3.04	0.57-16.33	0.25
≥11 gr/dL (notanemia)	51 (91.1)	62 (96.9)			
Number of children					
>2	27 (34.6)	15 (19.2)	2.22	1.07-4.62	0.03
1-2	51 (65.4)	63 (80.8)			

\*There were 36 missing hemoglobin data and statistical tests were performed with Fisher's Exact

**Table 3** Adjusted odd ratio of maternal factors for stunting in children aged 6-23 months

Variables	AOR	95%CI	p
Increase in body weight			
<10 kg or >12,5 kg	3.31	1.24-8.85	0.02
10-12,5 kg	1.00		
Suitability of body weight increase with BMI			
Unsuitable	3.53	1.55-8.07	<0.01
Suitable	1.00		

**Table 3** *Continue*

Variables	AOR	95%CI	p
Hemoglobin level			
<11 gr/dL (anemia)	5.02	0.79-31.71	0.09
≥11 gr/dL (not anemia)	1.00		
Children's sex			
Male	1.69	0.75-3.82	0.21
Female	1.00		
Maternal height			
<150 cm	1.50	0.54-4.21	0.44
≥150 cm	1.00		
Maternal education			
Junior high school	1.07	0.45-2.53	0.88
Senior high school and above	1.00		
Family income			
Below minimum wage	1.60	0.67-3.85	0.29
Minimum wage and above	1.00		
Number of children			
>2	0.72	0.45-1.15	0.17
1-2	1.00		

of children. All variables with p values <0.25 were included in the model for multivariate analysis using logistic regression. Table 3 shows that the increase of body weight during pregnancy that not suitable with BMI (AOR=3.53; 95%CI: 1.55-8.07) and an increase in maternal weight <10 or >12.5 kilograms (AOR=3.31; 95%CI: 1.24-8.85) increased the risk of stunting in children aged 6-23 months.

## DISCUSSION

This study showed that stunting in children aged 6-23 months was associated with the increase in body weight during pregnancy, which was not in accordance with the mother's BMI before pregnancy, and an increase in maternal weight <10 kilograms or >12.5 kilograms. Based on the Indonesian Ministry of Health Guidelines, an increase in body weight during pregnancy of 10-12.5 kg is recommended for mothers with "normal" or "ideal" weight before pregnancy,<sup>20</sup> while the results of this study indicate that maternal BMI before pregnancy needs to be taken into account in monitoring weight gain during pregnancy. If the mother before pregnancy was underweight and only pays attention to weight gain without taking into account the BMI before pregnancy, then when the mother experiences a weight gain of 16 kg during pregnancy, it increases the odds of stunting. But if taking into account the mother's BMI before pregnancy, the increase in body weight of 16 kg did not increase the odds of stunting.

Studies conducted in Yogyakarta and Bogor with a case control design among children under five also showed similar results to this study.<sup>14,21</sup> Several studies in other countries also showed that an increase in maternal weight during pregnancy which is not in accordance with BMI will increase the risk of children to experience growth disorders.<sup>22-25</sup> Studies conducted in India and Guatemala show that increasing weight <10 kilograms during pregnancy increases the risk of stunting of two-year-olds.<sup>12,23</sup> Several other studies also show that maternal weight gain in the first to third trimester is associated with femur bone length and fetal tibia (p<0.05) and the length of the baby at birth (p<0.001).<sup>23,24,26</sup>

Our study shows that anemia was not significantly associated with stunting in children aged 6-23 months. In this study maternal hemoglobin levels were obtained from the records in the ANC book and as many as 36 mothers had unrecorded hemoglobin levels. In addition, there were only 7 out of 120 mothers (5.83%) who had hemoglobin levels <11 gr/L. In the multivariate analysis it was found that the AOR of anemia was quite high at 5.02 but not statistically significant with 95%CI: 0.79-31.71. This is probably due to the small number of samples of anemic mothers. The results of this study are similar to a study conducted in Yogyakarta with a case control design which shows that there was no significant association between anemia during pregnancy and stunting.<sup>11</sup> Another

study conducted in Semarang with a cohort design, however, showed that anemia measured in the third trimester of pregnancy was associated with the length of the infant.<sup>26</sup> The hemoglobin levels of pregnant women in the study were measured using the cyanmethemoglobin method.<sup>26</sup>

The limitations of this study are data on hemoglobin levels, maternal body weight during pregnancy and before delivery were obtained from secondary data that were recorded in the ANC book. There is a possibility of different tools and ways to measure hemoglobin levels and maternal weight before pregnancy and before giving birth. In addition, in this study, the number of pregnant women who had anemia were limited so that they could not show significant differences. Finally, this study was conducted in one sub-district, so generalization of the results into a wider population needs to be taken in caution.

## CONCLUSION

Unsuitable weight gain during pregnancy with mother's BMI before pregnancy and weight increase of <10 kilograms or >12.5 kilograms during pregnancy are risk factors for stunting in children aged 6-23 months. In addition to monitoring the increase in maternal weight during pregnancy, the mother's BMI before pregnancy should be considered in order to reduce the risk of stunting.

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