

Gestational Weight Gain and Risk of Preeclampsia: A Case-Control Study

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Abstract

Introduction: This study aims to investigate the relationship between gestational weight gain and preeclampsia among patients who delivered in RSUD Prof. Dr. Margono Soekarjo, Purwokerto.

Methods: This was a case control study, conducted from October 2022 – March 2023. Data were gathered through electronic medical records and excluded pregnant patients with previous diagnosis of hypertension outside pregnancy, diabetes, renal disorder, and autoimmune disorder.

Results: In this study, 156 patients with preeclampsia and 156 patients without preeclampsia were enrolled. Patients with high GWG have an increased risk of preeclampsia (OR 2.154 95%CI 1.353 – 3.429) compared to patients with adequate GWG (OR 0.984 95%CI 0.691 – 1.401). Patients with pre-pregnancy obesity also has an increased risk of preeclampsia (OR 1.625 95%CI 1.165 – 2.267) compared to normal pre-pregnancy weight (OR 0.564 95%CI 0.379-0.869).

Discussion: Gestational weight gain and pre-pregnancy obesity appears to be independently linked to preeclampsia. Our findings reflect other studies that have been conducted on this subject, strengthening the synergistic effect between pre-pregnancy BMI and GWG on the risk of preeclampsia in local population.

Conclusion: Excessive GWG during pregnancy and pre-pregnancy obesity increases the risk of developing preeclampsia.

Key words: Preeclampsia, Gestational Weight Gain, Obesity

Peningkatan Berat Badan saat Kehamilan dan Risiko Preeklampsia: Sebuah Studi *Case-Control*

Abstrak

Pendahuluan: Penelitian ini bertujuan untuk mengetahui hubungan antara penambahan berat badan dan kejadian preeklampsia pada pasien bersalin di RSUD Prof. Dr. Margono Soekarjo Purwokerto.

Metode: Studi ini merupakan studi *case control* yang dilakukan dari Oktober 2022 – Maret 2023. Data dikumpulkan melalui rekam medis elektronik dengan kriteria eksklusi berupa pasien hamil dengan diagnosis hipertensi sebelumnya di luar kehamilan, diabetes, gangguan ginjal, dan gangguan autoimun.

Hasil: Dalam penelitian ini, terdapat 156 pasien dengan preeklampsia dan 156 pasien tanpa preeklampsia. Pasien dengan GWG tinggi memiliki peningkatan risiko preeklampsia (OR 2,154 95%CI 1,353 – 3,429) dibandingkan pasien dengan GWG adekuat (OR 0,984 95%CI 0,691 – 1,401). Pasien dengan obesitas prakehamilan juga memiliki peningkatan risiko preeklampsia (OR 1,625 95%CI 1,165 – 2,267) dibandingkan dengan berat badan normal sebelum hamil (OR 0,564 95%CI 0,379-0,869).

Diskusi: Pertambahan berat badan gestasional dan obesitas pra-kehamilan tampaknya terkait secara independen dengan preeklampsia. Temuan kami mencerminkan penelitian lain yang telah dilakukan mengenai hal ini, memperkuat efek sinergis antara BMI pra-kehamilan dan kenaikan berat badan kehamilan pada risiko preeklampsia pada populasi lokal.

Kesimpulan: Pertambahan berat badan selama kehamilan yang berlebihan selama kehamilan dan obesitas pra-kehamilan meningkatkan risiko terjadinya preeklampsia.

Kata kunci: Preeklampsia, Pertambahan Berat Badan Kehamilan, Obesitas

Introduction

Compared to the developed world, the burden of health caused by preeclampsia in Indonesia is still comparatively high, with a recorded incidence of 24% compared to 2-10% worldwide as noted by the World Health Organization¹. Major contributing risk factors were anemia, obesity, and chronic hypertension². While the link between pre-pregnancy obesity and preeclampsia has been firmly established^{3,4}, the impact of high gestational weight gain to maternal and fetal output is still being investigated. Several studies have found that high pregnancy weight gain increases the risk of preeclampsia in nulliparous women⁵⁻⁸; however other authors have also noted that high pregnancy weight gain and pre-pregnancy obesity may be independent risk factors towards the development of preeclampsia.⁶ Despite the ongoing investigation, there is little data among local Indonesian population to contribute to this discussion.

Therefore, in this study, we aim to investigate the relationship between gestational weight gain and risk of preeclampsia among women who delivered in Margono Soekarjo General Hospital, Central Java, Indonesia.

Methods

In this retrospective analysis, all pregnant patients who delivered during October 2022 to March 2023 at the Department of Obstetrics, Margono General Hospital were included and selected from electronic medical database. Our exclusion criteria were prior history of hypertension, diabetes mellitus, autoimmune disorder, and incomplete medical records. Case was defined as pregnant patients with preeclampsia who delivered in RSUD Prof. Dr. Margono Soekarjo during enrollment period; control was defined as pregnant patients without preeclampsia. Preeclampsia

was defined according to the International Society for the Study of Hypertension in Pregnancy (2018): new onset of hypertension (BP >140 mmHg systolic or >90 mmHg diastolic) at or after 20 weeks of gestation accompanied by one or more of the following conditions: proteinuria, signs of maternal organ dysfunction (creatinine >90 $\mu\text{mol/L}$, elevated transaminase, right upper quadrant pain, neurological complications, hematological complications, and uteroplacental dysfunction).⁹ Gestational weight gain was defined according to the definition set by the Institute of Medicine (IOM) in 2009, which recommended 12.5 – 18 kg weight gain for underweight patients; 11.5 – 16 kg for normoweight patients; and 7.5 – 11 and 5 – 9 kg for overweight and obese patients, respectively. Pre-pregnancy BMI was categorized according to the Asia Pacific BMI cut-off: <18.5 kg/m^2 for underweight; 18.5-22.9 kg/m^2 for normoweight; 23-24.9 kg/m^2 for overweight, and >25 kg/m^2 for obese¹⁰ To assess distribution normality, we conducted Kolmogorov-Smirnov test; categorical data were presented in median and percentages and assessed for statistical significance using χ^2 test. To assess association between variables, multinomial logistic regression was used. Data was analysed using IBM SPSS version 26.0.

Results

At the end of the study, 156 cases and 156 controls were obtained. Baseline demographics of both cases and controls are described in Table 1.

Most of our sample were between 21-35 years old. The majority were between 21-35 years old (64% case, 67.9% control) and we found no statistically significance difference between cases and control ($p=0.098$). There was no statistically significant difference in parity ($p=0.592$); and education ($p=0.867$). Most of our samples were multiparous and

Table 1 Baseline Demographics of the Study Population

Variable	Case (n=156)	Control (n=156)	p-value*
Age			0.098
<20 y.o.	3	9	
21-35 y.o.	100	106	
>35 y.o.	41	53	
Parity			0.592
Nulliparous	70	73	
Multiparous	85	83	
Grande Multiparous	1	0	
Education			0.876
Primary School	23	23	
Middle School	54	58	
High School and Above	75	79	
BMI			<0.001
Underweight	10	22	
Normoweight	35	61	
Overweight	20	17	
Obese	91	56	
Gestational Weight Gain			<0.001
Inadequate	39	68	
Adequate	61	62	
Excessive	56	26	

*Significance determined at p < 0.05 (Chi-squared test).

Table 2 Associations between Risk Factors and Preeclampsia

Risk Factors	Odds Ratio (95%CI)	p-value
Pre-pregnancy BMI		
< 18.5 kg/m ²	0.476 (0.224 – 1.011)	0.053
18.5-22.9 kg/m ²	0.57 (0.379 – 0.86)	0.009
23-24.9 kg/m ²	1.176 (0.616– 2.24)	0.622
>25 kg/m ²	1.625 (1.165 – 2.26)	0.004
Gestational Weight Gain		
Inadequate	0.582 (0.392 – 0.864)	0.007
Adequate	0.928 (0.691 – 1.401)	0.928
Excessive	2.154 (1.353– 3.429)	0.001

have achieved an educational level equivalent to high school and above.

There was statistically significant difference between pre-pregnancy BMI and gestational weight gain ($p < 0.001$). To further assess the risk between pre-pregnancy BMI, gestational weight gain, and preeclampsia, multinomial logistic regression was performed. Underweight and normoweight pre-pregnancy status had a protective effect towards preeclampsia (OR 0.476 95% CI 0.024-1.011; OR 0.57, 95%CI 0.379-0.86, respectively). We found an increased risk of preeclampsia among patients with pre-pregnancy obese BMI (OR 1.625 95%CI 1.165-2.267), whereas patients who were overweight had 1.176-fold risk (95%CI, 0.616 – 2.246) (Table 2).

We found no increased risk of preeclampsia among patients with inadequate or adequate GWG, while patients with excessive gestational weight gain had 2.154-fold risk of developing preeclampsia (95%CI, 1.353 – 3.429) (Table 2).

Discussion

Our study sought to investigate the relationship between gestational weight gain and the risk of preeclampsia. To isolate the impact of obesity and gestational weight gain on preeclampsia, we excluded women with previous history of hypertension and other chronic disorders that may contribute to the development of preeclampsia, such as diabetes mellitus and autoimmune disorder. Here, we have found that excessive gestational weight gain increases the risk of preeclampsia by 2.154-fold, whereas obesity is another major risk factor by 1.625-fold. Our result supports that of previous studies that have been conducted in this area, which showed that women with high pre-pregnancy BMI had a 3.28-fold risk of preeclampsia, whereas excessive gestational weight gain predisposes a patient to risk of preeclampsia by 3.37-fold.^{7,11-13}

While adequate GWG does not contribute

to preeclampsia, we also did not find any relationship between inadequate GWG and preeclampsia, which differed with some past findings.¹⁴ Zhang et al (2022) found that inadequate and excessive GWG both increased the risk of preeclampsia and contributed to different preeclampsia phenotypes.¹⁴ To date, the mechanism behind the association between inadequate GWG and preeclampsia remains unclear, however Zhang et al postulated that inadequate GWG may be a manifestation of maternal malnutrition, which in turn increases oxidative stress and endothelial dysfunction, resulting in preeclampsia¹⁴. Our result did not reflect this finding; however, this may be related to the smaller pool of sample in our study.

In our study, we were unable to delineate between the different preeclampsia phenotypes: mild, severe, early-, and late-onset preeclampsia as it relates to excessive GWG. Other authors have proposed that excessive GWG may be related to late-onset preeclampsia, as increased adipose tissue may increase inflammatory factors, and therefore the risk of preeclampsia.⁵

This study is also limited by its small sample size and lack of fat distribution analysis. Considering the mechanism by which rapid gestational weight gain may factor into preeclampsia may be associated with reactive oxygen species-induced inflammation and vascular damage, fat distribution and analysis of body fat composition may have yielded a more accurate result into the relationship between obesity, GWG, and the risk of preeclampsia.¹⁵⁻¹⁷ Furthermore, GWG may also be influenced by maternal fluid retention, therefore obscuring the possible biological pathway between GWG and preeclampsia.

A variety of genetic and environmental factors play a significant role in contributing to gestational weight gain and risk of developing preeclampsia during pregnancy.¹¹ Poor maternal nutrition, excessive caloric intake, an obesogenic environment, sedentary

lifestyle, and psychosocial stressors all factor into excessive gestational weight gain and risk of preeclampsia during pregnancy.^{11,12}

A longitudinal study may be required to observe the interplay between these risk factors and long-term maternal and neonatal health outcomes.

Conclusion

In conclusion, we observed a higher risk of developing preeclampsia among women with excessive gestational weight gain during pregnancy, and among women with obese BMI pre-pregnancy. Future research is required to observe interaction between multiple risk factors of developing excessive gestational weight gain, preeclampsia, and maternal and neonatal health outcomes.

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