Maternal Body Mass Index at Term Does Not Predict the Severity of Preeclampsia

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Objective: *Maternal pre-pregnancy weight is a risk of developing preeclampsia. Whether it is also associated with the disease severity is still elusive. This retrospective cohort was to determine the association between body mass index (BMI) at term and severity of preeclampsia.*

Material and Method: *BMIs on the delivery date of 229 patients were analyzed with various indicators of the disease severity. The corrected BMI (cBMI), calculated by an exclusion of feto-placental unit, was additionally analyzed.*

Results: *Neither maternal BMI nor cBMI correlated with the disease severity (p = 0.15 and 0.36). Patients who did and did not require $MgSO_4$ do not have different BMI or cBMI (p = 0.12 and 0.23). Neonatal weight from severe disease arm does not differ from those with mild disease (p = 0.51). Counter-intuitively, the correlations between birth weight and maternal BMI were stronger in the severe compared to the mild group (p = 0.0 and 0.03).*

Conclusion: *Neither BMI nor cBMI at the time of delivery predict the severity of preeclampsia or the need for seizure prophylaxis. Birth weight of the baby born from preeclamptic mother might be affected by multiple factors.*

Keywords: *Preeclampsia, Obesity, Body mass index, Fetal growth*

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Maternal weight is a predictor of several adverse pregnancy outcomes[1]. The prevalence of obesity in pregnant women has been on the rise, with the latest statistics of 22% of pregnant women in some areas of the United States fall into the obesity criteria in the year 2003[2]. Obesity itself has a clear association to the development of preeclampsia, especially for the severe disease[3,4]. However, whether maternal weight could predict the disease severity after preeclampsia is already developed is still elusive. The present study sought to determine the effect of maternal body habitus at the time of delivery to some parameters indicating the severity of preeclampsia. The authors also tried to find out if maternal weight could be predictive for the requirement of seizure prophylaxis.

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Material and Method

Every pregnant patient who suffered from hypertensive disease during pregnancy and who was admitted to the Department of Obstetrics and Gynecology, Faculty of Medicine Siriraj Hospital between June 2005 and June 2006 received a standardized care according to our in-house guidelines. Revision of their data was approved by the internal ethical committee of the Faculty of Medicine Siriraj Hospital. A one-year retrospective cohort was done on 288 preeclamptic women who delivered between June 2005 and June 2006, at Siriraj Hospital.

According to the authors' guidelines, the presence of new-onset proteinuric hypertension during pregnancy gives the diagnosis of preeclampsia[5,6]. The severe disease was defined as systolic blood pressure (SBP) of 160 mmHg or higher, and/or diastolic blood pressure (DBP) of 110 mmHg or higher. The decision to administer $MgSO_4$ depended on the clinical features of an impending eclampsia, including visual disturbances, epigastric pain, and hyperreflexia. Intravenous $MgSO_4$ administration was used in every case.

Body mass index (BMI), body weight (kilogram) divided by a square of height (meter), at the time of delivery was analyzed along with various indicators for the disease severity. In addition, the authors sought to eliminate the weight contribution from feto-placental unit. The corrected BMI (cBMI) was therefore calculated by subtracting the fetal, placental, and an estimated amniotic fluid volume from the equation. The estimated amniotic fluid volume at each gestational age was derived from a previous publication from Caspi et al in 1975[7]. In order to make this estimation most accurate, any patients complicated with oligohydramnios (deepest vertical pocket of the liquor amnii of less than 2 centimeters) or ruptured their membranes prior to arriving at the hospital were excluded from the present study.

Fetal growth could also be affected by preeclampsia. Whether the growth restriction should be included as one of the severity rating category is still controversial. However, the analysis to determine how the disease severity affects the growth of the fetus was also performed.

Statistical analyses

Study data were analyzed using SPSS version 12.0 (Chicago, IL). Normality of the data was tested with Kilmogorov-Smirnov tests. Descriptive statistics were used to describe characteristics of the parties. Student t-test were used for comparison between continuous variables. Correlation coefficient (r) was estimated to determine an association between variables. A p-value of less than 0.05 was considered statistically significant.

Results

After secondary data revision, 59 patients complicated with either oligohydramnios or premature rupture of the membranes, were excluded. This left 229 patients for further analysis. The average age of pre-eclamptic women was 28.4 ($\pm$ 7) years. Forty nine percent (113/229) of the patients were primigravidarum. The average weight at term of preeclamptic women enrolled was 77.7 ($\pm$ 15.4) kg on the delivery day. The average height was 1.6 ($\pm$ 0.6) meters. These parameters, including gestational age at delivery were not significantly different in women with mild and severe disease, as shown in Table 1.

For preeclampsia of any given severity, the average BMI was 30.9 ($\pm$ 3.8) kg/m^2, whereas the average cBMI was 29.5 ($\pm$ 3.5) kg/m^2. Using blood pressure criteria, 131 and 98 patients were having mild and severe preeclampsia, respectively. The average BMIs were 30.8 ($\pm$ 5.5) and 32 ($\pm$ 5.5) kg/m^2 in women with mild and severe disease, respectively. The slightly higher BMI in the severe group did not reach a statistical significance ($p = 0.16$). After the contribution from feto-placental unit was subtracted from the equation, the average cBMIs were 28.9 ($\pm$ 5.4) and 29.6 ($\pm$ 5.1) kg/m^2 in women with mild and severe disease, respectively. Again, the difference in maternal body habitus did not reach a statistical significance level ($p = 0.36$), as shown in Table 1.

Table 1. Demographic variables of preeclamptic women enrolled in the study

Demographic variables	Mild preeclampsia (n = 131)	Severe preeclampsia (n = 98)	p-value
Age (years)	27.4 ($\pm$ 6)	28.9 ($\pm$ 7)	0.45
Gestational age (weeks')	38.0 ($\pm$ 2.2)	37.5 ($\pm$ 2.3)	0.52
Weight (kg)	75.7 ($\pm$ 15.3)	78.7 ($\pm$ 15.5)	0.35
Height (m)	1.6 ($\pm$ 0.5)	1.6 ($\pm$ 0.6)	0.71
Body mass index (BMI) (kg/m^2)	30.8 ($\pm$ 5.5)	32.0 ($\pm$ 5.5)	0.16
Corrected body mass index (eBMI) (kg/m^2)	28.9 ($\pm$ 5.4)	29.6 ($\pm$5.1)	0.36
Birth weight (kg)	3.1 ($\pm$ 0.8)	2.8 ($\pm$0.7)	0.51

Data are presented in mean $\pm$ standard deviation

The authors also looked at the severity of the disease through the requirement of MgSO4 administration from the impending eclamptic symptoms. In the present series, 68 women received $MgSO_4$, whereas 161 women did not. The average BMIs were 31.9 (± 5.5) and 30.7 (± 5.5) kg/m^2 in women who did and did not receive $MgSO_4$. No statistical difference was observed (p = 0.12). The average cBMIs are 29.6 (± 5.2) and 28.7 (± 5.5) kg/m^2 in women who did and did not receive $MgSO_4$, which are not statistically different (p = 0.23). No eclampsias were found in the present series. The data regarding the BMI and the requirement of seizure prophylaxis are shown in Table 2.

The average weight of the babies born from mothers with mild and severe preeclamptic disease were 3.1 (± 0.8) and 2.8 (± 0.7) kg, respectively (p = 0.51). Overall, there was a significant correlation (r) between both BMI and cBMI to the birth weight (p = 0.02 and 0.02, respectively). Counterintuitively, the correlation coefficient is stronger in those with severe disease (p = 0 and 0.03, respectively). The scatterplots of BMIs and the birth weights are shown in Fig. 1 to 3.

Discussion

Maternal body habitus has a clear association to the development of severe hypertensive disorders of pregnancy in several reports[4,8,9]. BMI has been proposed to be one of the clinical predictors for the development of preeclampsia, but not HELLP syndrome[10]. However, the data on whether BMI in the women who readily developed preeclampsia is helpful in determining the disease severity and the requirement for $MgSO_4$ for seizure prophylaxis is limited. The present data showed an absence of correlation between BMI and cBMI at term gestation, and the disease severity. Maternal body habitus at term does not predict the need for seizure prophylaxis. Preeclampsia does not jeopardize the well-established association between maternal body habitus and the fetal weight. Counterintuitively, the correlation is stronger in women afflicted with severe disease compared to the mild one.

Table 2. Comparision of maternal BMI and cBMI in preeclamptic women with and without impending seizure symptoms

Variables	Impending seizure (n = 68)	Non impending seizure (n = 161)	p-value
BMI (kg/m^2)	31.9 (± 5.5)	30.7 (± 5.5)	0.12
cBMI (kg/m^2)	29.6 (± 5.2)	28.7 (± 5.5)	0.23

Weight gaining during pregnancy could be contributed from the feto-placental unit, water retention, breast tissue, and fat accumulation. Pre-pregnancy weight, which indicates the fat deposition, has a clear association with the development of preeclampsia. Abdominal fat has been proposed as a source of free

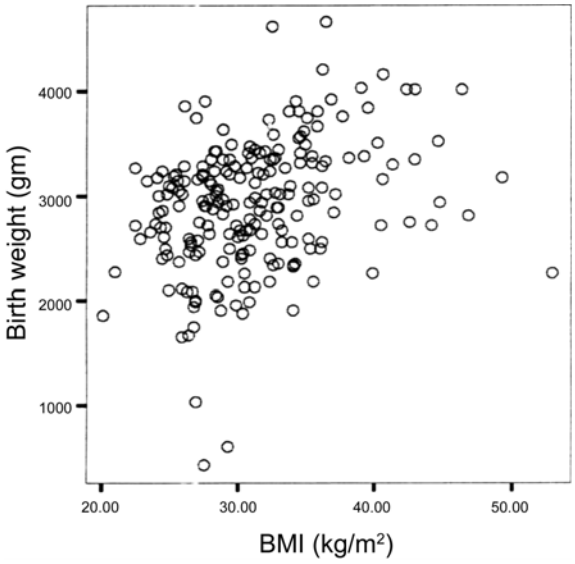

Fig. 1 An association between BMIs and birthweights in preeclamptic patient (p = 0.02)

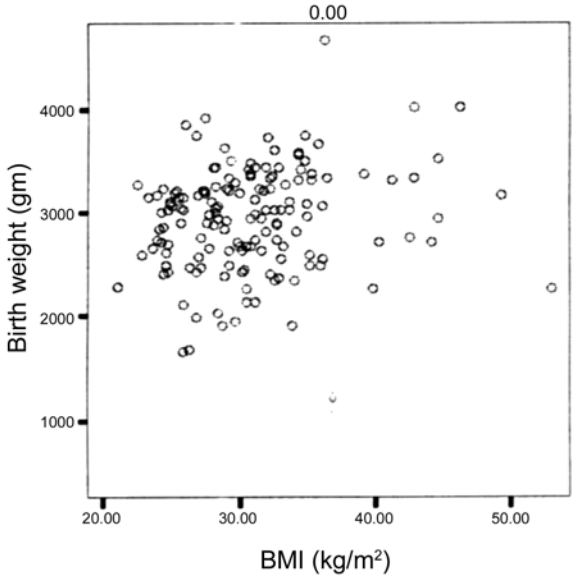

Fig. 2 An association between BMIs and birthweights in mild preeclamptic patients (p = 0.03)

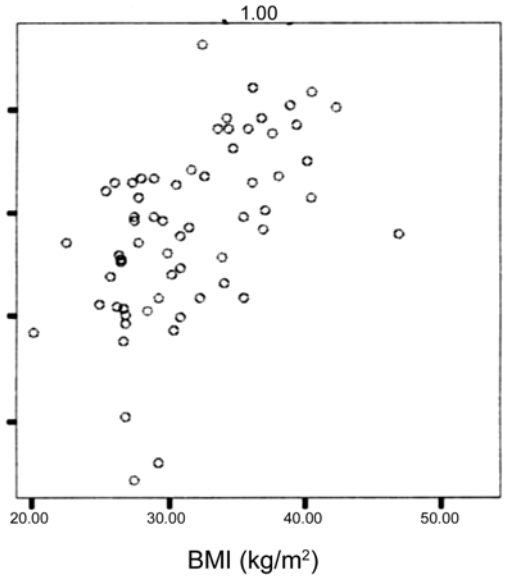

Fig. 3 An association between BMIs and birthweights in severe preeclamptic patients (p = 0)

fatty acid and cytokine production. Both of which factors would promote vascular inflammation and endothelial dysfunction, potentially resulting in insulin resistance and hypertension[11]. In addition, obese women tend to have other underlying diseases that might contribute to the development of preeclampsia, including insulin insensitivity and diabetes mellitus. However, if water retention and an additional fat accumulation during pregnancy could contribute to the disease severity is still elusive. Many obstetricians feel that a larger preeclamptic mother will have a more severe disease than the leaner one, even though the American College of Obstetricians and Gynecologists (ACOG) has recently eliminated edema from the diagnostic criteria of preeclampsia.

The present study design is to determine if the preeclampsia is more aggressive in heavier mothers. The data suggested an absence of association between maternal weight and the disease severity, even after feto-placental contribution was excluded. Excessive reactions to free fatty acids during pregnancy may not be solely responsible to the progress of preeclampsia. Other placental-derived vasoactive mediators may growingly influence the disease severity, and surpass the effect of free fatty acids when the gestational age is advancing. So far, there is no single model that could explain every scenario of preeclampsia, and the presented data support the multifactorial hypothesis of preeclampsia.

In healthy individuals, neonatal birth weights rely heavily on the mother's weight. However, generalized vasoconstriction in preeclampsia could diminish the uteroplacental blood flow, resulting in fetal growth restriction and low birth weight. The data show a preserved positive correlation between maternal BMIs and birthweights in any severity of preeclamptic disease. The comparable mean birth weights in mild and severe disease groups indicate that the disease does not curtail fetal growth as much as it has been concerned. Counterintuitively, the correlation between birth weights and BMIs is stronger in severe preeclamptic group. Mittal et al recently reported a higher serum placental growth hormone levels in some women who had severe preeclampsia but the neonatal birth weights were normal, compared to those who delivered small-for-date babies[12]. The 'natural rescue' by this growth factor might help the fetus gain weight amid the suboptimal condition in utero.

The sample size of the present study is rather limited. However, the data suggests that, even the marginal difference could be found from increasing the enrollment, the difference would not be clinically significant. Albeit the whole body habitus of the mother is not predictive for the disease severity, the lean weight gain during pregnancy could be more meaningful. Yet, the pre-pregnancy weight is not routinely documented in many institutes, and therefore is not reliably available. Data from obese premenopausal women who lost weight over 1 year indicate a reduction in inflammatory cytokine concentrations, a reduction in adhesion molecule concentrations including intercellular adhesion molecule-1 (ICAM-1) and an improvement in endothelial-dependent vascular function[13]. Whether controlling of weight gain during pregnancy in obese pregnant women could prevent the development of severe disease, or at least lessen that severity, is worth studying.

Conclusion

Maternal BMI and cBMI at the time of delivery do not seem to predict neither the severity of the readily developed preeclampsia nor the need for seizure prophylaxis. The effects of preeclampsia on fetal growth appeared to be less than expected, and might be lessened by increased natural growth factors in the affected individuals.

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ดัชนีมวลกายไม่สามารถใช้พยากรณ์ความรุนแรงของภาวะครรภ์เป็นพิษ

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วัตถุประสงค์: *น้ำหนักก่อนตั้งครรภ์มีความสัมพันธ์ต่อการเกิดครรภ์เป็นพิษ แต่ความสัมพันธ์ระหว่างน้ำหนักเมื่อครรภ์ครบกำหนด กับความรุนแรงของภาวะครรภ์เป็นพิษนั้นยังไม่ชัดเจน การศึกษานี้ต้องการสืบค้นความสัมพันธ์ระหว่างดัชนีมวลกายเมื่ออายุครรภ์ครบกำหนดกับความรุนแรงของครรภ์เป็นพิษ*

วัสดุและวิธีการ: *เป็นการศึกษาแบบย้อนหลังในผู้ป่วยครรภ์เป็นพิษ 229 ราย เปรียบเทียบดัชนีมวลกายกับตัวแปรที่บ่งชี้ความรุนแรงของครรภ์เป็นพิษ และยังศึกษาความสัมพันธ์ระหว่างดัชนีมวลกายที่แยกเอาน้ำหนักของทารก, รก, และน้ำคร่ำออกไปแล้ว กับความรุนแรงของครรภ์เป็นพิษอีกด้วย*

ผลการศึกษา: *ไม่พบความสัมพันธ์ระหว่างค่าดัชนีมวลกายทั้งสองแบบกับความรุนแรงของครรภ์เป็นพิษ ($p = 0.15$ และ 0.36) ผู้ป่วยครรภ์เป็นพิษที่ได้รับและไม่ได้รับแมกนีเซียมซัลเฟตมีค่าดัชนีมวลกายทั้งสองแบบไม่แตกต่างกัน ($p = 0.12$ และ 0.23) ไม่พบความแตกต่างของน้ำหนักทารกแรกคลอดในมารดาที่มีความรุนแรงของโรคแตกต่างกัน ($p = 0.51$) พบว่าน้ำหนักทารกแรกคลอดแปรผันตามดัชนีมวลกายของมารดา มากกว่าในรายครรภ์เป็นพิษขั้นรุนแรงเมื่อเทียบกับขั้นไม่รุนแรง ($p = 0$ และ 0.03)*

สรุป: *ดัชนีมวลกายเมื่ออายุครรภ์ครบกำหนดไม่สามารถใช้พยากรณ์ความรุนแรงของครรภ์เป็นพิษ อาจมีหลายปัจจัยนอกเหนือจากครรภ์เป็นพิษที่มีผลต่อน้ำหนักทารกแรกคลอด*