Gestational weight gain in Japanese women with preeclampsia

Shunji Suzuki

Department of Obstetrics and Gynecology, Japanese Red Cross Katsushika Maternity Hospital, Tokyo, Japan

Aim: Weight gain during the 2–4 weeks before the onset of preeclampsia was assessed to examine the effects of edema on weight gain in women with preeclampsia.

Methods: Weight gain up to 4 weeks, from 2–4 weeks, and from 2 weeks before the diagnosis of preeclampsia (preeclampsia group; n = 77) was retrospectively examined. Weight gain during the same period of gestational age in women with the same age, parity, height, and weight at prepregnancy (control group; n = 77) was also examined. The χ² test was used to examine categorical variables.

Results: Average weight gain up to 4 weeks before the diagnosis of preeclampsia did not differ from that of subjects with the same period of gestational age in the control group (6.1 ± 2.0 vs. 6.5 ± 2.6 kg, P = 0.25). However, average weight gain from 4 weeks before the diagnosis of preeclampsia was significantly greater than that of subjects with the same gestational age in the control group (weight gain from 2–4 weeks before the diagnosis of preeclampsia: 0.9 ± 0.4 vs. 1.6 ± 0.8 kg, P < 0.01; weight gain from 2 weeks before the diagnosis of preeclampsia: 0.8 ± 0.4 vs. 2.1 ± 1.5 kg, P < 0.01). The percentage of women with systemic edema in the preeclampsia group was significantly higher than that in the control group (53 vs. 4%, P < 0.01). In the preeclampsia group, average weight gain from 2 weeks before the diagnosis of preeclampsia in women with systemic edema was significantly higher than that in women without general edema (3.0 ± 1.1 vs. 1.1 ± 0.5 kg, P < 0.01).

Conclusion: Maternal weight gain associated with preeclampsia may be due to systemic edema that precedes the onset of preeclampsia.

Introduction

The Japan Society of Obstetrics and Gynecology (JSOG) guidelines created in 1995 and the Japanese Ministry of Health, Labour and Welfare (JMHLW) guidelines created in 2010 on gestational weight gain (GWG) had historically been strict, given the high priority of preventing preeclampsia. Recently, some large studies in Japan investigated optimal GWG; however, they may have insufficiently assessed the influence of GWG on the incidence of preeclampsia because GWG with preeclampsia is often due not only to eating habits, but also increased edema associated with renal and/or vascular endothelial dysfunction. Edema that accompanies preeclampsia often leads to weight gain just before the onset of preeclampsia, unlike that due to eating habits. Therefore, weight gain from 2–4 weeks before the onset of preeclampsia was assessed to examine the effects of edema on weight gain in women with preeclampsia.

Methods

The protocol for this study was approved by the Ethics Committee of Japanese Red Cross Katsushika Maternity Hospital. Oral informed consent was obtained for retrospective analysis from all subjects at their first perinatal visit.

Obstetric records of all Japanese singleton deliveries at ≥ 22 weeks of gestation managed at the Japanese Red
Weight gain in hypertensive disorders of pregnancy

Cross Katsushika Maternity Hospital between 2015 and 2016 were reviewed. Patients with chronic hypertension, renal disease, and systemic illnesses were excluded. In addition, patients with smoking or drinking habits were excluded.

Preeclampsia was defined as hypertensive disorders in pregnancy (HDP) at ≥ 20 weeks of gestation with proteinuria. HDP was defined as blood pressure ≥ 140/90 mmHg measured on two or more occasions at least six hours apart with the patient at rest. Proteinuria was defined as ≥ 300 mg protein/day in a 24-hour-collected urine specimen. During the study period, all pregnant women with preeclampsia were hospitalized.

Seventy-seven Japanese women whose weight gain could be followed from early pregnancy were selected for the preeclampsia group, and 77 Japanese women with the closest delivery date were selected for the control group, as follows: i) those who gave birth within a one month difference, 2) those with the same height (cm), 3) those within a one kg difference in prepregnancy body weight, and 4) those with the same parity.

The following were also examined: the rate of pregnancy achieved with Assisted Reproductive Technology; weight gain up to 4 weeks, from 2–4 weeks, and from 2 weeks before the diagnosis of preeclampsia; the presence or absence of systemic edema; gestational age at delivery; the rate of cesarean delivery; and neonatal birth weight.

In the control group, weight gain during the same period of gestational age was examined.

Data are presented as mean ± SD or number (percentage).

Results

Table 1 shows the clinical characteristics of the preeclampsia and control groups. The assessed variables did not significantly differ between the two groups.

Table 2 shows maternal weight gain and perinatal outcomes in the preeclampsia and control groups. Average gestational age at diagnosis of preeclampsia was 33.4 ± 4.2 weeks. Average gestational age at delivery and neonatal birth weight were earlier and lower, respectively, in the preeclampsia group than those in the control group (35.0 ± 5.0 vs. 39.4 ± 1.5 weeks and 1,890 ± 522 vs. 3,045 ± 342 g, P < 0.01). Average weight gain up to 4 weeks before the diagnosis of preeclampsia did not differ from that of subjects with the same gestational age in the control group (P = 0.25); however, average weight gain

---

Table 1. Clinical characteristics of the preeclampsia and control groups

|                     | Control     | Preeclampsia | P-value |
|---------------------|-------------|--------------|---------|
| Total number        | 77          | 77           |         |
| Maternal age at pregnancy (y) | 32.8 ± 5.3 | 32.8 ± 5.3 | 1.00    |
| Multiparity         | 16 (21)     | 16 (21)      | 1.00    |
| Smoking /drinking   | 0           | 0            | 1.00    |
| Pregnancy using Assisted Reproductive Technology | 6 (8)   | 14 (18) | 0.09    |
| Maternal height (cm) | 160.4 ± 5.5 | 160.5 ± 5.5 | 0.99    |
| Prepregnancy maternal weight (kg) | 57.4 ± 10.0 | 57.5 ± 10.1 | 0.99    |

Data are presented as mean ± SD or number (percentage).

Table 2. Maternal weight gain and perinatal outcomes in the preeclampsia and control groups

|                     | Control     | Preeclampsia | P-value |
|---------------------|-------------|--------------|---------|
| Total number        | 77          | 77           |         |
| Weight gain from 2 to 4 weeks before the diagnosis of preeclampsia (kg)* | 0.9 ± 0.4* | 1.6 ± 0.8 | < 0.01 |
| Weight gain from 2 weeks before the diagnosis of preeclampsia (kg)* | 0.8 ± 0.4* | 2.1 ± 1.5 | < 0.01 |
| Systolic blood pressure at the diagnosis of preeclampsia (mmHg)* | 116 ± 12* | 154 ± 9 | < 0.01 |
| Diastolic blood pressure at the diagnosis of preeclampsia (mmHg)* | 68 ± 11* | 96 ± 8 | < 0.01 |
| No (doubt of) proteinuria* | 73 (95)* | 0 (0) | < 0.01 |
| Systemic edema at the diagnosis of preeclampsia* | 3 (4)* | 41 (53) | < 0.01 |
| Gestational age at delivery (w) | 39.4 ± 1.5 | 35.0 ± 5.0 | < 0.01 |
| Cesarean delivery | 12 (16) | 43 (56) | < 0.01 |
| Neonatal birth weight (g) | 3,045 ± 342 | 1,890 ± 522 | < 0.01 |

Data are presented as mean ± SD or number (percentage).

* Same gestational age.
from 4 weeks before the diagnosis of preeclampsia was significantly greater than that of subjects with the same gestational age in the control group ($P < 0.01$).

As shown in Table 2, the percentage of women with systemic edema in the preeclampsia group was significantly higher than that in the control group (53 vs. 4%, $P < 0.01$). Moreover, in the preeclampsia group, average weight gain from 2 weeks before the diagnosis of preeclampsia in women with systemic edema was significantly higher than that in the women without general edema (3.0 ± 1.1 vs. 1.1 ± 0.5 kg, $P < 0.01$).

**Discussion**

In a number of previous studies, excessive GWG was found to be a significant and modifiable risk factor for preeclampsia. Excessive GWG has been suggested to increase the risk of preeclampsia, and be associated with the inflammatory milieu, maternal body composition, body fat distribution, hyperlipidemia, insulin resistance, and coagulation abnormalities associated with the pathogenesis of preeclampsia. However, the contribution of fluid retention secondary to edema has often been insufficiently considered in simple associations between total GWG and the prevalence of preeclampsia. The appearance of edema in pregnant women has been reported to have no adverse effect on perinatal outcome. In some previous Japanese studies, pregnant women with edema were reported to have a more favorable perinatal prognosis than those without edema.

In the present study, however, the rate of women with systemic edema in the preeclampsia group was significantly higher than that in the control group. In addition, the presence of systemic edema was associated with excessive GWG in women with preeclampsia. The current results also support the possible mechanisms underlying preeclampsia associated with the role of soluble vascular factors, because endothelial dysfunction has been thought to play a central role in the pathogenesis of the maternal symptoms of preeclampsia. Although the pathological significance of edema during pregnancy may be generally small, our experience has shown that systemic edema that occurs rapidly may lead to the development of preeclampsia associated with the presence of renal and/or vascular endothelial dysfunction and/or endocrine disorders.

The present study found that weight gain in the preeclampsia group increased suddenly from 3–4 weeks before the onset of preeclampsia compared with the control group. It is unlikely that pregnant women who develop preeclampsia suddenly show an increased appetite from 8–9 months of gestation, when fundal height is maximal. The rapid weight gain suggests the appearance of marked edema associated with the onset of preeclampsia that is unlikely to be related to dietary habits. Thus, weight gain associated with diet is unlikely to have an effect on the onset of preeclampsia. In addition, the current results suggest the possibility of edema associated with the onset of preeclampsia when a biweekly GWG of 1.9 kg or more is observed.

In conclusion, GWG associated with the pathogenesis of preeclampsia may be due to edema that precedes the onset of preeclampsia.

**Conflict of interest**

None.

**References**

1. Nakabayashi M. Recent advances in the pathophysiology of preeclampsia. Nihon Sanka Fujinka Gakkai Zasshi. 1996; 48: 733–741. (In Japanese.)
2. Promotion Council for Healthy Parents and Children 21 (second edition). Ministry of Health, Labour and Welfare, 2015. (In Japanese.) Available from URL: http://rhino3.med.yamanashi.ac.jp/sukoyaka2/english.html. Accessed July 5, 2017.
3. Enomoto K, Aoki S, Toma R, Fujiwara K, Sakamaki K, Hirahara F. Pregnancy outcomes based on pre-pregnancy body mass index in Japanese Women. PLoS One. 2016; 11: e0157081.
4. Nomura K, Kido M, Tanabe A, Nagashima K, Takenoshita S, Ando K. Investigation of optimal weight gain during pregnancy for Japanese Women. Sci Rep. 2017; 7: 2569.
5. Morisaki N, Nagata C, Jwa SC, et al. Pre-pregnancy BMI-specific optimal gestational weight gain for women in Japan. J Epidemiol. 2017; S0917–5040: 30110–30117.
6. Suzuki S. Optimal weight gain during pregnancy in Japanese women. J Clin Med Res. 2016; 8: 787–792.
7. Japan Society for the Study of Hypertension in Pregnancy. A Review of Best Practice Guide 2015 for care and treatment of hypertension in pregnancy. Hypertens Res Pregnancy. 2015; 3: 64–103.
8. Kurokawa T, Miyamoto S, Uchiumi Y, Higashihara J, Shimokawa H, Nakano H. The influence of gestational edema on maternal and perinatal outcome. Nihon Sanka Fujinka Gakkai Zasshi. 1988; 40: 9–13. (In Japanese.)
9. Lowe SA, Brown MA, Dekker GA, et al.; Society of Obstetric Medicine of Australia and New Zealand. Guidelines for the management of hypertensive disorders of pregnancy 2008. Aust N Z J Obstet Gynaecol. 2009; 49: 242–246.
10. Ferraro ZM, Contador F, Tawfiq A, Adamo KB, Gaudet L. Gestational weight gain and medical outcomes of pregnancy. Obstet Med. 2015; 8: 133–137.
11. Li N, Liu E, Guo J, et al. Maternal prepregnancy body mass index and gestational weight gain on pregnancy outcomes. PLoS One. 2013; 8: e82310.
12. Swank ML, Caughey AB, Farinelli CK, et al. The impact of change in pregnancy body mass index on the development of gestational hypertensive disorders. J Perinatol. 2014; 34: 181–185.
13. Chaiworapongsa T, Chaemsaiithong P, Yeo L, Romero R. Pre-
Weight gain in hypertensive disorders of pregnancy

eclampsia part 1: current understanding of its pathophysiology. Nat Rev Nephrol. 2014; 10: 466–480.

14. Chaiworapongsa T, Chaemsaithong P, Korzeniewski SJ, Yeo L, Romero R. Pre-eclampsia part 2: prediction, prevention and management. Nat Rev Nephrol. 2014; 10: 531–540.

15. Thomson AM, Hytten FE, Billewicz WZ. The epidemiology of oedema during pregnancy. J Obstet Gynaecol Br Commonw. 1967; 74: 1–10.

16. Takagi K, Itaya Y, Ono Y. Clinical significance and problems of hypertension in pregnancy. Kidney and Dialysis. 2011; 71: 756–760. (In Japanese.)

17. Sircar M, Thadhani R, Karumanchi SA. Pathogenesis of preeclampsia. Curr Opin Nephrol Hypertens. 2015; 24: 131–138.

18. Baumwell S, Karumanchi SA. Pre-eclampsia: clinical manifestations and molecular mechanisms. Nephron Clin Pract. 2007; 106: e72–81.

19. Sircar M, Thadhani R, Karumanchi SA. Pathogenesis of preeclampsia. Curr Opin Nephrol Hypertens. 2015; 24: 131–138.