Placental Ratio and Fetal Growth Pattern

PORNPIMOL RUANGVUTILERT, M.D., Ph.D.*,
VITAYA TITAPANT, M.D.*,
VASSANA KERDPHOO, M.Sc.**

Abstract

Introduction : Placental hypertrophy and reduced fetal growth have been postulated to be an adaptation to maintain placental function in pregnant women with complications such as malnutrition. If this is true, a pregnancy with impaired fetal growth, resulting in a small for gestational age (SGA) infant, should have an increased placental weight to birthweight ratio (placental ratio) compared to those with appropriate for gestational age (AGA) or large for gestational age (LGA) infants.

Objectives : To determine the relationship between placental ratio and fetal growth pattern.

Material and Method : Labour and delivery data of 1000 deliveries in the Department of Obstetrics & Gynecology, Siriraj Hospital from January 2001 to June 2001 were retrospectively studied to compare the placental ratios among pregnancies with SGA, appropriate for gestational age (AGA) and large for gestational age (LGA) infants.

Results : From 96 SGA, 804 AGA and 100 LGA cases, a higher placental ratio was found in the SGA group compared to AGA (0.2074 and 0.1985 respectively, $p = 0.013$). However, actual placental hypertrophy was not found as demonstrated by a lower placental weight in SGA compared with AGA pregnancies of the same birthweight range. There was no significant difference in placental ratio between the LGA and AGA group, the ratios being 0.2020 and 0.1985 respectively ($p = 0.260$). Although a positive correlation between placental weight and birthweight was observed in the AGA and LGA groups, it was not demonstrated in the SGA infants. This might influence the placental ratio in the SGA group.

Conclusion : SGA pregnancies are associated with an increased placental ratio which appears not to be due to placental hypertrophy. As reduced birthweight has been shown to be

correlated to diseases in adult life, whether this association between SGA and an increased placental ratio will have an implication in future obstetric care and prediction of diseases in adult life remains to be elucidated.

Key word : Placental Ratio, Small for Gestational Age, Appropriate for Gestational Age, Large for Gestational Age

RUANGVUTILERT P,
TITAPANT V, KERDPHOO V
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* Department of Obstetrics and Gynecology,
** Obstetric and Gynecologic Nursing Unit, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.

Placental weight and placental ratio (placental weight to birthweight ratio) have been extensively investigated in a number of studies. The main interest has originated from Barker's hypothesis[1]. In 1989 they found an inverse relationship between blood pressure and birthweight and proposed an association between the incidence of cardiovascular disease such as hypertension and the growth *in utero*. The group subsequently reported that the combination of a large placenta and a low birthweight is a strong risk factor for hypertension in adult life[2]. The use of both parameters may be better as birthweight alone may not be a real marker of subsequent blood pressure[3]. The association of later hypertension with large placenta and a low birthweight was also observed in anemic pregnant women by Godfrey et al[4]. They postulated that maternal malnutrition reflected by anemia induces placental hypertrophy and fetal growth is sacrificed to maintain placental function. If this is the case, growth restriction without an obvious cause should have an increased placental/fetal birthweight ratio (or placental ratio). The authors therefore set out to verify this presumption. Also, other possible associations were investigated.

MATERIAL AND METHOD

Data of 1000 deliveries of a singleton live birth in the Department of Obstetrics & Gynecology, Siriraj Hospital from January 2001 to June 2001 were reviewed. Only term pregnancies without known

Table 1. General features of patients, shown as mean ± SD.

	SGA group (n = 96)	AGA group (n = 804)	LGA group (n = 100)
Maternal			
Age	25.7 ± 5.8	26.8 ± 5.5	27.3 ± 4.9
Gravidity	1.6 ± 0.8	1.8 ± 0.9	1.9 ± 0.9
Parity	1.4 ± 0.6	1.6 ± 0.7	1.6 ± 0.7
Gestational age (wks)	39.2 ± 1.0	39.3 ± 1.0	39.6 ± 1.1
Apgar score			
1 min	8.9 ± 1.4	9.0 ± 1.3	8.8 ± 1.4
5 min	9.9 ± 0.5	9.9 ± 0.4	9.9 ± 0.4

No significant difference was found in these parameters among the three groups using ANOVA

maternal/fetal diseases or complications were recruited. Maternal age, gravidity, parity, gestational age, birthweight, placental weight, and apgar scores were analysed. In order to reflect fetal growth pattern, cases were categorized into small for gestational age (SGA), defined as pregnancies with an infant birthweight of $\leq 10^{th}$ percentile for their gestational age, appropriate for gestational age (AGA), comprising pregnancies with an infant birthweight between 10^{th} and 90^{th} percentile, and large for gestational age (LGA), infant birthweight being $\geq 90^{th}$ percentile. All the aforementioned collected parameters were compared among the three groups. They were tested for differences using analysis of variance

Table 2. Placental weight, birthweight and placental ratios from each group. Results are shown as mean ± SD.

	SGA group (n = 96)	AGA group (n = 804)	LGA group (n = 100)
Birthweight (g)	2487 ± 138	3121 ± 249	3853 ± 230
Placental weight (g)	515 ± 79	620 ± 110	780 ± 159
Placental ratio*	0.2074 ± 0.0322	0.1985 ± 0.0311	0.2020 ± 0.0360

* A significant difference in placental ratio among the three groups was found by Kruskal-Willis test (p = 0.030) and Mann-Whitney-U test revealed that the difference was found between the SGA and AGA groups (p = 0.013) but was not found between the AGA and the LGA groups.

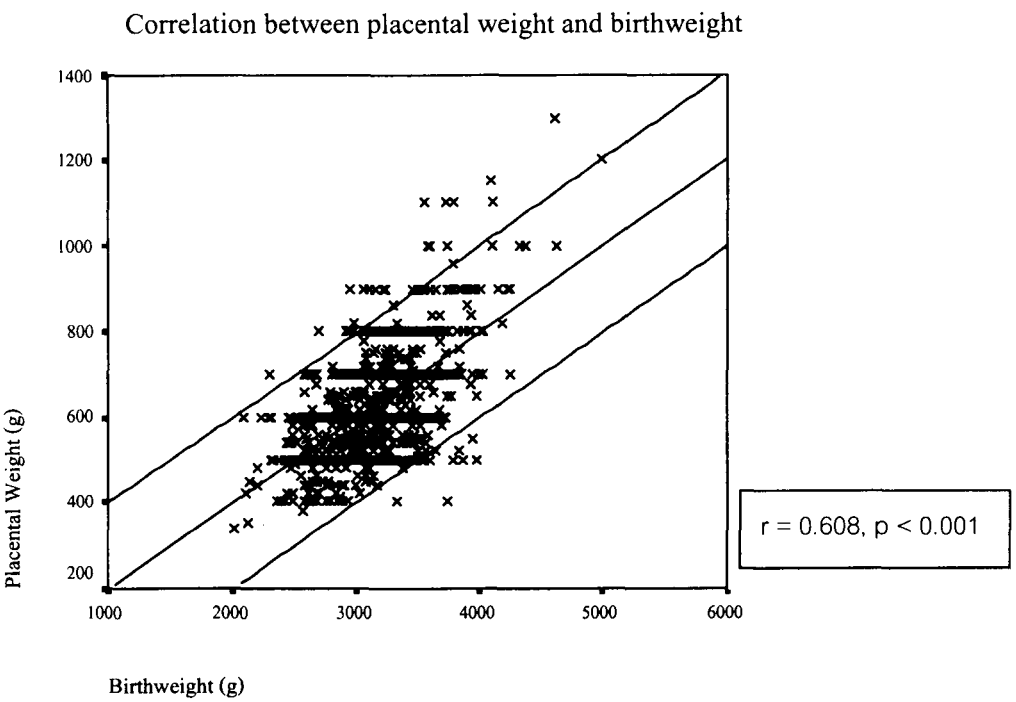

Fig. 1. Correlation between placental weight and birthweight in all cases. The fit line and 95 per cent confidence interval lines are illustrated.

(ANOVA) for data that were normally distributed, and Kruskal-Wallis test for those that were not, with the level of significance at 0.05. Comparison between each pair was performed using Student's *t*-test or Mann-Whitney-U test as appropriate. Correlation studies were carried out using Pearson and Spearman correlation coefficients for normally and non-normally distributed data respectively. Statistical calculation was performed using a commercial statistical package (SPSS/PC).

RESULTS

From 1000 deliveries, with gestational age ranging from 36 to 41 weeks, 96 were in the SGA, 804 in the AGA, and 100 in the LGA groups. General features of each group are presented in Table 1. These parameters were comparable among the three groups.

Table 2 shows the mean birthweight, mean placental weight and mean placental ratio from SGA, AGA and LGA groups. No trend was found in the values of placental ratios extending across SGA to AGA to LGA groups, the values being 0.207, 0.199 and 0.202 respectively A difference was found between placental ratio of the SGA and the AGA groups, that of SGA infants being higher. The placental ratios of the LGA and AGA groups were similar. Therefore, birthweight appeared not to be the only factor for placental ratios. Moreover, considering all cases, there was no significant correlation between placental ratio and birthweight (Spearman correlation coefficient, r = -0.026, p = 0.414).

In addition, considering all cases, no significant correlation was observed between placental ratio and placental weight either (Spearman correlation coefficient, r = 0.0173, p = 0.786). Considering all cases, actual placental weight and birthweight were correlated (Pearson correlation coefficient, r = 0.608). This was still the case for the AGA and LGA groups (r = 0.450 and 0.528 respectively, each

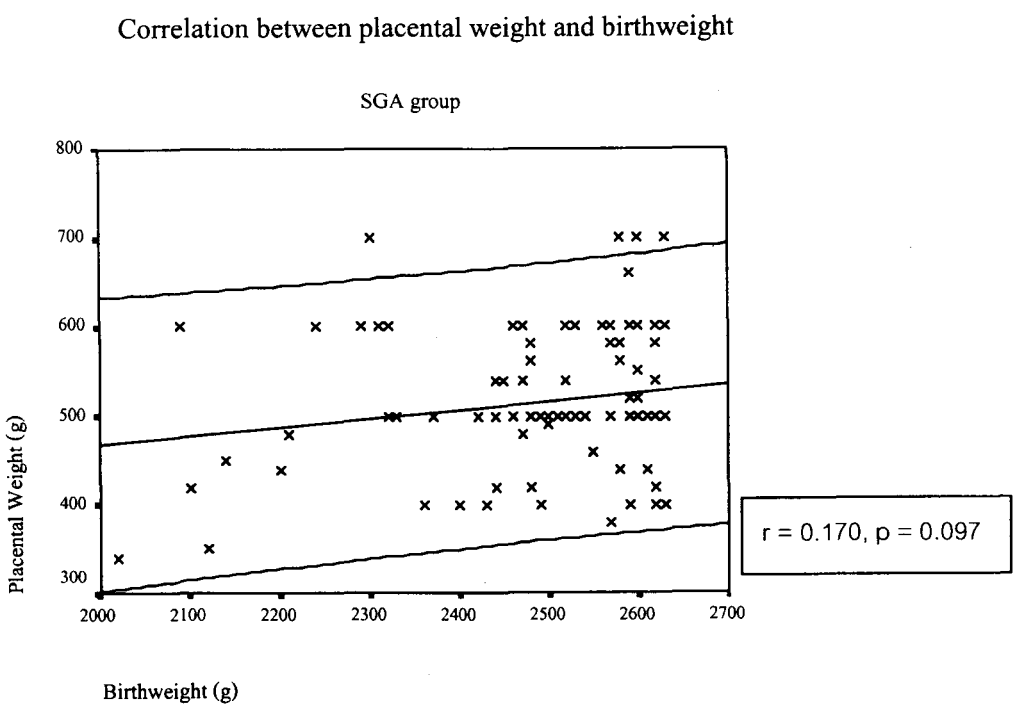

Fig. 2. Correlation between placental weight and birthweight in the SGA group. The fit line and 95 per cent confidence interval lines are illustrated.

with $p < 0.001$). Nevertheless, no such correlation was demonstrated when considering the SGA group separately ($r = 0.103$, $p = 0.097$). This might explain the similarity of placental ratios between the LGA and the AGA infants and at the same time, the difference of placental ratios between the SGA and the AGA infants. The correlation in all cases and in each group was illustrated in Fig. 1-4. Placental actual weight was also lower in SGA infants than in AGA infants of the same birthweight range (2,500-2,999 g, $p < 0.001$) as shown in Table 3. Placental actual weight was similar between LGA and AGA infants of the same birthweight range (3,500-3,999 g, $p = 0.182$). The results do not support the idea of placental hypertrophy in pregnancies with an SGA infant.

DISCUSSION

Babies with SGA in this study were growth restricted without an obvious cause as only patients without other known complications were recruited. The presumption that SGA pregnancies have an increased placental to fetal birthweight ratio appeared to be proven. In the present results, a slightly yet statistically significant increase in the placental ratio was observed in the SGA compared with the AGA group. This increase in the placental ratio in SGA infants has also been documented in previous studies (5,6). Lao and Wong have shown that there was a stepwise decrease in placental ratios extending across SGA to AGA to LGA growth patterns and this was also the case with complicated pregnancies(7). However, such a stepwise decrease was not found in the present study where the placental ratios in the AGA and LGA groups were similar, the value being even slightly higher (but not reaching a significance level) in LGA group. Another study also failed to confirm a difference in placental ratios between pregnancies with LGA and AGA babies(5). While the results were

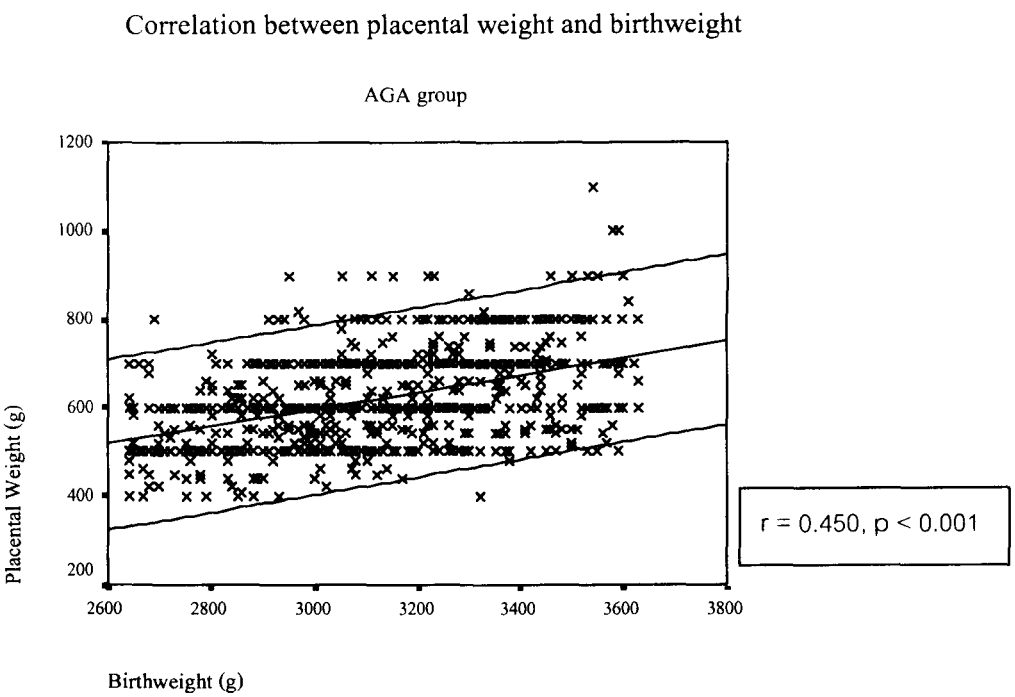

Fig. 3. Correlation between placental weight and birthweight in the AGA group. The fit line and 95 per cent confidence interval lines are illustrated.

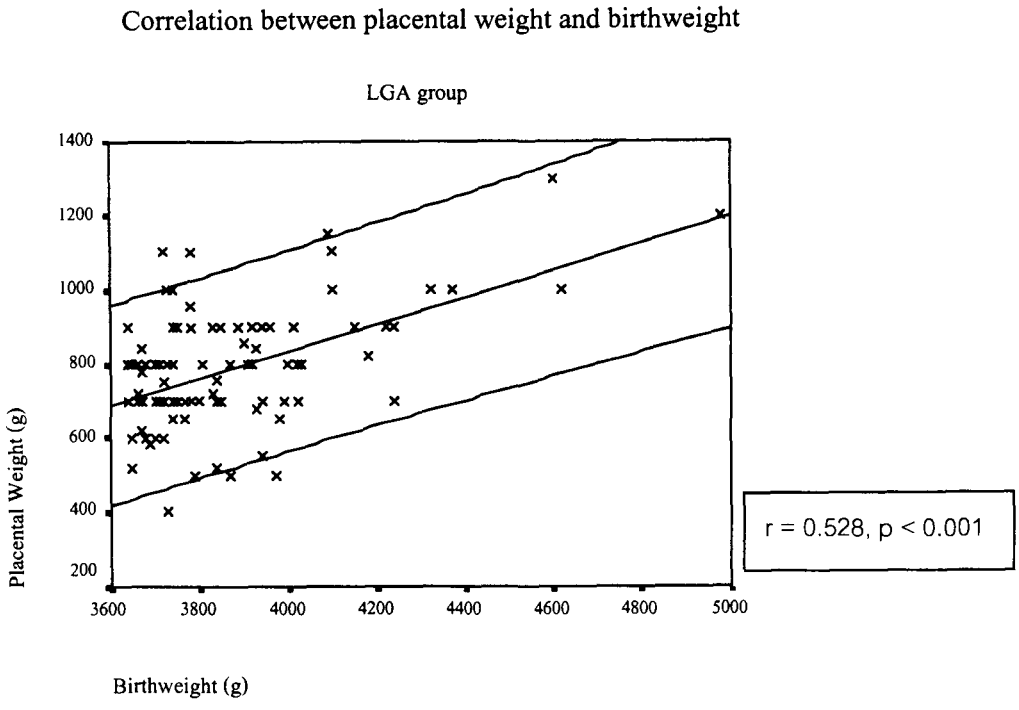

Fig. 4. Correlation between placental weight and birthweight in the LGA group. The fit line and 95 per cent confidence interval lines are illustrated.

Table 3. Mean placental weight in each group at the same range of birthweight.

Birthweight (g)	Mean placental weight (g) (number of cases)			P-value
	SGA	AGA	LGA	
≤ 2,499	504 (41)	-	-	-
2,500 - 2,999*	523 (55)	567 (265)	-	<0.001
3,000 - 3,499	-	636 (475)	-	-
3,500 - 3,999	-	714 (64)	745 (82)	0.182
≥ 4,000	-	-	943 (18)	-

* A difference was found between the placental weights of the SGA and the AGA groups using Student's *t*-test

in agreement with the presumption of an increased placental ratio in SGA pregnancies as deduced from Barker's hypothesis, the real reason might not have been due to placental hypertrophy. On the contrary, actual placental weight in the SGA group was lower than in AGA group with the same birthweight. This finding was in agreement with Heinonen et al[8]. A number of other factors have been demonstrated to affect placental ratio. A study which did not categorize the pregnancies as SGA, AGA or LGA, showed a progressive increase in fetal-placental weight ratio (or decrease in placental ratio) with gestational age, and with birthweight distribution[9]. Parity, gestational age and maternal body mass index have been

demonstrated to affect placental ratio in a study of Perry et al[10]. Maternal complications such as anemia or diabetes may influence placental ratio as well[4,11-13]. In addition, the difference in correlation between actual placental weight and birthweight, with no correlation in the SGA group as demonstrated in our results, could affect the ratios.

In conclusion, SGA pregnancies have an increased placental ratio, albeit without clear particular factors. Combined with Barker's hypothesis, an increase placental ratio may be an indicator or a predictor of a later development of common diseases in adult life. However, whether this will have a real implication remains to be elucidated.

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ความสัมพันธ์ระหว่างอัตราส่วนของรกกับการเจริญเติบโตของทารกในครรภ์

พรพิมล เรืองวุฒิเลิศ, พ.บ., ปร.ด.,*
วิทยา ถิฐาพันธ์, พ.บ., วาสนา เกิดภู่, วท.ม.***

มีความเชื่อกันว่าในสตรีตั้งครรภ์ที่มีภาวะทุโภชนาการ รกจะมีการเพิ่มขนาด ในขณะที่ทารกในครรภ์จะมีการเจริญเติบโตช้าลง ทั้งนี้เพื่อเป็นการปรับตัวให้เข้ากับสภาพที่ผิดปกติดังกล่าว ถ้าความเชื่อดังกล่าวเป็นจริง สตรีตั้งครรภ์ที่คลอดบุตรซึ่งมีน้ำหนักแรกเกิดน้อยกว่าปกติจึงควรจะมีอัตราส่วนระหว่างน้ำหนักของรกต่อน้ำหนักของทารกแรกเกิด (อัตราส่วนของรก) เพิ่มขึ้นเทียบกับผู้ที่มีบุตรน้ำหนักปกติ หรือมากกว่าปกติ

วัตถุประสงค์ : เพื่อศึกษาว่าอัตราส่วนของรกกับการเจริญเติบโตของทารกในครรภ์มีความสัมพันธ์กันหรือไม่และอย่างไร

วิธีการศึกษา : ทำการทบทวนบันทึกรายงานการคลอดของสตรีที่มาคลอดที่ภาควิชาสูติศาสตร์-นรีเวชวิทยา โรงพยาบาลศิริราช ระหว่างเดือนมกราคม 2544 ถึงเดือนมิถุนายน 2544 จำนวน 1,000 คน เพื่อเปรียบเทียบอัตราส่วนของรก ระหว่างการตั้งครรภ์ที่ทารกมีน้ำหนักแรกเกิดน้อยกว่าปกติ, อยู่ในเกณฑ์ปกติ, และมากกว่าเกณฑ์ปกติ

ผลการศึกษา : จากการศึกษาพบมีทารกมีน้ำหนักแรกเกิดน้อยกว่าปกติ 96 ราย อยู่ในเกณฑ์ปกติ 804 ราย และมากกว่าเกณฑ์ปกติ 100 ราย พบว่าอัตราส่วนของรกในกลุ่มทารกน้ำหนักน้อยมีค่าสูงกว่าทารกน้ำหนักปกติ (0.2074 กับ 0.1985 ตามลำดับ, p = 0.013) อย่างไรก็ตาม ไม่พบว่ารกมีการเพิ่มขนาดมากกว่าปกติ โดยแสดงจากผลการตรวจพบว่าน้ำหนักรกในกลุ่มทารกน้ำหนักน้อยมีค่าต่ำกว่ากลุ่มทารกน้ำหนักปกติเมื่อคิดในกลุ่มทารกที่มีน้ำหนักในช่วงเดียวกัน การศึกษานี้ไม่พบความแตกต่างอย่างมีนัยสำคัญระหว่างอัตราส่วนของรกในกลุ่มทารกน้ำหนักมากกว่าปกติกับกลุ่มทารกน้ำหนักปกติ คือ 0.2020 กับ 0.1985 ตามลำดับ (p = 0.260) แม้ว่าจะพบความสัมพันธ์ในเชิงบวกระหว่างน้ำหนักรกกับน้ำหนักทารกแรกเกิดในกลุ่มทารกน้ำหนักปกติ และกลุ่มทารกน้ำหนักมากกว่าปกติ แต่ก็พบว่าไม่มีความสัมพันธ์ดังกล่าวในกลุ่มทารกน้ำหนักน้อย ผลดังกล่าวอาจมีความสำคัญกับอัตราส่วนของรกในทารกกลุ่มนี้

สรุป : การตั้งครรภ์ที่ทารกมีน้ำหนักแรกเกิดน้อยกว่าปกติมีความเกี่ยวข้องกับการมีค่าอัตราส่วนของรกที่สูงขึ้น โดยที่ไม่ปรากฏว่า เป็นเพราะการโตกว่าปกติของรก เนื่องจากการมีน้ำหนักแรกเกิดน้อยอาจมีความสัมพันธ์กับโรคบางอย่างในวัยผู้ใหญ่ ยังคงต้องมีการศึกษาต่อไปว่า สิ่งตรวจพบนี้จะมีผลกระทบกับการดูแลผู้ป่วยทางสูติศาสตร์ในอนาคต ตลอดจนการเกิดโรคบางอย่างในวัยผู้ใหญ่หรือไม่

คำสำคัญ : อัตราส่วนของรก, ทารกแรกเกิดน้ำหนักน้อย, ทารกแรกเกิดน้ำหนักปกติ, ทารกแรกเกิดน้ำหนักมากกว่าปกติ

พรพิมล เรืองวุฒิเลิศ, วิทยา ถิฐาพันธ์, วาสนา เกิดภู่
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* ภาควิชาสูติศาสตร์-นรีเวชวิทยา,
** งานการพยาบาลสูติศาสตร์-นรีเวชวิทยา, คณะแพทยศาสตร์ศิริราชพยาบาล, มหาวิทยาลัยมหิดล, กรุงเทพ ฯ 10700