原 著

母親危險因子對低出生體重嬰兒、早產兒、及生長遲滯嬰兒之影響—前瞻性懷孕世代研究

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目標：本前瞻性世代研究以探討母親危險因子對低出生體重兒、早產兒、及生長遲滯兒的影響，包括生物學背景、母親產科史、懷孕中疾病及吸菸的可能影響。**方法**：1984至1987年間，針對在台北市立婦幼醫院產前檢查的所有懷孕六個月以上孕婦使用結構化問卷進行訪視，並於嬰兒出生後閱覽孕婦及新生兒的病歷進行摘錄。總共使用12,273單胞胎活產兒進行出生結果logistic迴歸分析。**結果**：關於低出生體重兒方面，母親產前出血及高血壓是最強的危險因子，瘦小及肥胖的母親、二次以上的自然流產經驗、以前有低出生體重或早產兒、以及梅毒感染是中度的危險因子，女嬰及初產婦亦與低出生體重兒有顯著相關。關於早產兒方面，母親產前出血亦是最強的危險因子，肥胖的母親、矮小的父親、二次以上的自然流產經驗、及以前有低出生體重或早產兒則有中等程度的影響。母親高血壓、低懷孕前體重、及初產婦皆是爲對稱及非對稱生長遲滯兒的危險因子，除初產婦外對非對稱生長遲滯兒有較大的影響，矮小母親或父親及以前有低出生體重或早產兒亦與對稱生長遲滯兒有顯著相關。**結論**：已知的危險因子持續存在，未來需要進行介入性預防措施。(中華衛誌 2000；**19(3)**：192-202)

關鍵詞：母親危險因子、低出生體重兒、早產兒、生長遲滯兒、前瞻性世代研究。

Influence of maternal risk factors on low birthweight, preterm delivery, and small for gestational age - A prospective cohort study of pregnancy

Objectives: This prospective cohort study investigated low birthweight (LBW), preterm delivery (PTD), and small for gestational age (SGA) in Taipei, Taiwan. Effects of maternal risk factors on birth outcomes were examined, including biological background, maternal obstetric history, as well as medical events and smoking during pregnancy. **Methods:** Between 1984 and 1987, each pregnant woman who came to the Taipei Municipal Maternal and Child Hospital for prenatal care was interviewed using a structured questionnaire. Maternal and newborn medical records were abstracted after delivery. A total of 12,273 singleton livebirths were analyzed. Potential risk factors associated with birth outcomes were examined using logistic models. **Results:** Antepartum hemorrhage and hypertension were the strongest risk factors for LBW infants, and lean and obese mothers, two or more prior spontaneous abortions, previous LBW or PTD history, and infection with syphilis had moderately increased risks. Female gender and primiparae were also significantly associated with the risk of LBW infants. Antepartum hemorrhage was the strongest risk factor for PTD infants, whereas obese mothers, short fathers, two or more prior spontaneous abortions, and previous LBW or PTD history gave moderately increased risks. Maternal hypertension, low pre-pregnancy weight, and primiparae were the risk factors for both symmetric and asymmetric SGA infants. Those effects except primiparae were considerably greater on asymmetric than symmetric SGA infants. Low parental height and previous LBW or PTD history were also significantly associated with the risk of symmetric SGA infants. **Conclusions:** The relationship between several known risk factors and birth outcomes consistently remains, and interventions should be promoted in Taiwan.*(Chin J Public Health. (Taipei): 2000;**19**(3):192-202)*

Key words: maternal risk factors, low birthweight, preterm delivery, small for gestational age, prospective cohort study.

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INTRODUCTION

Among the many factors linked to infant survival, the greatest risk is presented by physical underdevelopment associated with low birthweight (LBW), preterm delivery (PTD), or both [1,2]. If respiratory distress is included as one of the complications of prematurity, LBW and PTD are directly or indirectly responsible for more neonatal deaths, mental retardation, neurological and ophthalmic disorders than any other single factor [3]. Thus the past few decades have seen growing concern for the potential threat to fetal outcomes by genetic, biological, environmental, social, and psychological factors. Several articles [4,5] have systematically reviewed published studies concerning the effects on LBW, small for gestational age (SGA), and PTD. Despite the general recognition that LBW, SGA, and PTD can be caused by many factors, confusion and controversy remain about which factors have independent causal effects, as well as the quantitative importance of those effects.

Due to an improvement of maternal and child health care during the past few decades, infant mortality in Taiwan has been sharply reduced from 45 per thousand livebirths in 1952 to 6.4 in 1997 [6]. However, relatively few epidemiological studies [7,8] of birth outcomes in Taiwan have been published. This cohort study conducted during 1984-87 is the first prospective study to investigate perinatal outcomes in Taiwan. The association of parental socioeconomic status and birth outcome has been reported elsewhere [9]. In this paper, effects of maternal risk factors on birth outcomes were examined, including biological background, maternal obstetric history, and medical events and smoking during pregnancy. Finally, we compare our results with previous studies in Western countries.

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METHODS

Subjects

Between 1984 and 1987, the data was gathered at the Taipei Municipal Maternal and Child Hospital (TMMCH). Each pregnant woman with 26 or more weeks gestation who came to this hospital for antenatal care was invited to participate in the study. A total of 15,729 women were enrolled between September 1984 and June 1987. After excluding loss to follow-up (2,927 women), multiple deliveries (103 twins and 2 triplets), stillbirth (40 singletons), and subjects with incomplete data (340 singletons), 12,273 singleton livebirths were presented for detecting the effect of biological background and current obstetric events. To elucidate the effects of past obstetric history, only 6,485 singleton livebirths born from parous women were analyzed. A detailed description of the study subjects is provided elsewhere [9].

Measurements

Anthropometric measurements and gestational age of the infants are described in detail elsewhere [9]. Data on parental age were obtained from the maternal interview questionnaire. Data on gravidity and parity were obtained from the maternal medical record. Information on maternal height and pre-pregnancy and paternal height were also collected during interviews and are described in detail elsewhere [9].

Previous obstetric history was obtained from the maternal interview questionnaire, where perinatal outcome was requested for each previous pregnancy. Perinatal outcomes included spontaneous and induced abortions, LBW or PTD, and stillbirth. Current obstetric events were obtained from the maternal medical record. Maternal diseases and complications during pregnancy and delivery were classified according to the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM). They were

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divided into two groups for the purpose of this study: hypertensive diseases, defined as essential hypertension and pregnancy-induced hypertensive diseases (Code 642); and antepartum hemorrhage, defined as delivery complicated by abruptio placentae, placenta previa, or other antepartum hemorrhage (Code 641). Laboratory data on the tests for syphilis (VDRL) in the current pregnancy was also obtained from the maternal medical record although 2.1% of the values were not recorded.

Definitions

LBW refers to infants with birthweight below 2,500 grams and PTD refers to infants4 born before 37 completed weeks (259 days) of gestation, as measured from the first day of the LMP. SGA infants are defined as those infants falling below the 10th percentile of the appropriate gestation specific birthweight distribution in Taiwan [8]. Those were then subdivided according to their body proportions defined by the ponderal index (birthweight in grams multiplied by 100 and divided the cubic of birth length in centimeters). Infants with ponderal indices less than 2.32 [10,11] were said to be asymmetric, and those with high indices are called symmetric.

Statistics

For each birth outcome, Chi-squared tests were first employed to test each risk factor. Multiple logistic regression was used to estimate relative risks of these outcomes according to different categories of a risk factor after adjustment for each of the other factors and parental education [9]. Risk factors were classified and tested as follows: biological background, past obstetric history, current obstetric events, and smoking, as shown in Tables 1-3. This study was analyzed using SPSS for Windows, Release 6.1 [12,13].

RESULTS

Among the singleton livebirths, 2.8% had a LBW and 2.6% were born prematurely before 37 completed weeks of gestation. There were 8.1% SGA infants including 6.6% symmetric SGA and 1.4% asymmetric SGA infants. Of the LBW infants, 39.4%, 44.1%, and 19.4% were also classified as PTD, symmetric SGA, and asymmetric SGA, respectively. But only some PTD infants were classified as symmetric or asymmetric SGA. (Figure 1) Among the risk factors, there was a slightly correlation between maternal height and pre-pregnancy weight (Spear-

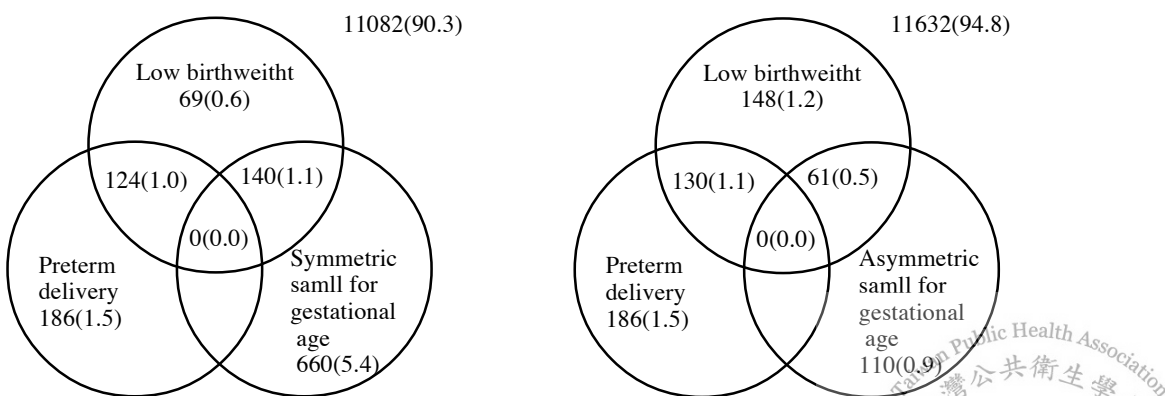

Figure 1.　Distribution of birth outcomes (Values in parentheses are percent.)

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man's $\rho = 0.11$) or paternal height ($\rho = 0.10$), and between previous LBW or PTD and stillbirth history (contingency coefficient = 0.12).

Biological background

Female infants had a higher risk of being LBW (adjusted RR=1.40) than males, but not a higher risk of being PTD and SGA. Primiparae had a higher risk for LBW (adjusted RR=1.57) and SGA infants (symmetric: adjusted RR=1.72 and asymmetric: adjusted RR=1.74) compared with the reference group. Maternal age did not demonstrate any significant effect after adjustment.

The shorter mothers showed a higher risk of having a symmetric SGA infant. Mothers who were 145 centimeters tall or less had a higher risk of having a symmetric SGA infant (adjusted RR=1.77) compared with the reference group. On the contrary, those who were more than 165 centimeters tall had a lower risk (adjusted RR=0.51). Fathers who were less than or equal to 160 centimeters tall also had high risks of having a preterm (adjusted RR=1.82) and symmetric SGA (adjusted RR=1.43) infant.

Except for SGA, there were roughly U-shape relationships between maternal pre-pregnancy weight and LBW and PTD. For either symmetric or asymmetric SGA infants, the lighter mothers had higher risks. Compared with the reference group, who were 41-70 kilograms pre-pregnancy weight, the lightest group who were less than 40 kilograms weight had about three times the risk of having a LBW (adjusted RR=3.03) or symmetric SGA infant (adjusted RR=2.64), and near four times the risk of producing an asymmetric SGA infant (adjusted RR=3.71). The heaviest group of women who were more than or equal to 71 kilograms weight also had high risks of having a LBW (adjusted RR=2.23) and preterm infant (adjusted RR=3.10) but not a SGA infant. (Table 1)

Past obstetric history

Mothers with two or more prior spontaneous abortions had a higher risk of having a LBW (adjusted RR=2.82) and preterm (adjusted RR=3.17) infant compared to mothers without prior spontaneous abortion. However, no significant results were found for prior induced abortions. Mothers with previous LBW or PTD infants still had a significantly higher risk for having a LBW (adjusted RR=2.69), PTD (adjusted RR=3.10), and symmetric SGA infant (adjusted RR=1.66). However, mothers with prior stillborn infants did not show excess risks. (Table 2)

Current obstetric events

Mothers with hypertensive diseases were associated with a five-fold increase in risk for LBW infants (adjusted RR=4.96), a two fold increase in risk for symmetric SGA infants (adjusted RR=2.25), and a six fold increase in risk for asymmetric SGA infants (adjusted RR=5.81). Those with antepartum hemorrhage had an eleven-fold increased risk for LBW and PTD infants (LBW: adjusted RR=11.38 and PTD: adjusted RR=11.42). Mothers with positive VDRL test results had a higher risk of having a LBW infant (adjusted RR=3.83). Mothers who smoked during pregnancy were not demonstrated to have a higher risk of adverse outcome. (Table 3)

DISCUSSION

The reasons for lower prevalences in adverse birth outcomes than those in the general population [8] could have some relation to the study design and population characteristics. Only pregnant women with 26 or more weeks of gestation without diabetes were included. Subsequently, the study population had a higher socio-economic level than the general population in Taipei area. Also, 18.9% of the subjects

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Table 1. Adjusted relative risks with 95% confidence intervals for birth outcomes by biological factors

Biological factor	Birth (%)	Low birthweight Adjusted RR (95% CI)[a]	Preterm delivery Adjusted RR (95% CI)	Symmetric SGA Adjusted RR (95% CI)	Asymmetric SGA Adjusted RR (95% CI)
Infant gender					
Male[b]	6289 (51.2)	1.00	1.00	1.00	1.00
Female	5984 (48.8)	1.40 (1.13, 1.75)**	0.97 (0.77, 1.21)	1.06 (0.92, 1.23)	1.16 (0.86, 1.57)
Parity					
Primiparae	5788 (47.2)	1.57 (1.24, 1.99)#	1.24 (0.97, 1.58)	1.72 (1.47, 2.00)##	1.74 (1.26, 2.40)#
Multiparae[b]	6485 (52.8)	1.00	1.00	1.00	1.00
Maternal age (years)					
≤19	132 (1.1)	1.09 (0.41, 2.86)	0.79 (0.24, 2.65)	0.63 (0.29, 1.37)	0.42 (0.06, 3.04)
20-34[b]	11761 (95.8)	1.00	1.00	1.00	1.00
35+	380 (3.1)	1.33 (0.76, 2.35)	1.51 (0.88, 2.57)	1.10 (0.72, 1.69)	0.88 (0.32, 2.41)
Maternal height (cm)					
≤145	120 (1.0)	1.00 (0.39, 2.54)	0.47 (0.11, 1.96)	1.77 (1.05, 2.99)*	0.76 (0.18, 3.19)
146-165[b]	11687 (95.2)	1.00	1.00	1.00	1.00
166+	466 (3.8)	0.79 (0.41, 1.51)	0.75 (0.38, 1.47)	0.51 (0.30, 0.86)*	0.60 (0.22, 1.63)
Paternal height (cm)					
≤160	621 (5.1)	1.47 (0.97, 2.24)	1.82 (1.21, 2.72)**	1.43 (1.07, 1.90)*	1.18 (0.63, 2.21)
161-180[b]	11430 (93.1)	1.00	1.00	1.00	1.00
181+	222 (1.8)	1.11 (0.48, 2.53)	0.77 (0.28, 2.10)	0.66 (0.34, 1.30)	1.79 (0.72, 4.42)
Maternal pre-pregnancy weight (kg)					
≤40	595 (4.8)	3.03 (2.17, 4.23)##	1.38 (0.88, 2.17)	2.64 (2.08, 3.34)##	3.71 (2.44, 5.66)##
41-70[b]	11545 (94.1)	1.00	1.00	1.00	1.00
71+	133 (1.1)	2.23 (1.01, 4.90)*	3.10 (1.57, 6.13)#	0.68 (0.27, 1.67)	0.60 (0.08, 4.43)

Abbreviations; CI, confidence interval; RR, relative risk; SGA, small for gestational age.

[a]Values have been adjusted for all factors in Table 1-3 and parental education.

[b]Reference category.

*, $p < 0.05$; **, $p < 0.01$; #, $p < 0.001$; ##, $p < 0.0001$.

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Table 2. Adjusted relative risks (RR) with 95% confidence intervals (CI) for birth outcomes by past obstetric history (parous women only)

Past obstetric history	Birth (%)	Low birthweight Adjusted RR (95% CI)[a]	Preterm delivery Adjusted RR (95% CI)	Symmetric SGA Adjusted RR (95% CI)	Asymmetric SGA Adjusted RR (95% CI)
Prior spontaneous abortions					
0[b]	5794 (89.3)	1.00	1.00	1.00	1.00
1	564 (8.7)	0.52 (0.24, 1.11)	0.88 (0.50, 1.58)	1.01 (0.68, 1.49)	0.64 (0.23, 1.77)
2+	127 (1.7)	2.82 (1.32, 6.03)**	3.17 (1.60, 6.32)**	0.89 (0.39, 2.06)	-
Prior induced abortions					
0[b]	4234 (65.3)	1.00	1.00	1.00	1.00
1	1572 (24.2)	0.79 (0.52, 1.19)	0.78 (0.53, 1.16)	1.04 (0.80, 1.36)	0.54 (0.27, 1.07)
2+	679 (10.5)	1.19 (0.73, 1.95)	1.23 (0.77, 1.96)	0.95 (0.65, 1.39)	0.94 (0.44, 2.01)
Previous low birthweight or preterm delivery					
Never[b]	6139 (94.7)	1.00	1.00	1.00	1.00
Ever	346 (5.3)	2.69 (1.78, 4.05)##	3.10 (2.12, 4.52)##	1.66 (1.20, 2.29)**	1.30 (0.62, 2.77)
Prior stillbirth					
Never[b]	6399 (98.7)	1.00	1.00	1.00	1.00
Ever	86 (1.3)	0.44 (0.10, 1.92)	0.45 (0.11, 1.91)	0.73 (0.26, 2.03)	0.96 (0.12, 7.73)

Abbreviations: CI, confidence interval; RR, relative risk; SGA, small for gestational age.
[a]Values have been adjusted for all factors in Table 1-3 and parental education.
[b]Reference category.
*, p < 0.05; **, p < 0.01; #, p < 0.001.

Table 3. Adjusted relative risks (RR) with 95% confidence intervals (CI) for birth outcomes by current obstetric events

Current obstetric events	Births (%)	Low birthweight Adjusted RR (95% CI)[a]	Preterm delivery Adjusted RR (95% CI)	Symmetric SGA Adjusted RR (95% CI)	Asymmetric SGA Adjusted RR (95% CI)
Maternal hypertension					
No[b]	12198 (99.4)	1.00	1.00	1.00	1.00
Yes	75 (0.6)	4.96 (2.45, 10.05)##	1.27 (0.38, 4.28)	2.25 (1.17, 4.32)*	5.81 (2.45, 13.82)#
Antepartum hemorrhage					
No[b]	12211 (99.5)	1.00	1.00	1.00	1.00
Yes	62 (0.5)	11.38 (6.11, 21.21)##	11.42 (6.12, 21.29)##	1.52 (0.65, 3.59)	2.24 (0.53, 9.42)
Maternal VDRL test					
Negative b	11989 (97.7)	1.00	1.00	1.00	1.00
Positive	31 (0.3)	3.83 (1.13, 13.01)*	1.23 (0.16, 9.16)	1.66 (0.50, 5.54)	-
No results	253 (2.1)	-	0.57 (0.16, 2.04)	0.80 (0.46, 1.38)	0.27 (0.04, 1.97)
Smoking during pregnancy					
No[b]	12159 (99.1)	1.00	1.00	1.00	1.00
Yes	180 (1.5)	1.73 (0.87, 3.44)	0.74 (0.26, 2.08)	1.47 (0.86, 2.49)	1.92 (0.76, 4.85)

Abbreviations: CI, confidence interval; RR, relative risk; SGA, small for gestational age; VDRL, Venereal Disease Research Laboratories.
a Values have been adjusted for all factors in Table 1-3 and parental education.
b Reference category.
*, p < 0.05; **, p < 0.01; #, p < 0.001; ##, p < 0.0001.

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were lost to follow-up because they delivered at other hospitals. Finally, only singleton livebirths were analyzed. In addition, the study population had relatively low prevalences of maternal smoking and alcohol consumption. The favorable birth outcome in the study population may to some extent reflect the high standard of health care available in Taipei. However, none of these differences were large, and it is unlikely that the study population was significantly biased.

Biological background

Previous studies noted that female infants have lower birthweights [14,15] and longer periods of gestation than males [16,17]. This study found similar influences by gender and showed that females had a higher risk of being a LBW infant. However, other studies showed no significant gender differences for gestational age or PTD infants [18,19]. Birth outcomes are more favorable for multiparae than primiparae. A U-shape relationship between parity and LBW [20,21] and a higher risk in primiparae with LBW [22], PTD [23], and SGA [24] has been reported. In the present study, significant effects of primiparae were also found on LBW and SGA infants and a borderline significance on PTD infants.

Although previous studies showed that younger maternal age was associated with a higher risk of LBW [20,21,25-27] and PTD infants [23,25,28], the results were not conclusive for SGA infants [25,27,29]. Older mothers also showed a higher risk of having a LBW [20,21,25,27], PTD [23,25,27,30,31], or SGA [27] infant. In the present study, maternal age did not show any significant effect because the mothers' age was not widely distributed in this population.

Short stature has also been associated with increased risks of PTD [30,32] and SGA infants [22]. Underweight mothers [22] had a higher risk for SGA infants and those with lower body mass index had higher risks of LBW [22] and SGA [29] infants. In the present study, adjusted analyzes showed that maternal weight might be more important than height in the association with LBW, PTD, and SGA infants. These observations confirmed that smaller mothers deliver smaller infants. Short fathers also showed small effects on PTD and symmetric SGA infants.

Except for SGA infants, there were roughly U-shape relationships between maternal pre-pregnancy weight and LBW and PTD. For SGA infants, the lighter mothers had the higher risks. There is no statistical or scientific basis for prescribing one set of cut-off values or reference standards over another when assessing pre-pregnancy weight. The relationship between pre-pregnancy weight and various birth outcomes is generally considered to be linear, with no well-defined threshold at either end of the pre-pregnancy weight distribution, although this view has not been verified by research.

Past obstetric history

Previous studies have demonstrated that previous LBW [27], PTD [27,32], or SGA 27,29,33] history is associated with adverse effects in the subsequent pregnancy. Similar outcomes among siblings imply that a similar fetal growing condition continued into the subsequent pregnancy. This could be either inherited or of environmental origin. In the present study, similar results on LBW and PTD infants were found, and although the results for SGA infants could not be examined due to lack of relevant information in the previous pregnancies. However, previous LBW or PTD history also gave some effects on symmetric SGA infants.

The effect of increasing risk of LBW [34,35,36], PTD [31,35,36], and SGA infants [36] with increased number of previous spontaneous abortions have been demonstrated in previous studies. A similar effect was also detected, but the results did not show a dose-response

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relationship. Previous studies also showed an increased risk of LBW [34] and PTD infants [31] with an increase in the number of prior induced abortions. However, no such effect was found in this study. It is suggested that the results were influenced by socioeconomic and cultural differences, as well as by variations in abortion techniques [37]. Although induced abortion is legal under certain circumstances and easily obtained in Taiwan, traditionally conservative thoughts might constrain women to discuss this issue, which is related to sexual history. This cultural difference could influence the accuracy of the measurement of abortion history, that is, the number of induced abortions could be underreported and/or misreported as spontaneous abortion.

Current obstetric events

Maternal medical conditions have been associated with adverse perinatal outcome in many studies. Mothers with vaginal bleeding had higher risks of LBW [38,39] and PTD infants [38,39] and those with hypertensive diseases also gave excess risks for LBW [40,41], PTD [32,40] and SGA infants [24,40,41]. Similar effects were demonstrated in this study, together with the exception of a five-fold risk for hypertensive diseases on LBW infants but no effect on PTD infants. Genital infections also play a role in the etiology of fetal growth and gestational age. Among these, syphilis infection is a known factor for LBW infants [42] and fetal death [43]. In this study mothers with positive VDRL test results showed a four-fold risk of having a LBW infant. Although this infection is not highly prevalent in Taiwan, it should still be carefully looked for and treated during pregnancy.

Cigarette smoking during pregnancy has been shown to be a major risk factor in Western countries. For example, cigarette smoking has been associated with PTD infants [30,32,44] and it is also one of the principal exogenous agents most directly linked with LBW [22,44,45] and SGA infants [24,44,45]. In this study, no significant effect of smoking on birth outcome was found, presumably because only 1.5% of the women smoked during pregnancy, and most of them were not heavy smokers.

Symmetric and asymmetric SGA

It has been reported that fetal growth ratio (relative weight for gestational age), pregnancy-related hypertension, fetal gender, and maternal height were the determinants of low ponderal index [46]. Our study demonstrated different sets of risk factors with different quantities of adverse effects on symmetric and asymmetric SGA infants. Primiparae, maternal pre-pregnancy weight, and hypertensive diseases were the risk factors for both types of SGA infants, but maternal and paternal heights, and previous LBW or PTD history gave significant effects on symmetric SGA infants only. The effects of maternal pre-pregnancy weight and hypertensive diseases were considerably more significant for asymmetric than symmetric SGA infants.

Asymmetric SGA infants are associated principally with risk factors that operate late in the pregnancy, whereas symmetric SGA infants may more likely be associated with a cause that operates over the entire length of gestation, such as malnourishment [47]. Higher neonatal mortality rates have been reported among asymmetric SGA infants [48,49], but better early catch-up growth and better prognoses for long-term growth and development than for those among symmetric SGA infants [50,51].

CONCLUSIONS

There are several implications of our findings. Firstly, our study confirmed that smaller parents deliver smaller infants. Except the linear effect on SGA infants, there were roughly U-shaped relationships between maternal pre-preg-

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nancy weight and LBW and PTD. Secondly, primiparae and prior spontaneous abortions still were important risk factors on adverse birth outcome. Thirdly, mothers with previous LBW and preterm infants tended to have repetitive experience in subsequent pregnancies. Fourthly, hypertensive diseases, antepartum hemorrhage, and current infection with syphilis were small, but well recognized, risk factors. Fifthly, cigarette smoking during pregnancy was not a significant risk factor in Taiwan. Finally, low prepregnancy weight and hypertensive diseases yielded bigger effects on asymmetric than symmetric SGA infants.

Although we cannot provide a complete explanation for the detailed biological mechanisms of adverse birth outcomes, this study indicates that the relationship between several known risk factors and adverse birth outcomes consistently remains in Taiwan. Interventions should be specific for high-risk groups and aimed at quantitatively important health-related determinants of adverse birth outcomes. To reduce the risk of adverse birth outcomes, one needs to provide comprehensive services, including increased attention to the stresses in a pregnant woman's life, and to provide counseling and information on modifiable risks.

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