Risk Factors of Small for Gestational Age and Large for Gestational Age at Buriram Hospital

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Background: *Babies with low birth weight, small for gestational age (SGA) and large for gestational age (LGA) are at increased risk of many perinatal complications.*
Objective: *To evaluate the risks factors associated with SGA and LGA births at Buriram Hospital.*
Material and Method: *Pregnant women who were admitted to the labor room at Buriram hospital were selected, alternate cases in the daytime between October 2012 and January 2013. Pre-pregnancy BMI and gestational weight gain were categorized based on Institute of Medicine BMI groups. The predicted risk of either SGA or LGA births were estimated using generalized linear modeling and multivariate regression.*
Results: *Data were collected on 197 pregnant women including pregnancy characteristics, antenatal care, labor characteristics, maternal complications and neonatal health. The average maternal age was 25.74±6.47 years old. The results showed that the factors of weight gain during pregnancy <recommend for the pre-pregnancy BMI weight, gestational age <37 weeks and pregnancy induce hypertension were correlated with SGA by logistic regression. Maternal age <19 years old was correlated with a lower incidence of LGA. When using multivariate analysis the factor associated with SGA was gestational age <37 weeks (Adjusted odds ratio 10.403, 95% CI 2.109-51.313, p = 0.004), whereas the factor associated with decreased LGA was maternal age <19 years old (Adjusted odds ratio 0.128, 95% CI 0.017-0.983, p = 0.048).*
Conclusion: *The risk factor associated with SGA was gestational age <37 weeks. The factor associated with LGA was maternal age, with maternal age <19 years old having the least incidence for LGA. Public health programs should be targeted towards improving antenatal care screening and close monitoring including maternal age, gestational weight gain, monitoring obstetric care, prevent preterm delivery and providing proper newborn resuscitation in order to decrease perinatal complications and improve the quality of perinatal health.*

Keywords: *Risk factors, SGA, LGA, Perinatal health, Buriram hospital*

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In 2009, there were 2.6 million stillbirths globally with more than 8,200 deaths a day. At least half of all stillbirths occurred in the intrapartum period. Among the 133 million babies born alive each year, 2.8 million die in the first week of life. The patterns of these deaths are similar to the patterns for maternal deaths; the majority occur in developing countries[1]. Infant birth weight is influenced by maternal, fetal and adnexal factors[2]. Babies with either low birth weight (<2,500 g) or large birth weight (>3,500 g) are at increased risk for many early perinatal complications[3,4]. Low birth weight includes babies born preterm and those who are small for gestational age (SGA). SGA refers to a neonate with an estimated weight or birth weight below the 10th percentile according to population standards for the gestational age. SGA may be constitutionally small (do to normal genetics) or pathologically small which is known as intrauterine growth restriction (IUGR) or fetal growth restriction (FGR)[2].

Problems originating fetally can lead to chronic diseases in adulthood[5,6]. Under nutrition during pregnancy and low birth weight increase the risks of diabetes and cardiovascular disease in adulthood[7].

In past studies many risk factors for abnormal birth weight have been studied, including: no prenatal

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care, inadequate gestational weight gain (GWG)[8], Black non-Hispanic race, maternal disease, and maternal age less than 20 years old[9] or more than 35 years old[8,10]. A vital factor for the health of both mother and infant is nutrition during pregnancy. Nausea and vomiting in pregnancy after food intake and may affect maternal nutrition[11,12].

Gestational weight gain (GWG) has been shown to be directly associated with birth weight[13-16]. Estimated optimal GWG ranges recommended by the Institute of Medicine are as follows: for pre-pregnancy BMI less than 18.5 kg/m^2 the optimal GWG ranges from 12.5 to 18.0 kg, for pre-pregnancy BMI 18.5-24.9 kg/m^2 the optimal GWG ranges from 12.5 to 18.0 kg, and for overweight and obese women who have a pre-pregnancy BMI >25 kg/m^2 the optimal GWG ranges from 5.0 to 9.0 kg[17].

Buriram hospital is the principle hospital in Northeast Thailand with a 500-bed capacity. Deliveries there are estimated at 16,330 live births per year. (Recorded by the labor room at Buriram hospital, 2010). The objectives of this study were to evaluate the risks factors associated with SGA and LGA births, and perinatal health in a retrospective cohort study.

Material and Method

The Ethics Committee of Buriram Hospital approved the following study protocols. Pregnant women who were admitted to the labor room at Buriram Hospital, recorded alternate case in the daytime between Oct 2012 and Jan 2013, completed in-person interviews and had their medical records reviewed after giving informed consent. Infant birth weight was first analyzed as a continuous variable, and then grouped into small for gestational age (SGA), appropriate for gestational age (AGA), and large for gestational age (LGA) groups by use Ballard score sheet for categorical analysis. Pre-pregnancy BMI and gestational weight gain were categorized based on the Institute of Medicine BMI groups and gestational weight gain guidelines. The predicted risk of either SGA or LGA births were estimated using generalized linear modeling procedures with adjustment for potential confounders. Associations among SGA or LGA births and pre-pregnancy BMI, gestational weight gain, and other factors were evaluated using multivariate regression.

Results

Data were collected on 197 pregnant women including maternal characteristics, antenatal care, labor characteristics, maternal complications and neonatal health (Tables 1-3).

Average maternal age was 25.74$\pm$6.47 years old. Recorded maternal characteristics including education level and marriage status (single 6.74%).

Antenatal care data were analyzed including first antenatal visit, morning sickness, pre-pregnancy weight, body mass index (BMI), weight gain during pregnancy, number of pregnancy (parity), history of delivery, gestational age at delivery, hematocrit, and ultrasound check up. The 1st, 2nd, 3rd, 4th, 5th, and 6th parity were 37.6, 38.1, 14.7, 8.1, 1.0 and 0.5% respectively. The time of the first ANC less than 12 weeks was 44.4%, no ANC 1%. Pre-pregnancy BMI <18.5, 18.5-24.9, 25-29.9, and $\geq$30 kg/m^2 = 21.3, 58.4, 13.2, and 3% respectively. Percentage of maternal morning sickness including vomiting was 48.2% and nausea 53.3%. Micronutrient supplement intake while pregnant was divided by frequency into 4-6 days/week, 2-3 days/week, 1 day/week, and no intake with results of 80.8, 13.5, 2.6, 1.0, and 2.1%, respectively.

Analyzed labor characteristics were in-labor induction, fetal number, anesthesia before and during labor, mode of delivery, analgesics and sedative used. There was one twin pregnancy. Mode of delivery by caesarean section was 12.7%, by vacuum extraction, was 1%.

Maternal complications were hypertension, maternal convulsion, meconium straining, retention of placenta, laceration into the rectum, postpartum hemorrhage, blood transfusion, antibiotic use within 24 hrs. after delivery and maternal death within 7 days (Table 2). The rate of retained placenta was 2.5%. The rate of maternal need for blood transfusion was 3%. No incidents of rectal tear, eclampsia or maternal death occurred during the time of the study.

Neonatal health was divided by birth weight for age (SGA, LGA and AGA), Apgar scores, absolute birth weight, preterm (<37 week), post term (>40 week), wound, respiratory problems, birth asphyxia, still birth, and death within 7 days (Table 3). The incidence of SGA was 8.1% and LGA was 12.7%. Neonatal complications were meconium aspiration (10.2%), stillbirth (1%), neonatal death (1%) and birth asphyxia (1.5%).

Risk factors for SGA and LGA

Neonatal weights were correlated with pregnancy outcomes. Univariate and multivariate analysis were used to analyze the correlation. Independent factors included maternal characteristics, antenatal visits, morning sickness, pre-pregnancy

Table 1. General maternal characteristics, maternal complications and neonatal health

Characteristics (total n)	n (%)
Maternal characteristics	
Maternal age group (183)	
10-19 years old	36 (18.7)
20-34 years old	138 (71.5)
≥35 years old	19 (9.8)
Education (195)	
Not graduated	1 (0.51)
Grade 6	55 (28.21)
Grade 9	59 (30.26)
Grade 12	44 (22.56)
Diploma	15 (7.69)
Bachelor's degree	17 (8.72)
>Bachelor's degree	4 (2.05)
Marriage status (193)	
Couple	180 (93.26)
Single	13 (6.74)
Antenatal care	
Antenatal visit (197)	
No	10 (5.1)
≤4 times	3 (1.5)
>4 times	184 (93.4)
Morning sickness (197)	
Yes	75 (61.9)
No	122 (38.1)
BMI before pregnancy (188)	
<18.5	42 (22.2)
18.5-24.9	115 (60.8)
25.0-29.9	25 (13.8)
≥30	6 (3.2)
Weight gain during pregnancy (188)	
Appropriate	61 (32.4)
Less than normal	58 (30.9)
More than normal	69 (36.7)
Number of pregnancy (197)	
Primigravida	74 (37.6)
Multigravida	123 (62.4)
History of delivery	
Preterm (194)	
Yes	5 (2.6)
No	189 (97.4)
Abortion (195)	
Yes	31 (15.9)
No	164 (84.1)
Gestational age at delivery (189)	
<37 weeks	18 (9.5)
37-39 weeks	130 (68.8)
≥40 weeks	41 (21.7)
Hematocrit (mg/dl) (191)	
<33	39 (20.4)
≥33	152 (79.6)

Table 1. cont.

Characteristics (total n)	n (%)
Ultrasound check up (197)	
Yes	147 (74.6)
No	50 (25.4)
Labor characteristics	
In-labor induction	
Phase 1 (hour/min)	4.39±5.56/ 11.87±17.40
Phase 2 (hour/min)	0.07±0.36/ 8.74±12.21
Phase 3 (hour/min)	0.01±0.07/ 2.76±6.11
Number of fetus (193)	
1	191 (99.0)
2	2 (1.0)
Anesthesia before and during labor (73)	
Epidural block	1 (1.37)
Spinal block	7 (9.59)
General anesthesia	65 (89.04)
Mode of delivery (176)	
Normal labor	90 (51.1)
Vacuum/forceps	2 (1.1)
Cesarean section	83 (47.2)
Breech vaginal	1 (0.6)
Analgesics and sedative (181)	
No	139 (76.8)
Pethidine	2 (1.1)
Others	40 (22.1)

Table 2. Complications of pregnancy and labor

Complication of pregnancy and labor	n (%)
Hypertension	8 (4.1)
Maternal convulsion	-
Meconium straining	20 (11.3)
Retention of placenta	5 (2.7)
Laceration into rectum	-
Postpartum hemorrhage	-
Blood transfusion	6 (3.1)
Antibiotic use within 24 hour after delivery	32 (18.0)
Maternal death within 7 days	-

weight, body mass index (BMI), and weight gain during pregnancy, gravida number, history of delivery, gestational age at delivery and hematocrit. The results showed that the variables of weight gain during pregnancy less than recommended for their pre-pregnancy BMI weight, gestational age <37 weeks and

Table 3. Neonatal health

Factors of newborn	Normal weight n (%)	SGA n (%)	LGA n (%)	Total n (%)
Apgar scores (193)				
At 1 min				
≤7	6 (3.9)	2 (13.3)	1 (4.2)	9 (4.7)
>7	148 (96.1)	13 (86.7)	23 (95.8)	184 (95.3)
At 5 min				
≤7	3 (1.9)	1 (6.7)	-	4 (2.1)
>7	151 (98.1)	14 (93.3)	24 (100)	189 (97.9)
New born weight (197) (gram)				
<2,500	-	16 (100)	-	16 (8.1)
2,500-3,500	156 (100)	-	-	156 (79.2)
>3,500	-	-	25 (100)	25 (12.7)
Pre-term (<37 week)	8 (5.3)	8 (57.1)	2 (8)	18 (25)
Post-term (>40 week)	6 (7.4)	-	-	6 (7.4)
Wound at newborn	5 (3.4)	-	-	5 (2.7)
Respiratory problems	3 (2.1)	1 (7.7)	-	4 (2.2)
Birth asphyxia	3 (1.9)	-	-	3 (1.5)
Newborn				
Still birth	2 (1.3)	-	-	2 (1)
Dead within 7 days	1 (0.7)	1 (7.7)		2 (1.2)

pregnancy induce hypertension were all correlated with SGA by univariate analysis. Maternal age <19 was correlated with a lower incidence of LGA while maternal age >35 was correlated with a higher incidence of LGA. When using multivariate analysis, factors associated with SGA were gestational age <37 weeks (adjusted odds ratio 10.403, 95% CI 2.109-51.313, $p = 0.004$). The factor of maternal age <19 years old was also associated with a decreased risk for LGA (adjusted odds ratio 0.128, 95% CI 0.017-0.983, $p = 0.048$) (Table 4).

Discussion

The neonatal mortality risk of babies who were both preterm and SGA was higher than that of babies with either characteristic alone (15.42; 9.11-26.12)[4]. The incidence of preterm was 9.1% (18/197) in Buriram hospital, this rate was nearly equivalent to the rate of preterm births worldwide (WHO 2005 = 9.5%)[18]. However, Buriram hospital is a tertiary hospital in the provincial capital so this rate is not representative of the whole Thai population.

The rate of SGA in this study was 12.7%, which is about the same as the average of the world at 13% according to WHO. The stillbirth rate in Thailand for 2009 was 4.0 per 1,000 total births (Bureau of Policy and Strategy of Public Health. Statistic Thailand 2013[19]). In this study, the results showed two stillbirths in 197 newborns with a stillbirth rate that was estimated at 10.15 per 1,000 total births. This is quite a bit higher than the Thai average rate, but as this study had a short period for data collection this should be interpreted with caution.

Maternal age was found to be the most important factor for predicting perinatal health. Obstetrical complications including having a very low birth weight infant were higher in teenage pregnancy compared with others ages[10,20]. In the present study, the incidence of teenage pregnancy was 18.7 which is higher than the worldwide incidence (11%)[1] according to WHO but lower than at Nongyai Hospital, Chonburi Province, Thailand (30.4%)[20].

This study showed a rate of pregnancy hypertensive disease of 4.1%. Univariate analysis for pregnancy hypertensive disease and weight gain during pregnancy showed an association with SGA which is consistent with other studies[9]. A higher pre-pregnancy body-mass index and excessive gestational weight gain are most probably risk factors for increased birth weight[13-16], including childhood obesity[16,21,22]. Moreover, maternal adiposity tends to be strongly related to birth weight and childhood BMI. Maternal obesity has been associated with a three-fold higher

Table 4. Risk factors analysis by univariate and multivariate analysis

Factors	SGA					LGA group				
	No.	Total No.	Adjusted odds ratio	95% CI	*p*-value	No.	Total No.	Adjusted odds ratio	95% CI	*p*-value
Age group (ref. 20-34 years old)										
10-19 year	1	35	3.001	0.529-17.017	-	1	35	0.128	0.017-0.983	0.048
≥35 year	-	18	0.287	0.021-3.856	-	1	19	0.242	0.031-1.903	0.177
Weight gain during pregnancy (ref. as recommended for theirs pre-pregnancy BMI weight)										
Less than recommended	9	54	1.540	0.529-17.017	0.215	4	49	1.859	0.332-10.414	-
More than recommended	2	55	0.886	0.021-3.856	0.347	14	67	0.927	0.312-2.753	-
Hypertension in pregnancy (ref. No)										
Yes	3	8	3.160	0.245-40.789	0.378	0	5	-	-	-
Gestational age (ref. 37-40 week)										
<37 week	8	18	10.403	2.109-51.313	0.004	-	-	-	-	-

risk of offspring obesity, whereas excessive gestational weight gain has been associated with a 33% increased risk of offspring obesity[16]. Correlated factors with the univariate analysis for the risk of SGA in the present study were weight gain during pregnancy less than recommended for their pre-pregnancy BMI weight, gestational age <37 weeks and pregnancy induce hypertension condition in mother. However, when using multivariate analysis, there was no significant association with pre-pregnancy BMI weight and hypertensive disease in the mother. This may be due to the limitation of a small sample population. This suggests we should increase the size of the study population for future data collection.

Mothers lacking adequate nutritional practices are more prone to deliver LBW babies[23]. Some studies have found that the proportional intake of carbohydrates was higher in nausea and vomiting in pregnancy subjects than in non-nausea and vomiting in pregnancy. Dietary and total intakes of vitamin B12, total intake of magnesium and dietary intake of zinc were lower in women with nausea and vomiting in pregnancy. Women with nausea and vomiting in pregnancy had shorter pregnancies compared with those without but neither pregnancy weight gain nor infants' weight and length differed[11]. In the present study, the results did not show an association between women with nausea and vomiting and infant weight as compared with past studies.

A study was done of 235 Lao mothers with LBW babies and 265 with babies of normal birth weight who had delivered them at four central hospitals in 2008. Significant associations with LBW in deliveries at <18 years old were physical labor during pregnancy, first childbirth and mothers lacking adequate nutritional practices[24]. These factors were analyzed by univariate and multivariate analysis in this study but not found to be associated with birth weight.

SGA and LGA in the present study were mostly found in 20-34 year-old mothers. This was significant by univariate analysis for SGA and significant by multivariate for LGA. Compared to the other studies, these conditions were not found more in teenagers or women aged 35 years or older[8].

The present study has limitations of a small population size and the methods for randomization. From the results of the present study, the data do show a slightly high incidence of stillbirth rate compared to the typical rate in Thailand. We should explore the root causes in future studies with a larger population size to identify maternal risk factors, so that we can improve

the perinatal care system at Buriram hospital. Moreover, recording referral data from the community health care system would help in improving the quality of antenatal care that is important in this setting.

Some studies suggest that appropriate interventions to lower GWG to decrease the prevalence of LGA may include individualized calorie goals, advice to maintain weight following the Dietary Approaches to Stop Hypertension dietary pattern without sodium restriction and attendance at weekly group meetings until delivery[25].

Public health programs should be targeted towards improving antenatal care screening and close monitoring including body mass index and weight gain[26] to identify risk factors and allow early intervention. Monitoring obstetric care and providing proper newborn resuscitation is also important to decrease perinatal complications and improve the quality of perinatal health[27].

Conclusion

The risk factors associated with SGA was gestational age <37 weeks. The factor associated with LGA was maternal age, with maternal age <19 years old having the lowest incidence for LGA.

What is already known on this topic?

The United Nations Millennium Development Goals (MDG) is composed of eight goals that all 191 UN Member States have agreed to try to achieve by the year 2015. Of the eight MDGs, the two - MDG 4 and MDG 5 that are specifically concerned with improving the health of women and children set the targets of reducing maternal mortality by 75% and achieving universal access to reproductive health. Problems originating fetally and abnormal birth weight can lead to chronic diseases in adulthood. Risk factors for abnormal birth weight have been studied, for example: no prenatal care, inadequate gestational weight gain (GWG), Black non-Hispanic race, maternal disease, and maternal age less than 20 years old or more than 35 years old.

What this study adds?

This study revealed the perinatal health in the one tertiary hospital in a provincial capital in northeast Thailand and studied the risk factors for abnormal birth weight. The results showed the risk factors associated with SGA was gestational age <37 weeks. The factor associated with LGA was maternal age, with maternal age <19 years old having the lowest incidence for LGA. Antenatal care programs should be targeted towards improving maternal screening and close monitoring to reduce preterm delivery and improve the quality of maternal and childcare.

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Potential conflicts of interest

None.

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ปัจจัยเสี่ยงของมารดาต่อภาวะทารกน้ำหนักตัวน้อยกว่าอายุครรภ์และมากกว่าอายุครรภ์ในโรงพยาบาลบุรีรัมย์

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ภูมิหลัง: *ภาวะทารกมีน้ำหนักตัวน้อยกว่าอายุครรภ์ (small for gestational age; SGA) และมากกว่าอายุครรภ์ (large for gestational age; LGA) ของทารกแรกเกิดก่อให้เกิดภาวะแทรกซ้อนต่อสุขภาพของทารก*

วัตถุประสงค์: *เพื่อหาปัจจัยเสี่ยงต่อภาวะ SGA และ LGA ของทารกแรกเกิดในโรงพยาบาลบุรีรัมย์*

วัสดุและวิธีการ: *เก็บข้อมูลโดยใช้แบบสอบถามปัจจัยที่เกี่ยวข้องในมารดาตั้งครรภ์ที่มาคลอดที่ห้องคลอดโรงพยาบาลบุรีรัมย์ในระหว่างวันที่ 1 ตุลาคม พ.ศ. 2555 ถึงวันที่ 31 มกราคม พ.ศ. 2556 โดยวิธีการสุ่มตัวอย่างแบบสลับรายคนในช่วงเวลาราชการ*

ผลการศึกษา: *หญิงมีครรภ์ผู้เข้าร่วมการวิจัยทั้งหมด 197 คน เก็บข้อมูลพื้นฐาน การฝากครรภ์ การคลอด ภาวะแทรกซ้อนของมารดาและของทารก หญิงมีครรภ์มีอายุเฉลี่ย 25.74±6.47 ปี เริ่มฝากครรภ์ครั้งแรกที่มากกว่า 12 สัปดาห์ ร้อยละ 44.4 ไม่ได้รับการฝากครรภ์ร้อยละ 1 เป็นครรภ์แฝดร้อยละ 0.5 ผ่าตัดคลอดร้อยละ 12.7 ดูดด้วยสุญญากาศร้อยละ 14 น้ำหนักของมารดาที่เพิ่มขึ้นตาม institute of medicine BMI group พบว่าน้อยกว่าเกณฑ์ร้อยละ 30.9 มากกว่าเกณฑ์ร้อยละ 36.7 ภาวะโภชนาการและการเจริญเติบโตของทารกพบว่า SGA ร้อยละ 8.1 LGA ร้อยละ 12.7 ภาวะแทรกซ้อนในการตั้งครรภ์และการคลอดของมารดาพบว่ามีภาวะรกค้างร้อยละ 2.5 มารดาต้องได้รับเลือดร้อยละ 3 ภาวะแทรกซ้อนของทารกแรกเกิดพบว่ามีภาวะสำลักน้ำคร่ำร้อยละ 10.2 ตายในครรภ์ร้อยละ 1 ทารกเสียชีวิตร้อยละ 1 ภาวะทารกขาดอากาศร้อยละ 1.5*

การหาความสัมพันธ์ระหว่างน้ำหนักทารกแรกเกิดกับปัจจัยที่เกี่ยวข้องโดยใช้ univariate logistic regression พบว่าปัจจัยที่มีความสัมพันธ์กับ SGA ได้แก่น้ำหนักของมารดาที่เพิ่มขึ้นน้อยกว่าเกณฑ์ตาม institute of medicine BMI group อายุครรภ์ก่อนกำหนด และภาวะความดันโลหิตสูงระหว่างตั้งครรภ์และปัจจัยที่มีความสัมพันธ์กับ LGA ได้แก่ อายุมารดา การวิเคราะห์ด้วย multivariate logistic regression พบว่าปัจจัยเสี่ยงต่อ SGA ได้แก่ อายุครรภ์ก่อนกำหนดคือ <37 สัปดาห์ (adjusted odds ratio 10.403, 95% CI 2.109-51.313, p = 0.004) และปัจจัยที่สัมพันธ์กับ LGA ได้แก่ อายุของมารดาโดยที่มารดาอายุ <19 ปี พบอุบัติการณ์ของ LGA น้อยที่สุด (adjusted odds ratio 0.128, 95% CI 0.017-0.983, p = 0.048)

สรุป: *ปัจจัยเสี่ยงต่อ SGA ได้แก่ อายุครรภ์ก่อนกำหนด ส่วนมารดาที่อายุ <19 ปีพบอุบัติการณ์ของ LGA น้อยกว่ากลุ่มมารดาที่อายุ 20-34 ปี และกลุ่มมารดาที่อายุมากกว่า 35 ปี นั่นคือควรเฝ้าระวังปัจจัยเสี่ยงต่างๆ รวมทั้งด้านอายุมารดาเพื่อป้องกันการคลอดก่อนกำหนดและให้คำแนะนำด้านโภชนาการที่เหมาะสมในระหว่างการฝากครรภ์เป็นสิ่งสำคัญที่ส่งผลต่อน้ำหนักของทารกแรกเกิดอันจะส่งผลต่อสุขภาพทารกต่อไป*