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ความชุกและปัจจัยเสี่ยงต่อภาวะทารกครรภ์เดี่ยวครบกำหนดตัวโต: การศึกษาเทียบกลุ่มควบคุม สหสถาบัน

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Prevalence and Risk Factors of Term Singleton Fetal Macrosomia: A Multicenter Case-Control Study

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บทคัดย่อ

หลักการและวัตถุประสงค์: ทารกตัวโต (fetal macrosomia) จะเพิ่มโอกาสเกิดภาวะแทรกซ้อนซึ่งในบางครั้งเป็นอันตรายถึงชีวิต โดยทั่วไปค่าน้ำหนักทารกที่มากกว่า 4,000 กรัมจะใช้เป็นเกณฑ์ในการวินิจฉัยภาวะนี้ อย่างไรก็ตามคำจำกัดความทางคลินิกในการตัดสินเกณฑ์น้ำหนักทารกตัวโตยังมีข้อมูลไม่มากพอ ซึ่งยังต้องการองค์ความรู้และความเข้าใจอีกมาก การศึกษานี้จึงนี้มีวัตถุประสงค์เพื่อศึกษาความชุก ปัจจัยเสี่ยง ผลลัพธ์ และค่าน้ำหนักที่เหมาะสมของการวินิจฉัยภาวะทารกครรภ์เดี่ยวครบกำหนดตัวโตในประเทศไทย

วิธีการศึกษา: การศึกษาย้อนหลังแบบเทียบกลุ่มควบคุมสหสถาบัน กลุ่มตัวอย่างเป็นมารดาและทารกที่มาคลอดที่โรงพยาบาลกุมภวาปี โรงพยาบาลอุดรธานี โรงพยาบาลหนองหาน โรงพยาบาลบ้านผือ โรงพยาบาลวานรนิวาส โรงพยาบาลบ้านดุง โรงพยาบาลหล่มสัก และโรงพยาบาลอ่างทอง ช่วงวันที่ 1 มกราคม พ.ศ. 2561 ถึง 31 ธันวาคม พ.ศ. 2566 ที่มีคุณสมบัติตามเกณฑ์การศึกษา เก็บข้อมูลย้อนหลังจากฐานข้อมูลคอมพิวเตอร์นำมาวิเคราะห์ข้อมูลโดยใช้สถิติเชิงพรรณนา และการวิเคราะห์การถดถอยลอจิสติกเชิงพหุ (multiple logistic regression)

ผลการศึกษา: มีทารกครรภ์เดี่ยวครบกำหนด 43,129 ราย เป็นทารกแรกเกิดครบกำหนดตัวโต (≥ 4,000 กรัม) 927 ราย คิดเป็นร้อยละ 2.15 เมื่อวิเคราะห์ด้วยสมการถดถอยสหสัมพันธ์แบบพหุปัจจัย พบว่า ปัจจัยเสี่ยงต่อภาวะทารกครบกำหนดตัวโต ได้แก่ ภาวะท้วม (AOR 2.21, 95%CI 1.74-2.80) หรืออ้วน (AOR 2.89, 95%CI 2.16-3.85) เบาหวาน น้ำหนักเพิ่มขณะตั้งครรภ์เกินเกณฑ์ (AOR 1.91, 95%CI 1.54-2.37) และเคยมีบุตรมาก่อน (AOR 1.73, 95%CI 1.39-2.16) ทารกตัวโตจะเพิ่มความเสี่ยงต่อภาวะคลอดติดไหล่ (AOR 41.17, 95%CI 10.18-166.42), การผ่าตัดคลอดครั้งแรก (AOR 3.01, 95%CI 2.47-3.68) และการตกเลือดหลังคลอด (AOR 2.81, 95%CI 1.40-5.64) และพบว่าค่าเฉลี่ยน้ำหนักแรกเกิดของทารกครรภ์เดี่ยวครบกำหนดเท่ากับ 3,036.59 กรัม ส่วนเบี่ยงเบนมาตรฐาน 498.42 กรัม และค่า 90 เปอร์เซ็นต์ไทล์คือน้ำหนัก 3,610 กรัม ซึ่งสอดคล้องกันเมื่อวิเคราะห์เปรียบเทียบน้ำหนักทารกเพิ่มขึ้นทีละ 100 กรัม พบว่าน้ำหนักทารกที่ ≥ 3,600 กรัมจะเพิ่มการเกิดภาวะแทรกซ้อนรวม การผ่าตัดคลอดครั้งแรก และการตกเลือดหลังคลอด อย่างมีนัยสำคัญทางสถิติ

สรุป: เมื่อใช้เกณฑ์น้ำหนักทารก ≥ 4,000 กรัม พบความชุกของทารกครรภ์เดี่ยวครบกำหนดตัวโต ร้อยละ 2.15 โดยปัจจัยเสี่ยงได้แก่ มารดาท้วมหรืออ้วน เบาหวาน น้ำหนักเพิ่มขณะตั้งครรภ์เกินเกณฑ์ และเคยมีบุตรมาก่อน อย่างไรก็ตามข้อมูลจากการศึกษานี้แนะนำการใช้เกณฑ์น้ำหนักทารกที่ ≥ 3,600 กรัม ในการวินิจฉัยเนื่องจากพบว่าทารกที่มีน้ำหนักแรกคลอดมากกว่าค่าดังกล่าวจะเพิ่มการเกิดภาวะคลอดติดไหล่ การผ่าตัดคลอดครั้งแรกและการตกเลือดหลังคลอดอย่างมีนัยสำคัญทางสถิติ ดังนั้นมารดาที่มีภาวะเสี่ยง และได้รับการประเมินน้ำหนักในครรภ์มากกว่าหรือเท่ากับเกณฑ์ดังกล่าวจึงควรเฝ้าระวังหรือได้รับส่งต่อไปโรงพยาบาลที่มีศักยภาพในการดูแลภาวะแทรกซ้อนดังกล่าวได้

คำสำคัญ: ทารกครบกำหนด, ปัจจัยเสี่ยง, ทารกตัวโต, ทารกแรกเกิดน้ำหนักมาก

Abstract

Background and Objective: Fetal macrosomia increases the complications that some is life threatening. The cut-off birthweight at over 4,000 gram is commonly used for its diagnosis, however the clinical definition of cut-off value of fetal macrosomia is still debatable and needs more knowledge to determine. This study aimed to study the prevalence, risk factors, outcomes and optimal cut-off value of term singleton high birthweight infants in Thailand.

Methods: A multicenter case - control study was conducted. The subjects were term singleton pregnant women who delivered in Kumphawapi, Udonthani, Nong Han, Ban Phue, Wanonniwat, Ban Dung, Lom Sak, and Ang Thong Hospital between 1 January, 2018 to 31 December, 2023. Data was collected from the hospital's database and then analyzed using descriptive statistics and multiple logistic regression analysis.

Results: There were 43,129 term singleton infants with 927 term macrosomic (≥ 4,000 grams) infants (2.15%). The risk factors of fetal macrosomia were obese (AOR 2.89, 95%CI 2.16-3.85), diabetes mellitus (AOR 2.90, 95%CI 2.31-3.64), overweight (AOR 2.21, 95%CI 1.74-2.80), excessive gestational weight gain (AOR 1.91, 95%CI 1.54-2.37), multiparity (AOR 1.73, 95%CI 1.39-2.16). Fetal macrosomia increased the risk of shoulder dystocia (AOR 41.17, 95%CI 10.18-166.42), primary cesarean delivery (AOR 3.01, 95%CI 2.47-3.68), and postpartum hemorrhage (AOR 2.81, 95%CI 1.40-5.64). The mean birthweight of term singleton infants was 3,036.59±498.42 g. The 90th percentile was 3,610 grams that correlated with the composite complication, primary cesarean delivery and postpartum hemorrhage were increased significantly when the birthweight was more than or equal to 3,600 grams when each 100 grams increment of birthweight was analyzed.

Conclusion: On the basis of the 4,000 grams traditional cut-off point, the prevalence of fetal macrosomia was found to be 2.15%. The risk factors of fetal macrosomia were maternal obesity, diabetes mellitus, overweight, and multiparity. However, the new cut-off birthweight at 3,600 grams (90th percentile) for the determination of high birthweight is suggested from this study's evidence that the risk of shoulder dystocia, primary cesarean delivery, and postpartum hemorrhage were increased significantly in the higher birthweight than this cut-off point. Pregnant women with risk factors who have estimated fetal weight more than or equal to this cut-point should be closely monitored or referred to the higher facility hospital for caring these complications.

Keywords: term, risk factor, fetal macrosomia, high birthweight

Introduction

High birthweight is a common condition that creates complications during labor and postpartum. The commonly used definition of fetal macrosomia is a fetus with a birthweight higher than 4,000 g regardless of gestational age. In some high-income countries, the birthweight threshold of 4,500 g is used[1,2]. However, some previous reports have suggested that the lower cut-off point was associated with pregnancy complications[3,4]. The reported prevalence of macrosomic fetus varies between countries and ranges from 0.5 to 14.9 percent of the total births in that country.[5]. This condition is associated with several obstetric complications such as birth trauma, dystocia, postpartum hemorrhage and cesarean birth, neonatal complications (hypoglycemia, respiratory problems) and long term sequalae in childhood, such as obesity and insulin resistance[6-13].

Birthweight has increased over the past few decades in Thailand and in many other countries[14,15]. This increasing birthweight is associated with pregnancy complications and an increase in cesarean birth rates. A recent study showed that, from both biological and social determinants, white mothers tended to have the largest babies, followed by Hispanic, Asian, and then black mothers[16]. Therefore, the threshold of macrosomic fetuses' diagnosis might be different dependent on the ethnicity of the mother. The World Health Organization also suggested that each population should identify its specific birthweight cut-off values for clinical use[17] Thai are also need a specific value which the 4,000 or 4,500 gram existing cut-off might not be appropriate for Thai women who are smaller than white women. To our knowledge, no previous Thai research has been conducted in this point. Therefore, this study aims to explore the prevalence, associated factors, adverse outcomes of fetal macrosomia and also the birthweight cut-off threshold that increases the pregnancy complications in Thai pregnant women from multiple centers and different levels of hospitals in Thailand.

Materials and Methods

The present study is a multicenter case-control study in Thailand which was approved from the Udonthani Hospital and Ang Thong Hospital Ethical committee in Human subject research (number UDH REC 92/2567 and ATGEC 48/2566) and was approved by the directors of all participating hospitals. The medical records of women who delivered at a regional tertiary care hospital (Udon Thani), and 7 general hospitals (Ang Thong, Kumpawapi, Nong Han, Ban Phue, Wanon Niwat, Ban Dung, and Lom Sak) from 1 January 2018 to 31 December 2023 was retrospectively reviewed. All hospitals belonged to the government public health system, the obstetric care was performed by both doctors and nurses, and obstetricians were available in all hospitals. The inclusion criteria were pregnant women who delivered in one of the participating hospitals during the study period, had their information recorded in the electronic database and had their first antenatal care at less than or equal to 20 weeks gestation. The exclusion criteria were preterm (less than 37 weeks) delivery, multifetal pregnancy and incompleteness of significant information such as birthweight or pregnancy complication.

The electronic medical databases were retrospectively reviewed for the maternal characteristics, pregnancy outcomes and neonatal outcomes. The possible associated variables from literature review were extracted from hospital database using Microsoft excel program. The data was checked by researchers in each hospital and rechecked by MS. In case of questionable data, the hospital database was searched again for inpatient or outpatient data. The macrosomic baby was defined as a newborn with their birthweight more than or equal to 4,000 g[18] which was classified to 3 grades according to birthweight; grade 1 for newborns 4,000-4,499 g, grade 2 for 4,500-4,999 g and grade 3 for more than or equal to 5,000 g[18]. Postpartum hemorrhage was defined as the postpartum blood loss in 24 hours that was more than or equal to 500

ml in cases of a vaginal delivery and 1,000 ml in cases of a cesarean delivery[19]. Shoulder dystocia was defined as a vaginal cephalic delivery that requires additional obstetric maneuvers to deliver the fetus after the head has delivered and gentle traction has failed[20]. The composite complication was defined as any participant who had at least one of the maternal or fetal complications which resulted from fetal macrosomia including preeclampsia, postpartum hemorrhage, primary cesarean delivery, shoulder dystocia, low one minute Apgar score, neonatal intensive care unit (NICU) admission.

Statistical analysis

The maternal and neonatal characteristics were described by the descriptive statistical methods such as number, percentage, mean with standard deviation. The prevalence of fetal macrosomia was presented as a in percentage with a 95% confidence interval. The comparison between macrosomic and non macrosomic groups were done using unpaired t test, Pearson chi square or Fisher exact test dependent on the nature of the data. The possible associated factors of fetal macrosomia were analyzed using univariate and multivariate logistic regression analysis. The variables with p value < 0.1 from univariate analysis and no collinearity were selected to multivariable analysis The new cut-off value was defined using 90 percentile of birthweight and the analysis of composite complication for each 100 g incremental of birthweight when compared with the birthweight 2,500- 2,999 g using logistic regression analysis.

Results

There were 43,129 medical records of the term singleton pregnant women included in this study. These composed of 1,6146 cases from a regional hospital, 26,983 cases from general hospitals. There were 927 cases of macrosomic infants, the macrosomic prevalence was 2.15% of which; 832 cases (89.75%) were grade1 (4,000-4,499 g), 81 (8.73%) were grade 2 (4,500-4,999 g), and 14 (1.51%) were grade 3 (≥5,000). Mean birthweight of term singleton infants was 3,036.59± 498.42 g. The 90 percentile of birthweight was 3,610 g. The comparison of maternal characteristics between macrosomic and non-macrosomic infants is shown in table1.

The macrosomic infant's mothers had significantly older age, had more parity, higher pre-pregnancy body mass index, and higher pregnancy weight gain than the normal weight infant's mothers. The details are shown in table1.

The possible associated factors were analyzed by univariate logistic regression analysis. The variables with p value less than 0.1 and no collinearity were analyzed in the multiple logistic regression analysis model. The associated factors of fetal macrosomia, which sort from descending order of adjusted odd ratio, were obese (AOR 2.89, 95% CI 2.16-3.85) diabetes mellitus (AOR 2.90, 95% CI 2.31-3.64), overweight (AOR 2.21, 95% CI 1.74-2.80), excessive gestational weight gain (AOR 1.91, 95%CI 1.54-2.37), multiparity (AOR 1.73, 95% CI 1.39-2.16). The details are shown in Table 2.

The macrosomic infants had significant higher gestational age at delivery and caesarean delivery was done in 70.12% of macrosomic babies. The details of delivery outcomes are shown in Table 3.

Table 1 Comparison of maternal characteristics between macrosomic and non-macrosomic infants.

	Population (N=43,129)		
	Macrosomic infant N=927, n (%)	Non-macrosomic infant N=42,202, n (%)	p-value*
Age (years), mean ± SD	29.09±6.06	27.09±6.43	<0.001
<20	49 (5.29)	5,300 (12.56)	<0.001
≥ 35	365 (21.16)	5,951 (14.38)	<0.001
Gravida, mean ± SD	2.33±1.09	2.00±1.04	<0.001
Primiparity	244 (26.32)	18,087 (42.86)	<0.001
Grand multiparity	32 (3.45)	1,004 (2.38)	0.035
Occupation			0.003
Housewife	507 (54.69)	23,508 (55.71)	
Employee	209 (22.55)	9,666 (22.91)	
Government officer	27 (2.89)	1,950 (4.62)	
Farmer	120 (12.95)	5,381 (12.75)	
Merchant	64 (6.91)	1,697 (4.02)	
Education			0.045
Less than Bachelor's degree	813 (87.72)	35,171 (83.34)	
Bachelor's degree or higher	114 (12.28)	7,031 (16.66)	
Payment			0.125
Universal coverage	584 (63.00)	26,206 (62.10)	
Social insurance	290 (31.27)	12,672 (30.02)	
Government	22 (2.37)	1,673 (3.96)	
Self-payment	31 (3.34)	1,651 (3.91)	
Pre-pregnancy Body mass index (kg/m^2), mean±SD	26.67±5.56	22.89±4.93	<0.001
Under (<18.5)	280 (6.38)	7,296 (17.52)	
Normal (18.5-22.9)	231 (24.92)	18,033 (42.73)	
Overweight (23-29.9)	445 (48.00)	13,143 (31.14)	
Obese (≥30)	22 (23.95)	3,909 (9.26)	
Pregnancy weight gain (kg), mean±SD	15.22±6.92	12.44±5.76	<0.001
Normal[a]	278 (29.99)	14,733 (34.91)	
Under[a]	109 (11.76)	15,219 (36.06)	
Over[a]	540 (58.25)	12,250 (29.03)	
Medical complication			
Diabetes mellitus	233 (25.13)	3,905 (9.25)	<0.001
Hypertension	94 (10.14)	3,022 (7.16)	0.001

Abbreviation: SD; standard deviation

*Analyzed by unpaired t test or Pearson's chi square.

[a]according to The Institute of Medicine recommendation (2009)[21]

Table 2 Possible associated factors with fetal macrosomia.

Factors	OR (95%CI)	p-value	AOR* (95%CI)
Maternal age ≥ 35 years	1.55 (1.32-1.82)	<0.001	1.06 (0.83-1.34)
Multiparity	2.10 (1.81-2.43)	<0.001	1.73 (1.39-2.16)
Occupation			
Employee	1.05 (0.86-1.29)	0.628	
Government officer	0.64 (0.40-1.03)	0.066	0.53 (0.25-1.10)
Farmer	1.04 (0.82-1.33)	0.746	
Merchant	1.76 (1.27-2.42)	0.001	1.63 (1.00-2.67)
Education			
Less than Bachelor's degree	1.43 (1.08-1.89)	0.013	1.12 (0.82-1.54)
Payment			
Universal coverage	1.19 (0.82-1.71)	0.357	
Social insurance	1.22 (0.84-1.77)	0.301	
Government	0.70 (0.40-1.22)	0.205	
Pre-pregnancy Body mass index			
Overweight (23-29.9)	2.64 (2.25-3.10)	<0.001	2.21 (1.74-2.80)
Obese (≥30)	4.43 (3.67-5.35)	<0.001	2.89 (2.16-3.85)
Pregnancy weight gain			
Over[a]	2.34 (2.012-2.71)	<0.001	1.91 (1.54-2.37)
Diabetes mellitus	3.29 (2.83-3.83)	<0.001	2.90 (2.31-3.64)
Hypertension	1.46 (1.18-1.82)	0.001	0.75 (0.55-1.02)
Male infant	1.25 (1.08-1.46)	0.004	1.14 (0.94-1.38)

Abbreviation: OR; Odd ratio, AOR; adjusted Odd ratio

*Adjusted by age, multiparity, occupation, education, body mass index group, diabetes mellitus and hypertension.

[a] according to The Institute of Medicine recommendation[21] .

Table 3 Comparison of delivery outcomes between macrosomic and non-macrosomic groups.

Delivery outcomes	Macrosomic infant N=927, n (%)	Non-macrosomic infant N=42,202, n (%)	p-value*
Gestational age at delivery (weeks), mean±SD	38.81±1.34	37.92±1.95	<0.001
Gestational age at delivery (weeks)			<0.001
<37	36 (3.88)	5,684 (13.47)	
37	105 (11.33)	6,561 (15.55)	
38	240 (25.89)	13,266 (31.43)	
39	246 (26.54)	10,169 (24.10)	
40	218 (23.52)	5,269 (12.49)	
≥41	82 (8.85)	1,253 (2.97)	
Mode of delivery			<0.001
Vaginal delivery	277 (29.88)	24,282 (57.54)	
Cesarean delivery	650 (70.12)	17,920 (42.46)	
Birthweight (grams), mean±SD	4,220.92±233.88	3,010.58±470.31	<0.001

*Abbreviation: SD; standard deviation

*Analyse by unpaired t test or Pearson's chi square.

Table 4 Comparison of pregnancy complications between macrosomic and non-macrosomic group.

Complications	Macrosomic group N=927	Non-macrosomic group N=42,202	OR* (95%CI), p-value	AOR** (95% CI)
Preeclampsia	94	3,022	1.46 (1.18-1.82), 0.001	0.84 (0.62-1.14)
Shoulder dystocia	21	35	27.93 (16.19-48.16), <0.001	41.17 (10.18-166.42)
Primary cesarean delivery	513	12,369	2.99 (2.62-3.41), <0.001	3.01 (2.47-3.68)
Postpartum hemorrhage	22	661	1.53 (0.99-2.35), 0.053	2.81 (1.40-5.64)
Low 1 minute Apgar score (≤7)	47	1,678	1.28 (0.96-1.74), 0.094	1.02 (0.72-1.44)
NICU admission	85	3,593	1.09 (0.87-1.36), 0.480	0.73 (0.45-1.20)
Composite complications	553	14,873	2.72 (2.38-3.10), <0.001	3.11 (2.51-3.85)

NICU: neonatal intensive care unit, aOR: adjusted odds ratio, CI: confidence interval.

*Univariate logistic regression analysis

**Multiple logistic regression analysis, adjusted by Adjusted by age, multiparity, occupation, education, body mass index group, and diabetes mellitus.

There was 59.66% (553/927) of the fetal macrosomic group had at least one pregnancy complications compared with 35.24 % (14,873/42,202) in the non macrosomic group. The pregnancy complications of fetal macrosomia, which the risks, sorted in a from descending order of adjusted odd ratio, were shoulder dystocia (AOR 41.17, 95% CI 10.18-166.42), primary cesarean delivery (AOR 3.01, 95% CI 2.47-3.68), and postpartum hemorrhage (AOR 2.81, 95% 1.40-5.64)

For each 100 g increment, the primary cesarean delivery and postpartum hemorrhage rate were increased significantly when the birthweight was more than or equal to 3,600 g. (Figure 1 and Table 5). The power calculations were performed between each subgroup analysis, the powers were more than 0.8 in all analysis.

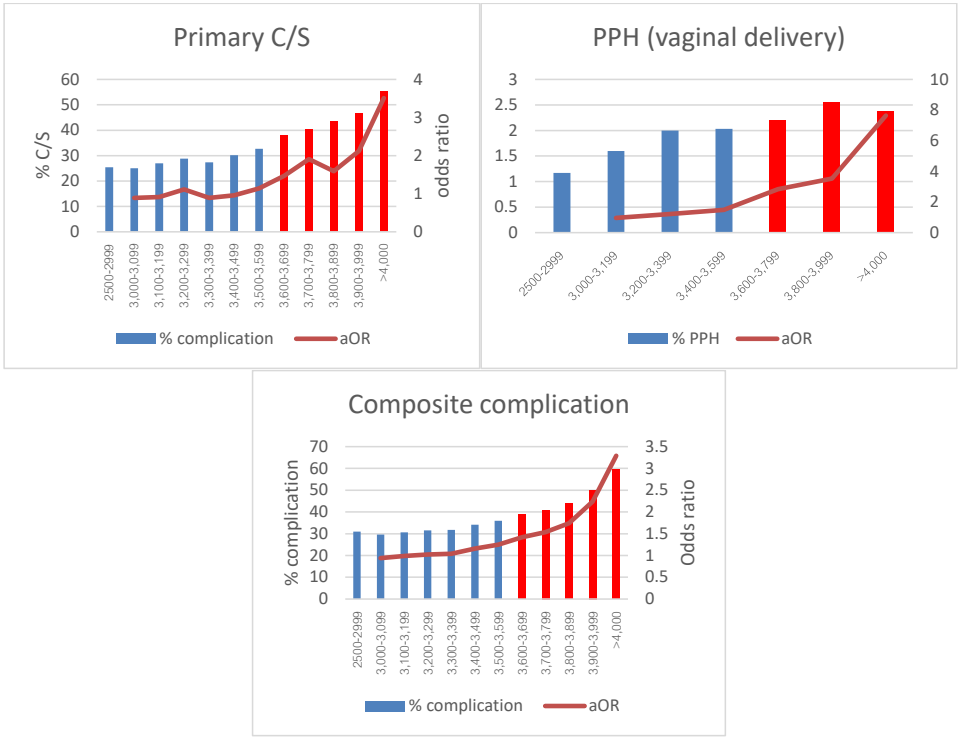

Figure 1 Comparison of composite complication for each 100 g increment

Table 5 Comparison of composite complication for each 100 g increment

Birthweight (g)	Composite complication, n (%)	AOR (95%CI)
2,500-2,999	4,454 (31.00)	-
3,400-3,499	883 (34.16)	0.91 (0.79-1.04),
3,500-3,599	719 (35.90)	1.05 (0.90-1.22)
3,600-3,699	584 (38.88)	1.51 (1.27-1.79)
3,700-3,799	426 (40.92)	1.62 (1.32-1.98)
Birthweight (g)	**Primary cesarean section, n (%)**	**AOR (95%CI)**
2,500-2,999	3,658 (25.46)	-
3,400-3,499	781 (30.21)	0.96 (0.83-1.11)
3,500-3,599	654 (32.65)	1.14 (0.97-1.33)
3,600-3,699	570 (37.95)	1.47 (1.23-1.75)
3,700-3,799	422 (40.54)	1.91 (1.56-2.34)
Birthweight (g)	**Postpartum hemorrhage, n (%)**	**AOR (95%CI)**
2,500-2,999	168 (1.17)	-
3,200-3,399	136 (2.00)	1.22 (0.69-2.16)
3,400-3,599	93 (2.03)	1.48 (0.81-1.11)
3,600-3,799	56 (2.20)	2.84 (1.49-5.41)
3,800-3,999	30 (2.56)	3.52 (1.59-7.81)

Discussion

The present study found that the prevalence of fetal macrosomia, using the 4,000 g cut-off point, was 2.15% which most cases were grade1 (birthweight 4,000-4,499 g). The associated factors of fetal macrosomia were maternal obesity, diabetes mellitus, overweight, and multiparity. Pregnancy complications occurred in 59.66 % of the fetal macrosomic group. The risk of shoulder dystocia, primary cesarean delivery, and postpartum hemorrhage were increased significantly in this group. However, the 90 percentile of term singleton infant was 3,610 g and the analysis of 100 g increment of birthweight showed that the birthweight more than or equal to 3,600 g increased the labor complication. Therefore, the new cut-off value at 3,600 g is suggested for the high birthweight of Thai population.

The prevalence of fetal macrosomia in this study was similar to a previous study by Koyanagi, et al which reported the prevalence of fetal macrosomia in 23 countries and reported that Thailand's macrosomic prevalence in 2007-2008 was 2.2%[5]. However, this prevalence was less than that in the United State's where the prevalence was 7% in a 2017 report[22], China had a prevalence of 6.9%, Vietnam 3.4%, but the prevalence in Thailand was higher than Indian's prevalence which was 0.5%, and the prevalence in the Philippines of 1.1% in 2007-2008[5].

The associated factors of macrosomic fetus from this study were maternal obesity, excessive gestational weight gain, multiparity and maternal diabetes which is compatible with previous studies[23-26]. The genetic factor, nutrition during pregnancy and high blood sugar are responsible for the high bodyweight of macrosomic fetus. The aOR of maternal obesity, multiparity and maternal diabetes in Asian women from a previous study were 2.50, 1.48 and 2.15[5] which were closed to this study. However, maternal age and infant sex, which were reported the association with fetal macrosomia[5,25], were not found their association in this study.

Pregnancy complications occurred in 59.66% of the fetal macrosomic group in this study. The risk of shoulder dystocia, primary cesarean delivery, and postpartum hemorrhage were increased significantly in the fetal macrosomic group which is compatible with a systematic review[27] which reported that there was an increased risk of emergency caesarean section, postpartum hemorrhage and shoulder dystocia in cases of fetal macrosomia which had OR (95% CI) of 1.98 (1.80–2.18), 2.05 (1.90–2.22), and 15.64 (11.31-21.64), respectively. However, the cesarean delivery rate was 70.12%, in the fetal macrosomia group that was higher than a previous systematic review[27] that reported a cesarean section rate of 8.26-43.94% in the fetal macrosomic group. The postpartum hemorrhage rate was 2.37% and the shoulder dystocia rate was 2.27%, in this study which were compatible with Beta J, et al study[28] that reported postpartum hemorrhage rate was 0.58-19.58% and shoulder dystocia rate was 0.73-17.40% in the fetal macrosomic group.

The current practice defines an absolute cut-off of 4,000 g when gestational age is not accounted for. However, its suitability for clinical use everywhere remains unknown. The different ethnicities affect the size of mother and baby such as the Asian mother and baby usually have a lower weight than the Western mother and the cut-off point should be different between different ethnic groups. The World Health Organization recommends that each population should identify its specific cut-off for clinical use[17]. The knowledge of cut-off of large fetal weight, that significantly increases the labor complications, has benefits for the healthcare team. who take care the pregnant women for the early detection and treatment of the any complications that arise. In this study, the 90 percentile was 3,610 g which was similar with the Koyanagi, et al study that reported the 90th percentile of Thai birthweight was 3,630 grams[5]. The 90th percentile of birthweight of the other Asian counties were 3,850 grams in China, 3,750 grams in India, 3,700 in Vietnam, 3,600 g in Cambodia, 3,500 g

in Nepal and Sri Lanka, and 3,485 grams in Philippine[5]. This 90th percentile value correlated with each 100 g incremental risk analysis, that the cut-off birthweight over 3,600 g increased the composite complication, cesarean section rate and postpartum hemorrhage. This cut-off weight is lower than the cut-off weight of 3,850 g from Choukem, et al study in Cameroon[3] and 3,800 g from Lawoyin study from Nigeria[4].

This new cut-off point can be used for the referral system, in the risk cases and the estimated fetal weight is higher than 3,600 g, who are in the antenatal care clinic or labor room of community hospitals, with fewer facilities and capabilities and where the health care teams are not equipped to deal with complications, such as the emergency cesarean delivery or postpartum hemorrhage. During antenatal care, pregnant women who show signs of fetal macrosomia, such as fetal weight more than 90 percentile of gestational age (Thai fetal weight) should receive the proper care during prenatal visit such as nutritionist counselling, diet advice and periodic ultrasonographic evaluation of large for gestational age fetus. The proper care protocol of large for gestational age fetus in the second and third trimester of pregnancy still requires further prospective implementation research.

The strength of this study is as a multicenter study enabling an adequate sample size for analysis. The limitation is its retrospective nature which the selection bias can be occurred due to the incompleteness of records in some hospitals that had to be excluded and some factors are missing such as socioeconomic factors and some complications such as shoulder dystocia, maternal and fetal morbidity and mortality still needs a large number of cases to analysis. The future prospective researches are still needed to validate the new cut-off point and evaluate its benefit in the clinical practice.

Conclusion

On the basis of the 4,000-g traditional cut-off point, the prevalence of fetal macrosomia was found to be 2.15% in Thailand, the associated factors of fetal macrosomia were maternal obesity, diabetes mellitus, overweight, and multiparity. However, the new cut-off birthweight at 3,600 g (90th percentile) for the determination of high birthweight is suggested from this study's evidence that the risk of shoulder dystocia, primary cesarean delivery, and postpartum hemorrhage were increased significantly in cases involving higher birthweights than the traditionally used cut-off point of 4,000 grams

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Disclosure of interest

The authors report no conflicts of interest.

Data availability statement

The data that supports the findings of this study is available on request from the corresponding author within five years after publication.

Author contribution

SN, MS, and SS contributed to the study conception and design. Material preparation and data collection was performed by SN, MS, YK, SS, NL, SP, PM, and KS. Data analysis was performed by US and MS. The first draft of the manuscript was written and reviewed by SN, MS and SS. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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