Placental Weight and Its Ratio to Birth Weight in Normal Pregnancy at Songkhlanagarind Hospital

Manop Janthanaphan MD*,
Ounjai Kor-anantakul MD*, Alan Geater PhD**

** Department of Obstetrics and Gynecology, Faculty of Medicine, Prince of Songkla University, Songkhla*
*** Epidemiology Unit, Faculty of Medicine, Prince of Songkla University, Songkhla*

Objectives: *To quantify placental weight and its ratio to birth weight in normal pregnancy; and to determine whether abnormal placental weight and its ratio are associated with poor pregnancy outcomes.*
Design: *Prospective, cross-sectional study.*
Material and Method: *From January 1st, 2004, to December 31st, 2004, placentae were obtained from 238 normal pregnancies, between the 36th-40th gestational weeks. The trimmed and drained placenta was weighed and the mean placental weight at term was defined. Distribution curves for placental weight and their ratios with gestational age were constructed. The outcomes for the intrapartum and perinatal periods were compared with normal placental weight, its ratio to the group above the 90th percentile and below the 10th percentile. Fisher's Exact Test was used to analyze the data. A p value < 0.05 was considered significant.*
Results: *The placental weight increased according to the birth weight (r = 0.450, p < 0.005). The mean placental weight at 36-40 gestational age was 519 g (SD = 89.01g). The mean placental weight to birth weight ratio was 17.08%. This ratio decreased slightly with advancing gestational age. There was an association between placental weight below the 10th percentile and fetal distress (p = 0.003). Placental weight to birth weight ratio below the 10th percentile was also associated with fetal distress (p = 0.02). Placental weight above the 90th percentile was associated with newborns requiring neonatal intensive care admission (p = 0.016).*
Conclusion: *The placental weight increased according to the birth weight.The placental weight to birth weight ratio decreased slightly with advancing gestational age.Abnormal placental weight and its ratio were significantly associated with some adverse pregnancy outcomes.*

Keywords: *Placental weight, Birth weight, Pregnancy outcomes*

J Med Assoc Thai 2006; 89 (2): 130-7
Full text. e-Journal: *http://www.medassocthai.org/journal*

The ability of the fetus to grow and thrive in utero is presumed to be a function of the placenta. The placenta at term is, on average, 185 mm in diameter and 23 mm in thickness, with an average volume of 497 ml, and a weight of 508 g. The ratio between placenta weight and newborn weight has been reported as 1:6[1]. However, measurement varies widely and differs in different countries with different placental preparations[2]. Placental weight and its relationship to infant size at birth have been studied for more than a century[3]. Past studies indicated that placental weight was associated with pregnancy outcome. High placenta weight was associated with a poor perinatal outcome, a low APGAR score, respiratory distress and perinatal death, whereas a low placental weight was associated with medical complications in the mother[4]. Recent studies indicate that altered growth of the placenta is a predictor of adult onset diseases including cardiovascular disease, hypertension and diabetes. A large placenta and a low birth weight are particularly strong independent risk factors[5].

Many factors such as race, socioeconomic problems, health problems, etc are associated with placental weight[6]. The present study was devised with the following aims: the primary objective was to define the normal range of placental weight and its ratio in

Correspondence to : Kor-anantakul O, Department of Obstetrics and Gynecology, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand. Phone: 0-7442-9617, Fax: 0-7442-9617, E-mail: ounjai.k@psu.ac.th

normally pregnant Southern Thai women for each gestational age from 36 gestational weeks to 40 gestational weeks. The secondary objective was to examine whether there is an association of abnormal placental weight and its ratio with adverse pregnancy outcomes.

Material and Method

Material

Placentae were obtained from 238 pregnant women who delivered at Songkhlanagarind Hospital between January 1st, 2004 and December 31st, 2004. The authors included subjects who had an accurate gestational age, meaning those women who had regular menstruation before their pregnancy. Antenatal records indicated no disparity between size and date. In some cases, first trimester ultrasonography was used to confirm the gestational age. The presented subjects delivered between the 36th-40th weeks and their fetuses were deemed appropriate for the corresponding gestational age (AGA). Exclusion criteria included maternal diseases affecting placental weights such as diabetes mellitus, hypertensive disorder, maternal anemia (having a hematocrit level less than 33%), vascular diseases and other medical problems. Multifetal pregnancies and congenital anomalies were also excluded. Abnormalities of the placenta including placenta adherence, placenta previa and abruption placenta detected after delivery were also excluded. Patients gave informed consent in the labor room before being included in the present study. Hospital records for the presence of any complications during maternal antepartum and intrapartum were also reviewed.

Placenta preparation

Placentae were prepared according to the method of placental preparation as described by Molteni et al[7], in the following manner. An accurate weighing of the placentas was done by trimming off all membranes and severing the umbilical cord at the insertion site on the placenta surface. Superficial fetal vessels were drained of all blood. Adherent blood clots were removed from the maternal surface. The placenta was weighed three times on a calibrated digital device to the nearest gram. The weights were recorded and means calculated. The weighing was accomplished within one hour after delivery.

Newborn protocol

The newborns' weight was recorded to the nearest gram immediately after delivery. Gestational age and relative growth were assessed by using the growth curve adapted by Battaglia and Lubchenco[8]. Only newborns that weighed in the AGA group were included. APGAR scores were recorded at 1 and 5 minutes, along with the presence of meconium stained amniotic fluid. All other relevant complications were recorded within 48 hours after birth including required admission to the Newborn Intensive Care Unit (NICU), for respiratory distress syndrome, infection, anemia, etc.

Statistical methods

The sample size was estimated by using the one sample problem equation, the maximum allowable error was set at 20 g. The standard deviation of placental weight for each gestational age as reported by Naeye[4] was used. The required sample sizes of 35-36, 37-38, 39-40 gestational weeks were 50, 55 and 56 cases, respectively. General categorical data were described as percentage. The placental weight ratio (PWR) was

Table 1. Maternal characteristics and perinatal outcomes

Characteristics	Number (%) (n = 238)
Age group	
- <20 years	24 (10.1)
- 20-34 years	185 (77.7)
- >34 years	29 (12.2)
Parity	
- Nulliparous	94 (39.5)
- Multiparous	144 (60.5)
Pregravid BMI	
- Low (BMI < 19.8)	108 (45.4)
- Normal (BMI 19.8-26)	116 (48.7)
- High (BMI > 26-29)	9 (3.8)
- Obese (BMI > 29)	5 (2.1)
Route of delivery	
- Normal delivery	140 (58.8)
- Caesarean section	60 (25.2)
- Vacuum extraction	26 (10.9)
- Forcep extraction	11 (4.6)
- Breech assisted	1 (0.4)
APGAR at 1 minute	
- ≤ 6	10 (4.2)
- > 6	228 (95.8)
APGAR at 5 minutes	
- ≤ 6	2 (0.8)
- > 6	236 (99.2)
NICU* admission	
- No	226 (95.0)
- Yes	12 (5.0)

* NICU = Newborn Intensive Care Unit

defined as the ratio of placental weight to newborn birth weight multiplied by 100 (%). Placental weight and PWR were described as median, the 10th and the 90th percentiles for each gestational age group. The Pearson product moment correlation coefficient was used to test the magnitude and significance of any relation between placental weight and birth weight. Fisher's exact test was used to compare abnormal placental weight and abnormal PWR with adverse outcomes of the newborn for the intrapartum and perinatal periods. P values of less than 0.05 were considered statistically significant.

The Faculty of Medicine Ethic Committee, Prince of Songkla University, approved the present study.

Results

The total number of cases in the present study was 238, 38 cases in 36 gestational weeks,100 cases in 37-38 gestational weeks and 100 cases in 39-40 gestational weeks. 77.7% of women were between 20 and 34 years of age. Forty eight point seven percent of the subjects had a normal body mass index. The rate for cesarean section was 25.2%. Most newborns had normal APGAR scores (> 6) at 1 and 5 minutes, 95.8% and 99.2%, respectively. NICU admission was required in only about 5% of cases. All maternal characteristics are shown in Table 1.

The distribution of placental weight between 36 weeks and 40 weeks is shown in Fig. 1, which indicates an almost normal distribution. The mean placental weight and the mean PWR were 519.0 g (standard deviation 89.0) and 17.01% (standard deviation 2.8).

The placental weight increased according to the birth weight and was shown to be statistically significant (Pearson Product Moment correlation coefficient $r = 0.450$, $p < 0.005$) as shown in Fig. 2.

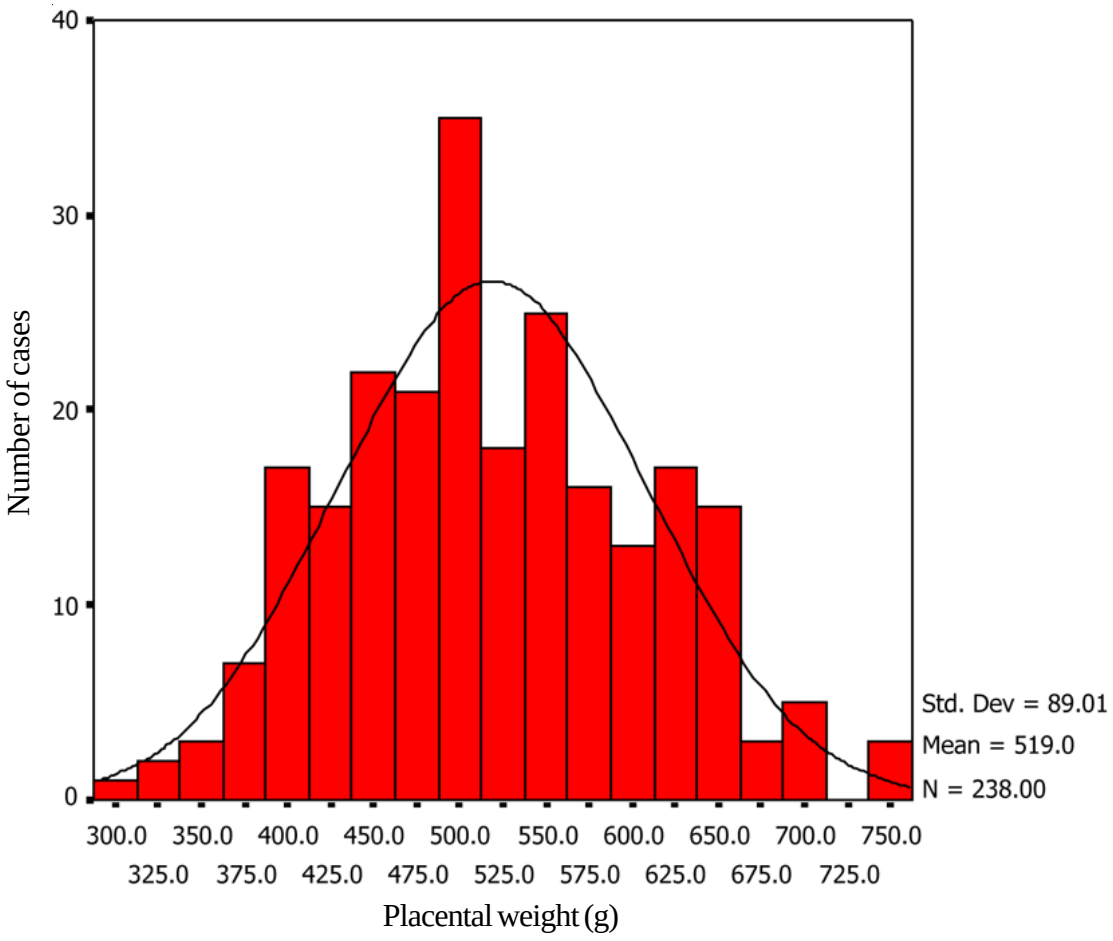


Fig. 1 The placental weight distribution between 36 week gestational age and 40 week gestational age in 238 cases; the mean ± SD placenta weight was 519 ± 89.01 g

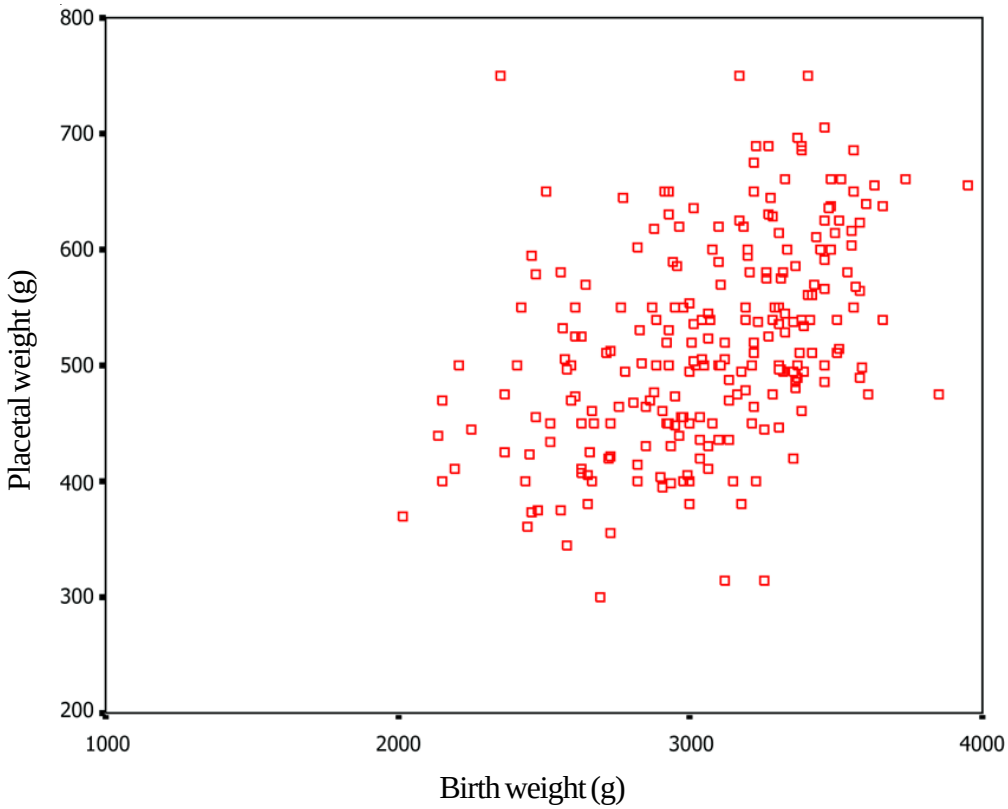
The median placental weight and PWR together with 10th and 90th percentiles at different gestational age are shown in Fig. 3 and 4, respectively. The median placental weight (10th, 90th percentiles) for each gestational age was 500 g (399.5 g, 650.0 g) at 36 weeks; 510 g (380.0 g, 620.0 g) at 37 weeks; 520 g (408.3 g, 641.7 g) at 38 weeks; 501.7g (400.0 g, 641.5g) at 39 weeks; and 512.5 g (442.0 g, 657.0 g) at 40 weeks. The median PWR (10th,90th percentiles) for each gestational age was: 19.39% (10th percentile = 14.12%, 90th percentile = 23.71%) at 36 weeks; 16.69% (14.05%, 21.55%) at 37 weeks; 16.67% (14.13%, 20.21%) at 38 weeks; 16.47% (13.53%, 19.33%) at 39 weeks; and 16.14% (13.63%, 18.71%) at 40 weeks.

The total twenty three cases (9.66%) had a placental weight below the 10th percentile for the relevent gestational age and 24 cases(10.08%) had placental weight above the 90th percentile. Four of the twenty three cases (17.4%) with a placental weight below the 10th percentile had fetal distress which was statistically significant (p = 0.003) higher than in the normal placental weight group. Moreover, 4 of the twenty four cases (16.7%) with a placental weight above the 90th percentile had newborns requiring intensive care unit admission, which was statistically significantly (p = 0.016) higher than in the normal placental weight group (Table 2). A similar association was seen with low placental weight ratio (PWR), among which had four of twenty three cases (17.4%) with PWR below the 10th percentile had fetal distress (p = 0.02, Table 3).

Discussion

The results of the present study reveal normal placental weight at term and also show that placental weight increases are associated with increased birth weight in normal pregnancy. The distribution curves of normal placental weight and PWR for each gestational age were constructed. In addition, the authors found that abnormal placental weight and PWR were associated with some adverse intrapartum and perinatal outcomes.

The subjects in the present study were assumed to be normal as they were free of medical



(Pearson product moment correlation coefficient, r = 0.450, p < 0.005)

Fig. 2 Scatter plot of placental weight and birth weight in 238 cases of normal pregnancy

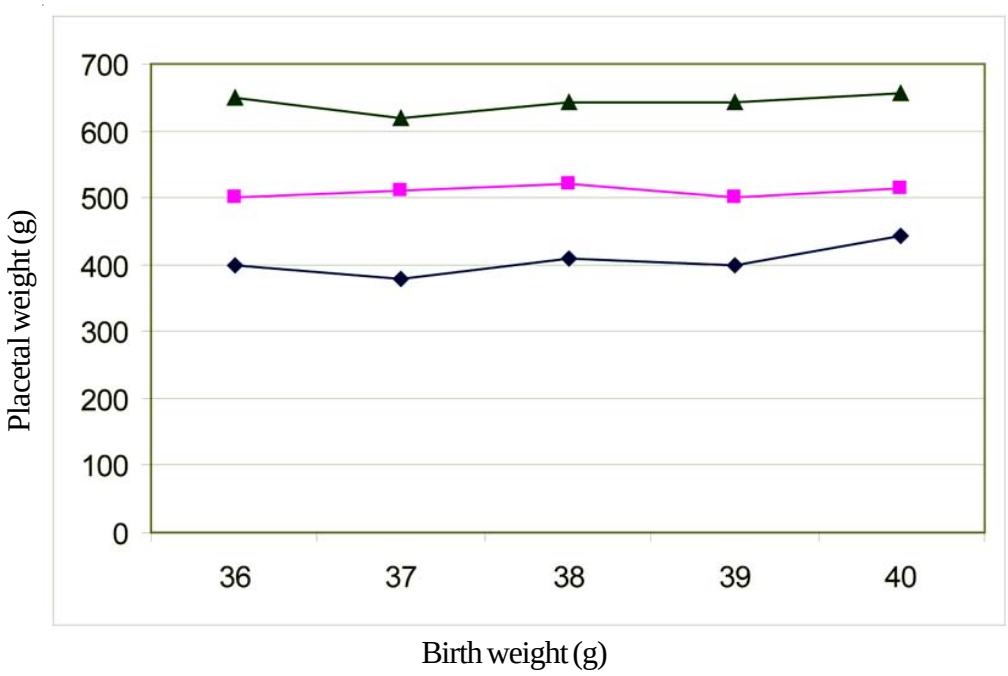


Fig. 3 Distribution of placental weight by gestational age distribution (◆ 10th percentile , ■ median , ▲ 90th percentile)

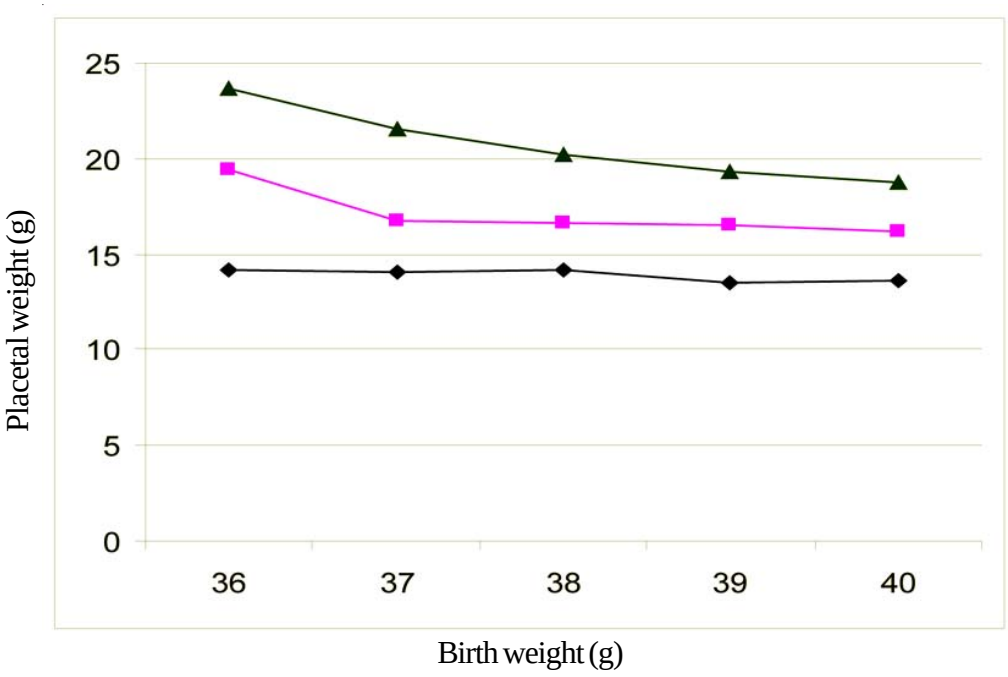


Fig. 4 Distribution of placental weight ratio (PWR) by gestational age distribution (◆ 10th percentile, ■ median, ▲ 90th percentile)

Table 2. Intarpartum and perinatal complications according to placental weight group in gestational age between 36th-40th week (total number of cases = 238)

Complications	Placental weight group				
	Normal Number (%) (n = 191)	≤ 10th percentile Number (%) (n = 23)	p-value*	≥ 90th percentile Number (%) (n = 24)	p-value*
Fetal distress	8 (4.2)	4 (17.4)	0.003 *	1 (4.2)	NS
NICU admission	6 (3.1)	2 (8.7)	NS	4 (16.7)	0.016*
APGAR ≤ 6 (at 1 minute)	6 (3.1)	2 (8.7)	NS	2 (8.4)	NS
Respiratory distress syndrome	3 (1.6)	0	-	1 (4.2)	NS
Hyperbilirubin-emia	17 (8.9)	3 (13)	NS	3 (12.5)	NS

* Fisher exact test
NICU = Newborn Intensive Care Unit
NS = not significant

Table 3. Intrapartum and perinatal complications according to placental weight ratio group in gestational age between 36th-40th week (total number of cases = 238)

Complications	Placental weight ratio group				
	Normal Number (%) (n = 192)	≤ 10th percentile Number (%) (n = 23)	p-value*	≥ 90th percentile Number (%) (n = 23)	p-value*
Fetal distress	7 (3.6)	4 (17.4)	0.02 *	2 (8.7)	NS
NICU admission	9 (4.7)	1 (4.3)	NS	2 (8.7)	NS
APGAR ≤ 6 (at 1 minute)	8 (4.2)	1 (4.3)	NS	1 (4.3)	NS
Respiratory distress syndrome	3 (1.6)	0	-	1 (4.3)	NS
Hyperbilirubin-emia	17 (8.9)	2 (8.7)	NS	4 (17.4)	NS

* Fisher exact test
NICU = Newborn Intensive Care Unit
NS = not significant

problems, were primarily in the normal BMI group, had no antenatal problems and delivered newborns at the appropriate gestational age. The cesarean section rate during the period of study was similar to that in the authors' department's database.

The mean placental weight and PWR were lower than the studies from some developed countries such as Europe and Australia[6,9]. In contrary, they were higher than the studies from some developing countries such as Ukraine and India[10,11]. These findings suggest that different ethnicity or some unknown factors may affect the placental weight and PWR.

The present study showed that placental weight increased according to birth weight, which concurs with other studies[10,12]. Placental weight was strongly correlated with newborn birth weight. The placental weight was rather static in the term period. Although there has been some discussion in the past as to whether the human placenta continues to increase in size until term[7]. The decline in PWR with increasing gestational age, as indicated in the present study, is similar to that described in several other studies[7,13-15].

The authors also found an association between low placental weight or PWR below the 10th percentile and fetal distress. This result is similar to that of the studies of Molteni and Bonds[7,12]. The observation suggests that placental function is directly proportional to the amount of placental tissue. The placental weight group above the 90th percentile showed some adverse neonatal outcomes. The strong association between manifestations of acute antenatal hypoxia and overweight placentas was probably due to placental villous edema[4]. However, the authors were

unable to provide conclusive results as the authors did not estimate the adequate sample size to analyze this aspect. Nevertheless, the finding of the significance suggests an association between abnormal placental weight or PWR with the adverse perinatal outcomes. At the same time the non significant results do not rule out possible association. Overall, it seems that abnormal placental weight or the abnormal placental weight ratio may predict adverse outcomes even in a low risk population. Further research is needed to confirm such associations.

The strength of the present study is that it was done prospectively, using the standard technique for placental preparation. The authors hope the placental weight and PWR distribution curves that have been constructed here will become a basic reference tool for future studies. The advent of ultrasonic techniques that may permit the assessment of PWR prior to term raises the possibility of the prenatal recognition of a high-risk group of newborns even in a low-risk population.

In conclusion, the authors have established reference curves for placental weight and PWR at 36-40 gestational weeks. This is a prospective cross-sectional study of placental weight and the placental weight ratio in the normally pregnant Thai southern female population.

Acknowledgements

The authors wish to thank Dr Tippawan Liabsuetrakul and Mrs Aeumporn Krissanaphan for their kind assistance with statistical analysis.

References

1. Cunningham FG, Leveno KJ, Bloom SL, Hauth JC, Gilstrap LC III, Wenstrom KD. Implantation, embryogenesis, and placental development. In: Williams obstetrics. 22nd ed. New York: McGraw-Hill; 2005: 39-90.
2. Thomson AM, Billewicg WZ, Hytten FE. The weight of the placenta in relation to birth weight. Br J Obstet Gynaecol Br Commonw 1969; 76: 865-72.
3. Adair FL, Thelander H. A study of the weight and dimensions of the human placenta in its relation to the weight of the newborn infant. Am J Obstet Gynecol 1925; 10: 172-205.
4. Naeye RL. Do placental weights have clinical significance? Hum Pathol 1987; 18: 387-91.
5. Barker DJ, Bull AR, Osmond C, Simmonds SJ. Fetal and placental size and risk of hypertension in adult life. BMJ 1990; 301: 259-62.
6. Perry IJ, Beevers DG, Whincup PH, Bareford D. Predictor of ratio of placental weight to fetal weight in multiethnic community. BMJ 1995; 310: 436-39.
7. Molteni RA, Stys SJ, Battaglia FC. Relationship of fetal and placental weight in human-beings: fetal/placental weight ratios at various gestational ages and birth weight distributions. J Reprod Med 1978; 21: 327-34.
8. Battaglia FC, lubchenco LO. A practical classification of newborn infants by weight and gestational age. J Pediatr 1967; 71: 159-63.
9. Blake KV, Gurrin LC, Beilin LJ, Stanley FJ, Landau LI, Newnham JP. Placental weight and placental ratio as predictors of later blood pressure in childhood. J Hypertens 2001; 19: 697-702.
10. Little RE, Zadorozhnaja TD, Hulchiy OP, Mendel NA, Shkyryak-Nyzhnyk ZA, Chyslovska N, et al. Placental weight and its ratio to birthweight in a Ukrainian city. Early Hum Dev 2003; 71: 117-27.
11. Sivarao S, Vidyadaran MK, Jammal AB, Zainab S, Goh YM, Ramesh KN. Weight, volume and surface area of placenta of normal pregnant women and their relation to maternal and neonatal parameters in Malay, Chineses and Indian ethnic group. Placenta 2002; 23: 691-6.
12. Bonds DR, Gabbe SG, Kumar S, Taylor T. Fetal weight/placental weight ratio and perinatal outcome. Am J Obstet Gynecol 1984; 149: 195-200.
13. Dombrowski MP, Berry SM, Johnson MP, Saleh AA, Sokol RJ. Birth weight length ratios, ponderal indexes, placental weights and birth weight-placenta ratios in a large population. Arch Pediatr Adolesc Med 1994; 148: 508-12.
14. Sinclair JG. Significance of placental and birth weight ratios. Anat Rec 1948; 102: 245-58.
15. Leyland A, Pritchard C. Fetal growth and ratio of placental weight to birth weight. BMJ 1992; 304: 1052-3.

น้ำหนักรกและสัดส่วนของน้ำหนักรกต่อน้ำหนักทารกในการตั้งครรภ์ปกติในโรงพยาบาลสงขลานครินทร์

มานพ จันทนพันธ์, อุ่นใจ กออนันตกุล, อลัน กีเตอร์

วัตถุประสงค์: *เพื่อศึกษาน้ำหนักรก ค่าสัดส่วนของน้ำหนักรกต่อน้ำหนักทารกในการตั้งครรภ์ปกติ และผลการคลอดในกลุ่มที่มีน้ำหนักรกหรือค่าสัดส่วนของน้ำหนักรกต่อน้ำหนักทารกที่ผิดปกติ*

รูปแบบการศึกษา: *การศึกษาแบบไปข้างหน้าชนิดตัดขวาง*

วัสดุและวิธีการ: *ตั้งแต่เดือนมกราคม พ.ศ. 2547 จนถึงเดือนธันวาคม พ.ศ. 2547 ได้ทำการเก็บรก ในสตรีตั้งครรภ์ปกติ อายุครรภ์ ระหว่าง 36 สัปดาห์ ถึง 40 สัปดาห์ จำนวน 238 ราย ที่มาคลอดใน โรงพยาบาลสงขลานครินทร์ โดยการตัดสายสะดือ เยื่อหุ้มทารกและถ่ายเลือดออกจากรก ก่อนชั่งน้ำหนักเพื่อหาค่าเฉลี่ย ค่าที่ได้นำมาสร้างเป็นกราฟแสดงการกระจายของน้ำหนักรกและสัดส่วนของน้ำหนักรกต่อน้ำหนักทารกในแต่ละช่วงอายุครรภ์ ทำการเปรียบเทียบผลการคลอด ระหว่างกลุ่มที่น้ำหนักรกอยู่ในช่วงปกติกับช่วงผิดปกติ คือน้อยกว่าเปอร์เซ็นต์ไทล์ที่ 10 หรือมากกว่าเปอร์เซ็นต์ไทล์ที่ 90และกลุ่มที่สัดส่วนปกติกับช่วงผิดปกติ โดยใช้ Fisher's exact test วิเคราะห์หาความสัมพันธ์ ค่า p ที่น้อยกว่า 0.05 ถือว่ามีนัยสำคัญทางสถิติ*

ผลการศึกษา: *ค่าเฉลี่ยของน้ำหนักรกในสตรีตั้งครรภ์ปกติอายุครรภ์ 36-40 สัปดาห์ คือ 519 กรัม (ค่าเบี่ยงเบนมาตรฐานเท่ากับ 89.01 กรัม) ค่าเฉลี่ยสัดส่วนของน้ำหนักรกต่อน้ำหนักทารกคือ 0.17 โดยสัดส่วนนี้จะลดลงเล็กน้อยเมื่ออายุครรภ์เพิ่มขึ้น น้ำหนักรกเพิ่มขึ้นตามน้ำหนักทารกตามอายุครรภ์อย่างมีนัยสำคัญทางสถิติ ($r = 0.450$, $p < 0.005$) กลุ่มที่มีน้ำหนักรกน้อยกว่าเปอร์เซ็นต์ไทล์ที่ 10 พบการเกิดภาวะเครียดของทารกระหว่างการคลอดสูงกว่ากลุ่มที่มีน้ำหนักปกติอย่างมีนัยสำคัญ ($p = 0.003$) กลุ่มที่มีสัดส่วนของน้ำหนักรกต่อน้ำหนักทารกน้อยกว่าเปอร์เซ็นต์ไทล์ที่ 10 พบการเกิดภาวะเครียดของทารกระหว่างการคลอดสูงกว่า กลุ่มที่มีสัดส่วนปกติอย่างมีนัยสำคัญเช่นเดียวกัน ($p = 0.02$) กลุ่มที่มีน้ำหนักรกมากกว่าเปอร์เซ็นต์ไทล์ที่ 90 พบทารกจำเป็นต้องอยู่ในหออภิบาลแรกคลอดสูงกว่ากลุ่มที่มีน้ำหนักปกติอย่างมีนัยสำคัญ ($p = 0.016$)*

สรุป: *น้ำหนักรกเพิ่มตามน้ำหนักทารก ค่าสัดส่วนของน้ำหนักรกต่อน้ำหนักทารกจะลดลงตามอายุครรภ์เมื่อใกล้กำหนดคลอด ในกลุ่มน้ำหนักรกและค่าสัดส่วนของน้ำหนักรกต่อน้ำหนักทารกผิดปกติ พบความสัมพันธ์กับผลการคลอดที่ไม่พึงประสงค์*