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Symphysis fundal height measurements in prediction of birthweight

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ABSTRACT

Objective: To determine the sensitivity, specificity and predictive value of symphysis fundal height measurement in prediction of infant birthweight and to determine the level of symphysis fundal height as cut off values for low birthweight and high birthweight. We also aimed to examine the association between symphysis fundal height and birth asphyxia, shoulder dystocia and cesarean section rate.

Materials and Methods: A prospective study of 2,020 pregnant women who attended antenatal care and delivered at Maharat Nakorn Ratchasima Hospital from September, 2009 to December, 2009. Symphysis fundal height measurement and others data were collected at labor room. Analysis was done for correlation, sensitivity and specificity.

Results: The results of this study shown that the best significant predictor of birthweight from maternal characteristics is symphysis fundal height measurement. The value of low birthweight is 8.5% and the value of high birthweight is 1.8%. The best predictive symphysis fundal height value for low birthweight infant is < 30 cm. with the sensitivity of 88.9%, specificity of 79.7%, PPV 98.2%, NPV 39.4%. The best predictive symphysis fundal height value for high birthweight infant is > 38 cm. with the sensitivity of 97.3%, specificity of 96.4%, PPV 34.3%, NPV 99.9%. The level of symphysis fundal height > 38 cm. associated with has increase risk for cesarean section and shoulder dystocia.

Conclusion: Symphysis fundal height measurement is an effective screening test to predict newborn with low birthweight at the cut point of < 30 cm and high birthweight at the cut point of > 38 cm. This test was appropriate for screening because it is simple, widely available, non invasive and cheap.

Keywords: high birthweight, low birthweight, symphysis fundal height

Introduction

Low birthweight and high birthweight infants are associated with high morbidity, mortality rate and various complications. Low birthweight infants may be associate with birth asphyxia, respiratory distress syndrome, intraventricular hemorrhage, hypoglycemia[1]. Most of them are mainly due to preterm birth and are required proper care in appropriate hospitals. High birthweight are mostly complicated with problems during labor including shoulder dystocia and prolonged labor,

which can cause birth trauma, birth asphyxia[1] as well as the psychological impact on the mothers. Thus, prediction of birthweight is an important factor in patient care including treatment planning, prevention of complications and appropriate care.

The prediction of birthweight can be done using history associated with the growth of the fetus such as maternal weight gain during pregnancy, abdominal examination (Leopold's maneuver), measuring symphysis fundal height, as well as the use of ultrasonography. Use of ultrasound in prediction of birthweight is popular but costly and need expertise personnel. It is also not effective in evaluating large fetus. Other methods such as measurement of symphysis fundal height (SFH) may be an alternative. Using tape measurement of symphysis fundal height is easy, safe and harmlessly could be done without expensive equipment or expertise.

SFH measurement first used to estimate the gestational age. In 1977, Westin B[2] found that the SFH could be used as a tool to follow fetal growth. One year later, Woo et al[3] demonstrated that SFH and abdominal girth could be used to predict birthweight. In 1995, Walraven GE et al[4] found that SFH could be used to predict the size of the infant. In Thailand, Pongrojpaw et al[5] and Pongsawatkul K[6,7] investigated the role of symphysis fundal height of as a prediction for fetal birthweight.

A study by Chaturachinda K et al[8] in 1993 found that the average birthweight and incidence of infant with low birthweight varied in each part of Thailand. The southern part had lowest incidence of low birthweight (8.2%), while the northern part had the highest rate of 12.8%. The incidence of infant with low birthweight in the northeastern region was 10.4%.

In Maharaj Nakhon Ratchasima Hospital, there are 700 deliveries per month. About 10 percent of these women have infants with low birthweight and about 2 percent have infants with high birthweight. These infants often have problems and need in the additional treatment. The aim of this study was to determine the sensitivity, specificity and predictive value of symphysis fundal height measurement for prediction of birthweight. The value of symphysis fundal height to predict in low birthweight and high birthweight. The second objective was to determine the association between symphysis fundal height and birth asphyxia, shoulder dystocia and, cesarean section rate.

Materials and Methods

This study was approved by the Ethics Committee of Maharaj Nakhon Ratchasima Hospital. The data were collected from pregnant women who delivered at Maharaj Nakhon Ratchasima Hospital from the 1st of September to the 31st of December 2009, excluding twin pregnancies, infants with transverse, oblique lie and pregnant women not delivered in the 24 hours from admission to the hospital.

Before data collection, the researchers explained the purpose of the study, the detailed process to those involved in the study and also taught the research staffs how to use required these tools. They would practiced until gaining and confident of the reproducible results of the measurement. The pamphlet indicating the process of the SFH measurement was placed on the admission table so that the women and nurses understand the process.

Fifteen well – trained nurses who could reproduce similar measurements were advised to perform the test and collected the following data: maternal age, number of gestation, gestational age, underlying diseases, symphysis fundal height, abdominal circumference, weight before pregnancy, weight before delivery, and weight gain during pregnancy, body mass index before pregnancy and before delivery, height, results of the pelvic examination, passage of delivery, complications during delivery, infant weight, sex of infant, Apgar score at 1 and 5 minutes, and complications of the infant. After urination, the maternal weight and height were measured. Women were told to lie down. Using a tape, SFH was measured from the top of the pubic bone, passed above the umbilicus to the top of the fundus by turning the centimeter side of the tape down. The tape was then turned it back up to read. Measurement was done during uterine relaxation. Then the same tape was used to measure maternal abdominal circumference at the level of umbilicus. History and other information were then recorded in a

log book. The same tape was used for all mothers.

The data was analysed in descriptive statistics which included the number, frequency, percentage, mean, standard deviation (SD), statistical data used to determine sensitivity and specificity and then the appropriate cut-off point was determined by using receiver operating characteristic(ROC) curve, the relationship between symphysis fundal height and complications was determined using relative risk.

Definition

- Low birthweight was defined as birthweight ≤ 2,500 gm.
- High birthweight was defined as birthweight ≥ 4,000 gm.

Results

Pregnant women who delivered at Maharaj Nakhon Ratchasima Hospital who met specified criteria were recruited (2,020 cases). Mean infant birthweight 3,061.66 gm and 173 (8.55%) of them were with low birthweight (≤ 2,500 gm) and 38 (1.88%) of them were with high birthweight (≥ 4,000 gm). The frequency of birthweight was shown in Table 2. Most women had SFH in the range of 31-35 cm. with mean of 32.3 cm. The frequency of symphysis fundal height as shown in table 3.

It was found that SFH, abdominal circumference, weight before pregnancy, weight before delivery, weight gain during pregnancy, body mass index (BMI) before pregnancy and before delivery, and maternal height were significantly associated with infant birthweight as shown in Table 4. SFH had the highest correlation coefficient of 0.84. For prediction of infant with low birthweight (Table 5 and Fig. 1), SFH was less than or equal to 30 cm., the sensitivity and specificity were found to have best value of 88.96% and 79.77%, respectively, positive prediction value (PPV) 98.2% and negative predictive value (NPV) 39.4%. To predict birthweight of high birthweight infant (Table 6 and Fig. 2) the sensitivity and specificity were found to have best value of 97.37% and 96.42%, respectively, PPV 34.3% and NPV 99.9% when SFH was more than or equal to 38 cm. Moreover, risk of cesarean section and shoulder dystocia significantly increased with SFH higher than 38 cm (Table 7).

Table 1. Characteristics of the study population

Factor	Mean	SD
Age (yr)	27.1	6.1
Weight (kg)	67.6	11.6
Height (cm)	157.2	6.8
GA (week)	38.13	1.7
Birthweight (gm)	3061.6	433.3
	N	**%**
Primigravida	918	45.3
Head engagement	214	10.5
Membrane intact	1793	88.6

GA = Gestation age

Table 2. Frequency of birthweight

Birthweight (gm)	N	%
</= 2500	173	8.55
2501-2999	699	34.61
3000-3499	840	41.59
3500-3999	270	13.37
> /= 4000	38	1.88

Table 3. Frequency of symphysis fundal height

SFH (cm)	N	%
< 25	22	1.09
25-30	575	28.47
31-35	1114	55.15
36-40	290	14.36
41-45	18	0.89
>45	1	0.04

SFH = symphysis fundal height

Table 4. The correlations between birthweight, SFH, abdominal girth, prepregnancy weight, predelivery weight, weight gain, prepregnancy BMI, predelivery BMI, Height

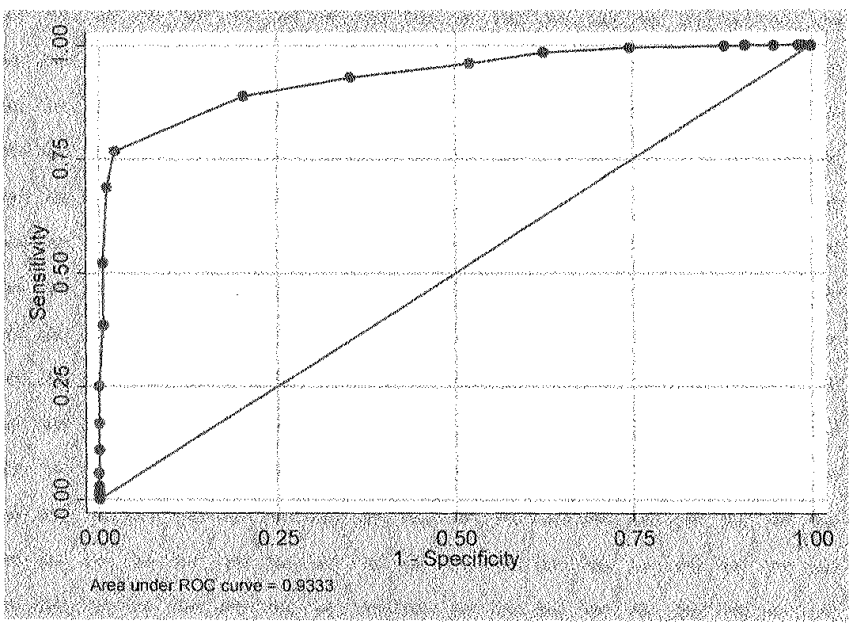
Factor	Birthweight	p-value
SFH	0.84	< 0.001
Abdominal girth	0.25	< 0.001
prepregnancy weight	0.28	< 0.001
Predelivery weight	0.36	< 0.001
Weight gain	0.22	< 0.001
Preprennancy BMI	0.31	< 0.001
Predelivery BMI	0.12	< 0.001
Height	0.16	< 0.001

* SFH = symphysis fundal height, BMI = body mass index.

Table 5. Sensitivity and specificity of low birthweight

SFH (cm.)	Sensitivity	Specificity	PPV(%)	NPV(%)
≥ 25	99.95	12.14	92.8	95.5
≥ 26	99.62	25.43	93.8	86.2
≥ 27	98.59	37.57	94.8	71.4
≥ 28	96.16	47.98	95.6	53.9
≥ 29	93.07	64.74	97.0	46.7
≥ 30	88.96	79.77	98.2	39.4
≥ 31	76.83	97.69	99.7	26.9
≥ 32	68.72	98.84	99.8	21.8

SFH = Symphysis fundal height



PPV = Positive predictive value

NPV = Negative predictive value

Fig 1. Receiver operating characteristics (ROC) curve for prediction of infant with low birthweight

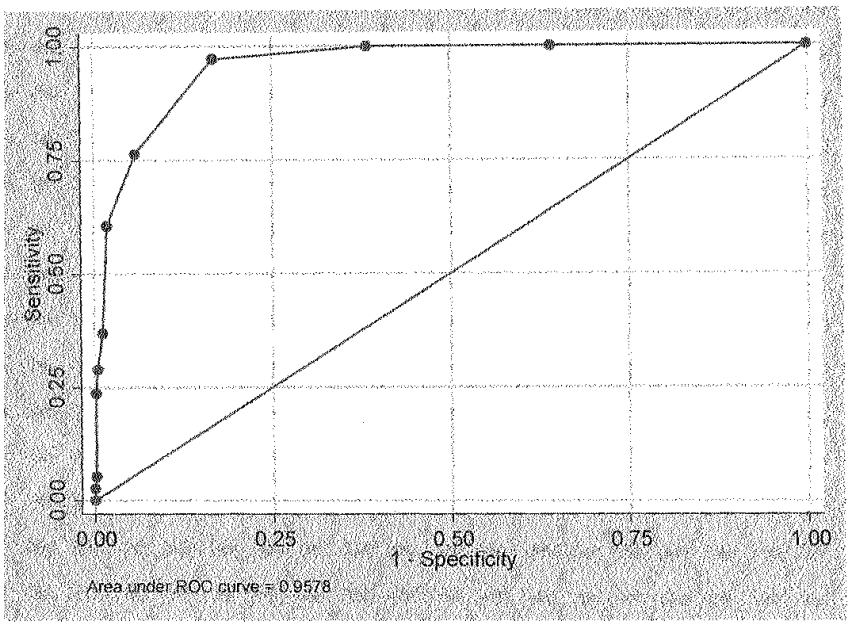
Table 6. Sensitivity and specificity of high birthweight

SFH (cm.)	sensitivity	Specificity	PPV (%)	NPV (%)
≥ 35	100	78.66	8.2	100
≥ 36	100	86.33	12.3	100
≥ 37	100	91.83	19.0	100
≥ 38	97.37	96.42	34.3	99.9
≥ 39	76.32	98.74	53.7	99.5

Table 6. Sensitivity and specificity of high birthweight (cont.)

SFH (cm.)	sensitivity	Specificity	PPV (%)	NPV (%)
≥ 40	60.53	98.74	74.2	99.2
≥ 41	36.84	99.75	73.7	98.8
≥ 42	28.95	99.90	85.6	98.7

SFH = Symphysis fundal height



PPV = Positive predictive value

NPV = Negative predictive value

Fig 2. Receiver operating characteristics (ROC) curve for prediction of infant with high birthweight

Table 7. Comparison of complication between SFH < 38 cm and SFH > 38 cm

Complication	SFH < 38 (cm.) n = 1912	SFH ≥ 38 (cm.) n = 108	p-value
C/S (%)	824 (43.1 %)	73(67.59%)	< 0.001
Shoulder dystocia (%)	4(0.21%)	3(2.78%)	0.004
Birth asphyxia (%)	13(0.68%)	1(0.59%)	0.538

C/S = cesarean section

SFH = Symphysis fundal height

Discussion

From this study, SFH, abdominal circumference, weight before pregnancy, weight before delivery, weight gain during pregnancy, BMI before pregnancy and before delivery, and maternal height were significantly associated with infant birthweight and these results were consistent with previous reports[3,4,9,10-16]. Among these parameters, SFH was the most significantly associated with birthweight[12] and can be used to predict infant birthweight. The correlation coefficient of SFH and infant birthweight was 0.84 similar to previous reports[9,10].

There may be confounders such as rupture of membranes, engagement of presentation. However, previous study has demonstrated the very low correlation between birthweight, membranes status and engagement of the presentation (0.06 and 0.11, respectively)[9]. As for maternal weight, it has been found that weight before pregnancy, weight before delivery, weight gain during pregnancy, BMI before pregnancy and before delivery were correlated with birthweight between 0.12 and 0.36. These may affect the SFH. Weight and BMI before pregnancy were more correlated with prepregnancy than predelivery period. Previous study have shown that the measurement of SFH varied between 1-4 cm[9] although the research staff have been trained. All staff were tested before the data were collected.

For infant infant birthweight prediction, SFH of less than or equal to 30 cm is used. This value had high sensitivity and specificity (88.96% and 79.77%, respectively) and is consistent with one previously report[3]. Some studies differed in cut off points such as 31, 32 and 34 cm[5,6,9] which may due to the different population. Prediction for high birthweight was SFH of 38 cm. with the sensitivity and specificity of 97.37% and 96.42%, respectively[3]. Other studies used the value of 39 and 40 cm[6,9]. This difference may also due to difference in population, number of samples and duration of data collection. From this study, mothers with SFH of higher than or equal to 38 cm had increased risk of cesarean delivery and shoulder dystocia. This means that doctors should be aware of this complication and notify the referral center.

We suggest for the benefit of both the mother and infant, SFH should be used as an alternative for prediction of infant birthweight especially in primary health care center or hospitals that do not have either ultrasonography or experienced personnel. This test was simple, widely available, non invasive and cheap which was appropriate for screening.

Conclusion

From the study of 2,020 pregnant women, the symphysis fundal height was found to be a good prediction for infant birthweight. The value used to predict infants with low and high birthweight was less than and equal to 30 cm and higher than or equal to 38 cm, respectively. These results are useful information to refer pregnant women patients, especially for mothers with the fundal height of higher than or equal to 38 cm, who had high risk of cesarean delivery and shoulder dystocia.

References

1. Cunningham FG, Leveno KJ, Bloom SL, Hauth JC, Rouse DJ, Spong CY. Williams obstetrics. 23st ed. New York : Mc Graw Hill; 2010.
2. Westin B. Gravidogram and fetal growth. Acta Obstet Gynecol Scand 1977;6:273-82.
3. Woo J SK, Ngan YS, Au KL, Fung KP, Wong CW. Estimation of fetal weight in utero from symphysis fundal height and abdominal girth measurements. Aust NZ J Obstet Gynecol 1985;25:268-71.
4. Walraven GEL, Mkanje RLB, Van Roosmalen J, Van Dongen PWJ. Single pre-delivery symphysis-fundal height measurement as a predictor of birthweight and multiple pregnancy . Br J obstet Gynaecol 1995;102:525-9.
5. Pongrojpaw D, Sututworawut S, Patrachai S. Intrapartum symphysis-fundal height measurement in prediction of low birthweight infant. Thammasat Med J 2001;1,2:32-37
6. Pongsawatkul K. Intrapartum symphysis - fundal height measurement in prediction of both low birthweight and big baby. Bull Dept Med Serv 2006; 31:47-54.
7. Pongsawatkul K. Fetal Birthweight Prediction by Multiplication of Intrapartum Symphysio-Fundal Height and Abdominal Girth at Umbilical Level. Buddhachinaraj Medical Journal 2007;24,1:15-21.
8. Chaturachinda K, Hiranraks A, Auamkul N, Kanchahasinith K, Amornvichet P, O-Prasertsawat P. Low birthweight in Thailand. J Med Assoc Thai 1993;76:36-9.

9. Tangnoi V. Estimation of fetal weight from symphysis-fundal height measurement. Maharat Nakhon Ratchasima Hosp Med Bull 2005;19,1:115–25.
10. Tangnoi V. Estimation of fetal weight from symphysis-fundal height measurement. Maharat Nakhon Ratchasima Hosp Med Bull 2001;15,1-2(Suppl): 67-78.
11. Field NT, Piper JM, Langer O. The effect of maternal obesity on the accuracy of fetal weight estimation. Obstet Gynecol 1995;86(1):102-7.
12. Rondó PH, Maia Filho NL, Valverde KK. Symphysis-fundal height and size at birth. Int J Gynaecol Obstet. 2003;81(1):53-4.
13. Nahum GG, Stanislaw H, Huffaker BJ. Accurate prediction of term birthweight from prospectively measurable maternal characteristics. Prim Care Update Ob Gyns 1998;5(4):193-4.
14. Nahum GG, Pham KQ, Stanislaw H. Prediction of term birthweight in Hispanic women using an equation based on maternal characteristics. Eur J Obstet Gynecol Reprod Biol 2004;112(2):145-50.
15. Rode L, Hegaard HK, Kjaergaard H, Møller LF, Tabor A, Ottesen B. Association between maternal weight gain and birthweight. Obstet Gynecol 2007 Jun;109(6):1309-15.
16. Fox NS, Bhavsar V, Saltzman DH, Rebarber A, Chasen ST. Influence of maternal body mass index on the clinical estimation of fetal weight in term pregnancies. Obstet Gynecol 2009;113(3):641-5.

การวัดระดับความสูงของมดลูกก่อนคลอดเพื่อใช้ในการทำนายน้ำหนักทารกแรกเกิด

พัทธวรรณ์ นาคาภรณ์ธรรม, พิเศก ทองสวัสดิ์วงศ์

วัตถุประสงค์ *: 1. เพื่อศึกษาหาความไว ความจำเพาะ ค่าการทำนายของระดับความสูงของมดลูกก่อนคลอดต่อน้ำหนักแรกเกิดของทารก 2. เพื่อวิเคราะห์ความสัมพันธ์ระหว่างความสูงของมดลูกก่อนคลอดกับการเกิดภาวะแทรกซ้อนด้าน birth asphyxia, shoulder dystocia, cesarean section rate*

วัสดุและวิธีการ *: ทำการศึกษาในสตรีตั้งครรภ์ 2002 คนที่มาคลอดบุตรที่โรงพยาบาลมหาราชนครราชสีมา ระหว่างวันที่ 1 กันยายน 2552 ถึง 31 ธันวาคม 2552 โดยเก็บข้อมูลระดับความสูงของยอดมดลูกและตัวแปรอื่นที่สำคัญและบันทึกลงในแบบบันทึกข้อมูล แล้วนำไปวิเคราะห์และเปรียบ เทียบทางสถิติ*

ผลการวิจัย *: จากการศึกษาพบว่าระดับความสูงของมดลูกก่อนคลอดและน้ำหนักทารกแรกเกิด มีความสัมพันธ์กันอย่างมีนัยสำคัญด้วยค่าสัมประสิทธิ์สัมพันธ์ (correlation coefficient) เท่ากับ 0.84 โดยมีทารกแรกเกิดน้ำหนัก ≤ 2500 กรัม และน้ำหนัก ≥ 4000 กรัม เท่ากับ ร้อยละ 8.5 และ 1.8ตามลำดับ ระดับความสูงของมดลูกที่ ≤ 30 เซนติเมตร มีค่าความไวร้อยละ 88.9 ค่าความจำเพาะร้อยละ 79.7 ค่าทำนายผลบวกร้อยละ 98.2 และค่าทำนายผลลบร้อยละ 39.4 ในการทำนายทารกน้ำหนัก ≤ 2500 กรัม และระดับความสูงของมดลูกที่ ≥ 38 เซนติเมตร มีค่าความไวร้อยละ 97.3 ค่าความจำเพาะร้อยละ 96.4 ค่าทำนายผลบวกร้อยละ 34.3 และค่าทำนายผลลบร้อยละ 99.9 ในการทำนายทารกน้ำหนัก ≥ 4000 กรัม และในกลุ่มหลังนี้ พบว่ามีความเสี่ยงต่อภาวะการคลอดติดไหล่ และ การผ่าตัดคลอดเพิ่มขึ้นอย่างมีนัยสำคัญทางสถิติ*

สรุป *: ระดับความสูงของมดลูกก่อนคลอดมีความสัมพันธ์กันอย่างมีนัยสำคัญกับน้ำหนักทารกแรกเกิด โดยค่าระดับความสูง ≤ 30 เซนติเมตรใช้ทำนายทารกน้ำหนัก ≤ 2500 กรัม และระดับความสูง≥ 38 เซนติเมตรใช้ทำนายทารกน้ำหนัก ≥ 4000 กรัม*