

Charts of Fetal Biometries at Sukhothai Hospital

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Objective: To construct charts of fetal biometries at Sukhothai Hospital.

Material and Method: One hundred and fifty-one pregnant women attending the antenatal care clinic, Sukhothai Hospital were recruited and received ultrasonographic examinations every four weeks until delivery.

Results: Biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL) were collected from 34 samples in each gestational age group. When comparing the results with those from Western studies, all four fetal size parameters tended clearly to be lower. When comparing the results with those from King Chulalongkorn Memorial Hospital, biparietal diameter, head circumference, and femur length tended to be lower in the gestational age group of 36-40 weeks.

Conclusion: The construction of charts of fetal biometries in each region may be useful for obstetric management.

Keywords: Fetal biometries, Biparietal diameter, Head circumference, Abdominal circumference, Femur length

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Currently, the ultrasonographic examination has an important role in the antenatal care clinics. In Thailand, it is available in almost all hospitals. In some hospitals, it is performed at least once throughout the pregnancy especially at 16-20 weeks' gestation as a screening protocol. Besides detecting fetal anomalies, the major aims are to estimate corrected gestational age and to assess fetal growth. Precise expected date of confinement and status of fetal growth are considerable in the management and planning for obstetric patients. To accomplish the objectives, fetal size is measured and compared with reference values that have been established from the present study in many normal pregnant women. The well-known fetal size parameters included biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL).

There are numerous reference values of fetal size parameter or charts of fetal biometries previously reported by many authors from several regions around the world⁽¹⁻⁵⁾ because differences in fetal biometries exist among various races of pregnant women^(6,7). In Thailand, several charts of fetal biometries have been

published⁽⁸⁻¹⁴⁾. They demonstrated that the four well-known fetal size parameters were lower than those from Western studies showing the importance of racial differences between populations. This elucidates the need to develop fetal biometries charts specifically for each region. All charts of fetal biometries in Thailand were studied in the urban areas.

Sukhothai province is located in the rural area at the northern region of Thailand. Most of the population is mainly farmers earning low incomes. From the author's personal experience, fetal size parameters in Sukhothai Hospital may be discrepant from previous reported Thai charts of fetal biometries caused by the difference of characteristics of population, such as socio-economic status. Therefore, the author has constructed the charts of fetal biometries from pregnant women attending the antenatal care clinic, Sukhothai Hospital to be used as reference values for estimating gestational age and assessing fetal growth in Sukhothai pregnant women.

Material and Method

In this prospective, descriptive study, one hundred and fifty-one pregnant women attending the antenatal care clinic, Sukhothai Hospital, between May 2003 and April 2006 were recruited into the present

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Table 1. Chart of fetal biometrics: biparietal diameter (BPD) (n = 151)

GA (weeks)	Mean (mm)	SD (mm)	5 th percentile (mm)	50 th percentile (mm)	95 th percentile (mm)
14	25.63	1.98	22.86	25.70	29.14
15	30.73	1.72	28.49	30.65	33.48
16	33.83	2.32	30.26	33.55	38.11
17	37.08	2.47	32.59	37.75	40.55
18	40.94	2.94	35.78	41.90	44.74
19	43.66	2.57	39.29	43.80	47.68
20	46.84	2.36	42.70	46.95	50.53
21	50.21	1.94	47.20	50.35	53.07
22	52.56	2.56	48.93	53.10	56.42
23	56.36	2.09	52.93	56.95	59.18
24	58.89	2.31	54.83	59.15	62.25
25	62.06	2.34	57.93	62.95	65.81
26	64.20	1.97	61.33	64.75	66.81
27	67.01	2.13	63.83	67.20	69.68
28	69.65	1.81	66.98	69.70	73.07
29	72.71	2.32	69.33	72.90	76.87
30	74.79	2.33	71.86	74.20	78.87
31	77.34	1.76	74.46	77.55	79.94
32	79.61	1.89	76.69	79.80	82.74
33	81.56	1.91	78.26	81.85	84.28
34	83.17	1.97	79.83	83.05	86.29
35	83.43	2.07	80.79	83.20	86.81
36	85.18	1.87	82.90	85.15	88.48
37	86.93	2.15	83.83	86.85	90.11
38	88.50	2.09	85.51	88.05	91.48
39	88.98	2.21	85.69	89.05	91.81
40	89.03	2.85	84.69	88.85	93.87

study. The inclusion criteria were: 1) single pregnancy that first antenatal care visit occurred before 12 weeks' gestation 2) history of regular menstrual cycle with certain last menstrual period 3) gestational age calculated from crown rump length measured in the first antenatal care visit differing from gestational age calculated from last menstrual period not more than seven days 4) voluntary participation with informed consent. The exclusion criteria were: 1) pregnant women with medical or obstetric complications that might affect fetal growth e.g. gestational diabetes 2) dead fetus *in utero* 3) fetus or infant with congenital anomalies 4) birth weight of infant in the range of small or large for gestational age (SGA or LGA) 5) loss to the follow-up or incomplete data. The sample size was calculated by using data from a pilot study of 10 samples in each gestational age and 34 samples in each gestational age were needed for the present study.

After taking the history, explaining about the study protocol and voluntary participation, ultra-

sonographic examinations were performed to measure crown rump length. At first, 136 recruited pregnant women were randomized into four groups. The first group received examinations at 14, 18, 22, 26, 30, 34, and 38 weeks' gestation. The second group received examinations at 15, 19, 23, 27, 31, 35, and 39 weeks' gestation. The third group received examinations at 16, 20, 24, 28, 32, 36, and 40 weeks' gestation. The fourth group received examinations at 17, 21, 25, 29, 33, and 37 weeks' gestation. Because some samples delivered before 40 weeks' gestation, an additional 15 pregnant women were recruited and randomized to fulfill the needed number of samples in groups of 37, 38, 39, and 40 weeks' gestation. Biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL) of fetuses were measured by the ultrasonographic examinations with standard definitions⁽¹⁵⁾. All ultrasonographic examinations were performed only by the author, using a 5 MHz convex probe. The samples were followed until delivery.

Table 2. Chart of fetal biometrics: head circumference (HC)

GA (weeks)	Mean (mm)	SD (mm)	5 th percentile (mm)	50 th percentile (mm)	95 th percentile (mm)
14	97.79	6.27	87.72	98.10	106.11
15	114.03	6.17	103.34	114.70	123.61
16	126.96	7.95	113.82	128.60	141.83
17	141.09	8.33	120.69	143.10	150.87
18	154.01	9.99	136.78	155.60	167.27
19	164.56	9.34	147.79	166.20	177.23
20	177.66	8.53	164.98	177.75	190.11
21	187.74	8.47	176.83	187.30	199.34
22	195.29	7.86	181.83	197.25	205.61
23	208.49	9.94	192.85	208.75	225.16
24	220.25	6.03	210.80	220.25	228.14
25	231.82	9.21	216.91	233.25	247.04
26	239.51	8.60	225.72	238.35	252.66
27	248.80	10.95	228.83	249.25	264.39
28	258.29	8.19	243.72	259.90	269.27
29	268.24	8.72	252.33	269.85	278.22
30	277.15	6.52	265.79	278.20	285.96
31	281.31	6.52	269.83	281.80	290.11
32	290.92	9.29	274.72	291.05	302.07
33	296.23	8.04	281.83	297.65	306.04
34	303.12	7.11	290.53	303.70	311.32
35	307.62	6.30	297.83	307.75	317.47
36	312.46	6.88	302.48	311.75	322.68
37	314.73	5.29	309.09	314.60	325.47
38	322.46	7.62	309.34	321.85	337.18
39	323.57	9.03	309.48	323.55	338.57
40	324.29	6.42	314.83	324.85	335.25

Kolmogorov-Smirnov test was used to test the normality of collected data ($p = 0.01$). Descriptive statistics i.e. mean \pm Standard Deviation (SD), range and percentiles were presented to describe the results. The present study was approved by the Ethics Committee of Sukhothai Hospital.

Results

Nine hundred and eighteen ultrasonographic examinations were performed on 151 pregnant women. The mean (\pm SD) age of the samples was 24.37 ± 3.12 years, ranging from 17 to 34 years. Most were primipara (64.23%). Most were farmers (58.28%) and earned low incomes.

From the 918 measurements, fetal size parameters were collected from 34 samples in each gestational age (GA) group. Kolmogorov-Smirnov test showed normal distribution of data in all gestational age groups. The mean, standard deviation (SD), 5th, 50th, and 95th percentiles of biparietal diameter (BPD),

head circumference (HC), abdominal circumference (AC), and femur length (FL) in each gestational age group are shown in Table 1-4 respectively. The author also compared the derived centiles for fetal size parameters with those from King Chulalongkorn Memorial Hospital⁽¹⁶⁾ as shown in Fig. 1-4.

Discussion

The well-known fetal size parameters including biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL) had several applications in clinical practices such as determining gestational age, estimating fetal weight, and evaluating fetal growth. In the establishment of reference values, selection of samples is very important to represent the population reliably. In the present study, the author tried to use strict inclusion and exclusion criteria to select the samples and all ultrasonographic examinations were performed only by the author to prevent interobserver variation. Furthermore, a

Table 3. Chart of fetal biometrics: abdominal circumference (AC)

GA (weeks)	Mean (mm)	SD (mm)	5 th percentile (mm)	50 th percentile (mm)	95 th percentile (mm)
14	82.81	6.12	70.06	83.55	89.42
15	99.55	5.37	89.69	99.20	106.48
16	108.67	5.84	98.59	109.70	115.61
17	120.28	9.49	102.98	121.40	133.77
18	131.69	8.74	117.05	134.75	143.96
19	140.66	8.02	129.22	140.85	155.74
20	154.86	8.06	143.33	154.85	167.48
21	164.44	10.46	147.40	165.75	179.77
22	172.05	6.40	162.83	171.15	184.38
23	184.13	8.10	171.78	184.85	194.84
24	194.49	8.13	182.28	194.30	208.57
25	206.00	9.92	188.72	206.35	220.12
26	212.91	7.82	200.33	212.55	223.96
27	224.49	8.02	210.63	224.75	236.68
28	236.47	9.12	220.98	236.85	250.42
29	246.01	8.59	233.91	246.25	260.53
30	259.41	10.79	236.83	259.60	271.49
31	266.50	8.48	254.98	266.70	280.09
32	273.89	13.00	255.26	275.40	293.44
33	285.48	7.96	273.52	286.15	297.12
34	293.79	12.53	273.91	295.25	312.32
35	301.13	13.56	275.83	303.85	316.42
36	306.52	15.63	276.98	309.75	327.57
37	315.46	14.81	296.98	315.35	338.61
38	323.37	15.55	300.69	322.55	348.73
39	329.55	16.31	303.98	331.60	350.52
40	334.39	18.75	307.17	333.65	364.77

considerable number of samples in each gestational age group were studied to construct these reliable charts. Descriptive statistics including mean, SD, 5th percentile, 50th percentile and 95th percentile were used to present the reference values because of convenience for using in clinical practices.

When comparing the derived centiles for fetal size parameters with those of Hadlock FP et al⁽¹⁷⁾ from a Western population, all the centiles of four fetal size parameters trended clearly to be lower in the gestational age groups of 28-40 weeks. These findings were similar to other Thai studies⁽¹¹⁻¹⁴⁾ and might confirm the differences of fetal biometrics among the races as reported in previous studies. These emphasized the need to establish separate charts of fetal biometrics for each specific population.

When comparing biparietal diameter, 95th and 50th centile lines of the present study were close to 50th and 5th centile lines of those from King Chulalongkorn Memorial Hospital⁽¹⁶⁾ respectively in the gestational

age group of 36-40 weeks (Fig. 1). These findings were consistent when comparing head circumference and femur length (Fig. 2, 4), but derived centiles of abdominal circumference trended to be indifferent when comparing those from the present study and from King Chulalongkorn Memorial Hospital⁽¹⁶⁾. However, more sample size was needed to prove whether differences of biparietal diameter, head circumference, and femur length were statistically significant.

All previous reports of Thai fetal biometrics were studied in urban areas such as Bangkok, Chiang Mai and Songkla. One of them⁽¹¹⁾ reported proximity of biparietal diameter between those from Siriraj Hospital and those from Songklanagarind Hospital but, in the present study, discrepancy was found as described before. This might demonstrate that not only race affected fetal biometrics, but other factors impacted them too. The difference among the present and previous Thai studies was characteristics of population. The present study was the first report of Thai fetal bio-

Table 4. Chart of fetal biometries: femur length (FL)

GA (weeks)	Mean (mm)	SD (mm)	5 th percentile (mm)	50 th percentile (mm)	95 th percentile (mm)
14	13.97	1.86	10.79	14.10	16.68
15	16.47	1.97	12.72	16.75	19.14
16	19.38	2.54	15.72	19.10	24.07
17	23.51	2.25	19.26	24.10	26.04
18	26.34	3.09	20.78	26.10	30.35
19	28.58	3.08	23.72	28.80	34.22
20	31.66	2.60	26.96	32.15	34.77
21	33.89	2.32	29.83	34.10	37.18
22	35.69	1.78	32.83	36.20	37.74
23	39.18	2.77	35.33	39.35	43.29
24	41.10	2.34	36.70	41.45	44.11
25	44.38	2.53	40.33	44.40	48.25
26	46.01	2.47	42.41	46.25	49.25
27	48.32	2.41	44.39	48.05	51.53
28	51.44	2.76	47.52	51.75	55.87
29	53.16	2.08	49.93	53.30	55.94
30	55.52	2.08	52.79	55.40	58.68
31	57.16	1.99	54.97	57.10	61.07
32	59.74	1.98	56.83	59.20	62.87
33	61.29	1.78	58.97	61.05	63.61
34	62.60	1.85	59.79	62.15	65.74
35	64.12	1.63	61.13	64.05	66.14
36	65.55	1.91	62.33	65.90	68.87
37	67.35	1.99	64.83	67.05	70.42
38	68.40	2.05	64.83	68.75	70.87
39	69.66	2.41	65.93	69.20	73.61
40	70.36	1.81	67.79	70.85	73.11

metries performed in a rural area setting in the northern region of Thailand. Most cases were farmers and had low socioeconomic, thus nutritional status and lifestyle was different from cases in an urban area setting. Therefore, the construction of charts of fetal biometries in each region might be necessary for proper management of obstetric patients. Additional analytic studies are required to prove influences of socioeconomic and other factors to fetal biometries.

Conclusion

The author has presented the charts of fetal biometries at Sukhothai Hospital derived from a carefully designed prospective study. The fetal biometries from the present study have a clear trend to be lower than those from Western studies and might be lower than those from other previous Thai studies. Therefore, the construction of charts of fetal biometries in each region may be useful for obstetric management.

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References

1. Humphrey M, Holzheimer D. Fetal growth charts for Aboriginal fetuses. *Aus N Z J Obstet Gynaecol* 2000; 40: 388-93.
2. Neufeld LM, Haas JD, Grajeda R, Martorell R. Ultrasound measurement of fetal size in rural Guatemala. *Int J Gynaecol Obstet* 2004; 84: 220-8.
3. Nasrat H, Bondagji NS. Ultrasound biometry of Arabian fetuses. *Int J Gynaecol Obstet* 2005; 88: 173-8.
4. Merialdi M, Caulfield LE, Zavaleta N, Figueroa A, Costigan KA, Dominici F, et al. Fetal growth in Peru: comparisons with international fetal size

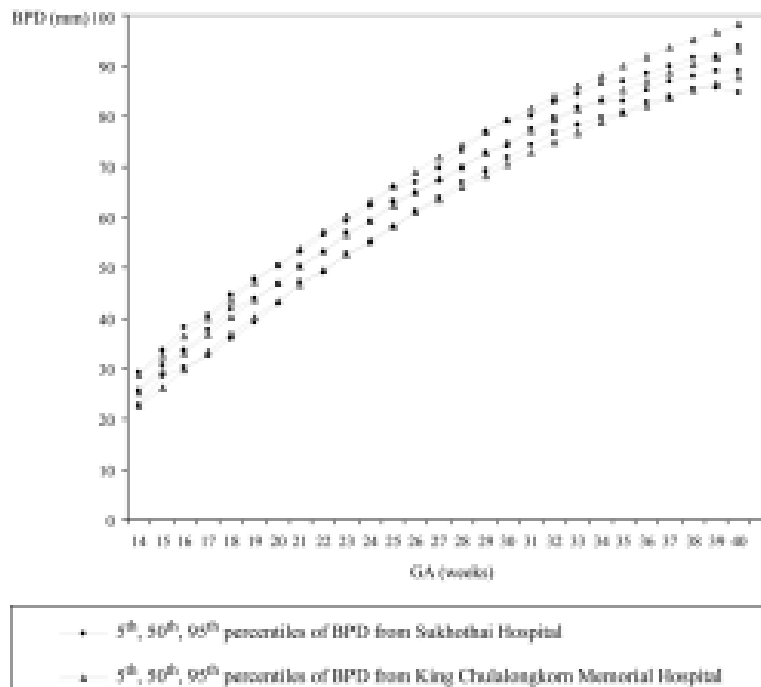


Fig. 1 5th, 50th, 95th percentiles of biparietal diameter (BPD) from Sukhothai Hospital and King Chulalongkorn Memorial Hospital

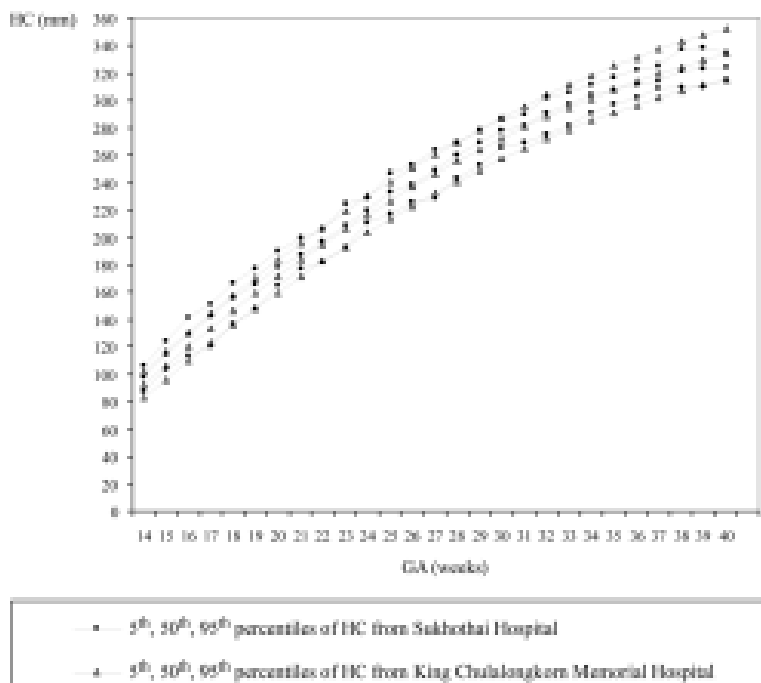


Fig. 2 5th, 50th, 95th percentiles of head circumference (HC) from Sukhothai Hospital and King Chulalongkorn Memorial Hospital

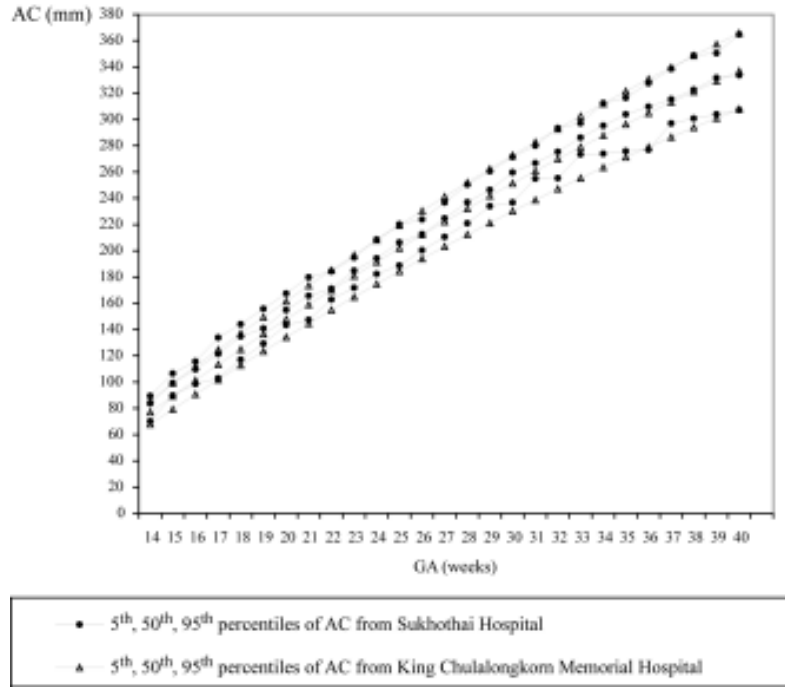


Fig. 3 5th, 50th, 95th percentiles of abdominal circumference (AC) from Sukhothai Hospital and King Chulalongkorn Memorial Hospital

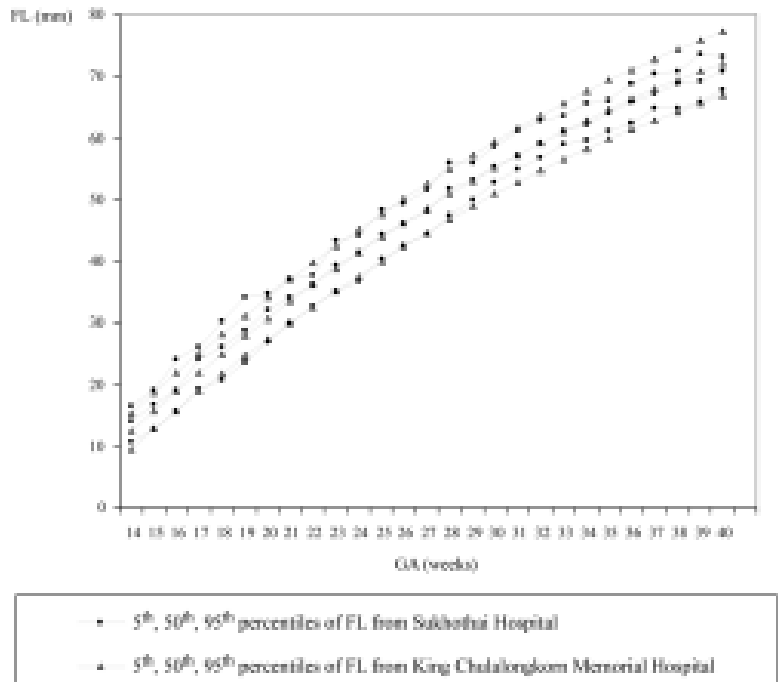


Fig. 4 5th, 50th, 95th percentiles of femur length (FL) from Sukhothai Hospital and King Chulalongkorn Memorial Hospital

- charts and implications for fetal growth assessment. *Ultrasound Obstet Gynecol* 2005; 26: 123-8.
5. Paladini D, Rustico M, Viora E, Giani U, Bruzzese D, Campogrande M, et al. Fetal size charts for the Italian population. Normative curves of head, abdomen and long bones. *Prenat Diagn* 2005; 25: 456-64.
 6. Davis RO, Cutter GR, Goldenberg RL, Hoffman HJ, Cliver SP, Brumfield CG. Fetal biparietal diameter, head circumference, abdominal circumference and femur length. A comparison by race and sex. *J Reprod Med* 1993; 38: 201-6.
 7. Jacquemyn Y, Sys SU, Verdonk P. Fetal biometry in different ethnic groups. *Early Hum Dev* 2000; 57: 1-13.
 8. Tongsong T, Wanapirak C, Yamphochai A. Ultrasonic measurement of fetal biparietal diameter in normal pregnant Northern Thai women. *Thai J Obstet Gynaecol* 1990; 2: 73-9.
 9. Tongsong T, Wanapirak C, Takapijitra A. Ultrasound fetal femur length in normal pregnant Northern Thai women. *Thai J Obstet Gynaecol* 1991; 3: 79-83.
 10. Koranantakul O, Rattanapreuksachart R, Chanvita P. Fetal biparietal diameters in normal pregnant Southern Thai women. *Thai J Obstet Gynaecol* 1991; 3: 71-7.
 11. Siwadune T, Sunsaneevithayakul P, Titapant V, Boriboonhirunsarn D, Kanokpongsakdi S. Charts of Thai fetal biometrics: 2. biparietal diameter. *J Med Assoc Thai* 2000; 83: 292-8.
 12. Titapant V, Siwadune T, Boriboonhirunsarn D, Sunsaneevithayakul P, Swasdimongkol S, Sutanthavibul A. Charts of Thai fetal biometrics: 3. femur length. *J Med Assoc Thai* 2000; 83: 299-306.
 13. Sunsaneevithayakul P, Boriboonhirunsarn D, Siwadune T, Titapant V, Vantanasiri C. Charts of Thai fetal biometrics: 4. abdominal circumference. *J Med Assoc Thai* 2000; 83: 307-14.
 14. Sutanthavibul A, Sunsaneevithayakul P, Boriboonhirunsarn D, Titapant V, Siwadune T. Charts of Thai fetal biometry: head circumference. *Siriraj Hosp Gaz* 2000; 52: 445-51.
 15. Benson CB, Doubilet PM. Fetal measurements-normal and abnormal fetal growth. In: Rumack CM, Wilson SR, Charboneau JW, editors. *Diagnostic ultrasound*. St. Louis: Mosby-Year Book, Inc.; 1998: 1013-31.
 16. Tannirandorn Y. Ultrasonography in obstetrics. In: Tannirandorn Y, Bunyavejchevin S, editors. *Clinical practice in obstetrics and gynecology*. Bangkok: Chulalongkorn University Printing House; 2001: 1-4.
 17. Hadlock FP, Deter RL, Harrist RB, Park SK. Estimating fetal age: computer-assisted analysis of multiple fetal growth parameters. *Radiology* 1984; 152: 497-501.

ตารางอ้างอิงของขนาดทารกในครรภ์ที่โรงพยาบาลสุโขทัย

กวิณ ก้านแก้ว

วัตถุประสงค์: เพื่อสร้างตารางอ้างอิงของขนาดทารกในครรภ์ที่โรงพยาบาลสุโขทัย

วัสดุและวิธีการ: สตรีตั้งครรภ์ที่ฝากครรภ์ที่คลินิกฝากครรภ์โรงพยาบาลสุโขทัยจำนวน 151 คนถูกคัดเลือก และได้รับการตรวจด้วยเครื่องตรวจคลื่นเสียงความถี่สูงทุกสี่สัปดาห์จนคลอด

ผลการศึกษา: เส้นผ่าศูนย์กลางไปพารไอดีล, ขนาดเส้นรอบวงศีรษะ, ขนาดเส้นรอบวงท้องและความยาวกระดูกต้นขาของทารกในครรภ์ได้รับการวัดด้วยจำนวน 34 รายในแต่ละอายุครรภ์ เมื่อเปรียบเทียบกับผลการศึกษาของประเทศทางตะวันตก พบว่ามีแนวโน้มต่ำกว่าอย่างชัดเจน เมื่อเปรียบเทียบกับผลการศึกษาของโรงพยาบาลจุฬาลงกรณ์ พบว่าเส้นผ่าศูนย์กลางไปพารไอดีล, ขนาดเส้นรอบวงศีรษะ, และความยาวกระดูกต้นขาของทารกในครรภ์มีแนวโน้มต่ำกว่า ในกลุ่มอายุครรภ์ 36-40 สัปดาห์

สรุป: การสร้างตารางอ้างอิงของขนาดทารกในครรภ์ในแต่ละพื้นที่อาจมีประโยชน์ในการดูแลรักษาผู้ป่วยทางสูติกรรม