Original Article

Discrepancy Analysis between Clinical Versus Ultrasound Estimated Fetal Weight and Actual Birth Weight at 3rd Trimester

Shewly NR[1], Ferdous M[2], Begum H[3], Khan SH[4], Debee SR[5], Rahman S[6], Tasnim KS[6], Zaman I[8]

Abstract

Background: In obstetric management fetal weight estimation is an important consideration when planning the mode of delivery in our day to day practice. In Bangladesh low birth weight is a major public health problem & incidence is 38% - 58%. Neonatal mortality and morbidity also yet high. So accurate antenatal estimation of fetal weight is a good way to detect macrosomia or small for date baby. Thus to improve the pregnancy outcome and neonatal outcome decreasing various chance of neonatal mortality and morbidity antenatal fetal weight prediction is an invaluable parameter in some situation where to identify the at risk pregnancy for low birth weight become necessary. Reliable method for prenatal estimation of fetal weight two modalities have got popularity - Clinical estimation and another one is ultrasonic estimation. This study was designed to determine the accuracy of clinical versus ultrasound estimated fetal weight detecting the discrepancy with actual birth weight at third trimester. So that we can verify more reliable and accurate method.

Objectives: To find out more accurate and reliable modality of fetal weight estimation in antenatal period during obstetric management planning. To compare clinical versus ultrasound estimated fetal weight & to determine discrepancy of both variable with actual birth weight.

Method: This prospective, cross sectional analytical study was carried out in Dhaka Medical College Hospital from January 2006 to December 2006. By purposive sampling 100 pregnant women fulfilling inclusion criteria were included in my study in third trimester (29wks-40wks). In clinical weight estimation procedure SFH (Symphysio Fundal Height) was measured in centimeter. On pervaginal finding whether vertex below or above the ischial spine was determined. By Johnson's formula fetal weight in grams was estimated. Then by ultrasound scan different biometric measurements were taken and finally by Hadlock's formula fetal weight was estimated. Eventually actual birth weight was taken after birth by Globe Brand weighing machine. Accuracy of both modalities were compared and which one was more reliable predictor was determined by statistical analysis.

Results: After data collection were analyzed by computer based software (SPSS). There was gradual and positive relationship between symphysiofundal height and estimated birth weight. Discrepancy between clinical and actual birth weight at third trimester was statistically significant – Paired Student's 't' test was done where p value was <0.001. Whereas discrepancy between sonographically estimated fetal weight with actual birth weight was not statistically significant (by paired 't' test where p value was >0.05). That implies discrepancy between ultrasound estimated fetal weight and actual birth weight was significantly less than that of clinically estimated fetal weight. 14% clinically and 46% sonographically estimated fetal weight were observed within ≤ 5% of actual birth weight. 31% clinical and 42% sonographically estimates observed within 6% to 10% of actual birth weight and 55% clinical and 12% sonographically estimate were >10% of actual birth weight. That is about 88% sonographical versus 45% clinical estimates were within 10% of actual birth weight.

Conclusion: There is no doubt about importance of fetal weight in many obstetric situations. Clinical decisions at times depends on fetal weight. Whether to use oxytocin, to use forceps or vacuum for delivery or extend of trial or ended by Caesarian section immediately or no scope of trial to be largely depend on fetal size and weight. So more accurate modality for antenatal fetal weight estimation has paramount importance. In my study sonographically estimated weight have more accuracy than that of clinical estimate in predicting actual birth weight. Sonographically estimated fetal weight is more reliable, accurate and reproducible rather than other modality.

1. Dr. Naznin Rashid Shewly, Associate Professor, Department of Obstetrics & Gynecology, Shaheed Suhrawardy Medical College Hospital
2. Dr. Menoka Ferdous, Associate Professor, Department of Obstetrics & Gynecology, Shaheed Suhrawardy Medical College Hospital
3. Dr. Hasina Begum, Consultant, Department of Obstetrics & Gynecology, Shaheed Suhrawardy Medical College Hospital
4. Dr. Shahadat Hossain Khan, Consultant (Pediatrics), UHC, Homna, Comilla
5. Dr. Sheema Rani Debee, Junior Consultant, Department of Obstetrics & Gynecology, Shaheed Suhrawardy Medical College Hospital
6. Dr. Sumana Rahman, Junior Consultant, Department of Obstetrics & Gynecology, Government Employees' Hospital, Fulbaria, Dhaka
7. Dr. Khandakar Shehneela Tasnim, Junior Consultant, Department of Obstetrics & Gynecology, Shaheed Suhrawardy Medical College Hospital
8. Dr. Iffat Zaman, Senior Consultant, Department of Obstetrics & Gynecology, Shaheed Suhrawardy Medical College Hospital
Correspondence to: Dr. Naznin Rashid Shewly, Associate Professor, Department of Obstetrics & Gynecology, Shaheed Suhrawardy Medical College Hospital, Dhaka. Mobile: 01818189717 E-mail: nazninshewli21@gmail.com

Introduction

Fetal weight is one of the important indicators of delivery outcome and birth weight is a reliable and sensitive indicator for predicting the immediate or later outcome of a newborn.[1] Therefore there is no doubt about the necessity and importance of estimation of fetal weight in utero in certain situation[2] Recognizing the importance of birth weight measurement 34" world Health Assembly, in 1981 recommended it to be one of the twelve global indicators for monitoring the health of community.[3] In both developed and developing countries, low birth weight is single most important factor that affect neonatal mortality and morbidity. In Bangladesh, low birth weight is a major public health problem and incidence of low birth weight is 38%-50%. Neonatal mortality is 54/1000 live birth and infant mortality rate is 81/1000 live birth, Early neonatal death contribute 33% of mortality.[4] So accurate antenatal prediction of fetal weight is to be a good way to identify the at-risk pregnancy for low birth weight. So that proper treatment can be given to improve the birth weight. Pregnant women, who are predicted to deliverintrauterine growth retarded infant can be referred to more equipped health care centre to get benefits from more sophisticated diagnostic and therapeutic modalities. After delivery, proper neonatal care can lower down the perinatal morbidity and mortality.Obstetric management is often influenced by clinical and ultrasound estimation of fetal weight. Estimated fetal weight is an important consideration when planning the mode of delivery for a suspected macrosomic or small fetus.[5] Reliable method for assessment of fetal growth during antenatal period continue to be explored. The common useful methods of assessing fetal weight are - clinical and ultrasonic estimation, In clinical method, various parameters are used for fetal weight estimation. Among clinical parameters – symphysio-fundal height measurement is important.[6] Use of symphysio fundal height as fetal growth assessment was being considered as early as 1953 by Rumbolze and MC Groogan.[7] There was comparative study between clinical versus ultrasonography for fetal growth prediction demonstrate that measurement of SFH can be used by medical and paramedical staff without loss of accuracy. No sophisticated equipment is necessary.[8] The uterine fundal and abdominal girth when related to gestational age, can accurately predict the neonatal birth weight category[9]. Monitoring via a cross sectional chart of fundal height offers a potentially useful screening method for detecting light for gestational agebirth during pregnancy.[10] Though fetal weight measurement clinically by using SFH is easy, non-expensive and readily feasible but in some

study underrate the diagnosis of intrauterine growth retardation (IUGR) and prenatal detection of IUGR using this method varies between 10 & 30 %.[11] Ultrasonic measurement of fetus during antenatal period are becoming an important means for assessing fetal maturity, size and growth rate, where facility is available, whereas clinical parameters for assessment of fetal growth continue to remain the only tool in our country: where facility is limited. In ultrasonic fetal weight estimation based on biometry measurement using different formula have been reported with systemic errors of less than of 10% relative to birth weight.[12] So, in spite of wide variation in prediction of IUGR antenataly by SFH measurement – the method simplicity, widespread use, low cost make it worth considering as a possible valuable predictor of fetal weight in context of our country and on the other hand as a non-invasive reliable technique like ultrasonography is quite popular tool for obstetric practice, where facility is available.This study was designed to determine the accuracy of clinical versus ultrasound estimated fetal weight detecting the discrepancy with actual birth weight at 3rd trimester. Moreover I wanted to find out that either sonographic estimated fetal weight or clinical estimated fetal weight is more reliable predictor of fetal actual birth weight when obstetric management plan become critical in some situation.

Objectives

To find out the most accurate method of estimation of fetal weight for better guidance in clinical case management. To estimate the fetal weight clinically by symphysio fundal height (SFH) and comparing it with actual birth weight determination of its predicting capacity. To compare clinical versus ultrasonic estimated fetal weight and the determine discrepancy of both variable with actual birth weight. To assess the predicting capability of both modalities-which one is more reliable predictor of actual birth weight.

Methods

This prospective, cross sectional analytical study was carried out in Dhaka Medical College Hospital from January 2006 to December 2006. By purposive sampling 100 pregnant women fulfilling inclusion criteria were included in my study in third trimester (29wks-40wks). Pregnant women having history of regular menstrual cycle, knew LMP exactly, singleton pregnancy, longitudinal lie, cephalic presentation & intact membrane were included. Women with presence of uterine anomaly, big fibroid with pregnancy, excessive obesity, presence of congenital

anomaly, presence of polyhydramnionwere excluded in clinical fetal weight estimation method. Symphysio fundal height was measured in centimeter & in pervaginal examination whether vertex presentation, membrane intact and station below or above the ischial spine. Then fetal weight was estimated by Johnson's formula (Fetal Weight = (SFH – 12/11) × 155 in grams). Then ultrasound scan was done by Fukuda Dehsi FF Sonic-UF 4000 ultrasound machine (using 3.5 MHz curvilinear array abdominal transducer). Following fetal biometry were recorded –(1) BPD mm (2) HC mm (3) FL mm (4) AC mm and finally expected fetal weight in grams by Hadlock'sFormula. Gestational age, amniotic fluid volume index (AFI) were recorded also during sonographic scanning. Then actual birth weight wasmeasured just after birth in labor room or operation theatre using GLOBE BRAND weighting machine in grams. All data were collected from predesigned data collection sheet. Then analyzed by using computer based software SPSS.

Results

Collected data of this prospective cross sectional analytical study after appropriate statistical analysis results and relevant information were presented in following tables.

Table- I

Age Distribution (n = 100)

Age Group (Years)	Number of patients	Percentage
= 20	29	29%
21 - 25	47	47%
26 – 30	20	20%
31-35	4	4%

Age of the study patients ranged from 16 to 35 years. Mean (± SD) age being 23.04 ± 3.77 years.

Table-II

Gravidity distribution (n - 100)

Gravidity	Number of patients	Percentage
1	61	61%
2	26	26%
3	10	10%
4	3	3%

Table-II shows that maximum number of women (61%), were primigravida and remaining were multigravida.

Table-III

Relationship between symphysiofundal height (SFH) and estimated birth weight.

SFH (cm)	n	Estimated birth weight (gm) (Mean ± SD)
27	1	1,243.00 ± 93.1
28	12	1,288.87 ± 147.03
29	7	1,354.00 ± 143.491
30	13	1,450.19 ± 124.18
31	7	1,573.54 ± 204.56
32	10	1,908.05 ± 262.82
33	8	2,201.94 ± 284.17
34	6	2,294.33 ± 261.34
35	11	2,643.05 ± 201.26
36	15	2,785.65 ± 196.11
37	9	2,910.26 ± 126.03
38	1	3,054.00
SFH (cm)	100	32.62 ± 3.03
Estimated birth weight (gm)	100	2,072.68 ± 639.04
r value		+0.943
P value?[a]		<0.001

Here a is Person's correlation-coefficient
***significant

The above table shows that there is gradual and positive relationship between SFH & estimated birth weight.

Table-IV

Comparison between clinical and actual birth weights at = 36 weeks gestation. (n = 39)

Parameters	Mean ± SD	Difference	t value	P value
Clinically estimated fetal weight (gm)	2964.03 ± 388.33			
		1234.39 ± 208.92	68.650	<0.001***
Estimated fetal weight (gm) after birth	1,729.64 ± 472.58			

Table IV shows that there was significant difference between clinically estimated weight and at birth estimated fetal weight at = 36 weeks gestation (t = 68.659, P < 0.001).

Table-V

Comparison between clinical and actual birth weights at > 36 weeks gestation. (n = 61)

Parameters	Mean ± SD	Difference	t value	P value
Clinically estimated fetal weight (gm)	3,671.23 ± 185.57			
		886.08 ± 154.71	46.175	<0.001***
Estimated fetal weight (gm) after birth	2785.15 ± 195.97			

Table V shows that there was significant difference between clinically estimated weight and at birth estimated fetal weight and at birth estimated fetal weight at > 36 weeks gestation (t = 46.175, P < 0.001).

Table-VI

Discrepancy between sonographically estimated fetal weights with actual birth weights at different gestation weeks.

This table showed different ultrasonographic biometric data, EFW and actual birth weight at (29-32) weeks including p-value. Then upto 40 weeks will be shown successively by table VII & VIII.

Gestational age	29 week	30 week	31 week	32 week
BPD(mm) (mean ± SD)	73.25 ± 2.49	74.85 ± 3.71	77.69 ± 2.43	79.57 ± 2.33
HC(mm) (mean ± SD)	249.63 ± 1.93	251.92 ± 1.91	253.69 ± 2.01	258.64 ± 3.11
AC(mm) (mean ± SD)	266.69 ± 4.96	271.88 ± 5.15	276.27 ± 4.96	281.73 ± 6.19
FL(mm) (mean ± SD)	56.91 ± 1.12	59.68 ± 1.01	61.85 ± 1.05	63.93 ± 1.21
EFW (gm) (mean ± SD)	1,274 ± 116	1,430 ± 30	1,508 ± 78	1,808 ± 152
Birth weight (gm) (mean ± SD)	1,276 ± 112	1,428 ± 56	1,510 ± 69	1,801 ± 25
p value	NS (>0.05)	NS (>0.05)	NS (>0.05)	NS (>0.05)

Paired Student's 't' test,   NS = not significant.

Table-VII

Discrepancy between sonographic fetal weights and birth weights with different sonographic biometric data, p – value at 33 – 36 weeks of gestation.

Gestational age	33 week	34 week	35 week	36 week
BPD(mm) (mean ± SD)	82.86 ± 1.69	83.39 ± 2.78	84.69 ± 2.96	85.96 ± 3.14
HC(mm) (mean ± SD)	260.00 ± 1.83	265.43 ± 1.99	269.79 ± 2.06	270.25 ± 2.11
AC(mm) (mean ± SD)	287.51 ± 4.09	292.65 ± 5.63	299.32 ± 14.43	302.11 ± 12.84
FL(mm) (mean ± SD)	65.14 ± 1.02	66.91 ± 1.13	67.11 ± 1.05	68.62 ± 1.45
EFW (gm) (mean ± SD)	1,901 ± 77	2,024 ± 166	2,290 ± 158	2,585 ± 110
Birth weight (gm) (mean ± SD)	1,906 ± 62	2,030 ± 96	2,293 ± 140	2,580 ± 99
p value	NS (>0.05)	NS (>0.05)	NS (>0.05)	NS (>0.05)

Paired Student's 't' test   NS = not significant.

Table: VIII

Discrepancy between sonographic fetal weights and birth weights with different sonographic biometric data, along with p – value at 37 – 40 weeks of gestation.

Gestational age	37 week	38 week	39 week	40 week
BPD (mm)				
(mean ± SD)	87.7 ± 2.89	89.66 ± 4.49	90.65 ± 3.99	91.96 ± 4.33
HC (mm)				
(mean ± SD)	274.35 ± 2.45	299.09 ± 1.76	319.37 ± 2.33	346.39 ± 3.11
AC (mm)				
(mean ± SD)	307.61 ± 22.04	311.22 ± 21.02	317.64 ± 22.5	320.31 ± 21.23
FL (mm)				
(mean ± SD)	69.28 ± 3.24	70.49 ± 3.99	71.93 ± 4.08	72.96 ± 4.22
EFW (gm)				
(mean ± SD)	2,666 ± 249	2,704 ± 173	2,853 ± 132	3,032 ± 66
Birth weight (gm)				
(mean ± SD)	2,670 ± 210	2,701 ± 165	2,858 ± 96	3,036 ± 77
p value	NS (>0.05)	NS (>0.05)	NS (>0.05)	NS (>0.05)

Paired Student's 't' test
NS = not significant.

Table-IX

Discrepancy between clinically and sonographically estimated fetal weight at different weight range.

Estimation	<3,000gm (n=48) Mean(%) error	3000-3500gm (n=39) Mean(%) error	>3000-4000gm (n=13) Mean(%) error	>4000gm (n=1) Mean(%) error	All weights (n=100) Mean(%) error
Clinical	19.89 (0.74)	18.31 (0.57)	14.04 (0.38)	0	33.38 (1.05)
Ultrasound	21.00 (1.49)	44.38 (2.13)	24.12 (0.87)	0	45.19 (2.18)
Significance	t=68.341 P<0.001	t=27.852 P<0.001	t=43.506 P<0.001		t=62.756 P<0.001

Table-X

Variation of clinically and sonographically estimated fetal weight from actual birth weight (%)

Modalities of ante-partum fetal weight estimation	= 5% of actual birth weight Number & % of estimates		6% - 10% of actual birth weight Number & % of estimates		> 10% of actual birth weight Number & % of estimates	
Clinical	n = 14	14%	n = 31	31%	n = 55	55%
Sonographical	n = 46	46%	n = 42	42%	n = 12	12%

Table IX shows that 14% clinical and 46% sonographical estimates observed within = 5% of actual birth weight, 31% clinical and 42% sonoraphical estimates observed within 6% - 10% of actual birth weight, 55% clinical and 12% sonographical estimates were > 10% of actual birth weight. That is about 88% sonographical versus 45% clinical estimates were within 10% of actual birth weight.

Discussion

Accurate estimated fetal weight (EFW) is of paramount importance in the management of labour and delivery. During the last decade, EFW has been incorporated into the standard, routine ante partum evaluation of high risk pregnancies and deliveries. The accuracy of predicting birth weight by a variety of different formulas, incorporating different ultrasonic measurements, has been studied extensively.[13,14] However, no particular formula or biometric measurement has superior accuracy.[15,16] In general the mean absolute error of sonographically predicated fetal weight varies between 6 and 12 percent of the actual birth weight, and 40 to 75 percent of estimates fall within 10 percent of the actual birth weight.[15, 17-19] Before the introduction of ultrasound, fetal weight was assessed clinically, by external palpation of fetal parts and uterine contour. Early studies[20-22] showed that 80-85 percent of clinical estimates are within 500 gm of the actual birth weight and 69 percent of estimates fall within 10 percent of the actual birth weigh.[20] This study was conducted in DMCH which is a tertiary referral hospital. From the admitted patients in labour emergency ward I dealt with 100 number of patients during my study period who satisfied the inclusion criteria, were prospectively evaluated and the findings analyzed. In this study, maximum number of patients belonged to 21-25 years age group, the mean age (ESD) being 23.04+3.77 years (Table-I). Maximum number of women 61% were primigravida, 26% percent second, 10% third and only 3% were fourth gravida (Table-II). An increase in the measurement of SFH is noted relative to the progression of pregnancy. The progressive increase of SFH is observed from 29 to 36 weeks after which the rate of growth diminishes until 38 weeks when stabilizes. A correlation between the uterine height measurement (SFH) per pregnant woman and the amenorrhea show a correlation-coefficient (r) of 0.934 (n = 100, P < 0.001). This finding reflects the fact that the higher the SFH at a given gestational age, the higher the weight of the fetus (Table - III). Walson WJ et al[23], in one comparative study said that it is not surprising that clinical estimation is not different from ultrasound estimation for the average-sized fetus. The accuracy of clinical determination decreases with small and macrosomic fetuses - the extremes of special clinical significance.[23] Sherman et al[8] showed that the birth weight range between 2500-4000gm were detected more accurately by clinical method than ultrasonography. Shearman et al[8] also suggested that in lower range of birth weight (<2500gm), ultrasonic estimation was significantly accurate than clinical estimation. In mystudy estimated fetal weight clinically and sonographically at different weight range showing (Table - IX) p-value <0.001 which is statistically

significant. So, this result is not consistent with the previous study. Again, comparison between clinical weight and estimated fetal weight after birth at d" 36 weeks gestation. (n = 39) showed that symphysiofundal height derived fetal weight greatly differ from actual birth weight (t = 68.650, p<0.001, mean difference 1,234.39 208.92 gm.) [Table - IV] At > 36 weeks gestation (n = 61), there was also significant difference between clinically estimated fetal weight and birth weight (t = 46.175, p<0.001, mean difference 886.08 + 154.71gm) [Table - V]. From above result it can be assumed that discrepancy between clinical fetal weight and actual birth weight is significant statistically and clinical method for prediction of birth weight is not so accurate. Almost similar result have been found in a study conducted by Sherman et al[8]. That clinical method for detection of birth weight is not as accurate as ultrasonographic method in predicting actual birth weight. Another study conducted in Bangladesh by Begum R. et al, also showed almost similar findings.[24] Shamley and Landon[12] noted that the error of clinical estimation was statistically higher than that for ultrasonographic estimation by formulas designed by Hadlocket al[25] and Shepard et al.[26] These results were similar to other two studies by Sabbaghaet al,[18] and Rose and McCallum.[27] Patterson et al[28] also noted that clinical estimation was less accurate than ultrasonographic estimation by Campbell formula but was comparable to the Warsof formula of ultrasonographic estimation. In my study (Table VI, VII, VIII) showing variable sonographic biometric data including sonographically estimation fetal weight and actual birth weight a paired student's 't' test was performed which p value NS(>0.05). So there is no significant discrepancy between sonographically estimated expected fetal weight (EFW) and actual birth weight. Sonographically estimated weight have more accuracy than that of clinical estimation in predicting actual birth weight. Again a large study was done by Benacerraf et al[15] demonstrated that 74 percent of ultrasonographic estimation of fetal weight were within 10 percent of the actual birth weight. Fetal weight estimations based on ultrasound biometry measurements using different formulae, have been reported with systemic errors of less than 10 percent relative to birth weight[12]. Data obtained from this study were analyzed which was congruent with previous studies. This study (Table - X) showed that more than two third (88%) of sonographic estimates and only 45% of clinical estimates fall within 10% of actual birth weight respectively. Begum R et al[24] concluded that clinical estimation of fetal weight is not as accurate as ultrasonographic estimation. My study also support the aforementioned statement. Furthermore, the accuracy of sonographic measurements has been questioned, as a

consequence of large inter-observer variations.[29] So, A large scale study by same observer at same institution using same machine we can get more accurate result regarding ante-partum sonographic prediction of fetal weight.

Consolation

There is no doubt about the importance of estimation of fetal weight in many obstetric situations. It is one of the important indicators of mode of delivery and delivery outcome. Clinical decisions, such as whether to use oxytocin, forceps or vacuum for delivery or a trial of labour in breech presentation, rely largely on accurate estimation of fetal weight. Prior to the use of ultrasound, fetal weight was assessed clinically on the basis of external palpation of the fetal parts. Many of the investigators believe that ultrasound estimated fetal weight varies a little form actual birth weight in comparison to that by clinical estimation. A few agreed to the reverse statement.The present prospective study was undertaken to determine the accuracy of ultrasound estimated fetal weight analyzing the discrepancy with actual birth weight at 3rd trimester. A total of 100 patients were enrolled. This study reveals and support the fact that sonographically estimated fetal weight is more reliable, accurate and reproducible. Statistically non-significant variation with actual birth weight was observed. Eventually it has been concluded that sonographic estimated fetal weight has more congruity with actual birth weight and we can rely considerably on sonogrphically predicted fetal weight when obstetric management at times being critically influenced by fetal weight.

References

1. Tabib SM Shahnawaz; naharNazmun, khan Mr. Anthrometric parameters of low birth weight of Bangladeshi Newborns Bangladesh J of Pedir. 2002; 27;26 - 30

2. Timor Trisch IE. ItsKovitz J, Brandis JM. Estimation of fetal weight by real Time sonography, Am J, ObstetGynaecol 1981;57;653-60.

3. WHO Development of indicators for monitoring progress towards "Health for All by the year 2000;Health for all series geveva; world health organization. 1981; 4; 2005-2001.

4. Chowdhury SA and Mahmud Z – 1998 cited in maternal determinants of IUGR lectured delivered by Dr. begum F. Presented at symposium on LBW of Bangladesh Perinatal Society; June 22, 1999.

5. Raman S, Urquhart R, Yusof M. Clinical versus ultrasound estimation of fetal weight. Aust NZ J ObstetGynecol 1992;2;196-9.

6. Ong HC sen DK. Clinical Estimation of Fetal Weight. Am j ObstetGynaecol 1972; 112; 877-80.

7. Calvert Jr; Crane EE, Newcombe RG & Pearson JF. " Antenatal Screening by Measurement of SFH ". Br. Med. J. 1982; 295; 846-9.

8. Sherman DJ, Arili S, Tovbin J, Seige G, Caspi E, Bukovosky I. comparison of clinical and ultrasonic estimation of fetal weight. ObstetGynecol 1988;91:212-7.

9. Walson WJ, Soisson AP, Harlan FE. "Estimated Weight of the term Fetus: accuracy of Ultrasound Vs Clinical Estimation". J Repord Med. 1988; 33; 369-71.

10. zthombson ML, Theron GB, Falti LP, Predictive value of conditional centile Charts for Weight and fundal height in pregnancy in detecting light for gestational age birth. Eur J. ObstetGynaeocolRepord – Biol. 1997 March; 72(1); 3-8

11. Beligan Jose M. Villarjose, Nardin Juan C. Malamud Julio. Diagnosis of Intra-uterian growth retardation by a simple clinical method; measurement of uterine height; Am J. ObstetGynaecol; July 15;1978643-46.

12. Shamley KT. Landon MB. Accuracy and modifying factors for ultrasonographic determination of fetal weight at term. Br. Journal of ObstetGynaecol 1994;84;926-930.

13. Hadlock FP, Harrist RB, Carpenter RJ, Deter RL, Park SK, Sonographic estimation of fetal weight, Radiology 1984;150;636-40.

14. Deter RL, Harrist RB, Assessment of normal fetal growth. In Chervenak FA, Isaacson GC, Campbell S, editors. Ultrasound in obstetrics and gynecology. Vol. I. Boston; Little, Browh, 1993;361-85.

15. Benacerraf BR, Gelman R, Frigoletta FD. Sonographically estimated fetal weights: accuracy and limitation. Am J obstetGynecol 1988; 159: 1118-21.

16. Robson S, Gallivan S, Walkinshaw SA, Vaughan, J Rodeck Ch. Untracsonic estimation of fetal weight: use of targeted formulas in small for gestational age fetuses. Br. J. ObstetGynecol 1993;82;359-64.

17. Shepard MJ, Richards VA, Berkowitz RL, Hobbins JC, An evaluation of two equations for predicting fetal weight by ultrasound. Am J ObstetGynecol 1982; 142:47-54

18. Sakbagha RE, Minogue J, Tamura RK, Hungerford SA. Estimation of birth weight by use of ultrasonographic formulas tragated to large appropriate and small-for-gestional age fetuses. Am J obtetGynecol 1982;854-62.

19. Pielet BW, Sakbagha RE, Macgregor SN Tamura Rk, Feignebaum SL. Ultrasonic prediction of birth weight in preterm fetuses; which formula is best ?ObstetGynecol 11987;157: 141-4.

20. Insler V, Bernstein D, Rikover M, Segal T, Estimation of fetal weight by simple external palpation. AM J ObstetGynecol 1967: 98: 292-3.

21. Leoffler FE. Clinical fetal weight prediction. Br. J. ObstetGynecolbr Com Welth 1967; 74 : 675-7.

22. Ong HC Ong HC, Sen DK. Clinical Estimation of Fetal Weight. Am J ObstetGynaecol 1972; 112; 877-80.

23. Walson WJ, Soisson AP, Harlan FE. Estimated weight of the term fetus: accuracy of ultrasound vs clinical examination. J Reprod Med 1988;33: 369 - 71

24. Begum R, Hoque JA, Khatun S. Clinical versus ultrasound estimation of foetal weight at term. Bangladesh J ObstetGynecol 2000; 15 : 46 – 51.

25. Shepard MJ, Richards VA, Berkowitz RL, Warsof SL, Hobbins JC. An evaluation of two equations predicting fetal weight by ultrasound. Am J obstetGynecol 1982; 142:47-54.

26. Hadlock P, Harrist RB, Carpenter RJ, Deter RL, Park Sk. Sonographic estimation of fetal weight. Radiology 1984;150:353-40

27. Rose BI. MCCallum WD. A simplified method for estimation of fetal weight using ultrasound measurements. Br. J. ObstetGynecol 1987;69 : 672 - 2.

28. Paterson RM. Estimation of fetal weight during labor Br. J obstetgynecol 1985;65:330-2.

29. Chauhan SP, Hendrix NW, Megaan EF, Marrison JC, Kenney SP, Devoe Ld. Limitation of clinical and sonograohic estimates of birth weight experience with 1034 parturient. Br J ObstetGynecol 1998; 91-72-7.