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Clinical and sonographic methods of foetal weight estimation in predicting fetal macrosomia at term: A prospective comparative study at Irrua Specialist Teaching Hospital, Nigeria

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Abstract
Fetal macrosomia, commonly defined as a birth weight of ≥4,000 g irrespective of gestational age, is a major obstetric concern because of its association with increased maternal and neonatal morbidity. Accurate antenatal estimation of fetal weight is therefore essential for appropriate obstetric management and improved pregnancy outcomes. Although ultrasonography is widely regarded as the standard method for fetal weight estimation, its limited availability in resource-constrained settings makes clinical methods attractive alternatives. However, the most accurate method for predicting fetal macrosomia among Nigerian women remains uncertain.
Objective: To compare the accuracy of clinical and sonographic methods of fetal weight estimation in predicting fetal macrosomia among term pregnant women attending Irrua Specialist Teaching Hospital, Nigeria.
Methods: A prospective comparative study was conducted among 300 women with singleton term pregnancies (37–42 weeks' gestation) attending the Department of Obstetrics and Gynaecology, Irrua Specialist Teaching Hospital, Edo State, Nigeria, following informed consent. Data was analysed using IBM SPSS version 20. Descriptive statistics were used to summarise the data, while Student's t-test and Chi-square test were used to compare fetal weight estimation methods. Diagnostic performance was assessed using sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV), with statistical significance set at $p < 0.05$.
Results: The AG × SFH method demonstrated the highest diagnostic accuracy for predicting fetal macrosomia, with no significant difference between estimated fetal weight and actual birth weight ($p = 0.746$), a sensitivity of 76.9%, and a specificity of 97.0%. Similarly, the combined clinical method showed no significant difference from actual birth weight ($p = 0.642$). In contrast, Johnson's formula, the 10% BMI method, and ultrasonography differed significantly from actual birth weight ($p < 0.05$), while ultrasonography demonstrated relatively low sensitivity (26.9%) for detecting fetal macrosomia.
Conclusion: The AG × SFH method was the most accurate clinical predictor of fetal macrosomia and demonstrated superior diagnostic performance compared with ultrasonography in this study. Its simplicity, low cost, and high diagnostic accuracy support its routine use in antenatal care, particularly in resource-limited settings. Further multicentre studies are recommended to validate these findings and improve fetal weight estimation practices.

Keywords: Fetal macrosomia, fetal weight estimation, ultrasonography, symphysiofundal height, abdominal girth, term pregnancy

Introduction

Accurate estimation of foetal weight is a fundamental component of modern obstetric practice and an integral part of routine antenatal assessment, particularly in high-risk pregnancies. Over the past two decades, prenatal foetal weight estimation has assumed an increasingly important role in the management of pregnancies complicated by conditions such as vaginal birth after a previous caesarean section (VBAC), diabetes in pregnancy, breech presentation, anticipated preterm delivery, and suspected foetal macrosomia. Reliable estimation of foetal weight enables clinicians to make informed decisions regarding the timing and mode of delivery, thereby optimizing obstetric management and improving both maternal and neonatal outcomes (Sherman *et al*.,1998) [15].

In pregnancies at risk of preterm birth, prenatal estimation of foetal weight provides valuable information for counselling parents regarding neonatal survival, guiding interventions aimed at delaying delivery, determining the most appropriate mode of delivery, and selecting the appropriate level of healthcare facility for delivery. Furthermore, identifying a foetus as small or large for gestational age facilitates timely obstetric interventions that may substantially improve pregnancy outcomes. (Nzeh *et al*., 2000; Hendinx *et al*., 2000) According to Diejomaoh,1988 [4, 12] reported that despite considerable advances in obstetric care, perinatal mortality remains a major public health challenge in developing countries, including Nigeria, where reported rates range from 39 to 130 per 1,000 total births. Birth weight is one of the most important determinants of neonatal survival and perinatal outcome. Consequently, accurate antenatal estimation of foetal weight is essential for identifying high-risk pregnancies, planning appropriate obstetric interventions, and reducing perinatal morbidity and mortality. (Chauhan *et al*.,1998) [3].

Foetal macrosomia is of clinical importance because of its association with adverse maternal and neonatal outcomes. Pregnancies complicated by foetal macrosomia are associated with an increased risk of prolonged labour, obstructed labour, shoulder dystocia, birth trauma, postpartum haemorrhage, obstetric anal sphincter injuries, and increased rates of operative vaginal and caesarean deliveries. Also, several studies have reported that women who deliver macrosomic infants are also at increased risk of anal sphincter lacerations and long-term pelvic floor morbidity (Walsh *et al*., 2007 [19]; Dietz and Wilson, 2005). Accurate prenatal prediction of foetal macrosomia is therefore essential for planning appropriate labour and delivery strategies. However, prenatal diagnosis remains challenging, and there is currently limited high-quality evidence to guide the management of pregnancies complicated by suspected foetal macrosomia. Furthermore, the diagnostic accuracy of both clinical and sonographic methods of foetal weight estimation remains suboptimal, limiting their effectiveness in the antenatal identification of foetal macrosomia (Kurmanavicius *et al*., 2004) [9]

The two principal approaches currently used for prenatal estimation of foetal weight are clinical and imaging methods. Clinical methods include abdominal palpation, symphysis-fundal height measurement, evaluation of maternal and obstetric risk factors, maternal self-estimation, and clinical prediction equations. Imaging methods primarily comprise ultrasonography and magnetic resonance imaging (MRI), both of which provide objective assessment of foetal size and estimated birth weight (Sherman *et al*., 1998 [15]; Ratnasiri *et al*., 2002; Oruamabo and John 1990) [13]. Although ultrasonography is widely regarded as the standard imaging modality for prenatal foetal weight estimation, its availability and affordability remain limited in many resource-constrained settings. Clinical methods are inexpensive, simple, and readily available but their accuracy in predicting foetal macrosomia remains uncertain. Consequently, there is a need to evaluate and compare the accuracy of clinical and sonographic methods of foetal weight estimation in detecting foetal macrosomia at term. This study therefore compares the clinical and sonographic methods of foetal weight estimation in determining foetal macrosomia among term pregnancies at Irrua Specialist Teaching Hospital.

Methodology

Study Area

The study was conducted in the Department of Obstetrics and Gynaecology at Irrua Specialist Teaching Hospital (ISTH), Irrua, located in Esan Central Local Government Area of Edo State, Nigeria. Irrua is situated within the Edo Central Senatorial District, one of the three senatorial districts in Edo State, in the South-South geopolitical zone of Nigeria.

Study design/ Study population

A prospective comparative study was used to comparatively evaluate three clinical methods and sonographic methods in detecting fetal macrosomia and to determine the accuracy of combining the three clinical methods in detecting foetal macrosomia at term. The study participants comprised pregnant women with singleton pregnancies at term (37–42 weeks' gestation), who were consecutively recruited from the antenatal clinic and the labour ward of the Department of Obstetrics and Gynaecology, Irrua Specialist Teaching Hospital.

Sample Size Determination

The minimum sample size was determined using the formula for comparing two means:

$N = 2(Z_{\alpha/2} + Z_{\beta})^2\sigma^2/d^2$ (Kasiulevičius *et al*., 2006; Taylor,1983 and Ibrahim, 2009) [7, 8, 17]

where:

N = minimum required sample size per group;

$Z\alpha/2$ = standard normal deviate corresponding to the desired confidence level. At a 95% confidence level ($\alpha = 0.05$), $Z\alpha/2 = 1.96$;

$Z\beta$ = standard normal deviate corresponding to the study power. A study power of 85% was adopted, giving $Z\beta = 1.04$;

σ^2 = variance of birth weight. Based on a previous Nigerian study, the standard deviation of birth weight was 0.622 kg; therefore, the variance (σ^2) was $0.622^2 = 0.387$;

d = minimum clinically significant difference (precision), set at 0.10 kg.

Substituting these values into the formula:

$N = (1.96 + 1.04)^2 \text{ x } 2 \text{ x } 0.387^2/ 0.1^2 = 269.58$

To compensate for an anticipated 10% non-response rate, the calculated sample size was increased to 297 participants. However, a total of 300 pregnant women were recruited for the study.

Data Analysis

Data obtained from the study were coded, entered into a Microsoft Excel spreadsheet, and exported to IBM SPSS Statistics version 20.0 (IBM Corp., Armonk, NY, USA) for analysis. Descriptive statistics were used to summarize participants' socio-demographic and obstetric characteristics. Continuous variables were presented as means and standard deviations (SD), while categorical variables were expressed as frequencies and percentages.

Comparisons between mean values obtained using the different fetal weight estimation methods were performed using the independent or paired t-test, as appropriate. Statistical significance was set at a p-value of <0.05. The diagnostic performance of the three clinical methods and the sonographic method in detecting fetal macrosomia was evaluated using standard measures of diagnostic accuracy, including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), overall accuracy, and likelihood ratios. Agreement between estimated fetal weight and actual birth weight was also assessed using appropriate statistical methods where applicable.

Ethical Considerations

Ethical approval was obtained from the Health Research Ethics Committee of Irrua Specialist Teaching Hospital, and written informed consent was obtained from all participants before enrolment. Participation was voluntary, no financial costs or inducements were involved, and confidentiality of participants' information was strictly maintained.

Result

Socio-Demographic Characteristics

The result obtained for the socio-demographic characteristics is reported that the mean age of the patients was 30.1 ± 4.7 years. About two hundred and ninety-one women (97%) were married while only 9(3.0%) were single mothers. The results indicated that a total of 182(60.6%) had secondary level of education and only 6(2.0%) women had no formal education. A good proportion of 213(71%) of women were christians, while 87 (27%) were muslims.

In parity distribution ninety-two (30.7%) women were parity 2, while 7(2.3%) women were para 6. Although all the respondents delivered at term, 83 (27.7%) women delivered at 39 weeks and 7 (2.3%) women delivered at 42 weeks of gestation. A good proportion of two hundred and twenty (73.3%) babies were delivered vaginally, and eighty (26.7%) babies were by caesarean section. Also, out of the 300 babies studied, 274 (91.3%) had a birth weight of less than 4.0 kg, while 26 (8.7%) had a birth weight of 4.0 kg or more.

The birth weight ranged between 2.80-4.30kg with the mean birth weight 3.48kg SD±0.34. The mean macrosomia weight was 4.1092 ± 0.10796 and the mean weight for non-macrosomia was 3.4208 ± 0.29473. The mean body mass index in the study was 35.1980 ± 3.59574. one hundred and twenty-four of the women were in the overweight category (41.30%).

Table 1: Distribution of Participants by Socio-Demographic Characteristics

Variables	Number	Percentage	Mean
Age			
20-24	31	10.3	
25-29	111	37.3	30.1 ± 4.7
30-34	90	30.0	
35-39	68	22.7	
Marital Status			
Single	9	3.0	
Married	291	97.0	
Education			
No formal	6	2.0	
Primary	31	10.3	
Secondary	182	60.6	
Tertiary	81	27.0	
Religion			
Christian	213	71.0	
Muslim	87	27.0	
Parity			
0	9	3.0	
1	20	6.7	
2	92	30.7	
3	79	26.3	
4	54	18.0	
5	30	10.0	
6	7	2.3	
7	9	3.0	
Gestational Age			
37	19	6.3	
38	79	26.3	
39	83	27.7	
40	67	22.3	
41	45	15.0	
42	7	2.3	
Mode of Delivery			
Vaginal	220	73.3	
Caesarean section	80	26.7	
Birth Weight			
<4KG	274	91.33	
>4KG	26	8.66	

Tables 2: Maternal Body Mass Index of Study Population

Category	Frequency	Percentage
Normal	42	14.00
Overweight	124	41.30
Obses class one	39	13.00
Obese class two	37	12.33
Obese class threee	58	19.33

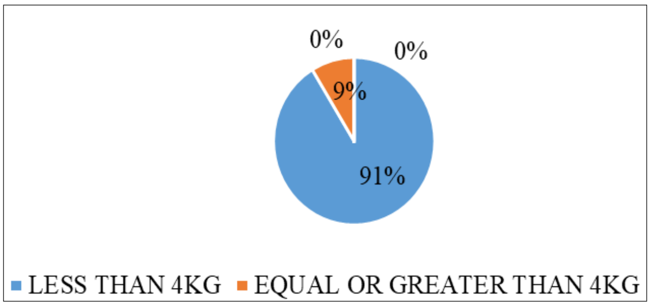

Fig 1: Distribution of Macrosomia and Non-Macrosomia

Among the 300 babies delivered in the study, 273 (91.0%) had birth weight of less than 4.0 kg and were classified as non-macrosomic, while only 27 (9.0%) had birth weight of 4.0 kg or greater and were classified as macrosomic.

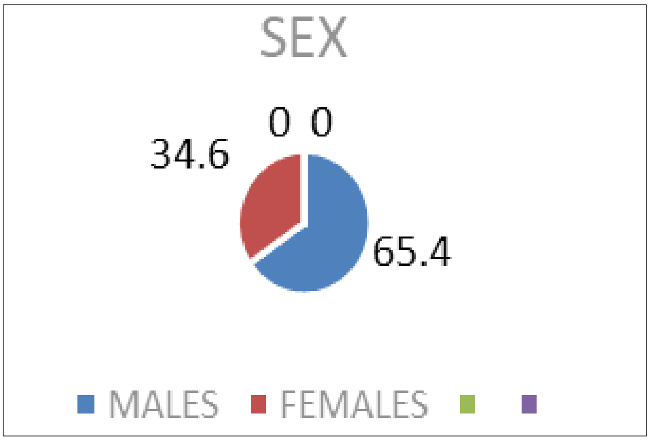

Fig 2: Sex Distribution of Macrosomic Babies I

In the sex distribution of the macrosomic babies seventeen (65.4%) were male and only eight (34.6%) were females.

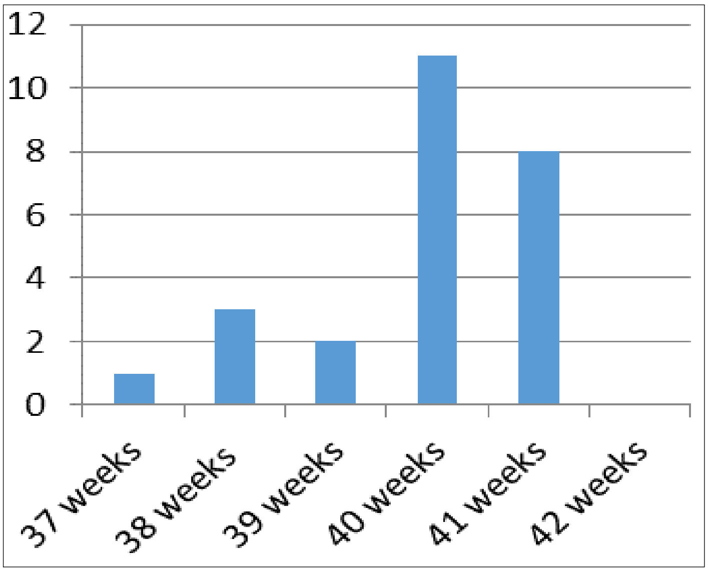

Fig 3: Gestation Age at Which Macrosomic Babies Were Born

Among the 26 macrosomic babies, the highest proportion was delivered at 40 weeks' gestation 11(42.3%), followed by 41 weeks 8(30.7%). Smaller proportions were delivered at 38 weeks 3(11.5%), 39 weeks 2(7.6%), and 37 weeks 1(3.8%), while no macrosomic babies were delivered at 42 weeks (0%). These findings suggest that macrosomic births occurred predominantly at term gestation, with the peak frequency observed at 40 weeks.

Table 3: Mean Birth Weight for all Method

Macrosomia	Mean	Standard deviation	Range
Ag x sfh	4.0893	0.29201	3.55 to 4.49
Johnson	4.5963	0.20536	4.19 to 5.27
10%bmi	3.3881	0.43590	2.48 to 4.44
Combined	4.0246	0.19159	3.66 to 4.36
Uss	3.6654	0.40491	2.90 to 4.50
Actual bt wt	4.1092	0.10796	4.00 to 4.30
Non-macrosomia			
Ag x sfh	3.8796	0.31271	3.12 to 5.40
Johnson	4.4311	0.23101	4.03 to 5.27
10%bmi	3.5323	0.34986	2.48 to 4.50
Combined	3.9476	0.20171	3.46 to 4.65
Uss	3.4261	0.42483	2.80 to 6.00
Actual bt wt	3.4208	0.29473	2.80 to 3.90
Total			
Ag x sfh	3.8978	0.31560	3.12 to 5.40
Johnson	4.4454	0.23328	4.03 to 5.27
10%bmi	3.5198	0.35957	2.48 to 4.50
Combined	3.9543	0.20172	3.46 to 4.65
Uss	3.4468	0.42783	2.80 to 6.00
Actual	3.4804	0.34341	2.80 to 4.30

It showed the mean actual birth weight was 3.4804 ± 0.34341, and while mean for macrosomia was 4.1092 ±0.10796. Using the AG X SFH and the combined methods, the mean were close to that of the actual macrosomic birth weight with a mean of 4.0893 ± 0.29201 and 4.0246 ± 0.19159 respectively.

Table 4: Comparision of the Mean of Various Methods with Actual Birth Weight for Macrosomia

Methods	Mean	Actual birth means	T-test	P-value
Ag x sfh	4.0893 ± 0.29201	4.1092 ±0.17096	0.3259	0.7458
Johnson	4.5963 ±0.20536	4.1092 ±0.17096	10.7063	<.0001*
10%bmi	3.3881± 0.43590	4.1092 ±0.17096	2.5911	0.0125*
Combined	4.0246 ± 0.19159	4.1092 ±0.17096	0.4677	0.6420
Uss	3.6654± 0.40491	4.1092 ±0.17096	5.4001	0.001*

*Statistically significant difference

The pair wise comparison of means for macrosomia using the student t- test was done. In this table, the mean of the Johnson method was higher and that of the 10% BMI and USS methods were lower than the actual macrosomic weight. Thus, they were statistically significant. While the mean of the AG X SFH method and the combined method were closed to the mean of the actual macrosomic birth weight and thus statistically not significant.

Thus, the value predicted by the AG X SFH and the combined methods can be used as an instrument to predict macrosomia.

Table 5: Comparision of Means of Various Methods with Actual Birth Weight for Non-Macrosomia

Methods	Mean	Actual birth	T-test	P-value
AG XSFH	3.8796± 0.31217	3.4208± 0.29473	18.3836	<0.0001*
Johnson	4.4311± 0.23101	3.4208± 0.29473	45.4540	<0.0001*
10% BMI	3.5323± 0.34986	3.4208± 0.29473	4.6859	<0.0001*
Combined	3.9476± 0.20171	3.4208± 0.29473	25.2504	<0.001*
USS	3.4261± 0.42483	3.4208± 0.29473	0.7459	0.4660

*Statistically significant difference

Ultrasound scan (USS) was the only method that showed no statistically significant difference from the actual birth weight of non-macrosomic newborns ($p = 0.4660$), indicating superior accuracy, whereas the AG × SFH, Johnson, 10% BMI, and combined methods all differed significantly from the actual birth weight ($p < 0.001$).

Table 6: Mean Percentage Error

Macrosomia	Mean	Standard Deviation	Range
Ag x sfh	-0.3834	8.01723	-15.50 to 22.52
Johnson	11.9161	5.58923	3.33 to 30.45
10%bmi	17.4557	11.16372	-6.67 to 37.91
Combined	-1.9743	5.70907	-10.75 to 12.97
Uss	-10.7849	9.77355	-27.50 to 11.39
Non-macrosomia			
Ag x sfh	14.1997	12.92108	-20.00 to 61.00
Johnson	30.4590	12.73639	7.31 to 70.50
10%bmi	-4.0845	14.26132	-45.77 to 24.99
Combined	16.2477	11.53265	-5.24 to 49.71
Uss	0.5824	12.62599	-23.08 to 76.47
Total			
Ag x sfh	12.9359	13.21745	-20.00 to 61.00
Johnson	28.8519	13.34278	3.33 to 70.50
10%bmi	-2.2176	15.26333	-45.77 to 37.91
Combined	14.6685	12.26918	-10.75 to 49.71
Uss	-0.4028	12.79854	-27.50 to 76.47s

This is the mean percentage at which the predictive method differs from the actual birth weight in percentages irrespective of the positive or negative sign. For macrosomia, the AG X SFH method had the least percentage error of 0.38% while the 10%BMI method had the highest mean percentage error of 17.5%.

Table 7: Estimates of Fetal Weight Using the Different Methods

Methods	All birth	Macrosomia	Non-macrosomia
AG X SFH			
Accurate estimate$^{\times}$	145 (48.3%)	22 (84.6%)	123 (44.9%)
Overestimate	152 (50.7%)	2 (7.7%)	150 (54.7%)
Underestimate	3 (26.3)	2 (7.7%)	1 (0.4%)
JOHNSON'S METHOD			
Accurate estimate	15 (5.0%)	12 (46.2%)	3 (1.1%)
Over estimate	285(95.0%)	14 (53.8%)	271 (98.9%)
Underestimate	-	-	-
10% OF BMI			
Accurate estimate	153 (51.0%)	4 (5.4%)	149 (54.4%)
Overestimate	80 (26.7%)	-	80 (29.2%)
Underestimate	64 (22.3%)	22 (84.6 %)	45 (16.4%)
COMBINATION			
Accurate estimate	111 (37.0%)	24 (92.3%)	87 (31.8%)
Over estimate	188 (62.7%)	1 (3.8%)	187 (68.2%)
Under estimate	1 (0.3%)	1 (3.8%)	-
ULTRASOUND			
Accurate estimate	170 (56.7%)	8 (30.8%)	162 (59.1%)
Over estimate	48 (16.0%)	1 (3.8%)	47 (17.2%)
Under estimate	82 (27.3%)	17 (65.4%)	65 (23.7%)

Table 7 shows that the combined method had the highest accuracy for predicting macrosomia, correctly identifying 24 (92.3%) cases, followed by the AG × SFH method 22(84.6%). In contrast, the Johnson method predominantly overestimated (53.8%) macrosomic birth weight, while the 10% BMI (84.6%) and ultrasound scan (USS) (65.4%) methods mainly underestimated macrosomic birth weight.

Table 8: Test of Significance of Two Methods for Macrosomia

	Ag × sfh	Uss
Accurate	22	8
Over estimate	2	1
Under estimate	2	17

X^2=18.7, dt =2 p =<0.001 Statistically significant.

	Combined method	Uss
Accurate	24	8
Over estimate	1	1
Under estimate	1	17

X^2= 22.22, df= 2, p < 0.001 Statistically significant

	Combined method	Ag× sfh
Accurate	24	22
Over estimate	1	2
Under estimate	1	2

X^2 =0.07536, df =2, *P* =0.686. Statistically not significant.

The chi-square analysis revealed a statistically significant difference between AG × SFH and ultrasound scan in the prediction of fetal macrosomia (χ^2 = 18.70, df = 2, p < 0.001). A similar statistically significant difference was observed between the combined method and ultrasound scan (χ^2 = 22.22, df = 2, p < 0.001). In contrast, the comparison between the combined method and AG × SFH was not statistically significant (χ^2 = 0.075, df = 2, p = 0.686), indicating that the combined method and AG × SFH had comparable performance in predicting fetal macrosomia.

Table 9: Proportions of Methods that Were True Positive, True Negative, False Positive, False Negative

Methods	Tp (%)	Fp (%)	Tn (%)	Fn (%0
Ag x sfh	20	83	191	6
Johnson	26	274	0	0
10%bmi	2	28	246	24
Combined	15	178	96	11
Uss	7	35	239	19

TP- True Positive: method predicted macrosomia and actual birth weight is macrosomic
FP – False Positive: method predict macrosomia and actual birthweight is non-macrosomic
TN – True Negative: method predicts non-macrosomia and actual birth weight is non-macrosomia
FN – False Negative: method predict non-macrosomia and actual birth weght is macrosomia Overall, AG × SFH and the combined method demonstrated a more balanced performance in predicting fetal macrosomia, whereas Johnson's formula had the highest true-positive rate but the greatest number of false positives, and the 10% BMI-adjusted method and ultrasound scan correctly identified more non-macrosomic fetuses but missed more cases of macrosomia.

Table 10: Validitiy of the Different Methods as Test Instrument for Assessment Fetal Macrosomia

Methods	Sensitivity	Specificity	Ppv%	Npv%
Ag×SFH	76.9	97	19.4	97
Johnson	100	0	8.7	0
10% BMI	7.69	89.78	6.67	91.1
Combined	57.69	35.03	7.77	89.72
USS	26.9	8.2	16.6	92.6

* Sensitivity = TP/TP+FN × 100, Specificity =TN/TN+FP × 100, PPV = TP/TP+FP × 100, NNV = TN/FN + TN × 100*

Overall, AG × SFH demonstrated the best diagnostic validity for predicting fetal macrosomia, with high sensitivity (76.9%) and specificity (97.0%), whereas Johnson's method had perfect sensitivity but no specificity, the 10% BMI method showed poor sensitivity despite high specificity, the combined method had moderate sensitivity with low specificity, and ultrasound scan exhibited low sensitivity of 26.9% and a poor specifity of 8.2% respectively.

Discussion

Accurate estimation of fetal weight is essential for identifying pregnancies at risk of fetal macrosomia and guiding appropriate antenatal and intrapartum management to reduce maternal and perinatal morbidity. Although clinical estimation remains attractive because it is inexpensive and readily available, its accuracy varies according to the method used.

The mean birth weight in this study was 3.48 ± 0.340 kg, while the mean birth weight among macrosomic neonates was 4.11 ± 0.108 kg. These values were higher than those reported in previous studies, where the mean birth weight was 3.3 ± 0.55 kg and the mean macrosomic birth weight was 3.6 ± 1.20 kg.(Ugwu *et al*., 2014; Ezegwui *et al*., 2011) [5, 18] This difference may be attributed to the study design, in which only women with a clinical estimated fetal weight greater than 3.5 kg were referred for ultrasound examination, thereby reducing the inclusion of small-for-gestational-age fetuses.

Among the clinical methods evaluated, AG × SFH demonstrated the best overall performance. The method produced a mean estimated birth weight of 3.8978 ± 0.31560 kg for all births and 4.0893 ± 0.29201 kg for macrosomic births, with mean differences of 0.4173 kg and 0.0199 kg, respectively. It showed the lowest mean percentage error for macrosomia (0.38%), indicating only minimal overestimation of macrosomic birth weight. These findings are consistent with (Bhandary *et al*.,2004) [2] who similarly reported that AG × SFH had the lowest average percentage error across birth-weight categories. Furthermore, the method demonstrated a sensitivity of 76.9% and specificity of 97%, indicating excellent ability to correctly identify both macrosomic and non-macrosomic fetuses. This agrees with the findings of (Chauhan *et al*., 1998) [3] who reported a sensitivity of 54% and specificity of 95% for clinical fetal weight estimation in a study involving 661 women.

Johnson's formula yielded a mean macrosomic birth weight estimate of 4.5963 kg, a mean difference of −0.4871 kg, and a mean percentage error of 11.9%. Although it achieved a sensitivity of 100%, its specificity was 0%, indicating that while all macrosomic fetuses were identified, a large number of non-macrosomic fetuses were incorrectly classified as macrosomic. The statistically significant difference between Johnson's estimates and actual birth weight ($p < 0.0001$) confirms its tendency to overestimate fetal weight. This finding supports the observations of (Numprasert,2004) [11] who also reported consistent overestimation with Johnson's formula. Clinically, such overestimation may increase unnecessary obstetric interventions, including caesarean delivery.

The 10% BMI-adjusted method had a mean estimated birth weight of 3.3881 ± 0.43590 kg and a mean difference of 0.7211 kg, with the highest mean percentage error for macrosomia (17.45%). Its sensitivity was only 7.69%, although specificity reached 89.78%, indicating poor ability to detect macrosomic fetuses despite good exclusion of non-macrosomic cases. The difference between estimated and actual macrosomic birth weight was statistically significant ($p = 0.0125$), unlike the findings of (Loto *et al*., 2012) [10] who reported no significant difference ($p = 0.265$). The discrepancy may reflect differences in study populations, as their analysis included all birth-weight categories rather than focusing on suspected macrosomia. Consequently, this method appears unsuitable for clinical prediction of fetal macrosomia.

The combined clinical method demonstrated a sensitivity of 57.69% and specificity of 35.03%. Although its mean percentage error for macrosomia was relatively low (1.97%) and comparison with actual birth weight was not statistically significant ($p = 0.642$), suggesting reasonable agreement, its diagnostic performance was comparable to AG × SFH but significantly different from ultrasound on chi-square analysis. Despite this, the complexity of combining multiple clinical methods limits its practicality in routine obstetric practice, particularly when AG × SFH alone provides similar predictive performance.

Ultrasound estimation produced a mean fetal weight of 3.6654 ± 0.40491 kg with a mean difference of 0.4438 ± 0.40048 kg and a mean percentage error of 10.78%. It correctly identified only 8 (30.8%) macrosomic fetuses while underestimating 17 (65.4%), resulting in a sensitivity of 26.9%. These findings, however, differ from those reported in an earlier study, which found a sensitivity of 65% and a specificity of 90% for the ultrasound prediction of fetal macrosomia (Benacerraf *et al*., 1988) [1]. The observed variation may be explained by differences in operator expertise, ultrasound equipment, and population characteristics. The ultrasound examinations in the present study used the Hadlock formula incorporated into the DC Mindray machine based on BPD, AC, FL, and HC measurements.

Nevertheless, the present findings are consistent with a study carried out in a tertiary hospital in Bangkok, Thailand by (Sritippayawan *et al*., 2007) [16] who reported a sensitivity of 33.3%, and Ugwu *et al*.,2014 [18] who concluded that ultrasound tends to underestimate fetuses weighing ≥4 kg.

Conclusion/Recommendation

The findings of this study demonstrate that AG × SFH is the most reliable, simple, and cost-effective clinical method for predicting fetal macrosomia, with no significant advantage observed from combining multiple clinical methods. Therefore, AG × SFH should be adopted as the primary screening tool, particularly in resource-limited settings, while ultrasound should be used to complement clinical assessment in suspected cases. Training midwives and other healthcare providers, especially in rural facilities such as Irrua Specialist Teaching Hospital, on the use of AG × SFH and timely referral of women with suspected fetal macrosomia may improve obstetric management and reduce maternal and perinatal morbidity and mortality.

It is recommended that the AG × SFH method be routinely used for screening fetal macrosomia, particularly in resource-limited settings, with ultrasound employed as an adjunct in suspected cases and healthcare providers trained in its application and timely referral of high-risk pregnancies.

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