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www.commprac.com
ISSN 1462 2815

Correlation Analysis of Insler's Technique and Ultrasonography in Estimating Fetal Weight in Preeclampsia

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10.5281/zenodo.14378729

Abstract

Background: Accurate fetal weight estimation plays a pivotal role in managing labor and delivery, ensuring optimal maternal and neonatal outcomes. In modern obstetrics, the overarching aim is to achieve the delivery of a healthy baby to a healthy mother. Fetal weight prediction relies primarily on clinical methods and ultrasonography. However, limited regional studies have compared the outcomes of clinical assessments and ultrasonography with actual fetal weight in pre-eclamptic primigravida and multigravida women. **Aims and objectives:** This study aims to evaluate the accuracy of fetal weight estimation using ultrasonography (USG) and clinical techniques in pre-eclamptic primigravida and multigravida women. The objective is to compare these methods against actual birth weights to determine the precision of each approach. **Material and Methods:** This research was done over a period of one year, beginning from March 2022 to February 2023; it was carried out in the Obstetrics and Gynecology department of BLDE (D.U.) Shri. B.M. Patil Medical College and Hospital, Vijayapura. Before the study commenced, patients were fully informed about it and provided written consent in line with the ethical guidelines set out by the Institute. As the study focused on preeclampsia patients, a sample of 130 was selected from a population frame of 453 preeclampsia patients who were admitted to BLDE Hospital's labour room between 28 weeks and the term gestation of pregnancy, using a stratified sampling technique. The sample size was estimated using the G*Power 3.1.9.4 tool, and it was determined to be 30% of the population frame of 453 preeclampsia patients, with a 95% confidence interval and a 5% margin for error. **Results:** The test results indicated that P = 0.000, which is less than 0.01, Pearson r = 0.871, and Alpha = 0.01. The correlation of U.S.G. fetal weight (0.871) with the actual birth weight is significantly higher compared to the clinical fetal weight correlation at a 1% significance level. The high association (0.871) indicates a robust correlation between the estimated ultrasound fetal weight and the actual birth weight, highlighting the accuracy of the ultrasound estimation. **Conclusion:** Accurate estimation of fetal weight during the intrauterine stage is crucial for planning delivery patterns, as it directly influences prognosis, neonatal survival rates, and the need for intensive care interventions. The study conclusively demonstrates that for pre-eclamptic Multigravida and Primigravida patients, the error in estimating the fetal weight using ultrasound (U.S.G.) was significantly lower than clinical estimates.

Keywords: Preeclampsia, Multigravida, Primigravida, Actual Fetal Weight, Clinical, Ultrasound.

Introduction

Accurate fetal weight measurements are crucial in managing the process of labour and delivery [1]. Modern obstetrics focuses on delivering a healthy baby and maintaining the mother's health postpartum. The birth weight is a crucial factor in determining the outcome and survival of the baby. [2]. Accurate fetal weight measurement is a critical component of the patient's prenatal care [3].

Fetal macrosomia and intrauterine growth restriction (IUGR) are both linked to increased perinatal fatalities and morbidity, as well as long-term neurological and developmental defects [4]. As a result, estimated fetal weight forms an important part of an antenatal examination of pregnancy [5]. Fetal weight has an impact on labour and delivery care in high-risk circumstances like hypertensive disorders complicating pregnancy, diabetes mellitus, and cardiac diseases, which further lead to intrauterine growth restriction (IUGR) and macrosomia [6]. Fetal growth abnormalities can be discovered clinically or by ultrasonography (U.S.G.). In low-resource settings, basic measures like symphysis-fundal height (S.F.H.) and abdominal girth (A.G.) are utilised to calculate effective fetal weight [7]. In obstetrics, there are two significant ways of calculating birth weight: the clinical approach and ultrasonography using

Hadlock's formula [8-10].

Obstetric ultrasonography has transformed the diagnosis of fetal medicine with the most investigative methodology and an unbelievable level of precision. Assessment of fetal weight by ultrasonography necessitates a higher degree of expertise, skill, and expensive equipment. In such cases, clinical procedures are critical for measuring fetal weight and assisting with obstetric decision-making [7]. Some researchers have conducted studies on the reliability of fetal weight measurements using clinical and ultrasonographic examinations. A few writers conclude that the ultrasonography technique exceeds all others. Additional research has shown that both clinical and ultrasound techniques have comparable accuracy in predicting fetal weight [11–12]. Very few regional studies have been conducted to compare ultrasound/clinical and actual fetal weight with respect to pre-eclamptic primigravida and multigravida.

Preeclampsia induces uteroplacental insufficiency, resulting in fetal growth restriction, SGA, preterm births, NICU admissions, and poor neonatal outcomes. These are the challenges faced by preeclampsia patients. These alterations cause hypertrophy of the vessels, loss of smooth muscle adaptations, and increased expression of hypoxia- inducible transcription factor-1a, resulting in poor endothelial vasodilation [13]. To address this research gap, the current study on the above-mentioned topic is conducted with obstetric score as the independent variable and fetal weight as the dependent variable.

This research contributes to the identification of the most reliable method for assessing intrauterine fetal weight and also tells the precision of each technique of estimating fetal weight. The present study is analogous that assesses the precision of the fetal weight of patients with preeclampsia through ultrasound (U.S.G.) and clinical fetal weight methods.

The accuracy of these two techniques was compared with the actual fetal weight for the same identified sample patients. Insler's formula and Hadlock's formula were used to determine fetal weight using clinical methods and ultrasonography, respectively.

MATERIALS AND METHODS

The correlation of ultrasonographic assessment of fetal weight with a clinical estimation of fetal weight to actual birth weight in patients with preeclampsia was investigated. This longitudinal study was conducted at the Obstetrics and Gynecology department of "BLDE (D.U.) Shri. B.M. Patil Medical College and Hospital, Vijayapura" for 12 months from June 2023 to May 2024. The patients were told in detail about the study in all respects, and informed written consent was obtained in accordance with the rules of the Institute's ethics committee. Since the study was concentrated on preeclampsia patients, a sample size of 130 was chosen from the population frame identified by our research team through the stratified sampling technique.

Sampling was done from the population size of 453 preeclampsia patients who were admitted to BLDE Hospital in the labour room with gestational age >28 weeks up to term presenting with preeclampsia by employing G*Power version 3.1.9.4 software for calculation.

Since 30 percent of the population was chosen as the sample, it was appropriate to set the confidence interval at 95% with an acceptable amount of estimating error of 5%.The inclusion criteria included pregnant ladies of gestational age >28 weeks to term with preeclampsia and a singleton pregnancy with cephalic presentation. The exclusion criteria included the known fetal malformation, maternal obesity, any adnexal mass, multiple gestations, fibroid with pregnancy, and presentation other than cephalic.

An ultrasonography scan was performed within 48 hours of birth to assess E.F.W. (effective fetal weight), which includes head circumference (H.C.), abdominal circumference (A.C.), fetal length (F.L.), and biparietal diameter (BPD) computed using Hadlock's method. Clinically, fetal weight was measured using Insler's/Dare's formula: effective fetal weight (E.F.W.) in grams = symphysis-fundal height (in cms) X abdominal girth (in cms) [4-5].

A 2-5 MHz transducer (SIEMENS ACUSON X 300) was used on a U.S.G. machine to perform a sonographic examination of all patients. During ultrasonography, the patient

was positioned in a supine posture. The transducer probe was put over the abdomen, and fetal components were seen; heart rates were identified, and the foetus's position and presentation were determined. The position and maturity of the placenta were observed. The fetal weight was assessed using sonography technology that measured the biparietal diameter (BPD), abdominal circumference (A.C.), femur length (F.L.), and head circumference (H.C.). The clinical and ultrasonological birth weights were compared in the same patient and compared to the accuracy of the baby's actual birth weight following delivery. The weight after birth was determined using a Beurer digital scale. A detailed history/profile was obtained, including the patient's education, employment, socioeconomic situation, menstruation history, obstetric history, previous medical and surgical history, and personal history. A comprehensive general physical examination was performed. Vital signs, anthropometric measures, and systemic examination results were noted [4]. Statistical analysis was performed in SPSS Ver.21 and Excel.

The data was collected from preeclampsia patients' profiles in terms of various parameters such as maternal pre-pregnancy weight, obstetric score, Doppler changes, IUGR, mode of delivery, imminent signs, duration of NICU stay, and many more.

The present study concentrates on data analysis on the independent variables like obstetric score, socio-economic status, etc. of the pregnant ladies with preeclampsia under study.

The data for clinical fetal weight with actual birth weight and U.S.G. fetal weight with actual birth weight were analysed using mean, standard deviation, percentage analysis, ANOVA, correlation, and regression.

RESULTS

Among the 130 women surveyed, 73% (95) were primigravida women and 27% (35) were multigravida women. The average mother's age was 23.78, with the smallest age of 18 years and the greatest age is 34 years.

The gestational age had a wide range between 28 and 42 weeks, with a mean of 39.59 weeks. The maximum number of women (94), 72%, underwent caesarean sections, while only 6, 28% were delivered by normal delivery.

Table 1: Correlation between Clinical Foetal Weight and Actual Birth Weight

		Actual Birth Weight (In Gms)	Clinical Foetal Weight (In Gms)
	Pearson Correlation	1	.348**
Actual Birth Weight (In Gms)	Sig. (2-tailed)		
	N	130	130
Clinical Foetal Weight (In Gms)	Pearson Correlation	348**	
	Sig. (2-tailed)	.000	
	N	130	130

"** Correlation is significant at the 0.01 level (2-tailed)."

The test yields P = 0.000, which is smaller than Alpha = 0.01 and Pearson's r = 0.348, indicating a 0.348 correlation between clinical and actual birth weight of fetus at a 1% significance level. This suggests that there is a slight positive relationship between clinical fetal weight and actual birth eight. However, the association is thought to be weak. This shows that there is a disparity between the measurement of clinical fetal weight and actual birth weight (Table 1). In the test (Table 2), it is seen that P=0.000, which is lesser than Alpha α =0.01, and Pearson's r=0.871; hence, the result shows that U.S.G. Foetal Weight has a 0.871 correlation at the significant level of 1 percent with Actual Birth Weight.

This indicates there is a high positive correlation between U.S.G. fetal weight and Actual Birth Weight. Since the association is considered to be high, it indicates that there is not much disparity between the assessment of U.S.G. fetal weight and Actual Birth Weight.

Table 2: Correlations between U.S.G. Fetal Weight and Actual Birth Weight

		Actual birth weight (Grams)	USG-fetal weight estimation (Grams)
Actual Birth Weight (Grams)	Pearson Correlation	1	.871**
	Sig. (2-tailed)		.000
	N	130	130
USG-Fetal Weight Estimation (Grams)	Pearson Correlation	.871**	1
	Sig. (2-tailed)	.000	
	N	130	130

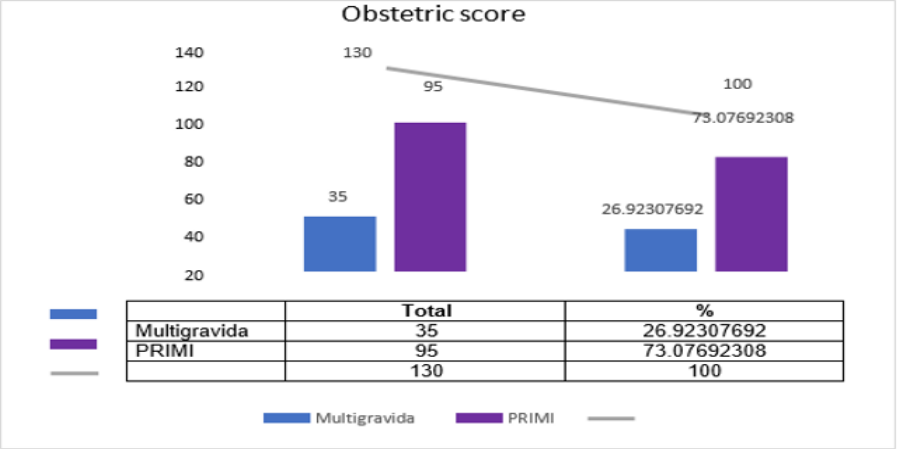

Figure1: Count of Obstetric score

Table 3: Association between the Obstetric score and Actual Birth Weight

Obstetric score	Count	Average Actual Birth Weight	SD
PRIMIGRAVIDA	95	2526.29	620.66
Others	35	2423.89	746.38
Total	130		

The obstetric score profile of the 130 preeclampsia patients. It is observed that 73 percent (95) of preeclampsia patients were Primigravida, and 27 percent (35) were Multigravidas. **(Figure1)** Table 3 shows that 95 preeclampsia patients were Primigravida, with a mean ($\bar{x}$) actual birth weight of 2526.29gms and a standard deviation (σ) of ±620.66, while 35 preeclampsia patients were Multigravida, with a mean ($\bar{x}$) actual birth weight of 2423.89gms and a standard deviation of ±746.38.

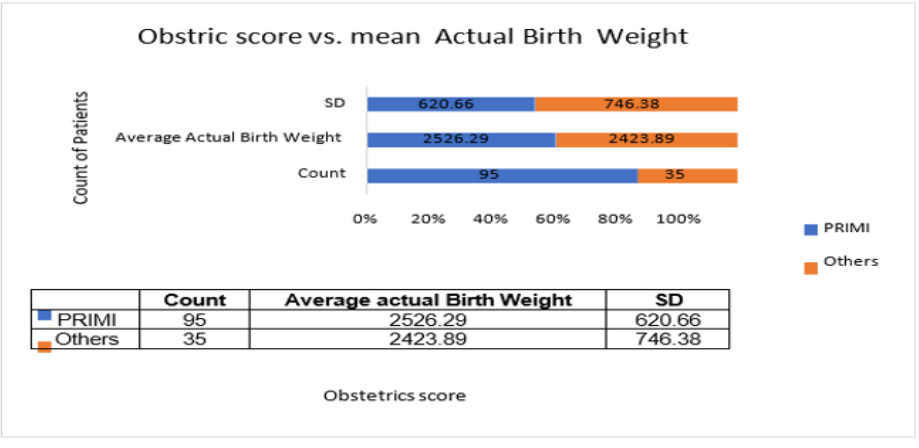

Figure 2: Association between the "Obstetric score and Actual Birth Weight"

Table 4: Status of PRIMIGRAVIDA USG/CFW/Actual Birth Weight outside the Range of 10 percent

Status of PRIMIGRAVIDA	Count	Percentage
Range of 10%	19	20.00
Outside Range of 10% by U.S.G. or C.F.W.	37	38.95
Outside the Range of 10% by C.F.W. only	28	29.47
Outside the Range of 10% by the U.S.G., only	11	11.58
Total	95	100

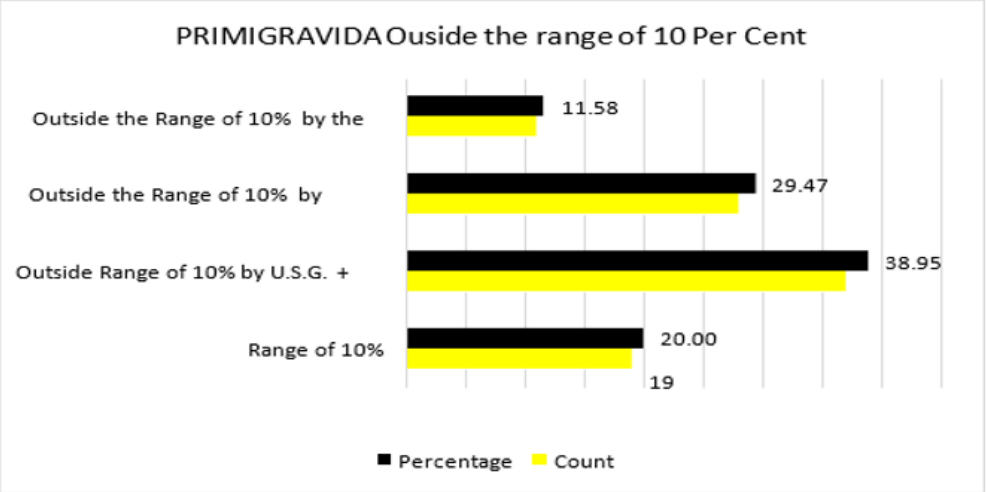

Figure 3: Status of PRIMIGRAVIDA USG/CFW/Actual Birth Weight outside the Range of 10 percent

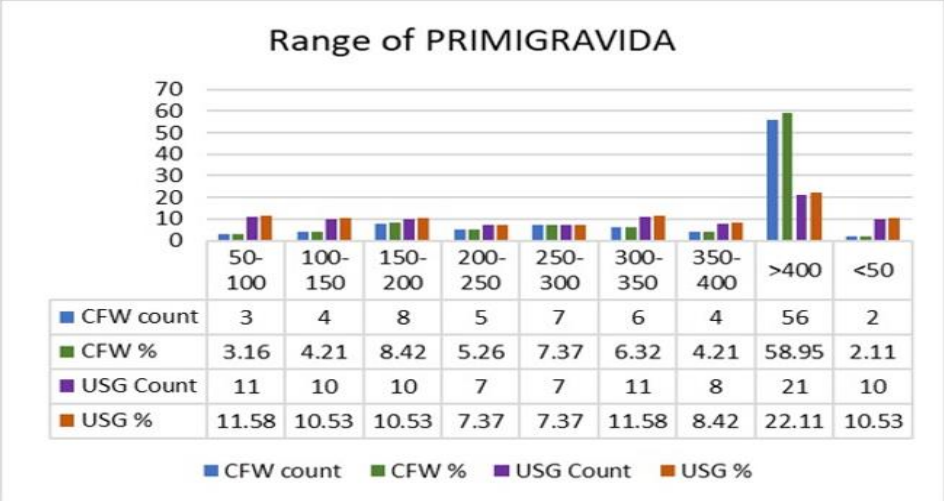

Figure 4: Range of variation in weight for Primigravida

Table 5: Range of variation in weight for Primigravida in class intervals of 50

Range in gms	C.F.W. Count	CFW %	USG Count	U.S.G. %
50-100	3	3.16	11	11.58
100-150	4	4.21	10	10.53
150-200	8	8.42	10	10.53
200-250	5	5.26	7	7.37
250-300	7	7.37	7	7.37
300-350	6	6.32	11	11.58
350-400	4	4.21	8	8.42
>400	56	58.95	21	22.11
<50	2	2.11	10	10.53

Table 6: Range of variation in weight for Primigravida

Range in gms	C.F.W. Count	CFW %	USG Count	U.S.G. %
Upto 50	2	2.11	10	10.53
Upto 100	5	5.26	21	22.11
Upto 150	9	9.47	31	32.63
Upto 200	17	17.89	41	43.16
Upto 250	22	23.16	48	50.53
Upto 300	29	30.53	55	57.89
Upto 350	35	36.84	66	69.47
Upto 400	39	41.05	74	77.89
Upto 1000	86	90.53	95	100.00
>1000	95	100.00	-	-

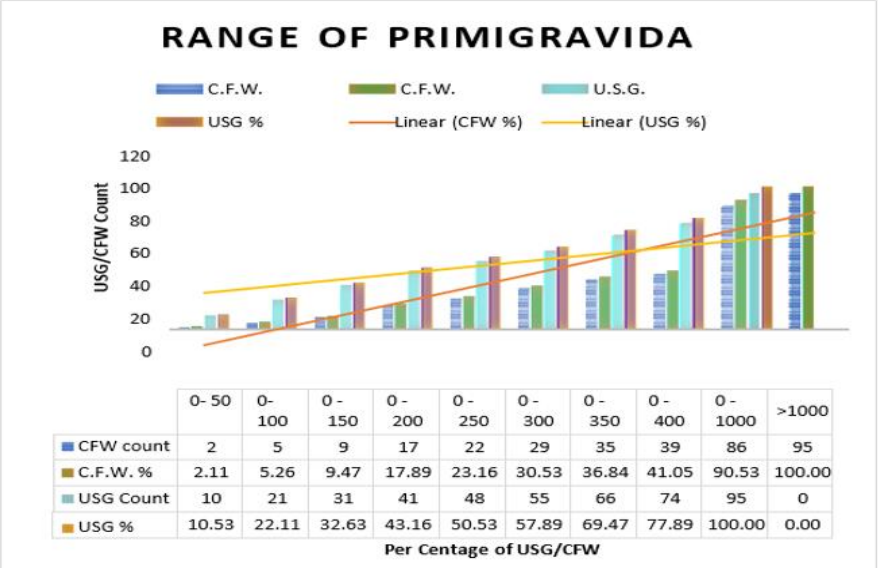

Figure 5: Range of weight difference in grams in primigravida patients

(Table 4) (Figure 3) Table 4 shows the Comparison between the U.S.G. Foetal weight, C.F.W. outside the Range of 10% in Comparison with Actual Birth Weight, which is represented in green, red, pink and yellow Colors for the power of distinction. T

he output depicted in the Horizontal Chart (figure 3) shows that only 11(11.58%) U.S.G. Primigravida were outside the range of 10 percent whereas 28(29.47%) of C.F.W. cases were outside the range of 10 percent from the total count of Primigravida.

Table 5 and Table 6 clearly stated that with >400 range, 56 counts of C.F.W. (58.95%) Twenty-one counts of U.S.G. (22.11%) and with <50 grams, just two counts of C.F.W. (2.11%) and ten counts of U.S.G. (10.53%) for primigravida.

Figure 5 also indicated that with >1000grams, all 95 counts of primigravida (100%) and No count of U.S.G. with >1000grams were found.

Table 7: Status of Multigravida USG/CFW/Actual Birth Weight outside the Range of 10 percent

Status of Multigravida	Count	Percentage
Range of 10%	4	11.43
Outside Range of 10% by U.S.G. or C.F.W.	16	45.72
Outside the Range of 10% by C.F.W. only	13	37.14
Outside the Range of 10% by the U.S.G., only	2	5.71
Total	35	100

Table 8: Range of variation in weight for Multigravida

Range in gms	CFW count	CFW %	USG Count	USG %
50-100	2	5.71	4	11.43
100-150	0	0.00	6	17.14
150-200	1	2.86	2	5.71
200-250	1	2.86	2	5.71
250-300	2	5.71	2	5.71
300-350	2	5.71	4	11.43
350-400	1	2.86	2	5.71
>400	26	74.29	9	25.71
<50	0	0.00	4	11.43

Table 7 shows the Comparison between the U.S.G. Foetal and Clinical Foetal Weight outside the Range of 10% in Comparison with Actual Birth Weight in multigravida patients, which is represented in green, red, pink and yellow colors for the power of distinction.

The output depicted shows that only 2 (5.71%) U.S.G. Multi Gravida were outside the range of 10 percent, whereas 13 (37.14%) of C.F.W. cases were outside the range of 10 percent from the total count of 35 Multigravida.

Table 8 clearly states that with the>400 range, 26 counts of C.F.W. (74.29%), 9 counts of U.S.G. (25.71%), and with <50 counts, zero counts of C.F.W. (0%) and four counts of U.S.G. (11.43%) for Multigravida.

Table 9: Average actual birth weight in different groups of preeclampsia

Range of P.E.	Count	Average actual Birth Weight	SD
Mild PE	53	2527.05	522.68
Severe PE	77	2494.46	675.02
Total	130		

(Table 9) Table 9 shows that 53 patients had mild preeclampsia with a mean birth weight of 2527.06gms and a S.D of ±522.682, while 77 had severe preeclampsia with a mean birth weight of 2494.46gms and a S.D of ±675.015.

Associated findings

Table 10: One-way ANOVA to know the association between Socioeconomic Status and preeclampsia

	Some of Squares	df	Mean Square	F	Sig.
Between Groups	.086	2	.043	.372	.001
Within Groups	14.691	127	.116		
Total	14.777	129			

The relationship between socioeconomic status and preeclampsia patients of 130 sample patients was analyzed with the help of ANOVA and is depicted in Table 10. The above interpretation portrays significant difference between the socioeconomic class and preeclampsia (F = .372, α=0.05, df = 2, P = .001 < 0.05). Post Hoc (L.S.D.) results imply that there is a significant difference between the Lower, Lower Middle and Middle class and preeclampsia. It can be interpreted that socioeconomic status and preeclampsia are related in the present study.

DISCUSSION

Precise calculation of the fetal weight is vitally significant in obstetric practice. Intrauterine fetal weight becomes crucial in all the stages of pregnancy. Certain complications during pregnancy, such as delayed labour, shoulder dystocia, and preterm labour, are all corresponding with fetal weight; hence, precise fetal weight assessment is particularly beneficial in managing the birthing process successfully [14-16]. "Several studies have been undertaken to figure out the comparative accuracy of clinical and ultrasound-based

fetal weight."

Sherman DJ et al. [17] found that clinical evaluation was more exact than ultrasound estimate, despite several research studies stating the opposite. Raghuvanshi et al. discovered that the average inaccuracy was lowest (140 grams) with ultrasound using Hadlock's formula and highest with Johnson's (454.9 grams) [18]. Our research on pre-eclamptic Multigravida and Primigravida has clearly shown that only 11.58 percent of ultrasound-assessed Primigravida were outside the range of 10%, while 29.47 percent of clinical fetal weight (C.F.W.) cases were outside the range of 10% of the total count of Primigravida.

In this aspect, our findings are consistent with prior observations that the typical absolute percentage error of anticipated birth weight ranges from 6% to 12% of actual birth weight [19–21]. The outcome of our study showed that only 5.71 percent of ultrasound-evaluated Multi Gravida were beyond the range of 10%, whereas 37.14 percent of C.F.W. instances were outside the range of 10% from the total count of 35 multigravida women.

Although the scope of our study differs, our present findings are consistent with those published by others, indicating that "ultrasound measurement of birth weight is more accurate than clinical estimation. Contrary to this, Hendrix et al. [22] and Raman et al."
[23] found that ultrasonography was less reliable than clinical evaluation. Similar to our study, Sharman et al. and Titapant et al. found that the ultrasonic estimate was more accurate [21, 24]. However, one starling difference they found in their study was that ultrasound turned out to be more precise only when there was low birth weight. Research by Watson et al. [25]. No noteworthy alteration between the two methods was established.

When we deployed Pearson's correlation, it was understood that the (Pearson's r = 0.871) U.S.G. fetal weight has a 0.871 correlation with the actual birth weight, whereas clinical fetal weight has a 0.348 correlation at the significant level of 1 percent with actual birth ight. These findings are in accordance with those of Anshumala Joshi et al. [26], who established a negative connection in the clinical estimate. However, they also say that increasing gestational age improves clinical diagnosis. In our investigation, the percentage variation in both clinical and U.S.G. estimation methods was quite close to prior studies, indicating that ultrasonography-estimated newborn weight is less divergent from the standard. Research conducted in Nigeria found a greater percentage of inaccuracy in clinical evaluation [27–28]. Our clinical and U.S.G. estimations are equivalent to those performed by Watchree et al. [29] and Aruna et al. [30]. The average absolute error and percentage error were the least for estimated fetal weight via the ultrasonography method. In our study, since the correlation is weak in the case of Pre-Eclamptic Multigravida and Primigravida, we state that the U.S.G. fetal weight estimation is more scientific and can be relied upon.

CONCLUSION

Estimating fetal birth weight during the intrauterine stage is more important for planning the mode of delivery, and it also influences prognosis, neonatal survival, and the requirement for intensive care. The present study categorically states that in both the case of pre-eclamptic Multigravida and Primigravida, the error was the least for U.S.G. estimation of baby weight compared with clinical estimation. Since India is developing in the fast-faceted technological landscape, it is always advisable to rely on technological intervention through U.S.G. estimation through clinical estimation of weight, which can act as a compliment if not a substitute.

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