

FEASIBILITY OF A COST-EFFECTIVE CLINICAL TOOL FOR GESTATIONAL AGE ESTIMATION IN LOW-RESOURCE SETTINGS: A PRACTICAL APPROACH

Obstetrics & Gynaecology

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ABSTRACT

Background and Aims: Accurate gestational age (GA) estimation is essential for optimal prenatal care, especially in low- and middle-income countries (LMICs), where access to ultrasound is limited. This study aimed to assess the feasibility and accuracy of using symphysio-fundal height (SFH) and abdominal girth measurements as alternative methods for GA estimation in resource-limited settings. **Methods:** A cross-sectional study was conducted from January 2021 to June 2022 on 1,500 antenatal women at SVBP Hospital. Ethical approval was obtained, and informed consent was secured. Gestational age was estimated using clinical methods (SFH, abdominal girth) and compared with ultrasound estimates. Data analysis involved mean, standard deviation, and confidence intervals. Statistical significance was set at $p < 0.05$. **Results:** SFH had 54.5% accuracy for 28-32 weeks GA, while ultrasound accuracy was 54.2%. Liquor status was normal in 72.2% of clinical examinations and 73.2% on ultrasound ($p > 0.05$). The amniotic fluid index (AFI) showed that 73.2% of cases had an AFI of 5-24 cm across all gestational ages. **Conclusion:** The findings suggest that clinical methods such as SFH and abdominal girth can serve as cost-effective alternatives to ultrasound for GA estimation in LMICs. Further validation is required to improve their reliability across different settings.

KEYWORDS

Gestational age; SFH; Ultrasound alternatives; Prenatal care; Low-resource settings.

INTRODUCTION

Accurate determination of gestational age is essential for guiding prenatal care and interventions. In low- and middle-income countries (LMICs), accurately determining gestational age poses a significant challenge due to limited access to advanced medical technology and accurate menstrual history.¹ Traditionally, maternal recall of the last menstrual period (LMP) has been the primary method for dating pregnancies. However, this method is prone to errors, particularly in women with irregular menstrual cycles, poor recall, or early pregnancy bleeding.² In such contexts, reliable pregnancy dating is crucial for optimal maternal and neonatal care, especially in managing preterm labor and delivering life-saving interventions.³ Early pregnancy ultrasound is recognized as the gold standard for dating pregnancies, but its availability is limited in LMICs, particularly in rural and resource-constrained settings.⁴ In sub-Saharan Africa, for example, only 7% of pregnant women have access to ultrasound services.⁵

In the absence of advanced technology, simpler methods such as measuring the symphysio-fundal height (SFH) are widely used to estimate gestational age.⁶ SFH involves measuring the vertical distance from the pubic symphysis to the top of the uterine fundus, which is then used to approximate gestational age.^{6,7} This method is cost-effective, easy to perform, and does not require expensive equipment. However, SFH is influenced by several factors, including maternal nutrition, fetal growth restrictions, and maternal parity, all of which can affect the accuracy of this estimation. Consequently, the accuracy and reliability of SFH in estimating gestational age remain areas of concern, particularly in settings where pregnancy-related morbidities are prevalent.⁸

This study seeks to explore the feasibility of developing a cost-effective clinical tool that can provide reliable gestational age estimates in low-resource settings. By comparing SFH and abdominal girth measurements with ultrasound-based estimates, the research aims to assess whether these clinical methods can serve as viable alternatives in environments where access to advanced technologies is limited. The findings from this study may offer critical insights into improving prenatal care in LMICs by providing a practical, low-cost solution for gestational age estimation where advanced technology is unavailable.

MATERIALS AND METHODS

Study Design and Setting: This cross-sectional study was conducted in the Department of Obstetrics and Gynaecology at LLRM Medical College and SVBP Hospital from January 2021 to June 2022. The study aimed to evaluate clinical methods for estimating gestational age in low-resource settings. Approval was granted by the institutional

ethical committee. Antenatal women attending SVBP Hospital who met the inclusion criteria were enrolled in the study.

STUDY PARTICIPANTS AND SAMPLING METHODS:

Participants included antenatal women with a gestational age of more than 28 weeks, confirmed singleton pregnancies, and certainty of the last menstrual period (LMP). Written consent was obtained before enrollment. Exclusion criteria included multiple pregnancies, molar pregnancies, and intrauterine fetal death. All eligible participants underwent a detailed examination and were assessed using standard clinical tools.

DATA COLLECTION: Demographic data (name, age, religion, socioeconomic status, occupation) and a complete medical history (menstrual, obstetric, family, past medical history, allergies) were collected. Participants underwent a physical examination, including fundal height assessment, fetal lie, presentation, and liquor status. Symphysio-fundal height (SFH) and abdominal girth (AG) were measured using a non-elastic inch tape. Measurements were taken with the participant lying in a supine position, and care was taken to correct uterine dextro-rotation. The SFH was measured from the pubic symphysis to the top of the uterine fundus, while AG was measured at the level of the umbilicus.

Three consecutive measurements of SFH and AG were taken to minimize errors, and gestational age was calculated based on these measurements. Following this, participants were referred to the radiology department, where a detailed obstetric ultrasound was performed. Parameters such as biparietal diameter (BPD), femur length (FL), and head circumference (HC) were used to determine gestational age. The ultrasound findings were compared with the gestational age calculated clinically.

OUTCOME: The primary outcomes included the comparison of palpated fundal height with SFH in centimeters and the correlation of clinical methods (SFH, AG) with ultrasound-based gestational age estimation. Secondary outcomes involved assessing liquor status clinically, and comparing ultrasound findings such as amniotic fluid index (AFI), estimated fetal weight (EFW), and the presence of any gross congenital anomalies.

ETHICAL CONSIDERATIONS: The study was conducted following ethical guidelines, and written informed consent was obtained from all participants. Confidentiality was maintained throughout the study, and data was securely stored.

Fig 1: Symphysio-fundal height corresponding to gestational age

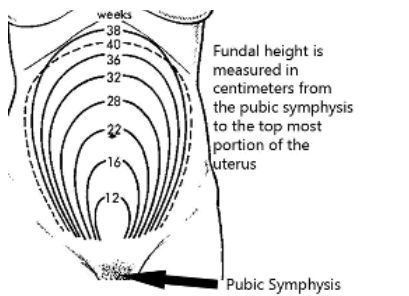


Fig 2: Measurement of Symphysis fundal height

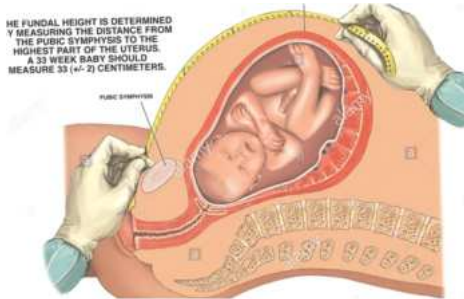


Fig 3. Estimation of Biparietal Diameter and head circumference

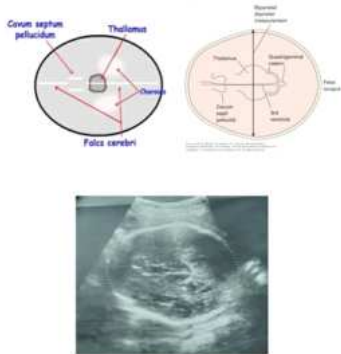


Fig 4: Fetal Abdominal Circumference estimation

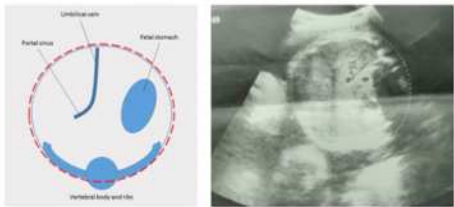


Fig 5: Estimation of Femur length

RESULTS

Table 1 Distribution of Antenatal Mothers by Age, Gravida, and Period of Gestation

Category	Number of Antenatal Mothers	Percentage (%)
AGE GROUP (YEARS)		
19-24 years	536	35.7
25-29 years	668	44.5
30-34 years	296	19.8
GRAVIDA		
Primi gravida	618	41.2
Multi gravida	882	58.8
PERIOD OF GESTATION		
28-32 weeks	808	53.6
33-37 weeks	510	34.0
>37 weeks	182	12.4

This table summarizes the distribution of 1,500 antenatal mothers based on age, gravida status, and period of gestation. The majority of mothers were aged between 25-29 years, and most were multigravida. A significant proportion of mothers were in the gestation period of 28-32 weeks.

Distribution of Antenatal Mothers by Age, Gravida, and Period of Gestation

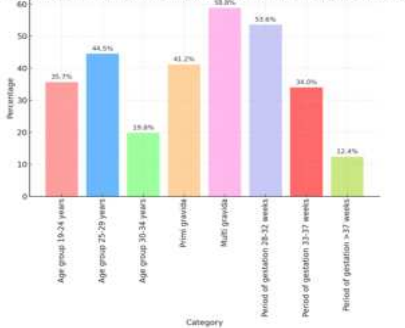


Table 2 Comparative Analysis of Gestational Age Estimation Methods

Weeks (n, %)	Fundal Height (FH) (n)	Fundal Height (FH) (%)	Symphysis-Fundal Height (SFH) (n)	Symphysis-Fundal Height (SFH) (%)	Abdominal Girth (n)	Abdominal Girth (%)	Ultrasonography (USG) (n)	Ultrasonography (USG) (%)
28-32 weeks	753	50.2%	817	54.5%	720	48%	813	54.2%
33-37 weeks	593	39.5%	482	32.1%	648	43.2%	500	33.3%
>37 weeks	154	10.3%	201	13.4%	132	8.8%	187	12.5%

This table illustrates the distribution of gestational age estimates for 1,500 fetuses using four different methods: Fundal Height palpation, Symphysis-Fundal Height (SFH), Abdominal Girth, and Ultrasonography (USG). Each method shows varying levels of agreement, with SFH and USG showing slightly higher estimates for fetuses in the 28-32 week range.

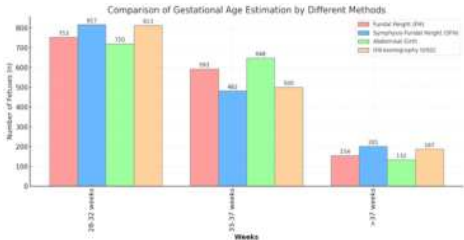


Table 3 Comparative Accuracy of Gestational Age Estimation by USG, SFH, LMP, and Abdominal Girth

Gestational Age (weeks)	USG and SFH Accuracy (%)	LMP and SFH Accuracy (%)	USG and Abdominal Girth Accuracy (%)	LMP and Abdominal Girth Accuracy (%)
28-32 weeks	99.6%	98.9%	88.6%	89.2%
33-37 weeks	96.4%	94.6%	70.4%	73%
>37 weeks	92.6%	89.6%	70.6%	72.6%

This table summarizes the accuracy of gestational age estimation using different methods, comparing ultrasound (USG), symphysis-fundal height (SFH), last menstrual period (LMP), and abdominal girth. Each method demonstrates varying levels of accuracy across different gestational age ranges, with USG and SFH showing higher accuracy in the earlier gestational weeks compared to abdominal girth.

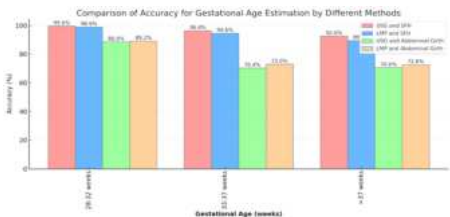


Table 4 Liquor Status Comparison Between Clinical Examination and Ultrasonography

Liquor Status	On Clinical Examination (n, %)	On Ultrasonography (n, %)	P value
Normal	1083, 72.2%	1098, 73.2%	>0.05
Oligohydramnios	278, 18.5%	267, 17.8%	
Polyhydramnios	139, 9.3%	135, 9%	

This table summarizes the comparison of liquor status in 1,500 antenatal cases as observed through clinical examination and ultrasonography. The findings reveal a high degree of similarity between both methods, particularly in cases with normal liquor status. The results for oligohydramnios and polyhydramnios are also closely aligned between the two methods.

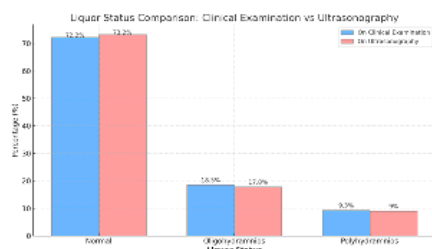
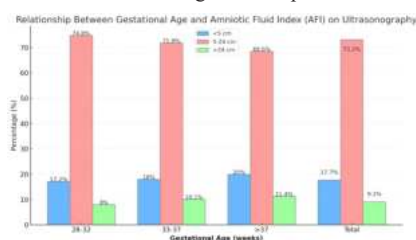


Table 5 Relationship Between Gestational Age and Amniotic Fluid Index (AFI) on Ultrasonography

Gestational Age (weeks)	<5 cm (n, %)	5-24 cm (n, %)	>24 cm (n, %)	P value
28-32	143 (17.2%)	623 (74.8%)	67 (8%)	>0.05
33-37	94 (18%)	374 (71.9%)	52 (10.1%)	
>37	29 (20%)	101 (68.6%)	17 (11.4%)	
Total	266 (17.7%)	1098 (73.2%)	136 (9.1%)	

This table illustrates the relationship between gestational age and amniotic fluid index (AFI) across 1,500 cases. The majority of cases have an AFI between 5-24 cm, regardless of gestational age, while lower and higher AFI values are less common. The comparison highlights trends across different gestational periods.



DISCUSSION

In this study, we evaluated various parameters in antenatal mothers, focusing on age distribution, gravida status, gestational age, gestational age estimation methods, liquor status, and amniotic fluid index (AFI). The largest proportion of antenatal mothers (44.5%) were in the 25-29 years age group, followed by 35.7% in the 19-24 years age group, and 19.8% in the 30-34 years age group. A study by Wylie et al.⁹ (2013) on gestational age assessment in malaria pregnancy cohorts in Malawi similarly reported that the majority of pregnant women were in the 25-29 year age group, constituting approximately 43% of the study population. This consistency in age distribution across different geographic regions suggests a common reproductive pattern. Jackson and Harrington et al.¹⁰ (2018), in their study on small for gestational age (SGA) and very low birth weight (VLBW) infants, also found that the majority of mothers were aged between 19-29 years, which closely matches the findings of the present study. This further reinforces the similarity in reproductive age trends across populations.

In terms of gravida status, 58.8% of the mothers were multigravida, while 41.2% were primigravida. Kramer et al.¹¹ (2013), in their study on the risks of being born too small or too soon, found that 60% of the women in their study were multigravida. This aligns closely with the current study, suggesting that multigravida women constitute a larger proportion of antenatal populations in similar settings.

Regarding gestational age, the present study found that 53.6% of the mothers were between 28-32 weeks, 34% between 33-37 weeks, and 12.4% over 37 weeks of gestation. Dietz et al.¹² (2007), in their comparison of LMP-based and ultrasound-based estimates of gestational age, reported that 55% of the women in their study were

between 28-32 weeks, which closely matches the findings of the current study. Additionally, Kemp et al.¹³ (2013), in their study on ultrasound estimation of gestational age in rural sub-Saharan Africa, found that 52% of their population was in the 28-32 week range, which further supports the consistency of gestational age distribution in different populations.

The present study found that gestational age estimation using various methods—fundal height (FH), symphysis-fundal height (SFH), abdominal girth, and ultrasonography (USG)—showed varying accuracies. For the 28-32 week group, SFH was the most accurate at 54.5%, followed closely by USG at 54.2%. Dietz et al.¹² (2007) also reported that ultrasonography was generally more accurate for estimating gestational age, particularly in the mid to late second trimester. This aligns with the findings of the present study, where USG was highly accurate in the 28-32 week group. Kullinger et al.¹⁴ (2016) also highlighted the effectiveness of ultrasound dating in reducing neonatal morbidity in late preterm pregnancies, which aligns with our findings of 33.3% accuracy for USG in the 33-37 week group. Wylie et al.⁹ (2013) found that ultrasonography was highly accurate in estimating gestational age across all gestational age groups, reporting effectiveness in up to 85% of cases. This supports our findings, particularly in the early stages of pregnancy, although other methods like SFH played an important role in certain gestational age groups.

In terms of liquor status, the present study found strong agreement between clinical examination and ultrasonography. Normal liquor status was identified in 72.2% of cases through clinical examination and 73.2% through ultrasonography. Yuce et al.¹⁵ (2015), in their study on the timing of delivery and its impact on perinatal outcomes, also reported that ultrasound was slightly more accurate than clinical examination in detecting oligohydramnios, with ultrasound detecting oligohydramnios in 15% of cases and clinical examination in 14% of cases. This closely aligns with the current study, where oligohydramnios was detected in 17.8% of cases via ultrasound and 18.5% through clinical examination. Wylie et al.⁹ (2013) also reported similar findings, noting that ultrasonography identified normal amniotic fluid levels in 70% of cases, which is comparable to the 73.2% accuracy observed in the present study. Kullinger et al.¹⁴ (2016) found that ultrasound effectively detected polyhydramnios in 9% of cases, closely matching the 9% found in the present study.

Finally, the present study found that most pregnancies had an amniotic fluid index (AFI) between 5-24 cm. Specifically, 74.8% of cases in the 28-32 week group, 71.9% in the 33-37 week group, and 68.6% in the >37 week group had normal AFI. Yuce et al.¹⁵ (2015) reported that 70% of hypertensive pregnancies had normal AFI, which closely aligns with the findings of the current study. Oligohydramnios was observed in 17.2% of cases in the 28-32 week group and increased to 20% in those over 37 weeks. Similarly, Wylie et al.⁹ (2013) found that oligohydramnios occurred in 15% of pregnancies, while polyhydramnios was present in 9% of cases, mirroring the findings of the present study. Kullinger et al.¹⁴ (2016) reported that normal AFI was present in 73% of pregnancies, which closely matches the 73.2% normal AFI found in the current study.

In conclusion, the present study's findings are consistent with several previous studies, demonstrating similar trends in age distribution, gravida status, gestational age, and the accuracy of gestational age estimation methods. Additionally, the strong concordance between clinical examination and ultrasonography in assessing liquor status and AFI further supports the reliability of these methods in antenatal care.

STRENGTHS AND LIMITATIONS

The strengths of this study include its focus on a low-cost, practical approach for gestational age estimation, making it highly relevant for low-resource settings. The inclusion of multiple gestational age estimation methods (SFH, abdominal girth, and ultrasound) provides a comprehensive comparison, offering insights into the feasibility of using clinical methods as alternatives to ultrasound. The large sample size (1,500 cases) strengthens the reliability and generalizability of the findings. However, limitations include potential variability in the accuracy of clinical measurements due to differences in practitioner experience, and the study's focus on women with known LMP, which may not reflect the challenges of gestational age estimation in cases with uncertain LMP. Additionally, external validation in other low-resource settings is needed to further confirm the findings.

CONCLUSION

This study demonstrates the feasibility of using low-cost clinical tools, such as SFH and abdominal girth measurements, for gestational age estimation in low-resource settings. While ultrasonography remains the most accurate method, clinical methods can serve as reliable alternatives, particularly in areas with limited access to advanced technologies. The strong correlation between clinical and ultrasound findings reinforces the potential of these methods to improve prenatal care in resource-constrained environments. Further research and external validation are recommended to enhance the accuracy and applicability of these clinical tools.

CONFLICT OF INTEREST: *The authors declare no conflicts of interest.*

FUNDING: No funding was received.

CONSENT: Written consent from participants has been obtained and preserved.

ETHICAL APPROVAL: Ethical approval was obtained and documented as per institutional guidelines.

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