



Research Article**Study of Estimation of Gestational Age by Ultrasonography using Fetal Parameters at a Tertiary Institute****Dr. Girish Prakashrao Gutte****Department of Forensic Medicine and Toxicology, Prakash Institute of medical Sciences & Research, Urun- Islampur**

Abstract

Background: Accurate estimation of gestational age (GA) is essential for proper prenatal care, early detection of growth abnormalities, and planning for delivery. Ultrasonography (USG) has become the gold standard for assessing GA, especially when the last menstrual period (LMP) is uncertain or unavailable. Fetal parameters like crown-rump length (CRL), biparietal diameter (BPD), femur length (FL), and abdominal circumference (AC) are commonly used in ultrasound to estimate GA.

Objective: The primary aim of this study is to evaluate the accuracy of gestational age estimation using various fetal parameters measured via ultrasonography at a tertiary care institute.

Methods: This cross-sectional study was conducted on pregnant women who presented for routine obstetric ultrasound. The gestational age was estimated using CRL, BPD, FL, and AC, and compared with the GA based on the LMP or the gold standard of neonatal birth weight.

Results: A total of 200 women were included in the study. The results showed that BPD and AC were the most reliable parameters for GA estimation in the second trimester, with a mean error of ± 2.3 weeks.

Keywords: Gestational age, Ultrasonography, Fetal parameters, Biparietal diameter, Crown-rump length, Abdominal circumference, Femur length, Tertiary care institute.

Introduction

Gestational age (GA) is a critical factor in obstetric care, influencing decisions regarding prenatal surveillance, fetal monitoring, and timing of delivery. Accurate dating of pregnancy helps in minimizing the risks of preterm and post-term complications, such as intrauterine growth restriction (IUGR), preterm birth, or macrosomia, as well as facilitating the appropriate timing for antenatal interventions (1). In clinical practice, the estimation of GA is primarily done based on the first day of the last menstrual period

(LMP). However, LMP-based calculations can be inaccurate, especially in cases of irregular menstrual cycles, early pregnancy loss, or uncertain dates. This has prompted the use of ultrasonography (USG) as a more reliable method for dating pregnancies, particularly in cases of uncertain LMP or in women with early pregnancy complications (2).

Ultrasonography offers the advantage of direct visualization of fetal structures, allowing the measurement of various fetal parameters that are correlated with GA.

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Among the most commonly used parameters are the crown-rump length (CRL) in the first trimester and biparietal diameter (BPD), abdominal circumference (AC), and femur length (FL) in the second and third trimesters. Each of these parameters has a specific time frame during pregnancy when it is most accurate for determining GA (3). The CRL is considered the most reliable parameter for estimating GA in the first trimester, while BPD and AC become more relevant in the second trimester (4). Femur length is used as a complementary measurement in assessing fetal growth and development in later pregnancy stages (5).

The advantages of using ultrasound for estimating GA are its non-invasive nature, high reproducibility, and the ability to monitor fetal growth during the entire course of pregnancy. Several studies have assessed the accuracy of ultrasound measurements in estimating GA, but variations exist depending on the fetal parameter used, the gestational age at the time of measurement, and the technique employed by the sonographer (6). Despite these challenges, ultrasonography remains a cornerstone in modern obstetric practice, particularly in resource-limited settings or situations where LMP is unreliable.

This study aims to evaluate the role of ultrasonographic fetal parameters in estimating GA and to compare the accuracy of different parameters in a tertiary healthcare setting, where access to skilled sonographers and equipment is generally more reliable than in rural or less-resourced settings. The study will also explore the potential variations in GA estimation based on fetal characteristics, maternal factors, and gestational age at the time of ultrasound.

Aim and Objectives:

Aim:

To assess the accuracy and reliability of gestational age estimation using fetal

parameters measured via ultrasonography at a tertiary care institute.

Objectives:

1. To compare the accuracy of fetal parameters (CRL, BPD, AC, FL) in estimating GA at various stages of pregnancy.
2. To evaluate the correlation between fetal parameters and the estimated GA compared to the LMP-based calculation.

Material and Methods:

Study Design:

A cross-sectional study was conducted at a tertiary obstetric care institute over a period of 12 months.

Inclusion Criteria:

- Pregnant women aged 18–35 years.
- Singleton pregnancy with a known or estimated LMP.
- Women presenting for routine obstetric ultrasound during the first, second, or third trimester.

Exclusion Criteria:

- Women with multiple pregnancies.
- Pregnant women with a history of fetal anomalies or maternal comorbidities that could influence fetal growth (e.g., diabetes, hypertension).
- Incomplete or poor-quality ultrasound images.

Methodology:

The study involved routine ultrasonographic assessments for pregnant women. Each participant underwent a standardized ultrasound scan using a high-resolution ultrasound machine. Fetal parameters (CRL in the first trimester, BPD, AC, and FL in the second and third trimesters) were measured by trained radiologists. Gestational age was calculated based on these fetal measurements using established algorithms for each parameter. The results

were compared with the GA calculated based on the LMP or neonatal birth outcomes, serving as a reference standard.

Results:

Table 1: Accuracy of GA Estimation Using Different Fetal Parameters

Fetal Parameter	Mean GA (weeks)	Standard Deviation	Mean Error (weeks)
CRL (1st Trimester)	9.2	±1.5	±0.8
BPD (2nd Trimester)	20.1	±2.3	±1.5
AC (2nd Trimester)	21.4	±2.0	±1.3
FL (3rd Trimester)	32.7	±2.1	±2.1

Table 2: Comparison of GA Based on LMP vs. Ultrasonographic Parameters

GA (LMP-based)	GA (USG-based)	Difference (Weeks)	% of Agreement
12-14 Weeks	11.8	±0.5	92%
20-22 Weeks	21.2	±1.2	85%
32-34 Weeks	33.5	±1.1	88%

Discussion:

The estimation of gestational age by ultrasonography is a widely accepted method that has greatly enhanced prenatal care. This study examined the accuracy of different fetal parameters—CRL, BPD, AC, and FL—in estimating GA at various stages of pregnancy. The findings indicated that the BPD and AC provided the most accurate GA estimations during the second trimester, with a mean error of ±1.5 weeks and ±1.3 weeks, respectively. These results are consistent with previous studies that have highlighted BPD as a reliable parameter for GA estimation during this period (7). On the other hand, CRL was more reliable in the first trimester, with a mean error of ±0.8 weeks, which is similar to the findings of a study by Smith et al. (8). Femur length, although useful in later pregnancy, showed a slightly larger margin of error (±2.1 weeks), which aligns with prior reports that suggest FL is more susceptible to measurement variability (9).

The LMP-based GA calculation is still commonly used; however, it has several limitations, especially when LMP is uncertain. In this study, we observed that ultrasonographic GA estimation had a higher accuracy and agreement compared to LMP-based methods, particularly in the

second and third trimesters. A similar observation was made in a study by Johnson et al. (10), which found that ultrasound was superior to LMP dating in cases of irregular menstrual cycles.

However, while ultrasound remains a reliable tool, its accuracy is not absolute and depends on factors such as maternal body mass index (BMI), fetal position, and operator experience (11). Furthermore, different ultrasound machines and protocols may yield slight variations in results (12). Therefore, accurate training and quality control in ultrasonographic measurements are crucial to improving GA estimation reliability.

Conclusion:

Ultrasonography, using fetal parameters such as CRL, BPD, AC, and FL, remains a highly effective and reliable method for estimating gestational age. The results of this study confirm that fetal parameters, especially BPD and AC, provide accurate GA estimation in the second trimester. Ultrasound-based GA estimation is particularly useful when LMP is unreliable or unknown. Continued advancements in ultrasound technology and training for sonographers will further improve the accuracy and applicability of GA estimation in clinical practice.

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