

# SONOGRAPHIC ASSESSMENT OF THE UMBILICAL CORD DIAMETER (UCD) TO DETERMINE THE GESTATIONAL AGE AMONG PREGNANT WOMEN IN A HEALTHY NIGERIAN POPULATION

## Abstract

**Background:** The knowledge of the exact gestational age of a foetus is required for comprehensive pregnancy care.

**Objective:** The aim of this study is to assess the umbilical cord diameter in order to determine foetal gestational age using ultrasonography.

**Methods:** A purposive sample of four hundred singleton pregnancies with gestational age of between 14 to 40 weeks were considered for this study. Transabdominal ultrasound scans were performed and measurements of the Umbilical Cord Diameter (UCD) were obtained in a cross-sectional plane of the umbilical cord at a point 2.0 cm away from the point of insertion into the foetal abdomen.

**Results:** The mean UCD value was  $13.3 \text{ mm} \pm 6.17 \text{ mm}$ . Mean recorded value for AC, FL, HC, BPD were  $190 \text{ mm} \pm 90.60 \text{ mm SD}$ ,  $43.6 \text{ mm} \pm 18.93 \text{ mm}$ ,  $211.8 \text{ mm} \pm 78.34 \text{ mm}$ ,  $61.32 \pm 22.64 \text{ mm}$  respectively. Umbilical cord diameter correlated positively with the LMP and AC ( $r = 0.993$ ,  $p < 0.0001$ ;  $r = 0.952$ ,  $P = 0.0001$ ) respectively. A strong positive and significant correlation was also noted between the UCD and other dating parameters ( $r = 0.925$ ,  $P = 0.0001$ ;  $r = 0.955$ ,  $P = 0.0001$ ,  $r = 0.972$ ,  $P = 0.0001$ ) respectively for FL, HC and BPD.

**Conclusion:** The UCD can be a good alternative to determine foetal gestational age and wellbeing.

**Key words;** Sonography, umbilical cord, diameter, gestational age, healthy, pregnant women.

## INTRODUCTION

The umbilical cord is a part of the foetus, contains two arteries and one vein that are buried in the Whatson's jelly. The developmental integrity and function of the cord are essential considerations for foetal growth and wellbeing[1]. Assessment of the morphometric alterations of the umbilical cord by prenatal sonography at different gestational ages permits

the identification of adverse perinatal outcomes[2]. Umbilical cord is sonographically visible from approximately 8 to 10 weeks of gestation and the cord diameter could be sonographic criterion for assessing maternal and fetal health. The Knowledge of the exact gestational age of a foetus, is required for comprehensive pregnancy care. It is an essential component of research evaluating causes of preterm birth to choose the times to perform various screening tests and assessments such as serum screening, assessment of foetal maturity, and knowing if the foetus is smaller or larger than expected[3]. It is also essential to aid decisions about delivery method, the trial of labour after Caesarean delivery, induction of labour for post-date pregnancies[4], and elective Caesarean section for patients suspected of having a macrosomic foetus. Over the years, several methods have been developed to estimate gestational age. The three primary methods used are menstrual history, clinical examination, and ultrasonography[5,6].

Obstetric ultrasonography is a modern method for assessing gestational age, and since its introduction in the 1970s, it has been noted as the most accurate technique for estimating gestational age. It typically involves the measurement of multiple biometric parameters of the foetus, which values are used to extract the estimated gestational age per trimester. Previous studies revealed that 20% to 40% of women cannot recollect their last menstrual period (LMP) with certainty[7]. Reasons for this uncertainty include oligomenorrhoea, bleeding in the first trimester of pregnancy, pregnancy following oral contraceptives or intrauterine devices, and becoming pregnant in the post-partum period. A previous study reported that menstrual history was considered reliable in only 18% of women[6]. The most common biometric parameters used are gestational sac diameter (GSD) and crown-rump length (CRL) in the first trimester. The biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL). These parameters of the foetal head, body, and extremities are used in the second and third trimesters. These most widely used and accepted foetal-derived growth parameters have potential errors and inaccuracies[8]. This study is therefore aimed at determining the foetal gestation age sonographically using umbilical cord diameter.

## **MATERIALS AND METHODS**

This was a cross-sectional study that involved healthy pregnant women who came to the antenatal clinic and were asked to perform ultrasound examination in general hospital Ogwashi-Uku, Delta State. It was conducted from June 2019 to December, 2019 and included all singleton pregnant women. A purposive sample of 400 healthy women pregnant with normal singleton foetuses was evaluated in the study.

The study involved the determination of the gestational age of each subject using Naegele's formula for gestational age estimation if the patient was sure of her date. The gestational age was then determined at prenatal sonography using the BPD, HC, AC, and FL biometric parameters. The recent results of the subject's laboratory investigations were examined to ensure that the subject is not suffering from any metabolic disorder. These investigations which results were scrutinised include urinalysis for the presence of sugar and protein in the urine, fasting blood sugar, random blood sugar and 2-hour postprandial blood sugar test for screening for diabetes mellitus, serum electrolyte, urea, and creatinine (S/E/U/Cr) test and total blood cholesterol test. All who met the inclusion criteria participated in the study.

Transabdominal scan was conducted using a Mindray ultrasound machine equipped with a 3.5MHz curvilinear transducer. The examination was conducted at various imaging planes with the patient in the supine position. The UCD was measured vertically in the longitudinal plane, adjacent to the insertion of the foetal abdomen. The calipers for measurement were placed from the outer to outer part of the cord to ensure that adequate measurements were obtained. The biparietal diameter (BPD), femur length (FL), head circumference (HC), and abdominal circumference (AC), were subsequently measured and used to estimate the GA based on the nomogram produced by Hadlock et al., [9]. To avoid errors due to measurement the examinations were conducted by one qualified sonographer and measurements of each parameter were done twice and an average taken.



**Fig.1:** Sonogram showing greyscale cross-sectional measurement of the umbilical cord diameter with the marks showing the position of the callipers placed on the outer part of the umbilical cord.

### Method of Data Analysis

Data generated were transferred into a Microsoft excel for analysis using SPSS version 20. The obtained data were presented in tables with frequency.

Correlation analysis was performed to assess the strength of linear association that exists between UCD and LMP estimated gestational age as well as UCD and the estimated gestational age using the commonly used ultrasound foetal dating parameters (AC, FL, HC and BPD). The statistical significance was set at  $P \leq 0.05$ .

### RESULTS

The gestational age of the subjects ranged from 14 weeks to 40 weeks. The mean gestational period was  $24.5 \pm 7.83$  wks. UCD ranged from 5mm to 24 mm and the average measurement recorded was  $13.3 \pm 6.17$ mm as shown in table 1.

The abdominal circumference (AC) ranged from 43 mm to 362 mm with an average measurement of  $190.1 \pm 90.60$  mm. The maximum GA from AC was 39 weeks and the

minimum 14 weeks. Mean AC predicted GA was  $24.3 \pm 7.86$  weeks. The mean femur length was  $436 \pm 18.93$ mm and ranged from 14 mm to 76 mm. The FL estimated GA ranged from between 13wks and 19wks with a mean of  $24.3 \pm 7.67$ wks. HC ranged from 65 mm to 357 mm and the mean was  $211 \pm 78.34$ wks. The HC estimated GA ranged from 14wks to 40wks and an average of  $24.3 \pm 7.70$ wks.

The BPD ranged from 28 mm to 99 mm. Mean BPD measurement was  $61.32 \pm 22.64$  mm. BPD estimated age ranged from 14wks to 40wks  $\pm 7.93$ wks.

In table 2, a strong positive correlation existed between the UCD and LMP ( $r = 0.993$ ,  $p < 0.0001$ ). UCD had a strong positive correlation with the AC and FL ( $r = 0.952$ ,  $0.925$ ;  $p < = 0.0001$ ,  $p < = 0.0001$ ) respectively. There is also a strong positive correlation between the UCD and the HC ( $r = 0.955$ ,  $p > 0.0001$ ). The BPD also displayed a strong positive correlation with the UCD ( $0.972$ ,  $P < = 0.0001$ ).

Table 1. Mean Gestational age According to Weeks

GA (LMP)	N	Minimum (mm)	Maximum (mm)	Mean	STD Deviation	Median
14 - 20	162	49	53	50.6	1.49	50.5
21 - 27	89	92	95	82.7	1.496	94.0
28 - 34	93	126	129	128.23	1.313	129
35 - 40	56	137	139	115.5	0.884	137

Table 2. Correlation between UCD and other parameters

Parameter	Correlation coefficient (r)	P - value
LMP	0.993	< 0.0001
AC	0.952	< 0.0001
FL	0.925	< 0.0001
HC	0.955	< 0.0001
BPD	0.972	< 0.0001

## DISCUSSION

The umbilical cord is a unique organ consisting of two umbilical arteries, one umbilical vein and Whartson's jelly which are sophisticated structures and performs vital functions to supply the necessary nutritional requirements to the foetus from the mother during the period of pregnancy[10]. The left and right umbilical arteries are developed from the internal iliac arteries and supplies deoxygenated blood from the foetus to the placenta[11].

Foetal gestational age estimation is very vital in the determination of foetal outcome and well being. Ultrasonography is indispensable in determination of foetal growth and general wellness of the foetus. It can determine when the growth is compromised and as such provides an early information about foetal maturity. Ultrasonography has the advantage of being readily available, has no risk of radiation and is very affordable.

Our study established the reference values for UCD during different gestational age. Weismann et al[12] did the first sonological study on umbilical cord cross sectional diameter for various gestational age. Other previous studies had also established reference values for their population[13,14]

The present study was conducted among pregnant women from 14wks to 40wks GA. in our locality. Eze, et al[15], Zeeshan, et al,[16] also conducted a similar study within this range while Udoh et al[17], conducted their own study from 10wks to 42wks GA. This study was conducted

as from 14wks GA because within this period all other foetal parameters for determining foetal gestational age such as, (BPD, HC, FL, AC) can be used to demonstrate the GA. Previous study has shown that dating pregnancies after 14 weeks is particularly relevant as for low and middle income countries where many women first seek antenatal care after 20 weeks of pregnancy[18]. In country like South Africa,53% of women receive no first trimester antenatal care and up to 20% of women attend their first antenatal visit after 20 weeks in some regions[19]. Nigeria is also a poor resource country and pregnant women may also present for antenatal care in the 14<sup>th</sup> week of their pregnancy/during the second trimester.Usually normal pregnancies last for 40 weeks and this influenced our choice of assessing the GA up to 40 weeks and not 42 weeks.

The obtained UCD in our study ranged from 5mm to 24mm while in the study done by Udoh et al[17], it ranged from 0.73cm to 1.68 cm. The variation in the range obtained in this study and that of Udoh et, al[17], may be due to the fact that our study involved pregnancy in the range of 14 weeks to 40 weeks while theirs ranged from 10 weeks to 42 weeks.

The study revealed that the mean gestational age was  $24.5 \pm 7.83$ wks and the UCD increases as the gestational age increases. Other previous studies[15,20,21] agreed with this finding of our study.

In this study, the mean UCD was  $13.3 \text{ mm} \pm 6.17$ mm. This our finding is close to that of Eze, et al[15], who stated a value of 14.5mm in their own study. In a study by Zunaira et, al [22] the mean UCD they obtained was  $11.63 \text{ mm} \pm 3.50$ mm. These values obtained in separate studies are very close to each other even though they were conducted in different countries.

There was direct positive relationship between the UCD and the LMP. In other words the UCD increased as the LMP increased. A linear and strong relationship also existed between the UCD and other ultrasound dating parameters (AC, FL, HC, and BPD). This is in tandem with other previous studies[15,222].

**CONCLUSION:** The umbilical cord diameter can be used as a parameter to determine foetal gestational age. It has a direct positive relationship with other ultrasound dating parameters. Umbilical cord diameter can be very useful in poor resource countries where pregnant women may not have enough resources to go for ultrasound scan regularly

#### Consent

Informed consents were also obtained from the participants.

#### Ethical approval

Ethical approval for the study were obtained from the Research and Ethics

committee

Department of the  
Federal Medical Centre, Asaba, Delta State, before the commencement of the study.

### **Disclaimer (Artificial intelligence)**

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- 2.
- 3.

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