

A Relationship between Gestational Age Determined by Ultrasound Biometric and Symphysis Fundal Height Measurements

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Abstract

Last Menstrual Period (LMP), Symphysis fundal height (SFH) or Ultrasound biometric measurements are being used to determine the gestational age (GA) and expected delivery date (EDD) by various ante-natal care (ANC) providers for pregnant women in both urban and rural areas. However, each method has its limitations in determining accurate gestational age of the fetus at different stages of gestation. Ultrasound facilities may not be readily available in some rural setups or may not be affordable for some pregnant women. Many have to depend on SFH measurements as actual LMP may not be remembered by the women when they visit ante-natal clinics. This study aims to establish a relationship between gestational age estimated by ultrasound biometric measurements and fundal height measurements to compute accurate gestational ages by measurement of fundal heights using 100 pregnant women. A non-linear regression equation was fitted from the measured data. The relationship between the gestational age(wks) and the fundal height(cm) was obtained from the mathematical modeling of the data by the equation $GESTATIONAL\ AGE(wks) = 9.166 e^{0.039 (FUNDAL\ HEIGHT)(cm)}$ with $R^2 = 0.931$.

Keywords: Gestational Age, Last menstrual age, Symphysis-fundal height, Ultrasound

1. INTRODUCTION

Knowledge of gestational age (GA) accurately is essential for optimal prenatal, delivery and postnatal care [1,2]. Ultrasound assessment of gestational age is the most popular and accurate method of predicting the expected date of delivery (EDD) and it is found to be more reliable than the last menstrual period (LMP) [3,4, 5]. Obstetric ultrasound scan is based on biometric measurements of the fetus such as bi-parietal diameter (BPD) and femur length (FL) among others. However, in rural areas where ultrasound facilities may not readily available or not affordable to the people, most ante-natal care (ANC) providers have to depend on mostly unreliable LMP or symphysis fundal height (SFH) measurements to determine the GA and EDD[6]. Fundal height is generally defined as the distance from the pubis symphysis and the fundus of the uterus measured in centimeters [7]. After the first 16 weeks of pregnancy, the SFH measurement often matches the number of weeks of the gestation. However, SFH is just only a tool for gauging fetal growth and gestational age. It is a routine practice in ANC where ultrasound is not available. SFH can be smaller or larger than expected value due to conditions such as high body mass index (BMI), twin or multiple gestations, over-filled bladder of the woman at the time of measurement, presence of uterine fibroids, too little or too much amniotic fluid in the gestational sac and the fetus prematurely descending into the pelvis or setting into a breech or other unusual position [7]. On the other hand, one of the biometric measurements, BPD may be less accurate especially in the third trimester of the pregnancy [8].

This study attempts to establish a non-linear relationship between the ultrasound gestational age (GA) based on BPD and FL measurements and the SFH measurements. From the regression equation, the reference values of GA for each measured SFH can be evaluated and can be used in ANC centres for more accurate assessment of GA and EDD.

2. METHODOLOGY

The study was conducted at the Faith Alive Foundation Hospital, Jos, Nigeria. Ethical clearance has been obtained from the hospital management and 100 consented pregnant women sent for obstetric scan from ante-natal clinic were randomly chosen. Patients with multiple gestations were excluded and SFH measurements were taken with empty bladder using a non-elastic measuring tape. The measurement was taken from the highest point of the uterus to the top of the symphysis pubis. Ultrasound biometric measurements (BPD and FL) were carried out to determine the gestational age. A transducer of frequency 3.5MHz [9] was used for the obstetric scans.

3. RESULTS AND ANALYSIS

The range for the ages of the pregnant women that participated in this study was from 16 to 42 years with a mean age of 26.5 years. The gestational age from two biometric measurements BPD and FL were determined from the

scan for each fetus. The average value of these two was computed and correlation coefficient between the average gestational age and SFH was determined using IBM SPSS Version 22 statistical package. This was found to be $r = 0.965$. $p < 0.01$. Finally, non-linear curve (exponential) between these two parameters was fitted using regression method as shown in Fig. 1.

The following relationship between the gestational age and symphysis fundal height was obtained from the regression analysis.

$$\text{GESTATIONAL AGE(wks)} = 9.166 e^{0.039 (\text{FUNDAL HEIGHT})(\text{cm})} \dots\dots\dots(1)$$

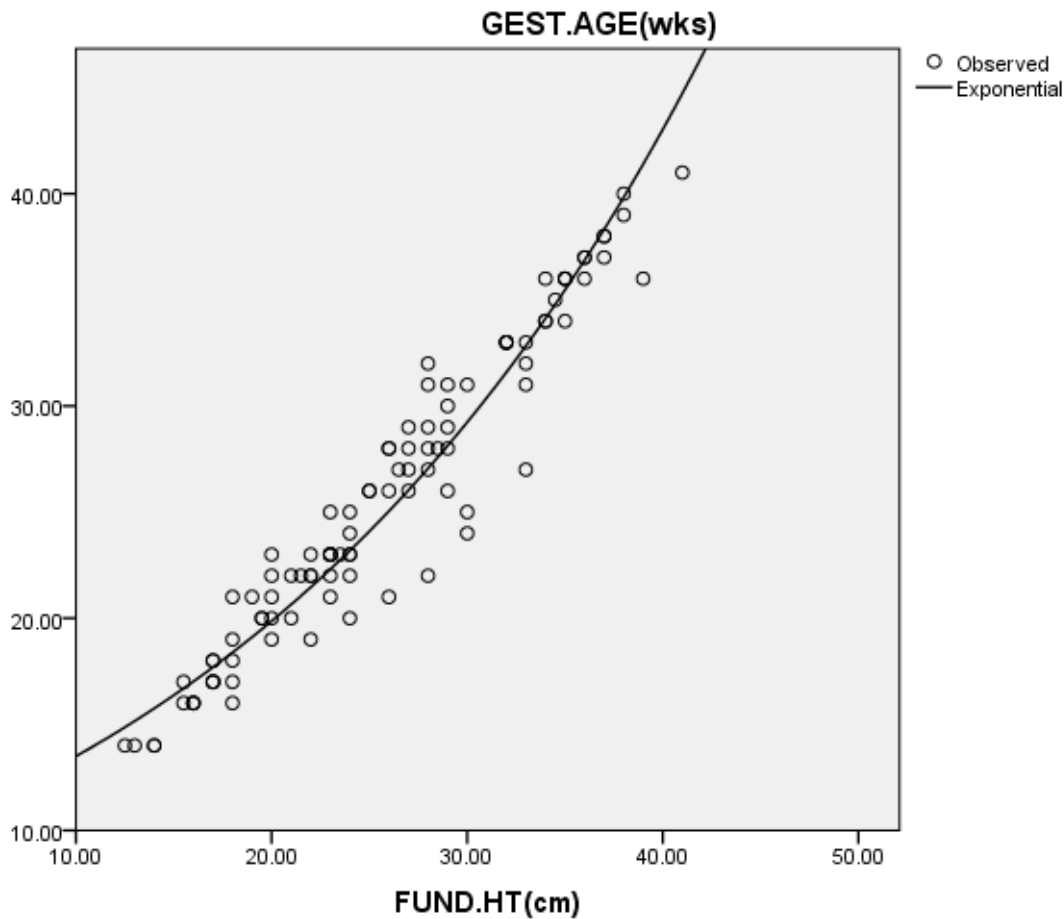


Fig.1. Exponential curve fitted between the gestational age and the fundal height

The ANOVA and regression coefficient tables are given in Table 1 and Table 2 below.

ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
Regression	7.210	1	7.210	1203.833	.000
Residual	.587	98	.006		
Total	7.796	99			

The independent variable is FUND.HT(cm).
 Table 1. ANOVA for the curve fitting.

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
FUND.HT(cm)	.039	.001	.962	34.696	.000
(Constant)	9.166	.273		33.625	.000

The dependent variable is ln (GEST.AGE(wks)).

Table 2. Regression coefficients for the curve fitting

4. DISCUSSION AND CONCLUSION

Equation (1) gives the relationship between the gestational age (GA) by ultrasound biometric measurements and the fundal height (FH) measurements. Using this equation gestational age corresponding to fundal heights from 16-40 cm were computed and shown in Table 3. This can be used as a reference table for more accurate determination of gestational age by simply measuring the fundal height and reading out the gestational age.

FH(cm)	GEST.AGE(wks)
16	17.1
17	17.8
18	18.5
19	19.2
20	20.0
21	20.8
22	21.6
23	22.5
24	23.4
25	24.3
26	25.3
27	26.3
28	27.3
29	28.4
30	29.5
31	30.7
32	31.9
33	33.2
34	34.5
35	35.9
36	37.3
37	38.8
38	40.3
39	42.0
40	43.6

Table 3. Computed gestational age from the regression equation for corresponding fundal heights

It can be seen that when the pregnancy is reaching the term (40 weeks of gestation) the variation between the fundal height and gestational age increases. However, in this study the gestational age by fundal height and ultrasound gestational age falls within ± 3.6 weeks interval.

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