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Effect of Maternal Age and Birth Order on Foetal Biometric Parameters

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ABSTRACT

Background: Foetal biometric parameters have been used to determine the growth pattern and viability of the foetus; however, some studies have suggested that the foetal development are also influenced by the age of the mother and parity (birth order). This research was therefore carried out to establish the effect of maternal age and birth order on foetal biometric parameters of Nigerians. **Methods:** The study was a prospective cross-sectional study, involving a total of 167 (76 male and 91 female) foetal records obtained from a semi-automated ultra-sonographic image. Four (4) biometric parameters (femur length [FL], abdominal circumference [AC], bi-parietal diameter [BPD], and head circumference [HC], were obtained from the sonographic machine while maternal (age), and birth order were determined after clinical examination and interview by the physician. XLSTAT (Addinsoft, version 2015.4.0.1) ANOVA and correlation were used to evaluate the strength of the relationship between maternal age, birth order and the measured foetal biometric parameters. $P<0.05$ was taken to be statistically significant at 95% confidence level. **Results:** The mean±S.D values of the biometric parameters for both sexes were observed as follows; male (FL = 51.40±18.41mm, AC = 245.56±72.02mm, BPD = 67.74±21.07mm, and HC = 230.07±64.34mm) and female (FL = 50.6±18.31mm, AC = 245.51±67.64mm, BPD = 68.47±20.34mm, HC = 235.07±64.27mm and NBL = 8.04±2.29mm). The mean values of the foetuses of the different birth orders were not significantly different ($P>0.05$). There was also no significant relationship between parity and maternal age on the foetal parameters ($P>0.05$). **Conclusion:** It could be concluded that maternal age and parity are not significant influencers of the foetal growth pattern and development.

Keywords: *Correlation, Foetal growth, Foetal biometrics, Maternal age, Parity.*

INTRODUCTION

Production of diagnostic images via sound generated waves made live by a monitor, is called ultrasonography; a procedure that brings to life, image of structures in-vivo.[1] Ultrasonography has been the method of choice for monitoring foetal development and condition.[2-4] Its use goes beyond monitoring the progress of the foetus, as sex can also be determined and abnormalities diagnosed.[5,6]

Studies have shown that ovarian and cervical dimensions can be used as adjuncts in accessing maternal factors which could play a role in foetal development.[7] Maternal physiologic state, physical appearance and general wellbeing have been related to the normal foetal body growth and development.[8,9] Vega et al.,[10] Teles et al.,[11] Mavalankar et al.,[12] Nahar et al.,[13] identified maternal pre-pregnancy weight, while Kirchengast and Hartmann,[14] and Ronnenberg et al.,[15] identified BMI as predictors of foetal birth weight. Hindmarsh et al.[16] reported that parity, maternal height, and body mass index were important determinants of birth weight.

Some researches have suggested an association between pre-pregnancy maternal weight and fetal growth;[17] with lighter mothers linked to smaller second trimester placental weight and foetal size,[18-19] as well as foetal growth rates from 28 to 32 weeks, and birth weight.[20] It is understood that the general foetal size and weight correlates with the proportionate development of the foetal body structures such as

head, femur, and abdomen.[21] However, only few studies have correlated maternal factors, parity to foetal biometrics. Therefore this study evaluates the relationship between maternal factors, parity and selected foetal biometric parameters.

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MATERIALS ANDMETHODS

Study design and population

The study was designed as a prospective cross-sectional study involving a total of 167 healthy gravid women within ages 20 to 47 years, with viable foetuses. Participants were volunteers from different ethnic groups, ages, background, tribes and occupations who reside in Port Harcourt, Rivers State. The study was conducted at the Image Diagnosis Center (Port Harcourt, Rivers State, Nigeria) and it involved gravid mothers who were in their second and early third trimester. Exclusion criteria included multiple pregnancy, evident fetal anomalies, fetal death at the time of enrollment, clinical conditions affecting maternal health (for example; asthma treated with steroids, HIV positives), and maternal history of previous chronic diseases (for example; cardiovascular abnormalities, chronic hypertension, diabetes).

Ethical considerations

Ethical clearance, with reference number UPH/CEREMAD/REC/04 was obtained from the University of Port Harcourt Ethical Committee after adequate consultations at the Department. Only patients who provided verbal and/or written informed consent for the collection of data were included in the study.

Measured Parameters

Five (5) foetal biometric parameters; femur length [FL], abdominal circumference [AC], bi-parietal diameter [BPD], and head circumference [HC] were obtained from the sonographic machine while maternal (age), and birth order were determined after clinical examination and interview by the physician.

Statistical analysis

The data were analysed using XLSTAT (Addinsoft, version 2015.4.0.1). ANOVA was used to determine the difference in the mean values of the foetal biometric parameters with respect to birth order (parity) while Pearson's correlation was used to evaluate the strength of the relationship between maternal age, birth order and the measured foetal biometric parameters. $P<0.05$ was taken to be statistically significant at 95% confidence level.

RESULTS

The results of this study were presented in Tables, and Graphs. Continuous variables were described as mean, standard deviation (S.D), and range (min-max). The mean values of the measured foetal biometric parameters were presented in Table 4.1 while Table 4.2 describes the comparison of the foetal biometrics stratified by parity. Pearson's correlation used to determine the relationship maternal age, parity and foetal biometric parameters was presented in Table 4.3. The scatterplots describing the relationship between maternal age, parity and femur length (FL), abdominal circumference (AC), biparietal diameter (BPD), and head circumference (HC) were presented in Figure 4.1-4.5 and Figure 4.6-4.10 respectively.

The mean(±S.D) age of the gravid mothers was 30.03±4.27years. The mean(±S.D) for the measured foetal biometric parameters were as follows; FL = 50.6±18.31mm (range; 19.10-84.50mm), AC = 245.51±67.64mm (93.30-360.30mm), BPD = 68.47±20.34 (range; 24.50-99.10mm), and HC = 235.07±64.27mm (range; 116.40-343.50mm) (Table 4.1). The difference in mean foetal values with respect to the birth order was not significant for any of the measured parameters; FL ($F=1.348$, $p=0.254$), AC ($F=1.394$, $p=0.238$), BPD ($F=1.257$, $p=0.289$), HC ($F=0.946$, $p=0.439$).

Pearson's correlation showed that the correlation of foetal biometric parameter and maternal age was positive while parity was negative; however the relationship ranged from very weak to no correlation, with no significance ($P>0.05$). FL vs (M.A; $r=-0.118$, $p=0.129$ and Parity; $r=0.087$, $p=0.263$), AC vs (M.A; $r=-0.004$, $p=0.950$ and Parity; $r=0.002$, $p=0.976$), BPD vs (M.A; $r=-0.069$, $p=0.375$ and Parity; $r=0.049$, $p=0.526$), and HC vs (M.A; $r=-0.022$, $p=0.782$ and Parity; $r=0.112$, $p=0.151$) [Table 4.3, Figure 4.1-4.10].

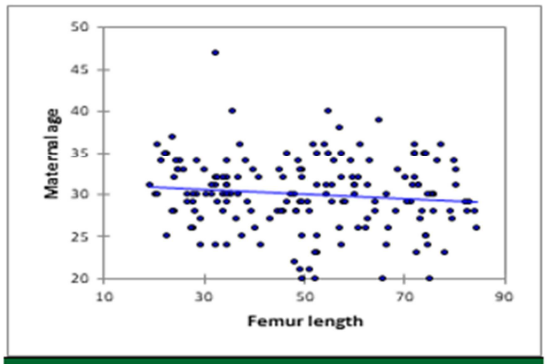

Figure 1: Scatter plot of the maternal age against femur length (FL).

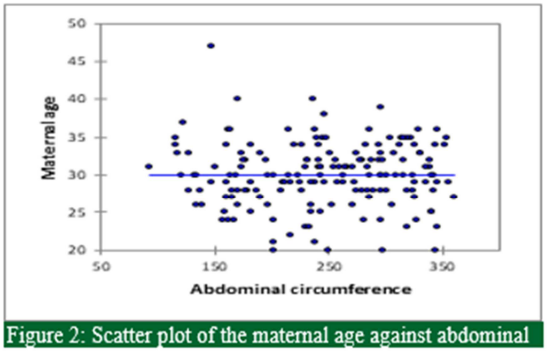

Figure 2: Scatter plot of the maternal age against abdominal

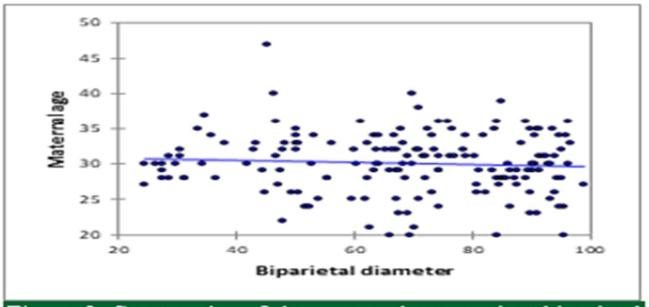

Figure 3: Scatter plot of the maternal age against biparietal diameter (BPD)

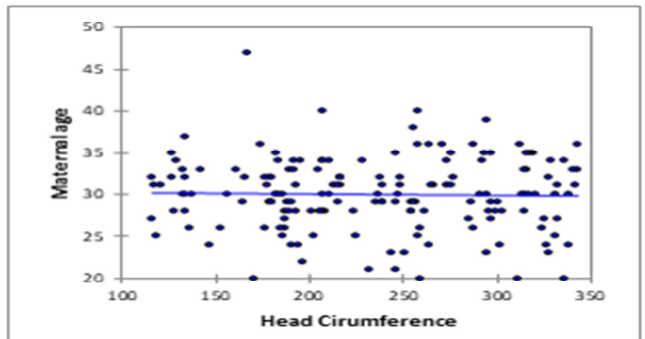

Figure 4: Scatter plot of the maternal age against head circumference

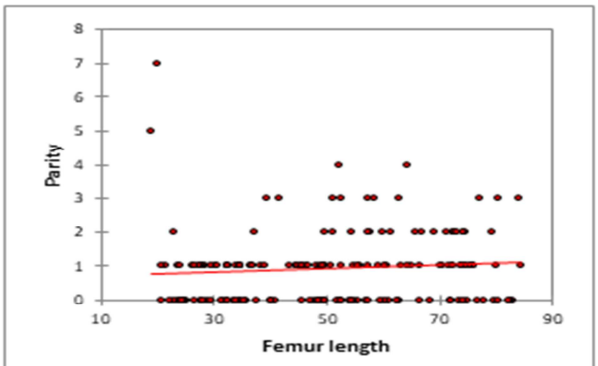

Figure 6: Scatter plot of the parity against femur length (FL)

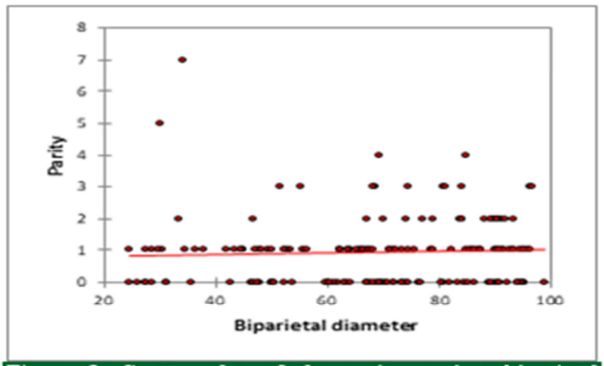

Figure 8: Scatter plot of the parity against biparietal diameter (BPD)

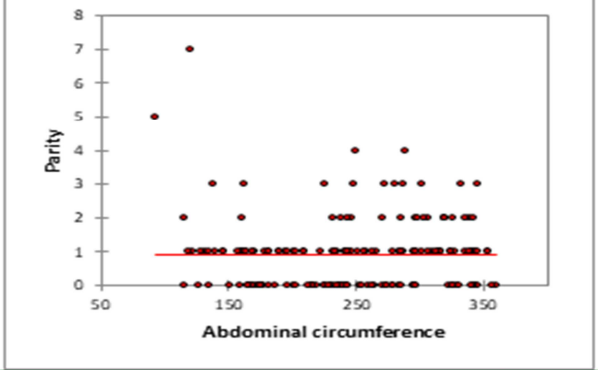

Figure 7: Scatter plot of the parity against abdominal circumference (AC)

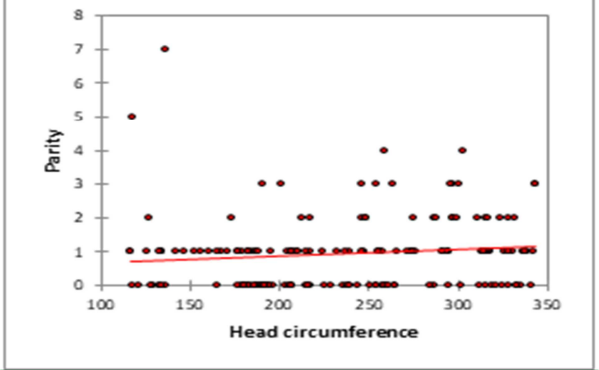

Figure 9: Scatter plot of the parity against head circumference (HC)

Table 1: Mean values of the measured foetal biometric parameters

Parameters	Total [N=167]			
	Mean±S.D	S.E	Min	Max
FL	50.6±18.31	1.42	19.10	84.50
AC	245.51±67.64	5.23	93.30	360.30
BPD	68.47±20.34	1.57	24.50	99.10
HC	235.07±64.27	4.97	116.40	343.50

Note: FL=Femur length, AC=Abdominal circumference, BPD=Biparietal diameter, HC=Head circumference.
N=distribution, S.D=Standard deviation, S.E=Standard error, Min=Minimum, Max=Maximum

Table 2: Mean values and comparison of foetal biometric parameters based on parity (birth order)

Parameters	Birth Order	N	Mean±S.D	Min	Max	F-value	P-value	Inf.
FL	None	66	48.83±17.97	20.7	84	1.348	0.254	NS
	One	67	50.59±18.78	20.2	84.5			
	Two	21	56.90±17.23	22.8	75.9			
	Three	10	53.63±18.20	27.9	80.3			
	Four and above	3	35.73±18.53	19.1	55.7			
	Total	167	50.60±18.31	19.1	84.5			
AC	None	66	248.93±63.51	134.1	354	1.394	0.238	NS
	One	67	239.95±68.44	115.2	360.3			
	Two	21	259.24±71.59	116	338.5			
	Three	10	254.38±70.41	161.5	345.7			
	Four and above	3	200.73±88.53	93.3	266.2			
	Total	167	245.51±67.64	93.3	360.3			
BPD	None	66	69.01±19.05	26.2	95.4	1.257	0.289	NS
	One	67	66.49±21.82	24.5	99.1			
	Two	21	73.43±19.37	33.4	92			
	Three	10	73.32±18.52	46.7	96.6			
	Four and above	3	59.93±22.44	30.3	74.4			
	Total	167	68.47±20.34	24.5	99.1			
HC	None	66	232.43±63.84	116.4	341.2	0.946	0.439	NS
	One	67	233.15±65.76	116.4	342.5			
	Two	21	245.07±61.36	127.1	328.1			
	Three	10	258.98±59.45	173.7	343.5			
	Four and above	3	186.33±79.61	117.9	273.7			
	Total	167	235.07±64.27	116.4	343.5			

Note: FL=Femur length, AC=Abdominal circumference, BPD=Biparietal diameter, HC=Head circumference, NBL=Nasal bone length
N=distribution, S.D=Standard deviation, S.E=Standard error, Min=Minimum, Max=Maximum, Inf.=Inference (NS=Not Significant)

Table 3: Correlation of maternal age and parity with FL, AC, BPD, HC and NBL

Variables	CORRELATION WITH MATERNAL AGE (in yrs)				CORRELATION WITH PARITY			
	r	R2	P-value	Inf.	r	R2	P-value	Inf.
FL (mm)	-0.118	0.014	0.129	NS	0.087	0.008	0.263	NS
AC (mm)	-0.004	0.000	0.950	NS	0.002	0.000	0.976	NS
BPD (mm)	-0.069	0.005	0.375	NS	0.049	0.002	0.526	NS
HC (mm)	-0.022	0.0005	0.782	NS	0.112	0.012	0.151	NS

Note: FL=Femur length, AC=Abdominal circumference, BPD=Biparietal diameter, HC=Head circumference, NBL=Nasal bone length, r=Pearson's correlation, R2=coefficient of determination, Inf.=Inference (NS=Not Significant; S=Significant).

DISCUSSION

The fact that the physical and physiologic state of the mother could influence foetal development is an indication that the growth pattern of the foetus may be disrupted when certain biochemical and nutritional requirements are altered.[8,9]

In this study, neither maternal age nor parity significantly correlated with the foetal FL, AC, BPD, and HC; however the relationship with maternal age was negative while that of parity was positive. When the mean values of the foetal biometric parameters where stratified with parity, the differences were not significant. Thus suggesting that birth order do not affect the development of the foetus. Although Aly et al.[22] suggested that Parity and maternal diabetes correlated with type 1 procollagen C-terminal propeptide (PICP) which is a bone formation marker; as increase in maternal parity correlated negatively with PICP concentration, but their study did not show a correlation with the developed bony structures.

Studies have shown that increase in maternal age increases the chances of Trisomy; diagnosed by foetal nasal bone morphology (nuchal translucency; NT) while decrease in maternal vitamin D level which may be associated with increasing age could affect foetal bone characteristics.[23-26] However, results obtained from the sonographs, showed normal growth pattern for the studied foetal biometrics parameters irrespective of the maternal age and birth order. On the other hand, increase in age can be regarded as a physiologic change that results in the decrease in reproductive hormones which supports foetal growth and development.[8,9] This physiologic interaction are likely to observed more at the micro level than the morphological level; as this study did not observe any significant influence foetal morphometry. This study cannot also exclude the fact that genetic, environmental and racial difference could vary foetal growth and development pattern.

CONCLUSION

From this study, it could be concluded that maternal age and parity do not significantly affect foetal growth and development. However, this study did not rule out the possibility that such maternal characteristics could have significant influences at the micro level.

Acknowledgements

From the observations in this study, it is recommended that other maternal factors such as hormone profile, and nutritional status be related to foetal biometrics.

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