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ORIGINAL ARTICLE

Relationship Between Amniotic Fluid Index and Ultrasound Estimated Fetal Weight in Healthy Pregnant African Women

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ABSTRACT

Introduction: Fetal weight (FW) estimation in late pregnancy is an important guide in obstetric care. Amniotic fluid protects the fetus against traumatic and infective insults. There possibly exists a relationship between FW and amniotic fluid index (AFI) that can be estimated by ultrasonography. **Materials and Methods:** Two hundred and fifty-eight low-risk pregnancies were prospectively studied by means of ultrasound over a 12-month period. FW was estimated using a combination of fetal parameters; bi-parietal diameter, fetal trunk cross sectional area, and femur length. AFI was assessed using the 4-quadrant method. Spearman's correlation was used to test possible relationship between amniotic fluid indices and estimated FW pairs. The level of statistical significance was set at $P \leq 0.05$. **Results:** The mean AF1 and estimated fetal weight (EFW) pairs were as follows: at 27-29 weeks the values were 172.1 mm and 1,250.2 g; at 30-32 weeks AF1 and EFW values were 170.3 mm and 1,648.0 g; at 33-35 weeks values were 162.3 mm and 2,273.5 g; at 36-38 weeks values were 144.09 mm and 2,906.1 g; at 39-40 weeks AF1 and EFW values were 125.0 mm and 3,222.6 g. Overall, there was no statistically significant relationship between AFI and EFW ($P > 0.05$; $r = 0.241$). **Conclusion:** While FW calculations and amniotic index showed variations in value in late pregnancy, there does not appear to be a linear relationship between ultrasound estimate of FW and amniotic index. The implication of this is that fetal size need not be taken into cognizance when alterations in amniotic fluid values are noted.

Key words: Amniotic fluid, fetal weight, ultrasound, Nigerian women

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INTRODUCTION

Sonographic estimation of fetal weight (FW), especially in late pregnancy is an important guide in obstetric care. This is particularly important when dealing with growth restricted or large for date babies.[1] Armed with this information informed decisions about delivery can be taken, thereby minimizing perinatal morbidity and mortality.[2]

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Amniotic fluid cushions the fetus from traumatic forces, cord compression, and pathogens, as well as playing an essential role in fetal lung development.[3] In late pregnancy, amniotic fluid production is largely dependent on fetal micturition[4] and renal size in the newborn has been shown to bear a significant relationship to birth weight.[5] It is therefore, reasonable to postulate a relationship between sonographically determined amniotic fluid index (AFI) and estimated FW.

Previous reports have investigated possible relationships between sonographically attained fluid index, and estimated fetal weight (EFW)[3,6] including the influence of AFI on the accuracy of sonographically EFW, among Caucasians. However, such studies are rare among Africans, especially Nigerians. This study was carried out to find out if any significant relationships exist between AFI and EFW in a Nigerian cohort of healthy pregnant women.

MATERIALS AND METHODS

This was a prospective study. Two hundred and fifty-eight low-risk pregnant subjects referred for routine ultrasound scans to the Radiology Department of the University of Benin Teaching Hospital, Nigeria were randomly selected over a 12-month period. Those with unsure dates, diabetes mellitus, and hypertensive disorders were excluded. Only those whose menstrual dates did not vary significantly from the estimated gestational age at first scan were enlisted. Approval of the Hospital's Ethics and Research Committee was sought and obtained.

Sonography was performed with a 3.5 MHz transducer (Fukuda Denshi; Fukuda Co Ltd, Japan). Cases found to have oligo- or poly-hydramnios and fetal anomalies were excluded. AFI was assessed using the four-quadrant technique as described by Phelan.[7] The sum of the measurements from the four quadrants was recorded for each subject. Fetal biometrics including biparietal diameter (BPD), using the cavum septum pellucidum as landmark, as depicted in Figure 1; fetal trunk cross sectional area (FTA) using the four chamber view of the heart, as illustrated in Figure 2; and the femur length (FL), with the 'hook' from the greater trochanter to the distal metaphysis included, as illustrated in Figure 3, were measured. The FW was automatically estimated by the scanner using a combination of the BPD, FTA, and FL, based on the in-built Osaka University system's formula. This is illustrated by Figures 4 and 5. All measurements were made by the first author. No patient was included more than once.

Data was entered into a Microsoft spreadsheet and analysed using the Statistical Package for the Social Sciences (SPSS version 16). Measurements were stratified into pairs of AFI and EFW as follows; 27-29 weeks, 30-32 weeks, 33-35 weeks, 36-38 weeks, and 39-41 weeks. Spearman's correlation was

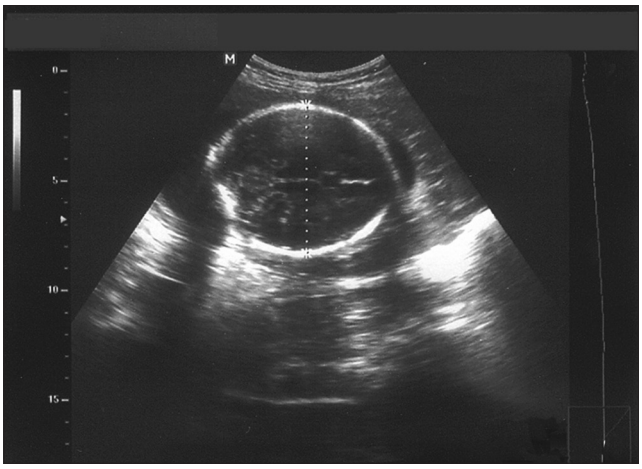

Figure 1: Ultrasound scan of abdomen shows how biparietal diameter is measured.

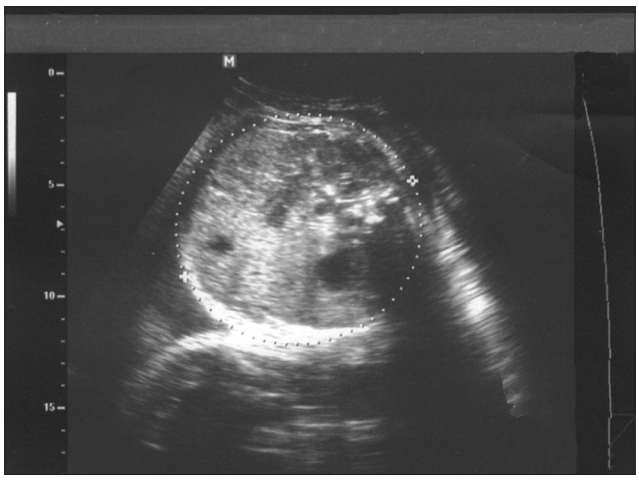

Figure 2: Ultrasound scan shows how to measure fetal trunk cross sectional area, using the four chamber view of the heart.

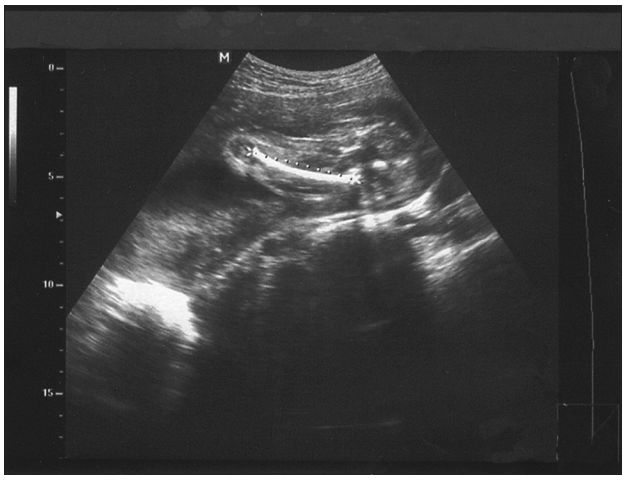

Figure 3: Ultrasound scan shows how to measure femur length, with the 'hook' from the greater trochanter to the distal metaphysis included.

used to test possible relationship between the AFI and EFW pairs. The level of significance was set at "*P*" values less than or equal to 0.05.

RESULTS

A total of 258 subjects were sonographically examined. The mean age of the subjects was 29.1 ± 4.9 years, and parity ranged from 0 to 7, with a mean of 1.5. The mean maternal weight was 71.4 ± 13.6 kg, and height was 1.6 ± 0.5 m.

The number of subjects in each gestational group were distributed as follows; 64 (24.8%) in the 27-29 weeks, 56 (21.7%) in the 30-32 weeks; 48 (18.6%) in the 33-35 weeks; 50 (19.4%) in the 36-38 weeks, and 40 (15.5%) in the 39-41 weeks; as outlined in Table 1.

Table 1 also shows that the mean AFI and EFW values for 27-29 weeks gestation were 172.1 mm and 1250.19 g respectively; 30-32 weeks were 170.3 mm and 1,648.04 g; 33-35 weeks were 162.3 mm and 2,273.54 g; 36-38 weeks were 144.0 mm and 2,906.12 g; and 39-41 weeks were 125.0 mm and 3,222.65 g. Spearman's correlation values between AFI and EFW were 0.123, 0.472, 0.179, 0.210, and 0.221 for 27-29 weeks, 30-32 weeks, 33-35 weeks, 36-38 weeks, and 39-41 weeks respectively. There was no significant association between AFI and EFW for all subdivisions of gestation age, except in the 30-32 weeks group ($P < 0.05$; $r = 0.472$). Overall, there was no statistically significant relationship between AFI and EFW ($P > 0.05$; $r = 0.241$). Figure 6 shows the scatter plot diagram for all pairs of AFI and EFW, with *r* value of 0.241.

Table 1: Amniotic fluid index and estimated fetal weight values for the gestational age ranges

Gestational age (weeks)	Amniotic fluid index (mm)		Estimated fetal weight (g)		Numbers (%)
	Mean	Range	Mean	Range	
27-29	172.1	114-240	1250.2	930-1484	64 (24.8)
30-32	170.3	110-220	1648.0	1134-1923	56 (21.7)
33-35	162.3	111-196	2273.5	1560-2632	48 (18.6)
36-38	144.0	97-192	2906.1	2234-3900	50 (19.4)
39-40	125.0	89-148	3222.6	2738-4001	40 (15.5)
All group	154.7	114-240	2260.0	930-4001	258

DISCUSSION

Amniotic fluid disorders, oligo-hydramnios, and poly-hydramnios have been associated with intrauterine growth restriction and abnormal fetal growth, but this relationship across the entire range of FWs is unclear.[3] However, when used alone, amniotic fluid measurement has been found to perform poorly in predicting fetal distress, fetal growth restriction or low Apgar scores, among others. It also has a wide range of reference values.[6] Polyhydramnios and oligohydramnios could overestimate or underestimate sonographic FW assessment.[1] While there are reports of AFI measurements and ultrasound EFWs, as separate parameters, both in the Nigerian and international literature,[8-10] there are few reports that assessed the possible relationship between AFI and estimated weight, for both normal (non-diabetic) and diabetic pregnancies.[1,3,6,11]

This study found a decrease in mean AFI values from 172.1 mm in early third trimester (27-29 weeks), to a value of 144.0 mm at 36-38 weeks, before a sharp drop to 125.0 mm at 39-40 weeks, as observed in previous studies.[8,11] As expected increase in FW was noticed throughout pregnancy, but there was no significant association between AFI and EFW when all the AFI and EFW pairs were considered ($P > 0.05$; $r = 0.241$). Only the AFI and EFW pair for gestation age 30-32 weeks showed any significant relationship; ($P < 0.05$). This lack of significant relationship between AFI and EFW across all gestational

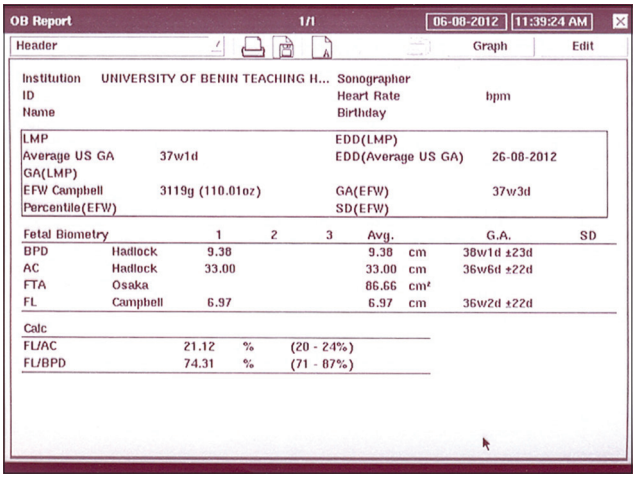

Figure 4: Sample report 1 shows estimated fetal weight calculated by the Osaka University system's formula.

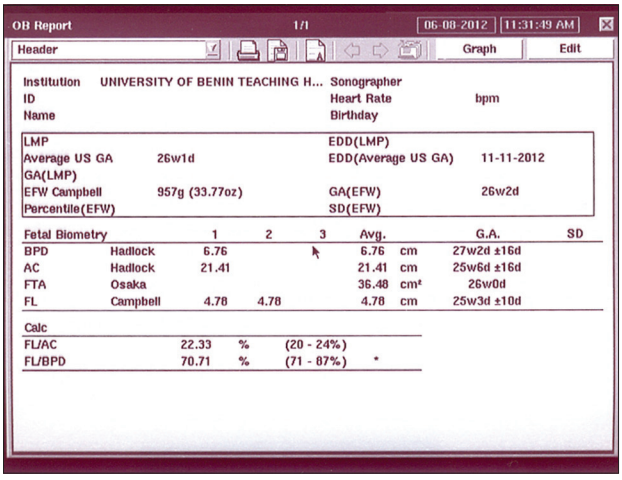

Figure 5: Sample report 2 shows estimated fetal weight calculated by the Osaka University system's formula.

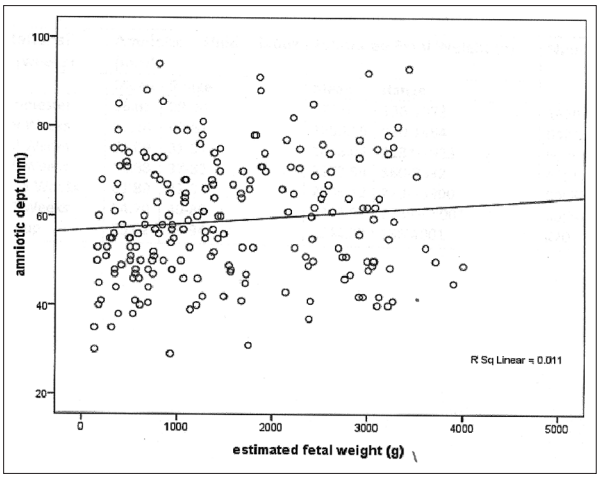

Figure 6: Scatter diagram of the relationship between amniotic fluid index and estimated fetal weight.

age strata is supported by the works of Perni et al., and Owen et al.[3,6] Possible reasons adduced for this are that swallowing and urinating mechanisms, rather than fetal size, are more involved in regulation of amniotic fluid volume. The implication of this is that fetal size may not need to be considered in variations of amniotic fluid volume across the gestational ages.

It is interesting to note that Kofinas and Kofinas[11] in 2012, found a significant relationship between AFI and EFW for both diabetic and non-diabetic pregnancies. While no explanation was offered for the former, it was postulated that fetuses of diabetic pregnancies spend more time breathing than swallowing; since swallowing and breathing are mutually exclusive, the fetuses do not swallow as much amniotic fluid as expected; thus in diabetic pregnancies, it may be necessary to consider fetal size when interpreting amniotic fluid variations across gestational ages.

This present report on relationship between amniotic fluid and estimated fetal weight is probably the first among pregnant women in Nigeria and therefore, raises the need for more studies on the subject, especially with larger sample sizes. It has nonetheless supported the majority of the views of similar works in the foreign literature that reported the non-dependence of amniotic fluid measurements on ultrasound estimated fetal size.

CONCLUSION

This study has produced a range of values of AFI and EFW among Nigerian Africans. However, no significant relationship exists between these parameters. The probable implication of this is neither parameter merits consideration when variations in the other are considered.

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