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The relationship between amniotic fluid index and accuracy of sonographic estimated fetal weight

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Abstract
Background: Ultrasound is the gold standard in evaluation of amniotic fluid volume and diagnosis of volume disorders as oligohydramnios and polyhydramnios. While the amniotic fluid may be thought of as an expansion of the foetus extracellular fluid compartment during the first two trimesters of pregnancy, most amniotic fluid is actually produced during the third trimester due to foetal micturition. We hypothesised a link between the amniotic fluid indexes (AFI) and estimated foetal weight (EFW), which might suggest that EFW be considered in amniotic fluid evaluation.
Methods: This cross-sectional study was conducted on 75 pregnant cases (Age was >18 years) and carrying singleton pregnancy with GA from 18 weeks to 40 weeks (GA evaluation was based on menstrual history & early US assessment) for 1 year. All participants underwent full history taking, abdominal ultrasonography examination and assessment of amniotic fluid index.
Results: The majority of included pregnancies showed cephalic presentation of the fetus. The overall AFI ranged from 2 to 30 cm, with a mean value of 17.2 (SD, 7.4) cm and a median value of 18 (IQR, 11) cm. The majority of included pregnancies showed a normal BPP. There was no significant association between AFI and EFW for all categories of gestational age, except in the 27-29 week's group.
Conclusions: The AFI and EFW numbers found in this research fell within a certain range. Nevertheless, these variables showed no statistically meaningful correlation with one another. Inferring from that, it seems unlikely that either measure is worth focusing on when the other is subject to fluctuation.

Keywords: Amniotic fluid index, fetal weight, pregnancy

Introduction
The amniotic fluid (AF) is a clear, pale, slightly alkaline fluid, with steadily increasing volume throughout pregnancy, reaching about one liter at full term (from 0.5 to 1.5). (1) The AF is mainly composed of water (98-99%) & it contains albumin, sodium chloride, small amounts of sugars, urea, creatinine, ammonia, enzymes, hormones, vernix caseosa, epithelial cells & suspended in it are lanugo hair [1].
Amniotic fluid volume (AFV) shows gradual increase with GA reaching a maximum volume of 1-1, 5L at 34-36 weeks. This is followed by a slight decline throughout the last 4 weeks, then a sharper & more rapid decline occurs after 40 weeks gestation [2].
Clinical evaluation of AF length is only subjective & seldom accurate especially in presence of maternal obesity, twins &uterine leiomyoma. Ultrasound (US) is the gold standard in evaluation of AFV & diagnosis of volume disorders as oligohydramnios & polyhydramnios. Measurement of amniotic fluid index (AFI) by measuring: AF length measurements in longitudinal &anterior posterior diameters in cm length& AF length index in which the vertical diameter of largest pocket is measured in each of the 4 abdominal quadrants. The sum of 4 quadrants gives an estimate AFI. Normal liquor (AFI10-15), oligohydramnios (AFI<5) & polyhydramnios (AFI>25) [3].
The obstetrical community relies heavily on sonographic estimates of foetal weight (FW), especially in the third trimester. When working with babies who are too big for their due dates or who are experiencing development delay, this is especially crucial. Informed decisions about labor can be made with this information, reducing perinatal morbidity and death [4].
AFI peaks and remains relatively plateau at the middle of the third trimester; and it eventually starts to decrease. During the first few months of pregnancy, AFV is more reliant on FW than on either gestational age or maternal weight [5].

While in the first trimester the AF may signify an expansion of the foetus interstitial fluid compartment, most AF is produced in the third trimester due to foetal micturition. Human infants' urine production is correlated with their body weight [6-7]. As foetus renal perfusion and kidney size are both predicted to rise with FW, we hypothesised that there may be a correlation between the AFI and estimated foetal weight (EFW), which would suggest that EFW be taken into account when assessing AF [8].
Aim of the study is to investigate sonographically determined foetal weight and its correlation with amniotic fluid index.

Patients and Methods

This cross sectional study was conducted at department of Obstetrics and Gynecology, Tanta University Hospital on about 75 pregnant cases (age was >18 years) and carrying singleton pregnancy with GA from 18 weeks to 40 weeks (GA evaluation was based on menstrual history & early US assessment) for 1 year.
An informed written consent was taken from all patients after full explanation of the study and the study was approved by the ethical committee.
Exclusion Criteria for groups were gestational diabetes, cholestasis, hypertensive disorders of pregnancy as gestational hypertension, preeclampsia, severe preeclampsia & eclampsia, fetal malformation, threatened preterm labor and still birth.

Methods

Patients were subjected to: complete history taking, personal history including, menstrual history: including age of Menarche, menstrual disturbance, dysmenorrhea & related symptoms, obstetrics history: detailed obstetric sheet was taken for each delivery e.g. Order of delivery, mode of delivery, complications & outcomes of pregnancy, history of Parity, history of infertility, Chronic illnesses, medications, hypertension, diabetes, allergies to drugs, previous surgery, laparoscopic interference, and laser therapy for hirsutism are all things to consider before deciding on a treatment plan.
Participants were also subjected to general examination, abdominal local examination of the pregnant cases including inspection, abdominal palpation for pregnancy evaluation (fundal height, fundal grip, lateral or umbilical grip and pelvic grip) and asculatation.

Abdominal ultrasonography examination

It was performed by SAMSUNG MEDISON H60, KOREA & 50/60 HZ trans abdominal probe for assessment of: fetal biometry (BPD, CRL, HC, AC and FL), presentation of fetus, fetal well-being (modified biophysical profile) and amniotic fluid index (AFI).

Assessment of amniotic fluid index

This was done by 2 methods: the maternal abdomen was divided into 4 quadrants using the midline & the umbilicus& by keeping the transducer perpendicular to the floor, the deepest pocket of AF was located in each quadrant. A vertical measurement of this pocket was performed, avoiding any areas of the pocket that contain extremity or umbilical cord. The sum of these measurements in centimetres was the AFI. Normal liquor (AFI10-15), oligohydramnios (AFI<5) & polyhydramnios (AFI>25) and amniotic fluid length measurements in longitudinal &anterior posterior diameters in cm length.

Estimated Sonographic FW

comprised US BPD, AC, and FL values for the Hadlock 3 algorithm. The BPD was taken at a level where a transverse picture of the cranium revealed a symmetrical, smooth head with a distinct midline echo, thalami, cavum septum pellucidum, and third ventricle. Calipers were positioned so that they ran from the outer parietal bone border to the interior parietal bone margin on the other side of the skull. In order to determine the foetus AC, a transverse picture was taken and the length of the umbilical section of the left portal vein was measured. This is the point where the right and left portal veins join together to form a J shape.
The bones were at a horizontal plane, the gut of the developing baby was a secondary landmark, and the spinal cord was the third landmark. It was necessary to locate an iliac bone in order to measure FL, and then to position the sensor so that the entire length was visible and as horizontal as feasible. The femoral length (FL) was measured from the outermost points of the diaphysis of the femur.

Modified fetal biophysical profile (MBPP)

the non-stress test, AFI & Doppler study of middle cerebral (MCA) & umblical artery were measured.

Statistical analysis

Description of means and standard deviation or median and interquartile range for quantitative variables and frequencies and percentage for qualitative variables were calculated using SPSS Version 22.0. Spearman correlation was carried out to investigate the relation between the EFW and AFI at different stages of gestation. P value less than 0.05 was considered to declare statistical significance.

Results

Maternal demographic data are summarized in (Table 1)

Table 1: Maternal Demographic Data (n = 75)

	N	%	Mean (SD)	Median (IQR)	Range
Age, years			28.9 (6.8)	29 (12)	18-40
18 – 24	22	29.3			
25 – 34	34	45.3			
35 – 40	19	25.3			
Weight, Kg			84.4 (9)	85 (15)	70 – 100
Height, cm			156.3 (10.8)	156 (20)	140 – 175
BMI, Kg/m^2			35.1 (6.2)	35 (9)	24 – 50
18 – 24.9	2	2.7			
25 – 29.9	14	18.7			
30 – 34.9	20	26.7			
35 – 39.9	20	26.7			

40 or more	19	25.3			
Gravidity			3.1 (1.4)	3 (2)	1 – 5
Primigravida	18	24			
Multigravida	57	76			
Parity			1.9 (1.4)	2 (2)	0 – 4
Nullipara	19	25.3			
Primipara	10	13.3			
Multipara	46	61.3			
GA, weeks			31.7 (5.9)	32 (8.8)	18 – 40
18 – 26	12	16.0			
27 – 29	11	14.7			
30 – 32	14	18.7			
33 – 35	10	13.3			
36 – 38	12	16.0			
39 – 40	16	21.3			

SD: Standard deviation; IQR: interquartile range; BMI: body mass index; GA: gestational age

Table 2 summarizes fetal characteristics data, including fetal presentation, amniotic fluid index (AFI), and fetal well-being presented by the modified biophysical profile (BPP).

Table 2: Fetal Characteristics

	N	%	Mean (SD)	Median (IQR)	Range
Fetal Presentation					
Cephalic	72	96			
Breech	3	4			
AFI, cm			17.2 (7.4)	18 (11)	2 – 30
Normal AFI	61	81.3	17.4 (5.7)	18 (9)	6 – 25
Oligohydramnios	7	9.3	3.4 (0.7)	4 (1)	2 – 4
Polyhydramnios	7	9.3	28.3 (1.3)	28 (2)	26 – 30
Modified BPP					
Normal	68	91			
Abnormal	7	9			

AFI: amniotic fluid index; BPP: biophysical profile

Table 3 demonstrates ultrasonographic measurements of fetal biometry.

Table 3: Fetal Biometric Measurements

	Mean (SD)	Median (IQR)	Range
Biparietal Diameter, mm (BPD)	83 (16)	87 (19)	39-105
Head Circumference, mm (HC)	291 (49)	304 (57)	143-358
Abdominal Circumference, mm (AC)	280 (65)	294 (92)	123-387
Femur Length, mm (FL)	60 (12)	62 (16)	26-78
Estimated Fetal Weight, gram (EFW)	2176 (1104)	2179 (1830)	304-4471

Spearman's correlation values between AFI and EFW were 0.053, 0.347, 0.121. 0.338, 0.301, and 0.209 for 18-26 weeks, 27-29 weeks, 30-32 weeks, 33-35 weeks, 36-38 weeks, and 39-40 weeks respectively. There was no significant association between AFI and EFW for all categories of gestational age, except in the 27-29 weeks group (P =.048; r = 0.347).

Table 4: Correlation between EFW and AFI According to GA

GA (weeks)	EFW (gram)		AFI (cm)		Correlation Coefficient	*P* value*
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)		
18-26	522 (174)	510 (245)	16.7 (8.7)	17 (15)	0.053	0.771
27-29	1316 (226)	1287 (327)	16.2 (7.1)	17 (9)	0.347	0.048**
30-32	1954 (290)	1943 (423)	17.8 (7.1)	19 (11.3)	0.121	0.445
33-25	2790 (406)	2746 (619)	17.7 (7.2)	19 (10)	0.338	0.054
36-38	3241 (490)	3217 (809)	17.1 (7.5)	19 (13.3)	0.301	0.106
39-40	3557 (443)	3446 (445)	17.4 (7.5)	19 (12)	0.209	0.276

EFW: Estimated fetal weight; * Spearman correlation. ** Statistically significant

Discussion

The present study showed that Fetal Characteristics; the majority of included pregnancies showed cephalic presentation of the fetus representing 96% of all participants, whereas only 3(4%) pregnancies showed breech presentation. The overall AFI mean value of AFI was 17.2 (SD, 7.4) cm. The majority (81.5%) of pregnancies had a normal AFI with a mean value of 17.4 (SD, 5.7) cm. 7 (9.3%) pregnancies had oligohydramnios with a mean value of 3.4 (SD, 0.7) cm. 7(9.3%) pregnancies had polyhydramnios with a mean value of 28.3 (SD, 1.3) cm. All patients with oligohydramnios scored abnormal modified (BPP), while the majority (91%) demonstrated a normal BPP.

However, in the study of Blitz *et al.*, oligohydramnios & polyhydramnios were identified in 9.7% &1.6% of pregnancies [9].

Whereas in the study of Karahanoglu *et al.*, the AFI values of the polyhydramnios, oligohydramnios & control groups differed significantly (P = 0.00), at 274 (34) mm, 35.4 (12) mm & 141.2 (21.7) mm, respectively [10].

Furthermore, Janas *et al.* demonstrated that mean AFI was 108.68 ± 37.14 mm in Group 1 & 22.17 ± 15.19 mm in Group 2 (p<0.001) [11].

The current study showed that as regard US measurements of fetal biometry: BPD ranged had a mean value of 83 (SD, 16) mm. The HC had a mean value of 291 (SD, 49). The had a mean value of 280 (SD, 65) mm. The FL had a mean value of 60 (SD, 12) mm. Using the Hadlock III formula: 10^ (1.335 – 0.0034 * AC * FL + 0.0316 * BPD + 0.0457 * AC + 0.1623 * FL), the EFW was calculated. The EFW had a mean value of 2176 (SD, 1104) grams.

Whereas in the study of Janas *et al.* mean EFW was not statistically significant different between both groups [11].

In the study of Ashwal *et al*. birth weight differed significantly among the groups. The rate of LGA was significantly higher in the polyhydramnios group in comparison to normal & oligohydramnios groups [12].

In addition, Karahanoglu *et al.* found that the average birth weight and the projected average prenatal weight were both greater in the polyhydramnios group than in the oligohydramnios group or the control group. Both the oligohydramnios and polyhydramnios groups overstated the EFW by roughly the same amount (63.9 vs. 66.3%) [10].

Our results showed that overall, there was a weak positive correlation between the EFW & AFI (Spearman test, correlation coefficient "r" = 0.113). However, the correlation did not reach a statistical significance (P = 0.111). There was no significant association between AFI & EFW for all categories of GA, except in the 27 -29 weeks group (P =.048; r = 0.347).

Wadnere *et al.* research.'s validated our own findings; they also found that, as anticipated, FW increased during pregnancy. However, when all possible combinations of AFI and EFW in the gestational group were examined, no significant relationship was found between the two variables (p> 0.05; r = 0.413). [13].

The research of both Perni *et al.* and Owen *et al.* reinforces the conclusion that there is no statistically significant correlation between AFI and EFW across any of the trimesters of pregnancy. Possible explanations include the fact that the processes responsible for swallowing and peeing have a greater impact on AFV control than does foetal growth. That means that differences in AFV at different stages of pregnancy might not be attributable to embryonic growth [14, 15].

Notably, Kofinas & Kofinas [16] discovered a substantial link between AFI & EFW for both diabetic & non-diabetic pregnancies.

In line with our findings, Adeyekun and Awosanya found that the AFI and EFW correlation coefficients were 0.123, 0.472, 0.179, 0.210, and 0.221 from weeks 27-29 to weeks 33-35, 36-38 to weeks 39-41. Except in the 30-32 weeks subset of GA (P 0.05; r = 0.472), no significant correlation was found between AFI and EFW. The correlation between AFI and EFW was not significant (p> 0.05; r = 0.241) [17].

In agreement with our study, Ashwal *et al.* stated that AFV was not found to significantly influence the accuracy of the sonographic fetal weight estimation (O.R 1.01, 95% C.I 0.67–1.54, p,0.93) [12].

In disagreement with our study, The AFI in the macrosomic group was found to be considerably higher by El Khouly *et al.* (P= 0.001). It was found that EFW's ROC curve had an area of 0.93, while AFI's ROC curve had an area of 0.67. Assuming a combined EFW and AFI cut-off of 4000 g and 164 mm, the PPV for the combined parameters is 92.3 percent, which is higher than the PPV for either EFW (75%) or AFI (27%), and the likelihood ratio for the combination is 93.7 percent, which is higher than either (EFW 24.7 percent or AFI's 21.1 percent) [18].

In disagreement with our study, Blitz *et al.* found that EFW was more likely to be overestimated in cases of oligohydramnios while Polyhydramnios was associated with a higher risk of underestimating EFW [9].

Further studies with larger sample size and multicenter studies are needed to confirm the current results. Sonographic EFW, especially in late pregnancy, is an important guide in obstetric care. We recommend the AFI & Accuracy of Sonographic EFW & other diagnostic methods for better accuracy.

Conclusions

The sonographic evaluation of EFW is a crucial obstetrical guidance, particularly in the later stages of pregnancy. This is of utmost significance when caring for infants who are too big for their age group. Reduce perinatal morbidity and death by making well-informed choices by following up this parameter.

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Conflict of Interest

Nil

References

1. Siemer J, Egger N, Hart N, Meurer B, Müller A, Dathe O, *et al*. Fetal weight estimation by ultrasound: comparison of 11 different formulae and examiners with differing skill levels. Ultraschall Med. 2008;29(2):159-64.
2. Hilliard NJ, Hawkes R, Patterson AJ, Graves MJ, Priest AN, Hunter S, *et al*. Amniotic fluid volume: Rapid MR-based assessment at 28-32 weeks gestation. Eur Radiol. 2016;26(10):3752-9.
3. Hughes DS, Magann EF. Antenatal fetal surveillance Assessment of the AFV. Best Pract Res Clin Obstet Gynaecol. 2017;38:12-23.
4. Ricchi A, Pignatti L, Bufalo E, De Salvatore C, Banchelli F, Neri I. Estimation of fetal weight near term: comparison between ultrasound and symphysis-fundus evaluation by Johnson's rule. J Matern Fetal Neonatal Med. 2021;34(7):1070-4.
5. Nash P. Amniotic fluid index. Neonatal Netw. 2013;32(1):46-9.
6. Araujo Júnior E, Peixoto AB, Zamarian AC, Elito Júnior J, Tonni G. Macrosomia. Best Pract Res Clin Obstet Gynaecol. 2017;38:83-96.
7. Okby R, Sheiner E. Risk factors for neonatal brachial plexus paralysis. Arch Gynecol Obstet. 2012;286(2):333-6.
8. Hackmon R, Bornstein E, Ferber A, Horani J, O'Reilly Green CP, Divon MY. Combined analysis with amniotic fluid index and estimated fetal weight for prediction of

severe macrosomia at birth. Am J Obstet Gynecol. 2007;196(4):333.e1-4.
9. Blitz MJ, Rochelson B, Stork LB, Augustine S, Greenberg M, Sison CP, *et al*. Effect of Maternal Body Mass Index and Amniotic Fluid Index on the Accuracy of Sonographic Estimation of Fetal Weight in Late Gestation. Am J Perinatol. 2018;35(13):1235-40.
10. Karahanoglu E, Altinboga O, Akpinar F, Gultekin IB, Ozdemirci S, Akyol A, *et al*. The Effect of the Amniotic Fluid Index on the Accuracy of Ultrasonographic-Estimated Fetal Weight. Ultrasound Q. 2017;33(2):148-52.
11. Janas P, Radoń-Pokracka M, Nowak M, Staroń A, Wilczyńska G, Brzozowska M, *et al*. Effect of oligohydramnios on the accuracy of sonographic foetal weight estimation in at term pregnancies. Taiwan J Obstet Gynecol. 2019;58(2):278-81.
12. Ashwal E, Hiersch L, Melamed N, Bardin R, Wiznitzer A, Yogev Y. Does the level of amniotic fluid have an effect on the accuracy of sonographic estimated fetal weight at term? J Matern Fetal Neonatal Med. 2015;28(6):638-42.
13. Wadnere N, Kosta S, Kumar R. Association between fetal weight and amniotic fluid index in women of Central India. Adv Biomed Res. 2014;3:243.
14. Owen P, Osman I, Farrell T. Is there a relationship between fetal weight and amniotic fluid index? Ultrasound Obstet Gynecol. 2002;20(1):61-3.
15. Perni SC, Predanic M, Cho JE, Kalish RB, Chasen ST. Association of amniotic fluid index with estimated fetal weight. J Ultrasound Med. 2004;23(11):1449-52; quiz 53.
16. Kofinas A, Kofinas G. Differences in amniotic fluid patterns and fetal biometric parameters in third trimester pregnancies with and without diabetes. J Matern Fetal Neonatal Med. 2006;19(10):633-8.
17. Adeyekun AA, Awosanya GG. Relationship between amniotic fluid index and ultrasound estimated fetal weight in healthy pregnant African women. J Clin Imaging Sci. 2013;3:2.
18. El Khouly NI, Elkelani OA, Saleh SA. Amniotic fluid index and estimated fetal weight for prediction of fetal macrosomia: a prospective observational study. J Matern Fetal Neonatal Med. 2017;30(16):1948-52.

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