The Correlation Between Amniotic Fluid and Neonatal Weight

Tuncay Bal*, Selim Karaküçük, Seda Nida Karaküçük

DOI: 10.17944/mkutfd.412051

Tuncay Bal: MD. Spec., Kahramanmaraş Necip Fazıl City Hospital, Clinic of Obstetrics and Gynecology, Kahramanmaraş, Türkiye
Eposta: tuncaybal46@hotmail.com
ORCID iD: https://orcid.org/0000-0002-0249-314X

Selim Karaküçü: Asst. Prof. Dr., Kahramanmaraş Sütçü İmam University, Department of Obstetrics and Gynecology, Kahramanmaraş, Türkiye
Eposta: karakucukselim@gmail.com
ORCID iD: https://orcid.org/0000-0002-9317-7926

Seda Nida Karaküçük: Asst. Prof. Dr., Kahramanmaraş Necip Fazıl City Hospital, Radiology Clinic, Kahramanmaraş, Türkiye
Eposta: drsedanida@gmail.com
ORCID iD: https://orcid.org/0000-0002-3789-6571

Bildirimler/Acknowledgement

Yazarlar bu makale ile ilgili herhangi bir çıkar çatışması bildirmemişlerdir.
The authors declare that they have no conflict of interests regarding content of this article.
Yazarlar bu makale ile ilgili herhangi bir finansal destek bildirmemişlerdir.
The Authors report no financial support regarding content of this article.

Received: 02.04.2018
Accepted: 22.05.2019

e-ISSN: 2149-3103
Web: http://dergipark.gov.tr/mkutfd

Öz

Amnion Sıvı İndeksi ile Yenidoğan Ağırlığının İlişkisi

Amaç: Bu çalışmanın amacı amniyotik sıvı indeksi (ASİ) değerinin, son adet tarihi, yaş ve parite durumundan etkilenip etkilenmediğini belirlemek ve ASİ, son adet tarihi, yaş ve parite durumu gibi değişkenler ile yeni doğan ağırlığı arasındaki ilişkiyi incelemektir.
Gereç ve Yöntem: Necip Fazıl Şehir Hastanesi, Kadın Hastalıkları ve Doğum Kliniğine doğum ağrıları ile miadında ağrılı gebe olarak 01.08.2017-01.11.2017 tarihleri arasında başvuran ardışık 153 sağlıklı gebenin demografik özellikleri ve yeni doğan ağırlıkları kaydedildi. ASİ ≤5 cm (oligohidroamnioz) ve 5.1-24 cm (normal-hidroamnioz) olarak iki gruba ayrıldı. Normal grupta kendi arasında 5.1-10 cm, 10.1-15 cm, 15.1-20 cm ve 20.1-24 cm arası olmak üzere 4 grup olarak sınıflandırıldı. Bu değişkenlerin birbirleri arasındaki ilişki incelendi. Veriler SPSS 22.0 istatistik programı kullanılarak analiz edildi. Yapılan analiz sonucu p<0.05 istatiksel olarak anlamlı kabul edildi.
Bulgular: Yaptığımız çalışmanın sonuçlarına göre SAT, yaş ve parite durumlarının oligohidroamnioz oluşumunda etkisinin olmadığı ve ASİ ortalamalarını etkilemediği bulundu. Yeni doğan ağırlığının ise SAT'tan etkilendiği (t/p=-3,002/0.03) ama yaş ve parite durumundan etkilenmediği saptandı. Ayrıca oligohidroamniozu olan gebelerin, normal ASİ değerine sahip gebelere göre daha düşük yeni doğan ağırlığına sahip bebekler doğurduğu (p<0.000) fakat normal ASİ değerine sahip gebelerin kendi içinde ASİ değeri ile yeni doğan bebek ağırlık ortalamaları arasında anlamlı bir ilişkinin olmadığı belirlendi.
Sonuç: Yaptığımız çalışmada değerlendirdiğimiz demografik faktörlerin ASİ değerlerini ve yeni doğan ağırlığını etkilemediği ancak oligohidroamniozlu gebelerde yeni doğan ağırlığının anlamlı olarak daha düşük olduğu belirlendi. SAT ile ASİ arasındaki ilişkiyi inceleyen ve farklı bölgelerde yapılan çalışmaların farklı sonuçlara sahip olmasının sebebinin ASİ'nin genetik yapı, sosyoekonomik durum ve coğrafi konum gibi faktörlerden etkilenmesi olduğunu ve bu değişkenleri gözeterek yapılacak yeni nomogramlara ihtiyaç olduğu kanaatindeyiz.

Anahtar kelimeler: Amniyotik sıvı, Yeni doğan ağırlığı, Fetal ağırlık, Ultrasonografi

Abstract

The Correlation Between Amniotic Fluid and Neonatal Weight

Aim: This study focused on determining whether or not amniotic fluid index (AFI) values were affected by last menstruation period (LMP), age and parity and assessing the correlation between such variables as neonatal weight and AFI, last menstruation period, age and parity.
Materials and Methods: Demographic characteristics and neonatal weights of 153 successive healthy women who presented to Necip Fazıl City Hospital, Clinic of Obstetrics and Gynecology by manifesting labor pain and full term pain between the 1st of August and the 1st of November, 2017 were recorded. They were sorted into two groups: oligohydramniosis group (AFI ≤5 cm) and normal-hydramniosis group (5.1-24 cm). The normal-hydramniosis group was sorted into 4 groups as 5.1-10 cm, 10.1-15 cm, 15.1-20 cm and 20.1-24 cm. The correlation among these variables was examined. The data were analyzed using SPSS 22.0 statistical program. As a result of the analysis; p<0.05 was accepted as significant.
Findings: According to the study results; it was found that LMP, age and parity did not affect oligohydramnios condition and average AFI values. However, neonatal weight was affected by LMP (t/p=-3,002/0.03), but not by age and parity. Besides, pregnant women with oligohydramnios gave birth to newborns with a lower neonatal weight as compared to those pregnant women with normal AFI values (p<0.000); yet there was no a significant correlation between AFI values and average neonatal weight values among pregnant women with normal AFI values.
Results: In this study; it was explored that demographic factors that we assessed did not AFI values and neonatal weight but among pregnant women with oligohydramniosis, neonatal weights were considerably lower. The reason why studies that investigated the correlation between LMP and AFI and that were done in different geographical regions demonstrated different results may be that AFI is influenced by such factors as genetic structure, socio-economic status and geographical location and we are of the opinion that we need new nomograms that take these variables into consideration.

Keywords: Amniotic fluid, Neonatal weight, fetal weight, ultrasonography

1. INTRODUCTION

Amniotic fluid (AF) is an environment that is necessary for fetus to grow healthily. Amniotic fluid serves many functions such as protecting fetus from traumas and infections during pregnancy, helping fetus develop a normal musculoskeletal system, providing fetal swallowing function necessary for gastro-intestinal system growth, allowing fetal breathing movements necessary for lung development and protecting umbilical cord and placenta and due to all these reasons, AF is a crucial marker in assessing wellbeing of fetus (1).

AF volume reaches to 30 ml in the 10th week, to 200 ml in the 16th week and to averagely 800 ml in the last trimester. 98% of amniotic fluid is water (2). In the advancing days of pregnancy, fetal urination and fetal lung liquid secretion are effective in the production of AF production whereas during resorption; fetal swallowing, intramembranous flow from fetal vascular structures on placental surface and transmembranous flow from amniotic membrane play a key role.

With these systems working regularly, AF volume is kept at a certain level. If one of these systems is hampered; reduction in AF (oligohydramniosis) or absence of AF (anhydramnios) or excessive volume of AF occurs (polyhydramnios) (3-4). It is reported that there is an increased fetal death risk in severe oligohydramnios or polyhydramnios (3). Many studies indicated that fetomaternal risk, fetal-neonatal morbidity and mortality increase in case of oligohydramnios among pregnant women (5-11).

Many methods –including invasive and sonographic methods- have been used in order to measure AF volume (12). But the most commonly used method is the one that was designed by Phelan et al; which is called Amniotic Fluid Index (AFI). In AFI, uterus is divided into four equal quadrants by imaginary lines running vertically and horizontally. Ultrasound probe is placed perpendicular to the floor, aligned longitudinally with the maternal axis. The deepest bags in 4 different areas are separately measured and added. These quadrants may include fetal parts and umbilical cord structures but these are not included in the measurement (13-15).

For AFI, normal reference range is between 5 and 24 cm. If there is no amniotic bag of waters to be measured, it is termed as anhydramnios; if AFI is ≤ 5 cm, it is termed as oligohydramnios and if AFI is ≥ 25 cm, it is termed as polyhydramnios or hydramniosis (3).

In this study; we focused on determining whether or not (AFI) values differed according to last menstruation period (LMP), age and parity and whether or not AFI affected neonatal weight. Moreover; we also targeted at comparing neonatal weights of pregnant women with oligohydramnios to neonatal weights of those with normal AFI by exploring whether or not there were any differences in neonatal weights according to AFI values among pregnant women with normal AFI.

2. MATERIAL AND METHODS

The study was prospectively planned and designed in descriptive and cross-sectional model. 153 successive healthy pregnant women who presented to Necip Fazıl City Hospital, Clinic of Obstetrics and Gynecology as full term pregnant women with pain (FTPWP) between the 1st of August and the 1st of November, 2017 and who gave birth between 37th and 42nd weeks were included in the study. Written official permission to undertake this study was gained from the hospital and informed consent was obtained from each participant. Approval of the ethics committee of Elazığ Medicine Faculty was also obtained. Detailed obstetric history of the participants was taken. Whether or not they had a chronic disease history and family disease history was asked. Pregnancy weeks were separately determined according to both LMP and ultrasonography (USG) measurements. Tensions were measured. Following routine vaginal examination; full blood tests, biochemical tests and full urine tests were performed. All the patients received USG assessments following Non-Stress Test. For standardization, USG assessments were performed by the same doctor from radiology unit using Toshiba Aplio 300 ultrasound device and 3.5 mhz abdominal probe. With USG; biparietal circumference (BPD), head circumference (HC), abdominal circumference (AC), femur length (FL) were assessed. According to USG; estimated fetal weights were found (16). While performing AFI measurements, uterus was divided into 4 equal quadrants. Ultrasound probe is placed perpendicular to the floor and parallel to the maternal axis. The deepest bags in 4 different areas are separately measured and added (13-15). After labor, neonatal weightings were done with EKS 8006 weighing machine and the data were recorded.

To the study, those healthy women who were 37-42 weeks pregnant and were aged between 17 and 35 years were recruited. Those women who had chronic diseases (diabetes, hypertension, renal diseases, collagenous tissue diseases), fetal anomalies, serious anemia, membrane rupture in medical examination and pregnancy history were excluded from the study. AFI values of the participant patients were classified into five groups: AFI values ≤5 cm, 5.1-10 cm, 10.1-15 cm, 15.1-20 cm and 20.1-24 cm. Two pregnant women with an AFI value of ≥25 cm were dropped off the study because one patient had diabetes and the other one had fetal anomaly. After birth, neonatal

weights were sorted out four groups: <2800 gr, 2800-3299 gr, 3300-3799 gr and 3800-4500 gr and data were recorded for comparison.

2.1. Statistical Analysis

In this study, all data were analyzed using "Statistical Package for Social Sciences (SPSS) 22.0 statistical package program. While data that were presented as average numbers and frequency were being analyzed; data related to oligohydramnios and normal-hydramniosis and LMP, age and parity were analyzed using chi-square test. The correlation between LMP and parity and AFI average values and neonatal weight was assessed with independent t test while the correlation between age and AFI and neonatal weight was analyzed using One way ANOVA. The correlation between AFI and neonatal weight was analyzed using One way ANOVA and One sample t-test. Results were considered significant at p<0.05 and confidence interval was set at 95%.

3. FINDINGS

Participants' demographic characteristics, AFI values, gestational week determined according to LMP and neonatal weights were demonstrated in Table-1. Minimum age was 17 whereas maximum age was 35. Average age was 25.2±0.4. 39.2% of the participant pregnant women belonged to 23-29 age group. 56.9% of the participant pregnant women were multiparous while 43.1% of them were primiparous. According to AFI values, 15% of the women had oligohydramnios (≤5 cm). According to average LMP, pregnancy week was 39.2±0.9. The rate of those who were 37-40 week pregnant according to LMP was by 49%. Upon looking at neonatal weights, only 11.8% of them had neonatal weight ≤ 2800 gr (Table-1).

Comparisons of variables of LMP, age and parity according to AFI values were presented in Table 2. When the correlation between pregnant women' oligohydramnios (≥5cm) and normal-hydramniosis (5-24 cm) and LMP, age and parity was assessed; p values were found as 0.108 for LMP, 0.866 for gestational age and 0.971 for parity. Oligohydramnios and normal AFI values were found not to be affected by these variables.

In Table 3, it was identified that average AFI values were not affected by LMP (t/p=0.41/0.967), age (t/p=0.124/0.725) and parity (t/p=0.644/0.520). As for average neonatal weights, they were significantly changed by LMP (t/p=-3,002/0.03), but not by age (t/p=2.238/0.137) and parity (t/p=0.825/0.411).

Table 1. Demographic And General Findings About Participant Women

Variables	n	%
Age		
<23	56	36.6
23-29	60	39.2
≥30	37	24.2
AFI (cm)		
≤5 cm	23	15.0
5.1-10 cm	74	49.4
10.1-15 cm	42	27.5
15,1-20 cm	9	5.9
20.1-24 cm	5	3.3
Gestational week determined by LMP		
37-40 week	75	49.0
40-42 week	78	51.0
Parity		
Primiparous	66	43.1
Multiparous	87	56.9
Neonatal Weight (gr)		
<2800 gr	18	11.8
2800-3299 gr	44	28.8
3300-3799 gr	67	43.8
3800-4500 gr	24	15.7
Total	153	100.0

Table 2. Comparisons of Variables Of LMP, Age And Parity According to AFI Values

Variables	AFI (≥5cm) Oligohidramnios		AFI (5-24 cm) Normal		X^2/p
LMP (week)	n	%	N	%	
37-40	12	52.2	63	48.5	0.108/0.459
40-42	11	47.8	67	51.5	
Age					
17-22	10	43.5	46	35.4	0.866/0.649
23-29	9	39.1	51	39.2	
30-35	4	17.4	33	25.4	
Parity					
Primiparous	13	56.5	74	56.9	0.971/0.573
Multiparous	10	43.5	56	43.1	
Total	23	15.0	130	85.0	

Chi-square test p<0.05

As seen in Table 4, neonatal weight in oligohydramnios (AFI ≤5 cm) group were significantly lower than the group with normal AFI (5-24 cm) (p<0.000). Average neonatal weight in oligohydramnios group was 3003.47±446.5 gr whereas average neonatal weight in normal group was 3402.80±390.4 gr.

As demonstrated in Table 5; its prevalence in Group-1, the oligohydramnios (≤5 cm) group, was by 15%. According to AFI; average weights of neonates in Group-1, the oligohydramnios (≤5 cm) group, were found significantly and statistically to be lower than average weights of neonates in other groups with normal AFI values (Group-2,

Group-3, Group-4, Group-5). However; according to intra-group analysis there was no statistically significant correlation among Group-2, Group-3, Group-4 and Group-5 –which were selected as normal groups- in terms of neonatal weights.

Table 3. Comparisons of Average AFI Values and Average Neonatal Weight Variables According to LMP, Age and Parity

Variables	AFI	Neonatal Weight
LMP (week)	Mean±SD	Mean±SD
37-40	9.57±4.4	3240.8±456.0
40-42	9.60±4.6	3440.8±364.8
t/p*	0.41/0.967	-3.002/0.03
Age	Mean±SD	Mean±SD
17-22	9.01±4.1	3266.9±399.3
23-29	9.61±4.0	3369.9±426.6
30-35	10.41±5.7	3413.5±444.2
f/p**	0.124/0.725	2.238/0.137
Parity	Mean±SD	Mean±SD
Primiparous	9.31±3.8	3310.3±385.5
Multiparous	9.79±5.0	3367.3±449.6
t/p*	0.644/0.520	0.825/0.411

*Independent t test **Oneway ANOVA test

Table 4. Comparison of Average Neonatal Weight in Oligohydramnios Group And Group With Normal AFI

AFI group	Total		Mean±SD	t*	P*
	n	%			
Oligohidramnios (≤5 cm)	23	15.0	3003.47±446.5	-4.423	0.000
Normal (5-24 cm)	130	85.0	3402.80±390.4	-4.025	0.000
Total	153	100.0	3350.00±422.7		

* One sample t test p<0.000

4. DISCUSSION

Oligohydramnios is closely associated with many conditions such as still birth, pre-mature birth, increasing prevalence of cesarean delivery due to non reassuring fetal status, neonatal mortality (17). Amount of amniotic fluid and fetal weight play a crucial role in assessing wellbeing of fetus and determining type of birth.

An incorrect assessment made using these parameters will cause unnecessary caesarian section and high risk for feto-maternal complications (18).

Table 5. Comparison of Amniotic Fluid Index and Average Neonatal Weights

Neonatal Weight (gr)	AFI CLASSIFICATION					Total	P*
	Group 1 ≤5 cm	Group 2 5.1-10 cm	Group 3 10.1-15cm	Group 4 15.1-20 cm	Group 5 20.1-24 cm		
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	
<2800gr	2536.25±340.9	2634.0±179.5	-	-	-	2590.55±259.6	0.001
2800-3299gr	3065.00±138.1	3062.50±107.2	3091.87±134.2	3133.33±76.3	3600.00±0.0	3090.68±142.3	0.002
3300-3799gr	3411.66±74.9	3511.66±149.2	3482.38±120.4	3400.00±100.0	3850.00±0.0	3493.58±141.7	0.012
3800-4500gr	3800.00±0.0	3983.0±172.0	3920.0±83.6	4000.00±173.2	3850.0±132.2	3948.12±151.3	0.001
Total n(%)	23(15.0)	74(48.4)	42(27.5)	9(5.9)	5(3.3)	153(100.0)	

*Oneway ANOVA p<0.05

In order to reduce these unwanted situations; factors affecting fetal weight and AFI should be known very well and the existing correlations should be uncovered.

According to Shripad et al.; when pregnancy week determined through LMP indicates week 42; AFI values decrease gradually (19) whereas according to Alao et al., AFI values increase (20). In this current study; when the correlation between pregnancy week determined through LMP and AFI values was investigated; it was identified that average AFI was 9.57±4.4 cm between 37th and 40th week of pregnancy and 9.60±4.6 cm between 40th and 42nd week of pregnancy but prevalence of oligohydramnios between 37th and 40th and 40th and 42nd weeks was 52.2% and 47.8% respectively; which did not show any statistically significant difference. These results concurred with the results of the study done by Brace et al. (21). The reason why literature studies present different results is that AFI values may change depending on many factors such as ethnicity, geographical region, socio-economical factors (22). Meanwhile, the current study suggested no significant correlation between age and parity and AFI.

In this study, no significant correlation existed between average neonatal weight and pregnant women's age and parity. Similar to the literature and as expected; the current study pointed out a significant increase between LMP and neonatal weighing (23).

It was identified that average neonatal weight among pregnant women with oligohydramnios was 3003.47±446.5 gr while average neonatal weight among pregnant women in the normal group was 3402.80±390.4 gr; which showed a significantly lower average neonatal weight among pregnant women with oligohydramnios as compared to the group with normal AFI. On the other hand, patients with

normal AFI values were divided into four groups in itself and as a result of the analyses no statistically significant correlation was seen among these groups in terms of average neonatal weights.

As a conclusion; in this study we found that age and parity status did not affect AFI and neonatal weight. As for LMP, we identified that it increased neonatal weight; which was in line with literature results. On the other side, we found that increase in LMP did not influence AFI. When studies that were undertaken in different regions and that investigated the correlation between AFI and LMP were examined, we understood that there were different studies suggesting that as LMP increases; AFI reduces or increases or does not change. We are of the opinion that the reason behind these outcomes is that AFI may change depending on many factors such as ethnicity, geographical region, socio-economical factors. Therefore; there is a need for new nomograms that take these variables and geographical regions into consideration. Another result of this current study was that pregnant women with oligohidramnios presented lower neonatal weight as compared to those women with normal AFI values. Yet, comparison which was made after dividing pregnant women with normal AFI values into groups did not show any statistically significant difference in terms of neonatal weight.

There is a need for wide scale and large series studies in which such factors as expanded age ranges, participation of pregnant women with polyhydramnios, socio-economical differences, smoking status are examined.

REFERENCES

1. Ross MG, Brace RA. National Institute of Child Health and Development Workshop Participants. National Institute of Child Health and Development Conference summary: amniotic fluid biology—basic and clinical aspects. J Matern Fetal Med. 2001;10(1):2–19.
2. Magann EF, Bass JD, Chauhan SP, et al. Curve of amniotic fluid volume in normal single to pregnancies. Obstet Gynecol 1997;90(4):524.
3. Rutherford SE, Phelan JP, Smith CV, et al. The 4 quadrant assessment of amniotic fluid volume: an adjunct to antepartum fetal heart rate testing. Obstet Gynecol 1987;70(3 pt 1):353.
4. Mark A, Underwood MD, William M, et al. Amniotic fluid: not just fetal urine anymore. J Perintol 2005; 25: 341–348.
5. Gizzo S, Patrelli TS, Rossanese M, Noventa M, Berretta R, DiGangi S, et al. An update on diabetic women obstetrical out comes linked to preconception and pregnancy glycemic profile: a systematic literature review. Scientific World Journal. 2013;6:254901.
6. Ozgu-Erdinc AS, Cavkaytar S, Aktulay A, Buyukkagnici U, Erkaya S, Danisman N. Mid-trimester maternal serum and amniotic fluid biomarkers for the prediction of preterm delivery and intrauterine growth retardation. J Obstet Gynaecol Res. 2014;40(6):1540–6.
7. Patrelli TS, Dall'asta A, Gizzo S, Pedrazzi G, Piantelli G, Jasonni VM, et al. Calcium supplementation and prevention of preeclampsia: a Meta-analysis. J Matern Fetal Neonatal Med. 2012;25(12):2570–4.
8. Chauhan SP, Taylor M, Shields D, Parker D, Scardo JA, Magann EF. Intrauterine growth restriction and oligohydramnios among high-risk patients. Am J Perinatol 2007; 24:215–221.
9. Gizzo S, Noventa M, DiGangi S, Saccardi C, Cosmi E, Nardelli GB, et al. Could molecular assessment of calcium metabolism be a useful tool to early screen patients at risk for pre-eclampsia complicated pregnancy? Proposal and rationale. Clin Chem Lab Med. 2014; 12.
10. Casey BM, McIntire DD, Bloom SL, Lucas MJ, Santos R, Twickler DM, et al. Pregnancy out come safterante partum diagnosis of oligo hydramnios at or beyond 34 weeks' gestation. Am J Obstet Gynecol. 2000;182(4):909–12.
11. Chauhan SP, Sanderson M, Hendrix NW, Magann EF, Devoe LD. Perinatal out come and amniotic fluid index in the antepartum and intra partum periods: A meta-analysis. Am J ObstetGynecol. 1999;181(6):1473–8.
12. Nabhan AF, Abdelmoula YA. Amniotic fluid index versus single deepest vertical pocket: a meta-analysis of randomized controlled trials. Int J Gynaecol Obstet. 2009;104(3):184–8.
13. Phelan JP, Smith CV, Broussard P, et al. Amniotic fluid volume assessment with the four-quadrant technique at 36-42 weeks gestation. J Reprod Med 1987;32:540.
14. Callen PW (ed): Amniotic fluid volume: its role in fetal health an disease. In Ultrasonography in Obstetrics and Gynecology, 5th ed. Philadelphia. Saunders Elsevier, 2008; 764.
15. Hill LM, Sohaey R, Nyberg DA: Abnormalities of amniotic fluid. In Nyberg DA, McGahan JR, Pretorius DH, et al (eds): Diagnostic imaging of Fetal Anomalies. Philadelphia, Lipincott Williams &Wilkins, 2003; 62.
16. Hadlock FP, Harrist RB, Sharman RS, et al. Estimation of fetal weight with the use of head, body, and femur measurements—a prospective study. Am J Obstet Gynecol 1985; 151: 333–337.
17. Petrozella LN, Dashe JS, McIntire DD, et al. Clinical Significance of borderline amniotic fluid index and oligohydramnios in pretem pregnancy. Obstet Gynecol 2011;117 (2 pt 1): 338.
18. Energin H. Ultrasonografi ile Ölçülen Tahmini Fetal Ağırlığa Etki Eden Faktörler. Dicle Tıp Dergisi 2016; 43(2): 294-298
19. Shripad H, Lavanya R, Prashant A, et al. Reference range of amniotic fluid index in late third trimester of pregnancy: What should the optimal interval between two ultrasound examination be? J Preg 2015; 2:132–136.
20. Alao OB, Ayoola OO, Adetiloye VA, et al. The amniotic fluid index in normal human pregnancies in South western Nigeria. Internet J Radiol 2007;5: 2–5.
21. Brace RA, Wolf EJ. Normal amniotic fluid volume changes through out pregnancy. Am J Obstet Gynecol , 1989;161:382 -388
22. Agwu EJ, Ugwu AC, Şhem SL, Abba M. Relationship of amniotic fluid index (AFI) in third trimester with fetal weight and gender in a southeast Nigerian population, Acta Radiol Open. 2016;5 (8).
23. American College of Obstetricians and Gyenocologists: Ultrasonography in pregnancy. Practice Bulletin No.101, February 2009, Reaffirmed 2011.