Open Access ORIGINAL ARTICLE

Reference range of Amniotic Fluid Index (AFI) in primigravidae with gestational age from 37 to 42 weeks in a local (Pakistani) population.

Abdur Raheem[1], Rayyan Pervez[2], Raheela Aqeel[3], Sanam Soomro[4], Aisha jang[5], Khurram Khalid Bhinder[6]

[1]Consultant Radiologist, Imaging Department, Dorset Country Hospital

[2]Consultant Radiologist, Radiology Department, Salisbury District Hospital.

[3,5]Consultant Radiologist, Radiology Department, Shifa International Hospital, Islamabad, Pakistan.

[4]Consultant Radiologist, Radiology Department, Dr. Salman Al Habib Medical Group, KSA.

[6]Resident Radiology, Radiology Department, Shifa International Hospital, Islamabad, Pakistan.

ABSTRACT

Background: Amniotic fluid index (AFI) is a key element in fetal biophysical profile that predicts pregnancy outcome especially near term in primigravidae. The objective of the study was to determine a reference range of AFI in primigravidae of a local population having gestational age from 37 to 42 weeks.

Methodology: This study was carried out from January 2019 to December 2019 after approval from Institutional Review Board and Ethical Committee at Shifa International hospital, Islamabad, Pakistan. Applying inclusion and exclusion criteria, a sample of 272 was selected. AFI was calculated for each subject using ultrasound and recorded on a data collection sheet. For the sake of simplicity and clinical relevance, the population was further stratified as term pregnancy (gestational age 37-39 weeks) and postdates pregnancy (40-42 weeks). The reference range of AFI was then calculated using mean ±two standard deviations.

Results: The reference range of AFI for gestational age of 37-42 weeks (population as a whole) was 6.8- 17.2 cm. For term pregnancy, it was 7.5- 17.5 cm, and for postdate pregnancy, it was 5.8 to 15.4 cm.

Conclusion: The reference range of AFI for gestational age of 37 to 42 weeks in Primigravida women was 6.8 to 17.2 cm. There is a decreasing trend in AFI as pregnancy advances from term to postdate.

Keywords: Amniotic Fluid Index, Gestational age, Primigravida, Reference Range.

Authors' Contribution:
[1]Conception; Literature research; manuscript design and drafting; [2,3] Critical analysis and manuscript review; [4,5]Data analysis; [6]Manuscript Editing.

Correspondence:
Raheela Aqeel
Email: rahilakhan119@hotmail.com

Article info:
Received: February 25, 2021
Accepted: March 17, 2022

***Cite this article**. Raheem A, Pervez R, Aqeel R, Soomro S, Jang A, Bhinder K K.* Reference range of Amniotic Fluid Index (AFI) in primigravidae with gestational age from 37 to 42 weeks in a local (Pakistani) population. *J Islamabad Med Dental Coll. 2022; 11(2):114-119.*
DOI: https://doi.org/10.35787/jimdc.v11i2.686

***Funding Source:** Nil*
***Conflict of Interest:** Nil*

Introduction

Measurement of amniotic fluid is considered an integral part of routine antenatal visits, especially in the last trimester and in particular when gestation is at term, where any change in volume or composition of amniotic fluid would significantly alter the outcome of pregnancy.[1] Hence amniotic fluid assessment should be done properly because of its clinical significance for the fetus and mother. [1]

There are three commonly used ultrasound

techniques for volume measurements of amniotic fluid. One is the subjective method, in which the observer uses his or her experience in deciding about the adequacy of fluid. The other two methods are objective, namely Single Deepest Pocket (SDP) and Amniotic Fluid Index (AFI), and results are equivocal as to which of these is superior in terms of accuracy.[2,3] However, in our setup AFI is the preferred technique used. In the single deepest pocket method, the operator places the probe on the abdomen of the pregnant patient at a right angle to the couch and searches for a pocket having maximum depth. The AFI is a four-quadrant technique in which the four deepest pockets are identified by the examiner after placing the probe at a right angle to the couch. These values are added together and the summed value is called AFI, measured in centimeters. There should be no fetal part or umbilical cord while measuring the deepest pocket. The value of AFI does not remain the same throughout pregnancy but changes on weekly basis as a result of the increasing maturity of the fetus and placenta. Similarly, AFI is said to be variable among different populations with different geographical and racial backgrounds. [4]

Based on the changing volume of amniotic fluid as the pregnancy progresses, the assessment at every stage in pregnancy has its importance but the period of utmost clinical significance is from 37 to 42 weeks, as major decisions about feto-maternal health and mode of delivery are taken into consideration at this age of gestation. This carries more weight when it comes to primigravida, as the current pregnancy's outcome would affect the subsequent pregnancies. Therefore, the accurate decision of mode of delivery based on the accurate reference of AFI is vital. Moreover, considering the effect of cultural and geographical variations on medical practice, some obstetricians show reluctance in following the published international AFI ranges and are therefore lacking confidence in their decisions. To our knowledge, no reference range of AFI has been published so far in the literature that is based on primigravidae only. Hence, we believe that this study would be of great help to our obstetricians in managing their cases efficiently and confidently.

Methodology

An observational study was carried out in the Department of Radiology, at Shifa International Hospital Islamabad, from January 2019 to December 2019. A total of 272 subjects were enrolled in the study based on sample calculation by the WHO sample size calculator using a confidence interval of 95% and a margin of error of 4.75%. All primigravidae (regardless of their age) with normal singleton pregnancy, of gestational age 37 to 42 weeks were included in the study and were followed till their delivery to make sure they end up in normal vaginal delivery. Cases excluded were those; with multiparity and previous abortions (to exclude confounding on AFI if any), foreign nationals, twin pregnancy, fetal congenital anomaly, a case with intrauterine growth retardation, and small or large for gestational age. Cases ending up in caesarian sections and those cases with maternal risk factors such as anemia, hypertension, diabetes, cardiac disease, chronic respiratory disorders, maternal jaundice, and kidney diseases were also excluded. Approval from the Institutional Review Board and Ethical Committee at Shifa International Hospitals, Islamabad, Pakistan was sought. 3.5 MHz curved transducer of XARIO Model SSA-660A (TOSHIBA Modified System) apparatus was used. Scans were done on these patients and were reviewed by the consultants to confirm the findings. Statistical analysis was performed using SPSS (Version 16). The gestational age was split into two groups, one from 37 to 39 weeks and the other from 40 to 42 weeks. The mean and standard deviation of AFI for these groups were calculated.

Results

The mean age of the population was 25.6 years with an age range of 17 to 41 years. Fourteen percent of subjects (n=39) had an age of 27 years. A large number of subjects were falling in age group 2 (23-28 years) forming 60.3% (n=164) of the total population. [Table I].

The mean gestational age was 38.4 weeks with a range of 37 to 42 weeks. Maximum number of pregnancies were at a gestational age of 37 weeks, comprising 29% (n=79) of the study population followed by those with a gestational age of 38 weeks [Graph II]. Grouping the subjects based on gestational ages, group 1 (37 to 39 weeks) was noted to have 209 participants as opposed to 63 in gestational age group 2 [Table II]. The mean AFI for gestational age of 37 to 42 weeks (studied population as one group) was 12.0 cm with a standard deviation (SD) of 2.6 and a reference range of AFI (using ±2SD) as 6.8 to 17.2 cm. When the population was split into two groups, the mean AFI of gestational age 37 to 39 weeks (group 1, denoting gestation at term) was found to be 12.5 cm and SD of 2.5 hence giving a reference range of 7.5 to 17.5 cm whereas the postdate pregnancies (group 2, denoting gestational age 40 to 42 weeks) had mean AFI of 10.6 cm and reference range of 5.8 to 15.4 cm using SD of 2.4 [Table II]. The reference range of AFI for each maternal group is as mentioned in Table III. Group 4 and group 5 were outliers as there were only a few subjects in the former and one in later.

Table I: Frequency of different age groups

No.	Age groups	No. of pregnant women	Percent
1	Group 1 (17 to 22 years)	60	22.1
2	Group 2 (23 to 28years)	164	60.3
3	Group 3 (29 to 34years)	43	15.8
4	Group 4 (35 to 40years)	4	1.5
5	Group 5 (Above 40 years)	1	0.4
	Total	272	100.0

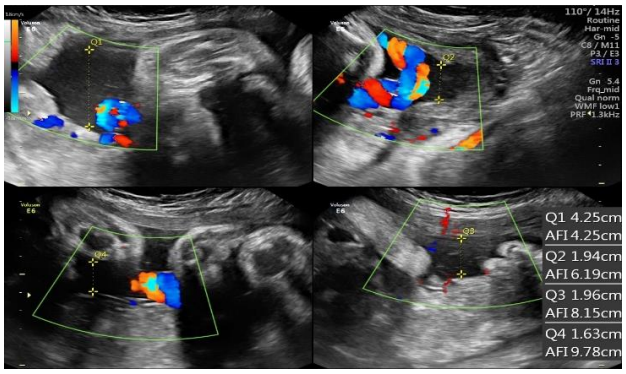

Figure 1 Ultrasound image showing AFI taken in four different quadrants by taking maximum vertical pocket excluding fetal parts and placental tissue.

Table :II Frequency of Subjects according to gestational age

No.	Gestational age group	Frequency	Percent	Mean AFI (cm)	Std. Deviation	Ref. Range (cm).
1	Group 1 (37 to 39 weeks)	209	76.8	12.5	2.5	7.5 - 17.5
2	Group 2 (40 to 42 weeks)	63	23.2	10.6	2.4	5.8 - 15.4

Table III. Reference range of AFI for each maternal group				
No	**Age group (Years)**	**Mean AFI (cm)**	**Std. Deviation**	**Ref. Range (cm)**
1	Group 1 (17 to 22)	11.8	2.4	7-16.6
2	Group 2 (23 to 28)	12.1	2.6	6.9-17.3
3	Group 3 (29 to 34)	12.0	2.8	6.4-17.6
4	Group 4 (35 to 40)	11.8	4.2	3.4-20.2*
5	Group 5 (40 plus)	11.0	1	NA*

Discussion

The amniotic fluid index is a commonly used technique worldwide because of its noninvasive nature and better correlation with the actual amount of amniotic fluid. With the notable differences in normal AFI ranges across the globe, obstetricians prefer to stick to their local values of AFI when deciding the mode of delivery. The study addresses the different AFI ranges for primigravida only, which we think is unique to this study. Secondly, we expect the results to provide a base for future studies if the effects of maternal age and parity on AFI are to be explored.

Gestational age affects the amniotic fluid volume because of certain anatomical and physiological changes in the fetus and mother. From a delivery perspective, the volume of amniotic fluid generally becomes significant around 37 weeks of gestation and beyond this gestational age. Hence amniotic fluid volume needs to be well understood at the gestational age of 37 weeks and onward in the third trimester. As a common occurrence during the progress of pregnancy, the AFI falls, hence its accurate record-keeping along with other denominators of the biophysical profile is important. For example, Gabbay-Benziv et al have seen a drop of median AFI down to 13.3 cm at 40 weeks gestational age from 16.4 cm at 22 weeks of gestation. [5] Kirshenbaum et al have found a similar outcome in centiles. [6] We find these values remarkably different than ours, of term pregnant women (7.5 to 17.5 cm), but there are certainly plausible explanations for it. One possibility can be geographical variation which like other medical conditions also affects the amniotic fluid volume. Another reason may be of parity of pregnant women, which has not been given enough attention in international literature. There is no proper segregation of the studied population into multigravida and primigravida which makes us different as our population is entirely of primigravida. The other reason can be sample size, a variable number of subjects in different age groups, and gestational age groups. For example, in our study 79 pregnant women had a gestational age of 37 weeks and only one pregnant woman had a gestational of 42 weeks. This variation in the frequency of study population groups might affect the variable AFI range. Last but not the least, is standard deviation, using two standard deviations to calculate the range will be different than that obtained with one standard deviation.

Luntsi et al. have also described AFI values in normal Northern Nigerian women from gestational age of 22 to 39 weeks with 206 as the sample size of the study. [7] The calculated AFI range in this study is 19.84 ± 3.64 cm. The result is somewhat similar to our population keeping in view that the said study has no postdate pregnancies enrolled. Our pregnant women population was grouped into two based on their gestational ages; group1 subjects were with gestational age from 37 to 39 weeks, whereas group 2 comprised of subjects having a gestational age of 40 weeks and onwards. This division was considered essential in our study as there is a difference in the management plan for pregnancies with gestation at

term and those with postdate pregnancies. Also, it is known that amniotic fluid volume regresses with advancing gestational age beyond 36 weeks. Hence, we cannot consider the AFI reference range of term gestation for those with postdate pregnancies as this may potentially lead to unnecessary interventions.

The effect of gravidity on AFI has not been thoroughly investigated in the literature, as the acquired reference ranges in different studies do not demarcate between primigravidae or multigravida. This would need further exploration by a comparative study of AFI between primigravida and multigravida keeping in view the lesser degree of confounding; for example, age, ethnicity, and gestational age. No attempts have been made in literature wherein different pregnant women's AFI was checked in different age groups. In our study, we separated the subjects into five subgroups based on their ages (of which the youngest was 17 and the eldest was 41 years old), and certain observations were made as follows. Group 1 had individuals with an age range of 17 to 22 years and showed a mean AFI of 11.8 cm which is not significantly changed then (12.1 cm) that of group 2 participants - comprised of the maternal age range of 23 to 28 years. The third group (maternal age range of 29- 34 years) had a mean value of 12 cm which is almost identical to the preceding group. Moreover, the population with maternal age greater than 34 was divided into two more groups – one group with maternal age 35 to 40 years and another with age more than 40 years - showing a mean of 11.8 and 11cm respectively, which do not differ significantly. Hence, we can postulate that maternal age might have not that profound effect on the AFI considering the fact of unequal subjects in these age-wise groups. For instance, 164 out of 272 were in the age group 2 (23-28 years) whereas 60 individuals were from age group 1 (17 to 22 years). This can also be confirmed in future studies by taking an equal number of subjects in these age groups.

According to Hughes et al, to be accurate in calculating abnormal amniotic fluid volume, our normal reference should be accurate as well. [3] Also, determining the correct estimation of AFI is important as it has a vital role in depicting fetal outcomes. [8,9] There is a tendency for overestimation of the fetal weight in the case of oligohydramnios and Polyhydramnios. [10, 11] The AFI determined in the third trimester can be used as a means to evaluate amniotic fluid levels [12]. Oligo and polyhydramnios can be established using defined values in certain populations and when correlated with Doppler ultrasound, can predict adverse fetal outcomes associated with AFI derangements [13,14,15]. Having said this, AFI values must always be correlated with clinical outcomes [16, 17] and the decision to initiate treatment [18].

The limitations in our study are not establishing any proper AFI reference range for the age group 35 years and above as limited number of cases were registered in this age group. Secondly, this study does not explore difference in amniotic fluid reference range between primigravida and multigravida .

Conclusion

By and large, we were able to achieve a reference range of AFI for our population. We wanted to target (primigravidae with a gestational age of 37 to 42 weeks) which is 6.8 to 17.2 cm and is fairly coherent to the one published in the literature. Having said that we hope this study would bring confident decision making by our obstetricians (both at regional and national levels) in managing their day-to-day cases.

Ethical Statement

The patient signed an informed consent form, as per the ethical guidelines of the hospital board.

REFERENCES

1. Cho HC, Sun S, Hyun CM, Kwon JY, Kim B, Park Y, et al. Automated ultrasound assessment of amniotic fluid index using deep learning. Medical Image Analysis. 2021 Apr 1; 69:101951.
2. Kehl S, Schelkle A, Thomas A, Puhl A, Meqdad K, Tuschy B, et al. Single deepest vertical pocket of the amniotic fluid index as evaluation test for predicting adverse pregnancy outcome (SAFE trial), a multicenter open-labeled randomized controlled trial. Ultrasound Obstet Gynecol. 2016 Jun;47(6):674-9.
3. Hughes DS, Magann EF, Whittington JR, Wendel MP, Sandlin AT, Ounpraseuth ST. Accuracy of the ultrasound estimate of the amniotic fluid volume (amniotic fluid index and single deepest pocket) to identify actual low, normal, and high amniotic fluid volumes as determined by quantile regression. Journal of Ultrasound in Medicine. 2020 Feb;39(2):373-8.
4. Agwu EJ, Ugwu AC, Shem SL, Abba M. Relationship of the amniotic fluid index (AFI) in the third trimester with fetal weight and gender in a southeast Nigerian population. Acta Radiol Open. 2016;5(8):2058460116652651.
5. Gabbay-Benziv R, Maor-Sagie E, Shrim A, Hallak M. Determination of reference values the third-trimester step amniotic fluid index: a retrospective analysis of a large cohort of pregnancies with comparison to previous nomograms. J Matern Fetal Neonatal Med. 2022; 35(1): 134-140.
6. Kirshenbaum M, Ziv-Baran T, Katorza E. Amniotic fluid index measurements in the second and third trimester and correlation to fetal biometric parameters- new reference based on big retrospective data. J Matern Fetal Neonatal Med. 2021 Sep 1:1-5.
7. Luntsi G, Burabe FA, Ogenyi PA, Zira JD, Chigozie NI, Nkubli FB, et al. Sonographic estimation of amniotic fluid volume using the amniotic fluid index and single deepest pocket in a resource-limited setting. J Med Ultrasound. Apr-Jun 2019;27(2):63-68.
8. Moin S, Mushtaq R, Iftikhar B, Khan M, Akram NA, Fatima S. Low amniotic fluid index (AFI) as a predictor of adverse fetal outcomes in the third trimester of pregnancy. Pakistan Armed Forces Medical Journal. 2020 Jan 27;70(Suppl-1): S69-73.
9. Jharwal R, Meena S, Meena V, Meena AK. Hospital-based Prospective Study to Determine the Relationship Between Amniotic Fluid Volume as Determined by Ultrasound Studies and Perinatal Outcome. International Journal of Health and Clinical Research. 2021 Jan 27;4(2):199-201.
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 Ultra sonographic-estimated fetal weight. Ultrasound Q. 2017 Jun;33(2)148-152.
11. Janas P, Radon-Pokracha M, Nowak M, Staron A, Wilczynska G, Brzozowska M, et al. Effect of oligohydramnios on the accuracy of Sonographic fetal weight estimation in at term pregnancies. Taiwanese Journal of Obstetrics and Gynecology. 2019 March;58(2): 278-281.
12. Anzaku SA, Gbala M, Dah TW, Didamson GD. Third Trimester Reference Values of Amniotic Fluid Index in a Group of Healthy Nigerian Women in Jos, Nigeria. Thai Journal of Obstetrics and Gynecology. 2018 Dec 28:255-61.
13. Onwuzu SW, Eze CU, Ugwu LC, Abonyi OE, Adejoh T. Ultrasound biometry of a normal human amniotic fluid index in a Nigerian population. Radiography. 2016 May 1;22(2):e86-92.
14. Talukdar RK, Deka N, Rahman M. Clinical Stud Regarding the Significance of Doppler & Modified Biophysical Profile in the Management of Post Dated Pregnancy. Sch Int J Obstet Gynec. 2019;2(11):277-283.
15. Yadav P, Basnet T, Yadav SP. MATERNAL AND PERINATAL OUTCOME IN BORDERLINE OLIGOHYDRAMNIOS: A HOSPITAL-BASED STUDY. International Journal of Medical Science and Diagnosis Research. 2021 Jan 9;5(1).
16. Ali MA. Assessment of Amniotic Fluid Volume in Sudanese Pregnant Women in Second and Third Trimester by Ultrasound Imaging (Doctoral dissertation, Sudan University of Science and Technology).
17. Mishra A, Neupane RP, Prasad PN, Thakur AK. Perinatal outcomes of pregnancies with borderline versus normal amniotic fluid index–A prospective study. Journal of General Practice and Emergency Medicine of Nepal. 2020 Jun 15;7(9):21-5.
18. Zafar H, Naz M, Fatima U, Shahzad U, Fatima A, Yasmeen A. Oral versus intravenous maternal hydration in isolated third-trimester oligohydramnios. International Journal of Research in Medical Sciences. 2020 Oct;8(10):3449.