

Sonographic Evaluation of Amniotic Fluid Index in Normal Pregnant Women in South Eastern Nigeria

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ABSTRACT

Background: Amniotic fluid index (AFI) is one of the key measures in obstetric ultrasound used for assessing amniotic fluid volume. **Objective:** To assess AFI in normal pregnancies and its relationship with gestational age and possible foetal anomalies in our local setting. **Materials and Methods:** A cross-sectional prospective survey was conducted on pregnant women between 20 and 40 weeks of gestational age with normal pregnancies who were referred for antenatal scan. Data were processed on SPSS version 25 and analyzed statistically using both descriptive and inferential statistics. The level of statistical significance was set at $p < 0.05$. **Results:** The AFI showed a gradual increase with gestational age. The mean AFI rises from 14.55 in weeks 20 to 24. Then, to 15.06 in weeks 35-40. The mean AFI in the second trimester was 14.62 cm. It was slightly lower than the third-trimester mean of 14.87 cm. At a p-value of 0.604, the difference between trimesters was not statistically significant, suggesting that AFI levels remained stable across these gestational periods. The correlation between amniotic fluid volume and gestational age showed that the correlation coefficient (r) was 0.114, indicating a very weak positive correlation between amniotic fluid volume and gestational age. **Conclusion:** The amniotic fluid index showed a mild, gradual increase with gestational age. Although not statistically significant across trimesters, AFI remained relatively stable, supporting normal fetal development with no signs of underlying anomalies in the study.

Keywords: Amniotic fluid, amniotic fluid index, normal pregnancy, and gestational age.

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Article Metrics

Submitted: 10 Nov. 2025

Accepted: 28 Jan. 2026

Published: July-Dec. 2026

Citation:

Oranusi IO, Okafor PO, Menkiti FE,
Maduikwe E. Management of anticipated
difficult airway in a 5-year-old child with
embryonal rhabdomyosarcoma of the
uvula in a resource poor environment
Trop J Med Res. 2026;25(1):101-108.
DOI: 10.5281/zenodo.21442668.

Journal Metrics

ISSN: p1119-0388, e2505-0338

Website: www.tjmr.org.ng

E-mail: info.tjmr@gmail.com

Publisher: cPrint, Nig. Ltd

Email: cprintpublisher@gmail.com

Access Code



www.tjmr.org.ng

INTRODUCTION

A mniotic fluid evaluation volume is an integral part of the routine obstetric ultrasound scan, and the amniotic fluid index (AFI) is one of the methods of doing this. The reduction or excessive production of amniotic fluid during pregnancy is a strong predictor of possible anomalies. AFI values tend to be affected by the difference of race and environment; caution is exercised when previously established AFI values are applied to pregnant women with different races and environmental backgrounds. This study evaluated the amniotic fluid index (AFI) in normal, pregnant women in the Nnewi community setting in South Eastern Nigeria and correlated it with gestational age and possible underlying anomaly. The amniotic fluid serves multiple functions necessary for adequate fetal development, ranging from biomechanical protection and immunologic properties, hormonal regulation, and the development of whole organ systems as seen with pulmonary development [1].

According to [2], at the beginning of pregnancy, amniotic fluid is largely a byproduct of maternal serum and resembles plasma due to hydrostatic and osmotic pressures. After 8 weeks of gestation, the fetal kidneys begin to function and produce urine; however, this does not become a key component of amniotic fluid until closer to 23-25 weeks, when fetal keratinization is complete. By the time keratinization is complete, fetal urinary production accounts for the main volume of amniotic fluid, with up to 1500 ml produced per day. In the last 20 weeks, fetal respiratory and gastric secretions also contribute up to 350 ml per day. Amniotic fluid is recycled primarily by fetal swallowing. Additional recycling pathways include the intramembranous

pathway of the placenta, umbilical cord, and fetal skin between the amniotic fluid and fetal blood (400 ml per day) [3].

A decrease in amniotic fluid index for a gestational age is termed oligohydramnios [4]. An increase in the amniotic fluid index for gestational age is termed polyhydramnios [5]. The volume of amniotic fluid changes over gestation, increasing linearly until 34 to 36 weeks of gestation, at which point the AFV levels off (approximately 400ml) and remains constant until term [6].

Transabdominal ultrasound evaluation of AFV includes the use of either the maximum vertical pocket (MVP) or the amniotic fluid index (AFI), depending on the institution. The sonographer systematically scans the abdomen and obtains an image that demonstrates the maximum vertical pocket - the deepest pocket of amniotic fluid that does not include the fetal umbilical cord or body parts. The measurement should be made from the 12 o'clock position to the 6 o'clock position. The normal range for MVP is 2-8 cm: a pocket <2cm is considered oligohydramnios in both single and multifetal gestations [7]. An MVP > 8 is considered polyhydramnios. The amniotic fluid index (AFI) is an alternative assessment of AFV. The AFI can be determined after 20 weeks of gestation by dividing the uterus into 4 quadrants through the umbilicus and determining the MVP in each quadrant. The sum of the 4 maximum vertical pockets is equal to the AFI. An AFI <5cm is consistent with oligohydramnios [8].

The use of the maximum vertical pocket tends to overly diagnose cases of polyhydramnios, while the use of the AFI tends to underdiagnose cases of oligohydramnios. With this in mind, some institutions opt to use the MVP in

gestations with low AFV and use the AFI in cases of high AFV. The MVP should serve to evaluate oligohydramnios in multifetal pregnancies, as you are not able to measure all four quadrants for each fetus [4]

However, AFI values tend to be affected by the difference of race and environment; caution is exercised when previously established AFI values are applied to pregnant women with different races and environmental backgrounds. Moreover, there is limited research on the AFI relationship with gestational age and possible related AFI anomaly in the studied locality. This study evaluated the amniotic fluid index (AFI) in normal pregnant women, correlated it with gestational age, and examined the possibility of underlying fetal anomaly in the community. The findings could be of great importance because accurate and early diagnosis of amniotic fluid level abnormalities will reduce the risk and rate of foetal death and maternal complications.

MATERIALS AND METHODS

We adopted a cross-sectional prospective survey study. The research was carried out in the Radiology department of Waves Medical Diagnostic and Research Center, Nnewi, Anambra State, Nigeria. The study population was pregnant women between 20 and 40 weeks gestational age with normal pregnancies referred for antenatal scan within the period of the study, which lasted for 3 months. Written informed consent was obtained from the subjects before inclusion into the study, and the procedure had been adequately explained to them.

Sample size estimation:

The sample size was determined by using the Yamen formula [9].

$$n = N / 1 + N(e)^2$$

n = the required sampling scope

N = Target population (134)

e = Margin error 5% = 0.05

1 = constant

Thus,

$$n = 134 / 1 + 134(0.05)^2$$

$$n = 100 / 1.25$$

$$n = 100$$

Women with gestational or overt diabetes mellitus, hypertensive disorders of the pregnancy, prelabour rupture of membranes, and congenital anomalies in the foetus, and those who delivered before 40 completed weeks were excluded from the study [10]. For AFI measurement, the uterine cavity was arbitrarily divided into four quadrants by a vertical and horizontal line running through the umbilicus. A linear array transabdominal probe was used to measure the largest vertical pocket (in cm) in the perpendicular plane to the abdominal skin in each quadrant. Amniotic fluid index was obtained by adding these four measurements [10]. Pregnant women with a positive history of diabetes mellitus and any other diseases that may change the nature of the amniotic fluid volume were excluded. The Amniotic fluid index values measured, biophysical information, and all data collected from each patient were recorded.

The obtained data were processed on SPSS version 25 and analyzed statistically using both descriptive and inferential statistics. The level of statistical significance was set at $p < 0.05$.

RESULTS

Data on the amniotic fluid index (AFI) across different gestational age groups among normal pregnant women were provided (Table 1). The AFI showed a gradual increase with gestational age. The mean AFI rises from 14.55 in weeks 20 to 24. Then, to 15.06 in weeks 35-40. Variability in AFI is relatively consistent across gestational

age. The 50th percentile values rise as pregnancy advances. The minimum and maximum AFI values range from 10.08 to 20.23 across all groups. Overall, the combined mean AFI for all gestational age groups was 14.79, with percentiles suggesting a relatively stable distribution of AFI measurements across the gestational timeline.

Table 1: Amniotic fluid index in normal pregnant women

Gestational age(weeks)	Mean	Standard Deviation	Median	5 th percentile	50 th percentile	95 th percentile	Min	Max
20-24 (n=27)	14.55	1.93	14.31	10.72	14.31	18.32	10.09	18.81
25-29 (n=15)	14.62	2.03	14.03	11.37	14.03	18.06	11.37	18.06
30-34 and (n=26)	14.82	2.43	15.56	10.28	15.56	18.67	10.08	18.84
35-40 (n=32)	15.06	2.24	14.47	11.53	14.47	19.04	11.03	20.23
Total (n=100)	14.79	2.16	14.44	11.06	14.44	18.39	10.08	20.23

We compared amniotic fluid volume across the second and third trimesters (Table 2).

The mean AFI in the second trimester was 14.62 cm. It was slightly lower than the third-trimester mean of 14.87 cm. At a p-value of 0.604, the difference between trimesters was not statistically significant, suggesting that AFI levels remained stable across these gestational periods.

Table 2: Comparison of amniotic fluid with each trimester.

Trimester	Mean±SD	T-value	p-value
First trimester (n=0)	0.00±0.00		
Second trimester (n=30)	14.62±1.86	2.977	0.604
Third trimester (n=70)	14.87±2.28		

Table 3. The correlation between amniotic fluid volume and gestational age showed that the correlation coefficient (r) was 0.114, indicating a very weak positive correlation between amniotic fluid volume and gestational age. At a p-value of 0.258, this correlation is not statistically significant, suggesting that amniotic fluid volume does not strongly correlate with gestational age in the study.

Table 3: Correlation between Amniotic fluid volume and Gestational age of the foetus.

Correlation (n=100)	Gestational age of foetus	
	R	p-value
Amniotic fluid volume	0.114	0.258

DISCUSSION

Regular sonographic evaluation of amniotic fluid is integral to monitoring high-risk pregnancies, guiding clinical interventions, and ensuring optimal outcomes for both mother and fetus [11]. This activity for healthcare professionals is designed to enhance the learner's competence in appropriately performing sonographic techniques to evaluate amniotic fluid volume, interpreting evaluation findings, and implementing an appropriate interprofessional management approach to improve patient outcomes [11]. This study provides a detailed evaluation of amniotic fluid index (AFI) in normal pregnancies, revealing the expected pattern of AFI across various gestational ages, in the second and third trimesters. The findings show that AFI levels increased steadily until around 30–34 weeks and then demonstrate a mild decrease or stabilization towards term. This is consistent with more recent research findings. Studies such as those by [11, 12] reported similar patterns, describing an initial rise in AFI during mid-pregnancy followed by a gradual decline or stability as the pregnancy approaches full term. The observed consistency with these studies reinforces the notion of AFI as a reliable indicator of amniotic fluid volume in normal pregnancies. It is noticeable that the majority of the studies agree that from 34 weeks onward, there is a gradual fall in AFI values. However, two studies from India reported a wide range of AFI. This may be because their observations were based on retrospective cross-sectional data. It is noticeable that AFI reference values

published by [10] are 2 to 3 cm more than all other series at all gestational ages; we presume this may be because the study was done in Indraprastha Apollo Hospital, New Delhi, where patients from very high socioeconomic status are catered to [10].

The mean AFI in this study across all gestational ages was 14.79 cm, which falls within the internationally accepted normal range of 8–25 cm, as established in various recent studies [13]. This range provides an effective baseline for distinguishing normal from abnormal fluid levels, which can aid in identifying conditions such as oligohydramnios and polyhydramnios. Consistency within this range across different gestational ages further validates AFI as a key measure for routine clinical monitoring. AFI values outside this range can be clinically significant, suggesting potential complications, as supported by a study by [14], which found that extreme AFI values correlate with adverse pregnancy outcomes.

Comparing amniotic fluid volumes between the second and third trimesters showed minimal differences, with a mean AFI of 14.62 cm in the second trimester and 14.87 cm in the third trimester. The p-value of 0.604 indicates no statistically significant difference between these trimesters. This result aligns with the findings of [13], which showed that in uncomplicated pregnancies, AFI tends to stabilize between the mid-second and late third trimesters. Studies like that of [15] support this view, suggesting that AFI remains relatively

constant in the later stages of pregnancy as fetal urine production and fluid turnover become balanced, a physiological process that allows AFI to stay within a stable range across these trimesters.

This study's investigation into the correlation between AFI and gestational age yielded a weak positive correlation ($r = 0.114$), with a p -value of 0.258, indicating no statistically significant relationship. This weak correlation is similar to findings by [16, 17], both of which reported that while there is an initial increase in AFI with gestational age, the relationship weakens in the later stages. This indicates that while amniotic fluid levels generally rise as pregnancy progresses, there are other variables—such as maternal hydration, placental function, and fetal health—that more directly impact AFI. This lack of a strong correlation suggests that gestational age alone should not be used as a primary indicator of amniotic fluid volume and supports the need for individual monitoring.

The minimum and maximum AFI values across the different gestational age groups in this study ranged from 10.09 to 20.23 cm. This range is comparable to studies conducted in different populations, such as those by [18, 17], which observed slight variations based on genetic and environmental factors. For instance, regional studies conducted in Asia and Africa have shown some variation in AFI values, highlighting the importance of locally relevant data. The data from this study provide valuable baseline values specific to this population, allowing for more precise clinical interpretations in similar settings. By having this regional data, clinicians can better identify deviations from the normal range, enhancing their ability to manage potential complications.

The stable AFI levels observed between the second and third trimesters suggest that, in normal pregnancies, the rate of fluid production and absorption reaches a state of equilibrium. This aligns with findings from [19], which demonstrated that by the second half of pregnancy, fetal renal function and swallowing contribute significantly to the maintenance of fluid levels. This homeostatic mechanism is crucial for fetal development, as amniotic fluid provides a protective environment and facilitates fetal movement. The stability in AFI levels during these periods supports the notion that AFI monitoring remains a useful tool for tracking fetal well-being without needing major adjustments based on gestational age alone.

Clinically, the results underscore the importance of AFI as a reliable metric in prenatal care. Given the consistency of AFI values across the second and third trimesters, clinicians can use AFI as an effective measure to assess fetal health without anticipating drastic changes solely due to gestational age progression. However, if AFI values fall outside the normal range, further investigation into other influencing factors is warranted. As noted by [20], AFI assessments, when combined with other fetal health indicators, improve the detection of at-risk pregnancies, allowing for earlier interventions and better outcomes which will reduce the risk and rate of foetal death and complications to the mother. However, the sensitive nature of the topic made a few numbers of the pregnant women declined to be scanned. This limited the availability of data and the sample size used in the study.

In conclusion, this study affirms that AFI levels in normal pregnancies increase at mid-gestation, plateau, and then slightly decrease toward term, a pattern that aligns with recent

literature. The findings demonstrate that while AFI is generally stable across the second and third trimesters, other factors, beyond gestational age, play a significant role in influencing amniotic fluid volume. The provision of population-specific reference values in this study adds valuable insight for local clinical practices, supporting the use of AFI as a dependable component of prenatal assessment. These findings contribute to a broader understanding of amniotic fluid regulation in healthy pregnancies and underscore the importance of individualized AFI monitoring to ensure maternal and fetal health.

Acknowledgment: We are grateful to the management and staff of Waves Medical Diagnostic and Research Center, Nnewi, Nigeria.

Author's contributions: DCU, conceived the plan, structure, and developed ideas for the paper. VCE contributed to the plan, structure, and revision of the manuscript, and CJC wrote the first draft. All the authors revised the manuscript, gave their approval, and agreed to be accountable for all aspects of the work.

Data availability: Available on reasonable request from the corresponding author, Daniel Chimuanya Ugwuanyi. Email dc.ugwuanyi@unizik.edu.ng

Funding: No funding sources.

Conflict of interest: The authors declared no conflict of interest.

Ethics approval and consent to participate: By the principles of the Declaration of Helsinki, the study protocol was reviewed and approved by an independent ethics committee of the Faculty of Health Sciences and Technology, College of Health Sciences, Nnamdi Azikiwe University,

Nigeria. Protocol number: FHST/REC/024/1027. Data were retrospectively collected and analyzed, ensuring the confidentiality and privacy of the patient's information.

Consent to participate: Written informed consent was obtained from the subjects before inclusion into the study, and the procedure was adequately explained to them.

REFERENCES

1. Underwood MA, Gilbert WM, Sherman MP. Amniotic fluid: not just fetal urine anymore. *J Perinatol*. 2005; 25(5):341-8
2. Holly B. Crellin, Vikramjeet Singh. *Sonography Evaluation of Amniotic Fluid*, Treasure Island (FL).2023; StatPearls Publishing
3. Sherer DM. A review of amniotic fluid dynamics and the enigma of isolated oligohydramnios. *Am J Perinatol*. 2002; 19(5):253-66.4. Keilman C, Shanks AL. Oligohydramnios. [Updated 2022 Sep 12]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan
5. A. Hamza D. Herr EF, Solomayer G. Meyberg-Solomayer. Polyhydramnios: Causes, Diagnosis and Therapy, *GeburtshilfeFrauenheilkd*. 2013 Dec; 73(12): 1241-1246
6. Rabie N, Magann E, Steelman S, Ounpraseuth S. Oligohydramnios in complicated and uncomplicated pregnancy: a systematic review and meta-analysis. *Ultrasound Obstet Gynecol*. 2017Apr;49(4):442-449.
7. Ippolito DL, Bergstrom JE, Lutgendorf MA, Flood-Nichols SK, Magann EF. A systematic review of amniotic fluid assessments in twin pregnancies. *J Ultrasound Med*. 2014 Aug;33(8):1353-64.

8. 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. *J Ultrasound Med.* 2020 Feb;39(2):373-378.
9. Uzoagulu, AE. Practical guide to writing research project reports in tertiary institutions. Enugu: 2011; Cheston Ltd.
10. Hebbar S, Rai L, Adiga P, Guruvare S (2015). Reference ranges of amniotic fluid index in the late third trimester of pregnancy: what should the optimal interval between two ultrasound examinations be? *J Pregnancy.* 2015;2015:319204. doi: 10.1155/2015/319204. Epub 2015 Jan; 15. PMID: 25685558; PMCID: PMC4312643
11. Crellin HB, Singh V. Sonography Evaluation of Amniotic Fluid. [Updated 2025 Jan 22]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan; Available from: <https://www.ncbi.nlm.nih.gov/books/NBK570623/>
12. Nabhan A F, Abdelmoula, Y A. Amniotic fluid index versus single deepest vertical pocket as a screening test for preventing adverse pregnancy outcome. *Cochrane Database of Systematic Reviews* 2009; (3).
13. Magann E F, Chauhan S P, Bofill J A, Martin, J N. Comparability of the amniotic fluid index and single deepest pocket measurements in clinical practice. *American Journal of Perinatology*, 2011; 28(8), 573-578.
14. Morris R K, Malin G, Khan K S, Kilby M D. Systematic review and meta-analysis of amniotic fluid index and single deepest vertical pocket as screening tests for adverse pregnancy outcome. *Ultrasound in Obstetrics & Gynecology*, 2014; 44(2), 138-146.
15. Chhabra S, Mehta D, Malhotra N. Amniotic fluid index and its association with perinatal outcome in low-risk pregnancies at or beyond term. *Journal of Obstetrics and Gynaecology of India*, 2018; 68(2), 120-124.
16. Park S J, Norwitz E R, Galyean, A M. Rethinking fetal distress: Approaches to fetal hypoxemia, acidosis, and brain injury during labor. *American Journal of Obstetrics and Gynecology*, 2014; 210(2), 105-110.
17. Mukherjee K., Kalra, J, Roy, M. A cross-sectional study on amniotic fluid index in normal and hypertensive pregnant women in the third trimester of pregnancy. *International Journal of Reproduction, Contraception, Obstetrics, and Gynecology*, 2015; 4(5), 1362-1366.
18. Chandraharan E, Arulkumaran, S. Physiological changes in pregnancy. In *Obstetric Clinical Algorithms* 2014; 7-15. Springer, London.
19. Sultana S, Alam M, Parvin S, Begum S. Study of amniotic fluid index in different gestational age groups and its relation with perinatal outcome. *Northern International Medical College Journal*, 2017; 9(1), 260-263.
20. Vink J, Feltovich H, Cervantes E. Prediction of preterm birth: Short cervix, cervical elastography, and other cervical measurements. *Clinics in Perinatology*, 2016;43(3), 529-540.