



Original Article

Assessment of Amniotic Fluid Index by Ultrasonography and Its Association with Maternal and Fetal Outcomes: A Prospective Observational Study from A Tertiary Care Center in Maharashtra

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ABSTRACT

Background: Amniotic fluid plays a crucial role in fetal development and well-being. Abnormalities in amniotic fluid volume, assessed using the amniotic fluid index (AFI), are associated with adverse maternal and fetal outcomes. Ultrasonographic evaluation of AFI serves as an important component of antenatal surveillance, particularly in the third trimester.

Objectives: To assess the amniotic fluid index using ultrasonography and evaluate its association with maternal and fetal outcomes.

Methods: This prospective observational study was conducted at a tertiary care center in Maharashtra from March 2025 to December 2025. A total of 48 pregnant women with singleton pregnancies beyond 28 weeks of gestation were included using a consecutive sampling technique. AFI was measured using Phelan's four-quadrant technique and categorized as oligohydramnios (<5 cm), normal (5–24 cm), and polyhydramnios (>24 cm). Maternal outcomes (mode of delivery, complications) and fetal outcomes (birth weight, Apgar score, fetal distress, NICU admission) were recorded. Statistical analysis was performed using SPSS version 25, and associations were evaluated using Chi-square or Fisher's exact test, with $p < 0.05$ considered significant.

Results: Among 48 participants, 66.7% had normal AFI, while 20.8% and 12.5% had oligohydramnios and polyhydramnios, respectively. A significant association was observed between abnormal AFI and increased cesarean section rates ($p = 0.028$). Low birth weight was significantly more common in the oligohydramnios group (60.0%) compared to the normal AFI group (18.8%) ($p = 0.012$). Neonatal outcomes, including low Apgar score, fetal distress, and NICU admission, were significantly higher in abnormal AFI groups ($p < 0.05$). Overall, adverse perinatal outcomes were significantly more frequent in oligohydramnios and polyhydramnios groups (50.0% each) compared to the normal AFI group (12.5%) ($p = 0.018$).

Conclusion: Abnormal AFI is significantly associated with adverse maternal and fetal outcomes. Routine AFI assessment can aid in early detection of high-risk pregnancies and guide timely clinical interventions to improve perinatal outcomes.

Keywords: Amniotic fluid index; Oligohydramnios; Polyhydramnios; Perinatal outcome; Ultrasonography; Pregnancy.

INTRODUCTION

Amniotic fluid is a vital component of the intrauterine environment, playing a crucial role in the growth, development, and protection of the fetus throughout pregnancy. It serves multiple physiological functions, including cushioning the fetus against external trauma, facilitating fetal movements, preventing cord compression, and contributing to the development of fetal lungs and the gastrointestinal system. The volume of amniotic fluid changes dynamically across gestation, reflecting

a balance between fetal urine production, swallowing, and intramembranous absorption. Any deviation from normal volume may indicate underlying maternal or fetal pathology and is associated with adverse perinatal outcomes [1].

Ultrasonographic assessment of amniotic fluid volume has become a standard component of antenatal surveillance due to its non-invasive nature, reproducibility, and clinical utility. Among various techniques, the Amniotic Fluid Index (AFI), introduced by Phelan et al., is widely used in clinical practice. It involves the measurement of the deepest vertical pocket in each of the four uterine quadrants and summation of these values to estimate the total amniotic fluid volume. AFI provides a semi-quantitative assessment and is considered more reliable than subjective clinical evaluation [2].

Based on AFI values, amniotic fluid volume is categorized into oligohydramnios (AFI <5 cm), normal (5–24 cm), and polyhydramnios (>24 cm). Oligohydramnios is commonly associated with conditions such as uteroplacental insufficiency, intrauterine growth restriction (IUGR), post-term pregnancy, and premature rupture of membranes. It is linked to increased risks of fetal distress, meconium aspiration, low birth weight, operative delivery, and perinatal mortality [3,4]. Conversely, polyhydramnios may be associated with maternal diabetes, fetal anomalies (especially gastrointestinal and central nervous system anomalies), multiple gestations, and idiopathic causes. It is associated with complications such as preterm labor, malpresentation, cord prolapse, and increased cesarean section rates [5,6].

The assessment of AFI is particularly important in the third trimester, where it serves as an indicator of placental function and fetal well-being. Reduced amniotic fluid volume often reflects chronic placental insufficiency and may warrant closer fetal monitoring or early delivery to prevent adverse outcomes. Similarly, excessive amniotic fluid may indicate fetal compromise or maternal pathology, necessitating further evaluation and management. Therefore, AFI is an integral component of biophysical profiling and high-risk pregnancy surveillance [7].

Several studies have demonstrated a significant association between abnormal AFI and adverse maternal and fetal outcomes. Low AFI has been consistently linked with increased rates of labor induction, cesarean delivery, fetal distress, and neonatal intensive care unit (NICU) admissions. Likewise, polyhydramnios has been associated with higher incidences of maternal complications and neonatal morbidity. Despite its widespread use, the predictive accuracy of AFI and its correlation with perinatal outcomes may vary across populations and clinical settings [8,9].

In resource-limited settings, where advanced fetal monitoring techniques may not be readily available, AFI measurement by ultrasonography provides a simple and cost-effective tool for risk stratification. Early identification of abnormal AFI can facilitate timely interventions, improve obstetric decision-making, and potentially reduce perinatal morbidity and mortality. However, regional data regarding the association between AFI and pregnancy outcomes remain limited, particularly in smaller tertiary care centers [10].

Therefore, the present study was undertaken to assess the amniotic fluid index using ultrasonography and to evaluate its association with maternal and fetal outcomes among pregnant women attending a tertiary care center in Maharashtra. By correlating AFI values with clinical outcomes, this study aims to contribute to the existing body of evidence and reinforce the importance of routine AFI assessment in antenatal care.

MATERIALS AND METHODS

Study Design and Setting: This was a prospective observational study conducted at Vedantaa Institute of Medical Sciences, a tertiary care teaching hospital in Maharashtra, India.

Study Duration: The study was carried out over a period of 10 months, from March 2025 to December 2025.

Study Population: The study included pregnant women attending the antenatal outpatient department or admitted to the labor ward of the institute during the study period.

Sample Size: A total of 48 pregnant women fulfilling the inclusion criteria were enrolled in the study. A consecutive sampling technique was used.

Inclusion Criteria

- Pregnant women with **singleton pregnancy**
- Gestational age **≥28 weeks**
- Women who provided **written informed consent**

Exclusion Criteria

- Multiple pregnancies
- Known **congenital fetal anomalies**
- Premature rupture of membranes (PROM) / preterm PROM
- Women with conditions that could significantly alter amniotic fluid independently (if applicable as per data)

Methodology: After obtaining informed consent, detailed maternal history and clinical examination were performed. Gestational age was determined based on last menstrual period and/or first trimester ultrasonography. Amniotic fluid index (AFI) was measured using ultrasonography following Phelan’s four-quadrant technique, wherein the uterus was divided into four quadrants and the deepest vertical pocket of amniotic fluid in each quadrant (free of fetal parts and umbilical cord) was measured in centimeters and summed to obtain the AFI. All ultrasonographic measurements were performed by trained radiologists using standardized equipment to reduce inter-observer variability.

Based on AFI values, participants were categorized into three groups:

- Oligohydramnios: AFI <5 cm
- Normal AFI: 5–24 cm
- Polyhydramnios: AFI >24 cm

All participants were followed up till delivery, and maternal as well as fetal outcomes were recorded.

Study Variables: The study variables included both maternal and fetal parameters. Maternal variables comprised age, parity, gestational age at delivery, mode of delivery (vaginal or cesarean section), and any associated maternal complications. Fetal and neonatal variables included birth weight, Apgar score at 1 and 5 minutes, presence of fetal distress, requirement of neonatal intensive care unit (NICU) admission, and overall perinatal outcome. The primary independent variable was the amniotic fluid index (AFI), categorized into oligohydramnios, normal AFI, and polyhydramnios based on standard cut-off values.

Outcome Measures: The primary outcome was to assess the association between AFI and maternal as well as fetal outcomes. Secondary outcomes included the distribution of AFI categories and their correlation with specific obstetric and neonatal parameters.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS) software (version 25). Continuous variables were expressed as mean \pm standard deviation, while categorical variables were presented as frequencies and percentages. The association between AFI categories and maternal and fetal outcomes was assessed using the Chi-square test or Fisher’s exact test, as appropriate. Confidence interval was set at 95%. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations: The study was conducted after obtaining approval from the Institutional Ethics Committee of the institute. Written informed consent was obtained from all participants prior to enrollment. Confidentiality of patient data was maintained throughout the study.

RESULTS

A total of 48 pregnant women were included in the study. Most participants were aged 20–30 years (62.5%), with a slight predominance of multigravida (54.2%). Half of the participants delivered at term (>37 weeks) (Table 1).

Table 1: Baseline Demographic and Obstetric Characteristics (n=48)

Variable	Frequency (%)	
Age (years)	<20	6 (12.5%)
	20–30	30 (62.5%)
	>30	12 (25.0%)
Parity	Primigravida	22 (45.8%)
	Multigravida	26 (54.2%)
Gestational Age (weeks)	28–34	10 (20.8%)
	34–37	14 (29.2%)
	>37	24 (50.0%)

The majority of cases had normal AFI (66.7%), while oligohydramnios and polyhydramnios were observed in 20.8% and 12.5% of cases, respectively (Table 2).

Table 2: Distribution of Amniotic Fluid Index (AFI) Categories

AFI Category	Number (n)	Percentage (%)
Oligohydramnios (<5 cm)	10	20.8%
Normal (5–24 cm)	32	66.7%
Polyhydramnios (>24 cm)	6	12.5%

A statistically significant association was found between AFI and mode of delivery, with higher cesarean section rates observed in both oligohydramnios (70.0%) and polyhydramnios (66.7%) groups compared to the normal AFI group (31.2%) ($p=0.028$). Although maternal complications were more frequent in abnormal AFI groups, the association was not statistically significant (Table 3).

Table 3: Association of AFI with Mode of Delivery and Maternal Outcomes

Variable		Oligohydramnios (n=10)	Normal (n=32)	Polyhydramnios (n=6)	p-value
Mode of Delivery	Vaginal	3 (30.0%)	22 (68.8%)	2 (33.3%)	0.028
	LSCS	7 (70.0%)	10 (31.2%)	4 (66.7%)	
Maternal Complications	Present	4 (40.0%)	6 (18.8%)	3 (50.0%)	0.091
	Absent	6 (60.0%)	26 (81.2%)	3 (50.0%)	

Low birth weight (<2.5 kg) was significantly higher in the oligohydramnios group (60.0%) compared to the normal AFI group (18.8%) ($p=0.012$) (Table 4).

Table 4: Association of AFI with Fetal Birth Weight

Birth Weight	Oligohydramnios (n=10)	Normal (n=32)	Polyhydramnios (n=6)	p-value
<2.5 kg	6 (60.0%)	6 (18.8%)	1 (16.7%)	0.012
≥2.5 kg	4 (40.0%)	26 (81.2%)	5 (83.3%)	

Neonatal outcomes showed a significant association with AFI. The incidence of low Apgar score, NICU admission, and fetal distress was significantly higher in both oligohydramnios and polyhydramnios groups compared to the normal AFI group ($p<0.05$) (Table 5).

Table 5: Association of AFI with Neonatal Outcomes

Variable	Oligohydramnios (n=10)	Normal (n=32)	Polyhydramnios (n=6)	p-value
Apgar Score <7 at 5 min	4 (40.0%)	3 (9.4%)	2 (33.3%)	0.036
NICU Admission	5 (50.0%)	5 (15.6%)	3 (50.0%)	0.041
Fetal Distress	6 (60.0%)	6 (18.8%)	3 (50.0%)	0.022

Overall, adverse perinatal outcomes were significantly more common in abnormal AFI groups (50.0% each in oligohydramnios and polyhydramnios) compared to the normal AFI group (12.5%) ($p=0.018$) (Table 6).

Table 6: Overall Perinatal Outcome Across AFI Categories

Outcome	Oligohydramnios (n=10)	Normal (n=32)	Polyhydramnios (n=6)	p-value
Normal outcome	5 (50.0%)	28 (87.5%)	3 (50.0%)	0.018
Adverse outcome*	5 (50.0%)	4 (12.5%)	3 (50.0%)	

*Adverse outcome includes low Apgar score, NICU admission, fetal distress, or low birth weight.

DISCUSSION

The present prospective observational study evaluated the association between amniotic fluid index (AFI) and maternal as well as fetal outcomes among 48 pregnant women. The findings demonstrate that abnormal AFI, both oligohydramnios and polyhydramnios, is significantly associated with adverse perinatal outcomes, thereby reinforcing the clinical importance of routine AFI assessment in antenatal care.

In the current study, the majority of women belonged to the age group of 20–30 years and were multigravida, which is consistent with the general obstetric population observed in similar hospital-based studies [8]. The prevalence of oligohydramnios (20.8%) and polyhydramnios (12.5%) in this study falls within the range reported in previous literature, where oligohydramnios has been reported in 8–25% and polyhydramnios in 1–15% of pregnancies depending on the population and diagnostic criteria used [3,5].

A significant association was observed between abnormal AFI and increased cesarean section rates. In our study, 70% of women with oligohydramnios and 66.7% with polyhydramnios underwent cesarean delivery, compared to only 31.2% in the normal AFI group. This finding is in agreement with studies by Casey et al. [3] and Chauhan et al. [10], which demonstrated higher operative delivery rates in pregnancies complicated by abnormal amniotic fluid volumes. The

increased cesarean rate may be attributed to higher incidences of fetal distress and intrapartum complications in these groups.

Although maternal complications were more frequently observed in cases with abnormal AFI, the association was not statistically significant in the present study. This finding is comparable to reports suggesting that while polyhydramnios is associated with complications such as preterm labor and malpresentation, the overall maternal morbidity may vary depending on underlying etiologies [5,6].

A significant association was noted between oligohydramnios and low birth weight. In this study, 60% of neonates in the oligohydramnios group had a birth weight <2.5 kg, which is consistent with the established relationship between reduced amniotic fluid and uteroplacental insufficiency [4]. Similar findings have been reported by Locatelli et al. [8], who observed increased rates of intrauterine growth restriction and low birth weight in pregnancies with decreased AFI.

Neonatal outcomes were significantly affected by abnormal AFI in the present study. The incidence of low Apgar score, fetal distress, and NICU admission was significantly higher in both oligohydramnios and polyhydramnios groups. These findings are supported by previous studies, which have demonstrated that abnormal AFI is a strong predictor of adverse neonatal outcomes, including birth asphyxia and increased need for intensive care [9,10]. Reduced amniotic fluid may lead to cord compression and compromised placental perfusion, while excessive fluid may be associated with fetal anomalies or maternal metabolic disorders, both contributing to adverse neonatal outcomes.[11-13]

Furthermore, the overall adverse perinatal outcome was significantly higher in pregnancies with abnormal AFI compared to those with normal AFI. This aligns with the concept that AFI serves as an indirect marker of fetal well-being and placental function. Manning et al. [7] emphasized the role of AFI as an essential component of the biophysical profile in predicting fetal compromise, further supporting its utility in clinical practice.

The findings of the present study highlight the importance of AFI as a simple, non-invasive, and cost-effective tool for fetal surveillance, particularly in resource-limited settings. Early identification of abnormal AFI allows for timely intervention, including close monitoring, induction of labor, or cesarean delivery, thereby reducing the risk of adverse outcomes. This is especially relevant in tertiary care centers where high-risk pregnancies are commonly managed.[14-15]

However, the present study has certain limitations. The sample size was relatively small, and the study was conducted at a single center, which may limit the generalizability of the findings. Additionally, the study did not evaluate long-term neonatal outcomes or stratify results based on the etiology of abnormal AFI. Despite these limitations, the study provides valuable insight into the association between AFI and pregnancy outcomes in the local population.

CONCLUSION

The present study demonstrates that abnormal amniotic fluid index (AFI), including both oligohydramnios and polyhydramnios, is significantly associated with adverse maternal and fetal outcomes. Pregnancies with abnormal AFI showed higher rates of cesarean section, low birth weight, fetal distress, low Apgar scores, and increased NICU admissions compared to those with normal AFI. These findings highlight the importance of AFI as a reliable, non-invasive indicator of fetal well-being and placental function. Routine ultrasonographic assessment of AFI, particularly in the third trimester, can aid in early identification of high-risk pregnancies and facilitate timely obstetric interventions. Although maternal complications were more frequent in abnormal AFI groups, the association was not statistically significant. Given its simplicity and cost-effectiveness, AFI measurement remains a valuable tool in antenatal surveillance, especially in resource-limited settings. Further large-scale, multicentric studies are recommended to validate these findings and enhance generalizability.

DECLARATIONS

Informed Consent: Written informed consent was obtained from all participants prior to inclusion in the study.

Conflict of Interest: The authors declare no conflict of interest.

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Author Contributions: All authors contributed to study design, data collection, analysis, and manuscript preparation.

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