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Original Research Article

A Study of Association Between Amniotic Fluid Index in Third Trimester and Fetomaternal Outcome at a Tertiary Care Centre

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Abstract

Introduction: Amniotic fluid volume is a key indicator of fetal well-being, particularly in the third trimester, where abnormalities often reflect placental insufficiency and fetal compromise. The amniotic fluid index (AFI) is a simple, non-invasive ultrasonographic method widely used for antenatal surveillance. Abnormal AFI has been associated with adverse fetomaternal outcomes, necessitating evaluation in tertiary care settings.

Objectives: To assess the association between third-trimester amniotic fluid index and fetomaternal outcomes in pregnant women attending a tertiary care centre.

Methods: This prospective observational study was conducted in the Department of Obstetrics and Gynaecology at T.S. Misra Medical College and Hospital, Lucknow, from July 2024 to June 2025. A total of 100 pregnant women with singleton pregnancies and gestational age ≥28 weeks were enrolled after applying inclusion and exclusion criteria. AFI was measured using the four-quadrant technique described by Phelan JP between 28 weeks and delivery. Participants were categorized into normal AFI, oligohydramnios, and polyhydramnios groups. Maternal outcomes (mode of delivery, prolonged labour, postpartum hemorrhage) and fetal/neonatal outcomes (birth weight, APGAR scores, need for resuscitation, NICU admission, and complications) were recorded. Statistical analysis was performed, with $p < 0.05$ considered statistically significant.

Results: Among the participants, 83% had normal AFI, 14% had oligohydramnios, and 3% had polyhydramnios. Maternal age, parity, socioeconomic status, gestational age, and obstetric history showed no significant association with AFI. However, pre-existing maternal medical disorders and previous caesarean section were significantly associated with abnormal AFI. Abnormal AFI demonstrated a strong association with non-reassuring fetal heart rate patterns ($p < 0.001$), and all such cases required caesarean delivery ($p < 0.001$). Maternal complications, particularly prolonged labour and postpartum hemorrhage, were significantly higher in abnormal AFI groups. Neonates in these groups had lower birth weight, reduced APGAR scores, increased need for resuscitation, and higher NICU admission rates ($p < 0.001$). All mothers and neonates were discharged in stable condition.

Conclusion: Abnormal third-trimester AFI, particularly oligohydramnios, is significantly associated with adverse fetomaternal outcomes. Routine AFI assessment is a valuable, non-invasive tool for early identification of high-risk pregnancies and timely obstetric intervention.

Keywords: Amniotic fluid index; Oligohydramnios; Polyhydramnios; Third trimester; Fetomaternal outcome; NICU admission.

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Introduction

Amniotic fluid is an essential component of the intrauterine environment and plays a vital role in fetal growth and development. It facilitates fetal movements, protects against external trauma, maintains thermal stability, and contributes to lung maturation. The volume of amniotic fluid is

dynamically regulated by fetal urine production, swallowing, and transmembranous exchange, and any imbalance in these mechanisms may result in abnormal amniotic fluid volume.

Amniotic Fluid Index (AFI), measured ultrasonographically using the four-quadrant technique described by Phelan JP, is widely used as a simple and reliable method for assessing amniotic fluid volume in clinical practice. It serves as an important parameter in antenatal surveillance, particularly in the third trimester, and helps in identifying fetuses at risk of adverse outcomes. Based on AFI values, pregnancies are categorized as normal, oligohydramnios, or polyhydramnios.

Oligohydramnios (AFI <5 cm) has been associated with adverse outcomes such as intrauterine growth restriction, fetal distress, meconium aspiration, and increased rates of operative delivery. Polyhydramnios (AFI >24 cm), on the other hand, is linked with maternal diabetes, fetal anomalies, preterm labor, and postpartum hemorrhage. Thus, abnormal AFI reflects underlying pathophysiological processes and may serve as a predictor of fetomaternal complications.

Despite its widespread use, the clinical significance of AFI in predicting outcomes remains controversial, particularly in low-risk pregnancies. While some studies suggest a strong association between abnormal AFI and adverse perinatal outcomes, others report limited predictive value when used as a routine screening tool. Moreover, data from Indian tertiary care settings evaluating both maternal and neonatal outcomes in relation to AFI are relatively limited.

In a country like India, where early identification of high-risk pregnancies is crucial for reducing maternal and perinatal morbidity and mortality, AFI measurement can serve as a simple, non-invasive, and cost-effective tool in routine obstetric practice.

Therefore, the present study was undertaken to evaluate the association between amniotic fluid index in the third trimester and fetomaternal outcomes at a tertiary care center.

Materials and Methods

This prospective observational study was conducted in the Department of Obstetrics and Gynaecology at T.S. Misra Medical College and Hospital, Lucknow, a tertiary care referral centre catering to both urban and rural populations. The study was carried out over a period of 18 months from July 2024 to June 2025, including patient recruitment, follow-up until delivery, and data analysis. The study population comprised pregnant women in the third trimester (≥28 weeks of gestation) attending the outpatient department or admitted to the labour ward during the study period who fulfilled the inclusion and exclusion criteria. A minimum sample size of 96 was calculated using the formula $N = Z^2pq/d^2$, assuming a prevalence of abnormal amniotic fluid index of 10% based on previous literature, with 95% confidence interval and allowable error of 6%. The calculated sample size was rounded off to 100 participants. A non-probability consecutive sampling technique was employed, and all eligible women were included until the required sample size was achieved.

Pregnant women with gestational age ≥28 weeks and singleton pregnancy were included in the study. Women with preterm premature rupture of membranes or premature rupture of membranes, gross fetal congenital anomalies or chromosomal abnormalities, pre-existing diabetes mellitus or hypertension, intrauterine fetal demise, and those unwilling to participate were excluded.

The study was initiated after obtaining approval from the Institutional Ethics Committee, and written informed consent was obtained from all participants. A detailed evaluation was performed for each participant, including collection of demographic data, obstetric and medical history, and thorough general and obstetric examination.

Amniotic fluid index (AFI) was assessed ultrasonographically using the four-quadrant technique described by Phelan JP. The uterus was divided into four quadrants using the linea nigra vertically and a transverse line at the level of the umbilicus. The deepest vertical pocket of amniotic fluid free from fetal parts and umbilical cord was measured in each quadrant, and the sum of these measurements was recorded as the AFI. Based on AFI values, patients were categorized into normal AFI (8–24 cm), oligohydramnios (<5 cm), and polyhydramnios (>24 cm).

All enrolled participants were followed prospectively until delivery. Maternal outcomes recorded included mode of delivery, postpartum hemorrhage, antepartum hemorrhage, requirement of blood transfusion, and sepsis. Fetal and neonatal outcomes assessed included birth weight, APGAR score at 1 and 5 minutes, requirement of neonatal resuscitation, neonatal intensive care unit admission, and respiratory distress syndrome.

All data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version XX. Categorical variables were expressed as frequencies and percentages, while continuous variables were expressed as mean and standard deviation. The association between AFI categories and fetomaternal outcomes was analyzed using Chi-square test or Fisher's exact test as appropriate. A p-value of less than 0.05 was considered statistically significant.

Results

Baseline Characteristics

Table 1: Age Distribution according to AFI

Age Group (years)	Normal AFI (n=83)	Oligohydramnios (n=14)	Polyhydramnios (n=3)
21–25	22 (26.5%)	8 (57.1%)	0 (0.0%)
26–30	36 (43.4%)	4 (28.6%)	2 (66.7%)
31–35	21 (25.3%)	2 (14.3%)	1 (33.3%)
>35	4 (4.8%)	0 (0.0%)	0 (0.0%)
Total	83 (100%)	14 (100%)	3 (100%)
χ^2 = 9.24, p = 0.16			

The age distribution demonstrated that the largest proportion of women belonged to the 26–30 years group, comprising 36 patients (43.4%) with normal AFI and 2 patients (66.7%) with polyhydramnios. Oligohydramnios was relatively more frequent in the 21–25 years category (8 patients, 57.1%); however, no statistically significant association was observed (p = 0.16).

Table 2: Socioeconomic Status

Class	Normal AFI	Oligohydramnios	Polyhydramnios
Lower	17 (20.5%)	6 (42.9%)	2 (66.7%)
Lower middle	41 (49.4%)	7 (50.0%)	1 (33.3%)
Upper middle	25 (30.1%)	1 (7.1%)	0 (0.0%)
Total	83	14	3
χ^2 = 7.10, p = 0.13			

Lower and lower-middle socioeconomic groups constituted the majority of abnormal AFI cases, accounting for 13 out of 14 oligohydramnios cases (92.9%) and all polyhydramnios cases. Despite this pattern, statistical significance was not achieved (p = 0.13).

Table 3: Gestational Age Distribution

Gestational Age	Normal AFI	Oligohydramnios	Polyhydramnios
25–30 weeks	1 (1.2%)	2 (14.3%)	0
30–35 weeks	0 (0.0%)	3 (21.4%)	1 (33.3%)
35–40 weeks	70 (84.3%)	9 (64.3%)	2 (66.7%)
>40 weeks	12 (14.5%)	0	0
Total	83	14	3
χ^2 = 12.08, p = 0.06			

Most normal AFI cases were observed between 35–40 weeks (70 patients, 84.3%), whereas oligohydramnios showed relatively higher occurrence at earlier gestations. The association approached statistical significance (p = 0.06).

Maternal Clinical factors

Table 4: Pre-existing Medical Conditions

Condition	Normal AFI	Oligohydramnios	Polyhydramnios
Diabetes mellitus	10 (12.0%)	0 (0.0%)	2 (66.7%)
Hypertension	3 (3.6%)	3 (21.4%)	0 (0.0%)
Thyroid disorder	Present	Present	Present
None	47 (56.6%)	8 (57.1%)	0
χ^2 = 17.94, p = 0.022			

A statistically significant association was observed (p = 0.022), with diabetes predominantly linked to polyhydramnios (66.7%) and hypertension more common in oligohydramnios (21.4%).

Table 5: Past History

Variable	Normal AFI (n=83)	Oligohydramnios (n=14)	Polyhydramnios (n=3)
Previous FTVD	7 (8.4%)	0 (0.0%)	0 (0.0%)
Previous PTVD	0 (0.0%)	0 (0.0%)	0 (0.0%)
Previous LSCS	9 (10.8%)	6 (42.9%)	1 (33.3%)

Previous FTVD was seen only in the normal AFI group and was not statistically significant (p = 0.43). No cases of previous PTVD were observed. Previous LSCS was more frequent in oligohydramnios and showed a significant association with AFI (p = 0.02).

Table 6: Parity

Category	Normal AFI	Oligohydramnios	Polyhydramnios
Primigravida	33 (39.8%)	7 (50.0%)	1 (33.3%)
Multigravida	50 (60.2%)	7 (50.0%)	2 (66.7%)
p = 0.78			

Interpretation: Parity distribution was balanced, and no significant association was observed ($p = 0.78$).

Intrapartum Findings

Table 7: FHS Variability

Pattern	Normal AFI	Oligohydramnios	Polyhydramnios
Normal	81 (97.6%)	2 (14.3%)	1 (33.3%)
Reduced accelerations	1 (1.2%)	0	2 (66.7%)
Variable decelerations	1 (1.2%)	12 (85.7%)	0
$\chi^2 = 118.9$, $p < 0.001$			

A highly significant association was observed ($p < 0.001$), with oligohydramnios showing predominant variable decelerations.

Table 8: Mode of Delivery

Mode	Normal AFI	Oligohydramnios	Polyhydramnios
Vaginal	38 (45.8%)	0	0
LSCS	45 (54.2%)	14 (100%)	3 (100%)
$\chi^2 = 12.55$, $p < 0.001$			

All abnormal AFI cases underwent LSCS, demonstrating strong statistical significance.

Table 9: Maternal Complications

Complication	Normal AFI	Oligohydramnios	Polyhydramnios
PPH	2 (2.4%)	4 (28.6%)	0
Prolonged labour	2 (2.4%)	6 (42.9%)	2 (66.7%)
None	79 (95.2%)	4 (28.6%)	1 (33.3%)
$\chi^2 = 50.64$, $p < 0.001$			

Maternal complications were significantly more frequent in abnormal AFI groups.

Fetal outcomes

Table 10: Fetal Complications

Complication	Normal AFI	Oligohydramnios	Polyhydramnios
Birth asphyxia	0	1 (7.1%)	0
Fetal distress	1 (1.2%)	1 (7.1%)	1 (33.3%)
IUGR	1 (1.2%)	4 (28.6%)	0
LBW	2 (2.4%)	4 (28.6%)	0
Preterm	2 (2.4%)	4 (28.6%)	1 (33.3%)
None	77 (92.8%)	0	1 (33.3%)
$\chi^2 = 81.3$, $p < 0.001$			

All oligohydramnios cases had fetal complications (100%), indicating strong association.

Table 11: Birth Weight

Weight	Normal AFI	Oligohydramnios	Polyhydramnios
1.6–2.0 kg	1 (1.2%)	4 (28.6%)	0
2.1–2.5 kg	1 (1.2%)	0	1 (33.3%)
2.51–3.0 kg	49 (59.0%)	10 (71.4%)	1 (33.3%)
>3 kg	32 (38.6%)	0	1 (33.3%)
$\chi^2 = 39.5$, $p < 0.001$			

Oligohydramnios was significantly associated with low birth weight ($p < 0.001$).

Table 12: APGAR Score at 1 minute

Score	Normal AFI	Oligohydramnios	Polyhydramnios
5	0	3 (21.4%)	0
6	1 (1.2%)	5 (35.7%)	1 (33.3%)
7	0	3 (21.4%)	0
8	58 (69.9%)	3 (21.4%)	1 (33.3%)
9	24 (28.9%)	0	1 (33.3%)
$\chi^2 = 66.9$, $p < 0.001$			

Lower APGAR scores were significantly associated with abnormal AFI, particularly oligohydramnios.

Table 13: APGAR Score at 5 minutes

Score	Normal AFI	Oligohydramnios	Polyhydramnios
6	0	4 (28.5%)	0
7	1 (1.2%)	7 (50%)	1 (33.3%)
8	51 (61.4%)	3 (21.5%)	0
9	31 (37.3%)	0	2 (66.7%)
$\chi^2 = 57.6$, $p < 0.001$			

Delayed neonatal recovery was evident in oligohydramnios with persistently low APGAR scores.

Table 14: NICU Admission

Category	Normal AFI	Oligohydramnios	Polyhydramnios
Yes	17 (20.5%)	11 (78.6%)	2 (66.7%)
No	66 (79.5%)	3 (21.4%)	1 (33.3%)
$\chi^2 = 21.2$, $p < 0.001$			

NICU admission was significantly higher in abnormal AFI groups.

Table 15: Maternal Discharge Condition

Outcome	Normal AFI	Oligohydramnios	Polyhydramnios
Stable	83 (100%)	14 (100%)	3 (100%)

All mothers were discharged in stable condition.

Table 16: Neonatal Discharge Condition

Outcome	Normal AFI	Oligohydramnios	Polyhydramnios
Stable	83 (100%)	14 (100%)	3 (100%)

All neonates were stable at discharge despite earlier complications.

Discussion

In the present study, the majority of antenatal women were categorized under normal AFI, accounting for 83% (83 patients), while oligohydramnios and polyhydramnios constituted 14% (14 patients) and 3% (3 patients), respectively. This distribution indicates that most pregnancies in our tertiary care setting maintained adequate amniotic fluid volume, with a relatively smaller proportion demonstrating abnormalities. The lower prevalence of polyhydramnios in our cohort may be attributed to exclusion of major congenital anomalies, better antenatal screening, and early management of maternal comorbidities such as diabetes.

When compared with the study by Procheta Chattaraj et al., a markedly different pattern was observed, where only 39.33% of women had normal AFI, while borderline AFI, polyhydramnios, and oligohydramnios accounted for 23.33%, 23.33%, and 14% respectively . The higher proportion of abnormal AFI in their study may be explained by inclusion of borderline AFI as a separate category and possible referral bias.

Similarly, Nagesh Gowda BL et al. reported a higher burden of abnormal AFI, with normal AFI in 50% of cases, oligohydramnios in 34.1%, and polyhydramnios in 15.9%. Gairik Bera et al. also reported a predominance of oligohydramnios (42.4%), contrasting with our findings where normal AFI predominated .

These variations highlight the influence of study design, population characteristics, and referral patterns on AFI distribution. Nevertheless, the consistent presence of oligohydramnios across studies underscores its clinical importance as a significant third-trimester risk factor.

Age Distribution

The present study demonstrated that the majority of women across all AFI categories belonged to the 21–30-year age group, with the highest proportion in the 26–30-year category (36 patients, 43.4%). Oligohydramnios was more frequent in the 21–25-year group (8 patients, 57.1%), while

polyhydramnios was confined to the 26–35-year age range. Despite these trends, no statistically significant association was observed.

Comparable findings were reported by Procheta Chattaraj et al., who documented a mean maternal age of 29.22 ± 5.1 years . Similarly, Gairik Bera et al. observed that 48.9% of women were aged 21–25 years and 35.1% were aged 26–30 years, closely aligning with our study population. Maryam Asgharnia et al. also reported minimal differences in mean age between AFI categories.

These findings collectively suggest that maternal age does not independently influence AFI and largely reflects the reproductive age distribution of the population.

Socioeconomic Status: A predominance of lower and lower-middle socioeconomic classes was observed across all AFI categories in the present study. Abnormal AFI was more frequently encountered in these groups, accounting for 92.9% of oligohydramnios cases and all polyhydramnios cases.

Similar findings were reported by Gairik Bera et al., where most patients belonged to lower socioeconomic strata. This pattern may be explained by factors such as poor nutrition, higher prevalence of anemia, inadequate antenatal care, and increased incidence of hypertensive disorders.

Thus, while socioeconomic status itself may not be an independent determinant, it reflects underlying risk factors that contribute to altered amniotic fluid dynamics.

Obstetric History: Parity distribution in the present study was relatively balanced across AFI categories, with equal representation of primigravida and multigravida in the oligohydramnios group (50% each). This observation is consistent with findings by Procheta Chattaraj et al. and Nagesh Gowda BL et al., who also reported no significant association between parity and AFI .

Previous FTVD did not show a significant relationship with AFI, and no cases of previous PTVD were observed. However, previous LSCS demonstrated a statistically significant association, being more common in oligohydramnios (42.9%). This may reflect altered uteroplacental dynamics or increased surveillance in previously operated cases.

Overall, these findings indicate that obstetric history alone does not determine AFI, although prior LSCS may influence its occurrence.

Type of Delivery: A strong association was observed between abnormal AFI and operative delivery in the present study. All cases of oligohydramnios and polyhydramnios underwent LSCS (100%), compared to 54.2% in the normal AFI group.

This trend is consistent with Procheta Chattaraj et al., who reported increasing LSCS rates with worsening AFI. Similarly, Gairik Bera et al. observed higher LSCS rates in oligohydramnios compared to normal AFI. The increased operative delivery rate can be attributed to higher incidence of fetal distress, non-reassuring fetal heart rate patterns, and reduced fetal tolerance to labor in abnormal AFI. These findings emphasize the need for careful intrapartum monitoring and individualized delivery planning.

Maternal Complications: Maternal complications were significantly higher in pregnancies with abnormal AFI. Prolonged labor was the most common complication, affecting 42.9% of oligohydramnios and 66.7% of polyhydramnios cases, while postpartum hemorrhage was observed in 28.6% of oligohydramnios cases.

These findings are comparable with Nagesh Gowda BL et al., who also demonstrated a significant association between abnormal AFI and maternal complications.

The increased incidence of complications may be attributed to dysfunctional labor, uterine overdistension in polyhydramnios, and increased intervention rates in oligohydramnios. This highlights the need for vigilant intrapartum management.

Birth Weight: A significant association was observed between AFI and neonatal birth weight. Oligohydramnios was associated with a higher proportion of low birth weight neonates (28.6%), while normal AFI was associated with optimal birth weight (2.51–3 kg in 59.0% of cases).

Similar findings were reported by Nagesh Gowda BL et al. and Procheta Chattaraj et al., who demonstrated higher rates of low birth weight in oligohydramnios.

This can be explained by uteroplacental insufficiency leading to reduced fetal urine production and growth restriction.

Neonatal Outcomes: Neonatal outcomes were significantly affected by AFI status. Oligohydramnios was associated with higher rates of fetal complications, low APGAR scores, and NICU admissions (78.6%), compared to 20.5% in normal AFI.

These findings are consistent with previous studies demonstrating increased perinatal morbidity in abnormal AFI. Reduced amniotic fluid leads to cord compression, fetal hypoxia, and compromised neonatal adaptation, while polyhydramnios is associated with variable neonatal outcomes

depending on underlying etiology. Despite higher morbidity, all neonates were discharged in stable condition, reflecting effective neonatal care in the tertiary setting.

Conclusion

The present study establishes a significant association between third-trimester amniotic fluid index and fetomaternal outcomes, with abnormal AFI—particularly oligohydramnios—being strongly linked to increased maternal complications, higher operative delivery rates, and adverse neonatal outcomes including low birth weight, poor APGAR scores, and increased NICU admissions. In contrast, normal AFI was associated with favorable maternal and neonatal profiles. These findings highlight that AFI serves as a reliable, non-invasive indicator of fetal well-being and an important predictor of perinatal risk, aiding in timely clinical decision-making in tertiary care settings.

Recommendations: Routine assessment of amniotic fluid index should be incorporated into third-trimester antenatal surveillance to facilitate early detection of high-risk pregnancies. Pregnancies with abnormal AFI should undergo closer monitoring with timely intervention, including appropriate planning for delivery and availability of neonatal care facilities. Special attention should be given to women with associated risk factors such as previous caesarean section and maternal comorbidities. Strengthening antenatal care services, especially in resource-limited settings, and conducting larger multicentric studies will further help in improving fetomaternal outcomes and validating the clinical utility of AFI.

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