Section: Obstetrics and Gynaecology

Original Research Article

AMNIOTIC FLUID INDEX - A PROSPECTIVE STUDY OF ITS PERINATAL OUTCOME

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Received : *16/06/2026*
Received in revised form : *30/07/2026*
Accepted : *14/08/2026*

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DOI: 10.70034/ijmedph.2026.3.525

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 3361-3367

ABSTRACT

Background: Amniotic fluid volume is an important indicator of fetal well-being and reflects the interaction between maternal, placental, and fetal physiological processes. Abnormal amniotic fluid volume, including oligohydramnios and polyhydramnios, may be associated with adverse maternal and perinatal outcomes. Amniotic fluid index (AFI) measurement is widely used during antenatal surveillance to identify pregnancies at increased risk and guide obstetric management. **Objective:** To evaluate the association between amniotic fluid index abnormalities and perinatal outcomes and to identify maternal risk factors associated with abnormal amniotic fluid volume.

Materials and Methods: A prospective observational study was conducted in the Department of Obstetrics and Gynecology, Government Medical College, Gondia, Maharashtra, from June 2024 to December 2025. A total of 381 antenatal women with singleton, non-anomalous pregnancies between 34 and 41 weeks of gestation admitted for delivery were included. Amniotic fluid volume was assessed using the amniotic fluid index (AFI) by the four-quadrant technique. Participants were categorized into three groups: oligohydramnios (AFI ≤5 cm), normal AFI (>5–24 cm), and polyhydramnios (>24 cm). Maternal characteristics, antenatal findings, mode of delivery, and neonatal outcomes including birth weight, Apgar scores, NICU admission, perinatal morbidity, and mortality were recorded. Statistical analysis was performed using Chi-square test and one-way ANOVA, with $p<0.05$ considered statistically significant.

Results: Among the 381 participants, 171 (44.9%) had oligohydramnios, 133 (34.9%) had polyhydramnios, and 77 (20.2%) had normal AFI. The mean maternal age was 27.0 ± 4.98 years. A significant association was observed between AFI category and fetal distress ($p=0.027$). However, neonatal mortality did not differ significantly among the AFI groups ($p=0.846$). Comparison of continuous neonatal outcomes showed no significant differences in birth weight, Apgar score at 1 minute and 5 minutes, NICU duration, and estimated fetal weight among normal AFI, oligohydramnios, and polyhydramnios groups ($p>0.05$).

Conclusion: Abnormal amniotic fluid volume, particularly oligohydramnios, is associated with an increased risk of fetal distress and may influence obstetric decision-making. However, AFI abnormalities alone may not reliably predict all neonatal outcomes. Comprehensive fetal surveillance incorporating AFI assessment along with other clinical and ultra-sonographic parameters may help optimize maternal and neonatal outcomes.

Keywords: Amniotic fluid index; Oligohydramnios; Polyhydramnios; Perinatal outcome; Fetal distress; Antenatal surveillance.

INTRODUCTION

Amniotic fluid is a dynamic and essential component of pregnancy that provides a supportive environment for fetal growth and development. It is a complex biological fluid composed predominantly of water along with various organic and inorganic constituents, including proteins, carbohydrates, lipids, phospholipids, enzymes, hormones, electrolytes, urea, uric acid, and creatinine. The composition of amniotic fluid changes throughout pregnancy and reflects the interaction between maternal, placental, and fetal physiological processes.[1] It originates from multiple sources, including maternal plasma, fetal urine, and fetal membrane secretions, and serves several important functions essential for normal fetal development.

The primary role of amniotic fluid is to provide mechanical protection by acting as a cushion against external trauma and preventing umbilical cord compression. It also facilitates fetal movement, which is necessary for musculoskeletal development, maintains a stable thermal environment, and contributes to lung maturation through fetal breathing movements. In addition, amniotic fluid contains antimicrobial components that provide protection against ascending infections and serves as a medium for the exchange of water, nutrients, and biochemical substances between the mother and fetus. Various fetal-derived components, including epithelial cells, respiratory and gastrointestinal tract cells, urinary tract cells, blood cells, and stem cells, are present in amniotic fluid and contribute to fetal development and diagnostic evaluation.[1]

The volume of amniotic fluid varies with advancing gestation. Under normal physiological conditions, amniotic fluid volume gradually increases during pregnancy and reaches its maximum level around 34 weeks of gestation, when it may exceed 800 mL. Subsequently, a gradual decline may occur towards term due to changes in fetal urine production, swallowing, and placental function.[1] Disturbances in this balance can result in abnormal amniotic fluid volume, mainly classified as polyhydramnios and oligohydramnios.

Polyhydramnios is characterized by excessive accumulation of amniotic fluid, commonly defined as an amniotic fluid index (AFI) greater than 24 cm.[2] It may occur due to maternal, fetal, or placental factors. Common associated conditions include maternal diabetes mellitus, fetal cardiac abnormalities, impaired fetal swallowing mechanisms, and congenital infections.[3] Increased amniotic fluid volume is associated with several maternal and fetal complications, including preterm birth, caesarean delivery, placental abruption, abnormal fetal presentation, fetal macrosomia, umbilical cord prolapse, and maternal respiratory discomfort.[2,4]

Conversely, oligohydramnios refers to reduced amniotic fluid volume, generally defined as an AFI less than 5 cm.[5] It may result from conditions such as premature rupture of membranes, placental insufficiency, intrauterine growth restriction, and fetal congenital abnormalities.[3] Reduced amniotic fluid volume can interfere with fetal movement, restrict normal growth, and increase the risk of umbilical cord compression, fetal deformities, and adverse perinatal outcomes. The clinical significance of oligohydramnios varies according to gestational age and underlying aetiology. Early-onset oligohydramnios during the first trimester is associated with poor prognosis and may result in pregnancy loss, whereas outcomes during the second trimester depend largely on the underlying cause. In late pregnancy, oligohydramnios is frequently associated with placental insufficiency, fetal growth restriction, fetal distress, and meconium aspiration due to reduced protection against umbilical cord compression.[5,6]

Assessment of amniotic fluid volume has therefore become an important component of antenatal surveillance, particularly during the second and third trimesters. Abnormal amniotic fluid volume may serve as an indicator of underlying maternal or fetal pathology and may help identify pregnancies at increased risk of adverse outcomes. Several methods have been developed for assessment of amniotic fluid volume, including subjective qualitative evaluation and semi quantitative techniques such as amniotic fluid index (AFI) and single deepest pocket (SDP) measurement. Qualitative assessment is commonly used as an initial evaluation, while AFI and SDP provide standardized measurements, particularly in high-risk pregnancies and during third-trimester fetal surveillance.

Although both AFI and SDP are widely used methods for evaluating amniotic fluid volume, differences exist regarding their diagnostic performance. AFI has been associated with increased detection of oligohydramnios, whereas SDP may result in higher detection rates of polyhydramnios. Previous studies have suggested that AFI may lead to increased obstetric interventions without a corresponding improvement in neonatal outcomes, highlighting the need for appropriate interpretation of amniotic fluid measurements in clinical practice.

Given the increasing recognition of abnormal amniotic fluid volume as a marker of maternal and fetal risk, evaluation of its association with pregnancy outcomes remains clinically important. Understanding maternal factors associated with amniotic fluid abnormalities and their impact on delivery characteristics and neonatal outcomes may assist clinicians in developing appropriate surveillance strategies and management protocols.

Therefore, the present prospective study was undertaken to evaluate the relationship between amniotic fluid disorders and perinatal outcomes, assess associated maternal risk factors, and determine the influence of abnormal amniotic fluid volume on mode of delivery and fetal outcomes.

MATERIALS AND METHODS

Study design and study setting

This prospective observational study was conducted in the Department of Obstetrics and Gynecology, Government Medical College (GMC), Gondia, Maharashtra, a tertiary care teaching hospital. The study was carried out over a period of 18 months, from **June 2024 to December 2025**. The study included antenatal women admitted for delivery with a gestational age between **34 and 41 weeks**.

Study population and sample size

A total of **381 pregnant women** fulfilling the eligibility criteria were enrolled in the study. Participants were recruited after obtaining written informed consent. All enrolled women were followed prospectively from admission until delivery, and maternal as well as neonatal outcomes were recorded.

Inclusion criteria

Pregnant women meeting the following criteria were included:

- Singleton pregnancy
- Gestational age between **34 and 41 weeks**
- Live, non-anomalous fetus
- Intact membranes at the time of antenatal assessment
- Women admitted for delivery and willing to participate in the study

Exclusion criteria

Women with conditions that could independently affect amniotic fluid volume or perinatal outcomes were excluded. The exclusion criteria included:

- Premature rupture of membranes (PROM)
- Multiple pregnancy
- Known congenital fetal anomalies or chromosomal abnormalities
- Gestational diabetes mellitus
- Rh incompatibility
- Placental abnormalities
- Any other significant maternal medical or obstetric condition likely to influence pregnancy outcome

Data collection and clinical assessment

After enrolment, a detailed maternal history was obtained, including demographic characteristics, obstetric history, previous pregnancy outcomes, medical and surgical history, and current pregnancy-related complaints. A complete clinical examination was performed, and gestational age was confirmed using available clinical records and ultrasonographic findings.

Maternal risk factors associated with abnormal amniotic fluid volume were recorded, including hypertensive disorders of pregnancy, diabetes mellitus, postdated pregnancy, and other relevant medical or obstetric complications.

Assessment of amniotic fluid volume

Amniotic fluid volume was assessed by measuring the amniotic fluid index (AFI) using the four-quadrant technique described by Phelan et al. [7]. The measurement was performed within 7 days prior to delivery or at the onset of labour after obtaining informed written consent.

The AFI was calculated by dividing the uterus into four quadrants and summing the maximum vertical depth of the largest amniotic fluid pocket in each quadrant.

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

- Oligohydramnios: AFI ≤5 cm
- Normal amniotic fluid volume: AFI >5 cm to 24 cm
- Polyhydramnios: AFI >24 cm

Fetal surveillance

All participants underwent antenatal fetal assessment, including non-stress testing (NST). NST findings were recorded as reactive or non-reactive according to standard interpretation criteria. Ultrasonographic assessment of fetal growth, placental location, and Doppler parameters was performed whenever clinically indicated.

Assessment of maternal and perinatal outcomes

Participants were followed until delivery. Maternal and neonatal outcomes were documented and analyzed according to AFI category.

The following outcomes were assessed:

Maternal outcomes

- Mode of delivery (vaginal delivery or cesarean delivery)
- Indication for operative delivery, particularly fetal distress
- Presence of meconium-stained amniotic fluid

Neonatal outcomes

- Birth weight
- Apgar score at 1 minute and 5 minutes
- Neonatal intensive care unit (NICU) admission
- Perinatal morbidity
- Perinatal mortality

Statistical analysis

Data were entered into a structured database and analyzed using appropriate statistical methods.

Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequency and percentage.

The association between categorical variables was assessed using the Chi-square (χ^2) test. Continuous variables among the three AFI groups were compared using one-way analysis of variance (ANOVA).

A p-value <0.05 was considered statistically significant, with a significance level of $\alpha = 0.05$.

Ethical considerations

The study was conducted after obtaining approval from the Institutional Ethics Committee of Government Medical College, Gondia. Written informed consent was obtained from all participants before inclusion in the study. Confidentiality of participant information was maintained throughout the study.

RESULTS

The study included 381 pregnant women with a mean age of 27.0 ± 4.98 years (median: 27 years; range: 19–35 years). Nearly three-fourths (73.0%) were booked cases. Gestational age at admission was almost equally distributed between 8 months (49.9%) and 9 months (50.1%). Multigravidae (gravida ≥3) constituted the largest group (46.7%), followed by primigravidae (36.7%). Most women (80.1%) reported regular menstrual cycles, and a history of menorrhagia was present in 14.4% of participants.

Table 1: Baseline maternal characteristics of the study population (n = 381)

Characteristic	n (%) / Mean ± SD
Age (years)	27.0 ± 4.98
Median (Range)	27 (19–35)
Booking status	
Booked	278 (73.0)
Unbooked	103 (27.0)
Gestational age at admission	
8 months	190 (49.9)
9 months	191 (50.1)
Gravidity	
Primigravida	140 (36.7)
Gravida 2	63 (16.5)
Gravida ≥3	178 (46.7)
Menstrual cycle	
Regular	305 (80.1)
Irregular	76 (19.9)
History of menorrhagia	
Yes	55 (14.4)
No	326 (85.6)

Data are presented as mean ± standard deviation (SD), median (range), or number (percentage).

Previous adverse obstetric outcomes were uncommon, with 2.9% reporting a previous anomalous baby and 2.6% reporting a previous intrauterine fetal death. Pre-existing infection was documented in 10.2% of women, whereas hepatic or renal disease was present in only 2.6%. Most participants (59.1%) had no previous surgical history. Previous lower-segment caesarean section (LSCS) was the most common prior surgery (18.9%), followed by abortion-related procedures (16.5%).

Table 2: Previous obstetric and medical history (n = 381)

Variable	n (%)
Previous anomalous baby	11 (2.9)
Previous intrauterine death	10 (2.6)
Hepatic/renal disease	10 (2.6)
Pre-existing infection	39 (10.2)
Previous LSCS	72 (18.9)
Previous abortion surgery	63 (16.5)
Myomectomy	9 (2.4)
Appendectomy	7 (1.8)
Other surgery	5 (1.3)
No previous surgery	225 (59.1)

Data are expressed as number (percentage).

Most women were in good general condition (65.9%) and were afebrile (93.4%) at presentation. Nearly half (46.7%) had a non-reactive non-stress test (NST), while 44.9% of fetuses were not appropriate for gestational age on initial assessment. Initial Doppler examination was normal in 57.0% of cases, whereas abnormal Doppler findings were observed in the remaining participants. The placenta was most commonly located on the posterior (34.9%) or anterior (34.6%) uterine wall.

Table 3: Antenatal clinical and ultrasound findings (n = 381)

Variable	n (%)
General condition	
Good	251 (65.9)
Fair	106 (27.8)
Poor	24 (6.3)
Temperature	
Afebrile	356 (93.4)
Febrile	25 (6.6)
Non-stress test	
Reactive	203 (53.3)
Non-reactive	178 (46.7)
Appropriate for gestational age	

Yes	210 (55.1)
No	171 (44.9)
Initial Doppler	
Normal	217 (57.0)
Increased resistance	26 (6.8)
Absent end-diastolic flow	10 (2.6)
Reversed end-diastolic flow	9 (2.4)
Reversed diastolic flow	111 (29.1)
Not done	8 (2.1)
Initial placental location	
Anterior	132 (34.6)
Posterior	133 (34.9)
Lateral/Fundal	86 (22.6)
Placenta previa	18 (4.7)
Low lying	12 (3.1)

Data are presented as number (percentage). Doppler findings represent the initial antenatal assessment.

On follow-up ultrasonography, 44.9% of pregnancies were diagnosed with oligohydramnios, 34.9% with polyhydramnios, and 20.2% had normal amniotic fluid volume. Most fetuses (80.1%) demonstrated appropriate growth for gestational age, and follow-up Doppler studies were normal in 80.1% of participants, indicating stable fetal circulation in the majority of pregnancies.

Table 4: Ultrasound findings during follow-up (n = 381)

Variable	n (%)
USG diagnosis	
Normal	77 (20.2)
Oligohydramnios	171 (44.9)
Polyhydramnios	133 (34.9)
Follow-up fetal growth	
Appropriate for gestational age	305 (80.1)
Small for gestational age	76 (19.9)
Follow-up Doppler	
Normal	305 (80.1)
Absent end-diastolic flow	35 (9.2)
Reversed end-diastolic flow	41 (10.8)

Data are presented as number (percentage).

The occurrence of fetal distress differed significantly among the three AFI groups ($\chi^2 = 7.26$, $p = 0.027$), indicating an association between abnormal amniotic fluid volume and fetal distress. In contrast, neonatal mortality did not differ significantly across AFI categories ($\chi^2 = 0.335$, $p = 0.846$), suggesting that AFI was not significantly associated with neonatal death in this cohort.

Table 5: AFI category and categorical perinatal outcomes

Outcome	Normal AFI n (%)	Oligohydramnios n (%)	Polyhydramnios n (%)	p value
Fetal distress*	20	21	25	0.027
No fetal distress*	57	150	108	
Neonatal death	2	3	2	0.846
Survived	75	168	131	

Data are expressed as number (percentage). The Chi-square test was used to compare categorical variables among AFI groups. A p-value <0.05 was considered statistically significant.

There were no statistically significant differences in mean birth weight, APGAR score at 1 minute, APGAR score at 5 minutes, duration of NICU stay, or estimated fetal weight among the normal AFI, oligohydramnios, and polyhydramnios groups (all **p > 0.05**). These findings suggest that, in this study population, AFI category was not associated with significant differences in these continuous neonatal outcome measures.

Table 6: Comparison of neonatal outcomes according to AFI category

Outcome	Normal AFI	Oligohydramnios	Polyhydramnios	p value
Birth weight (g)	2847.4 ± 405.5	2763.5 ± 401.3	2802.3 ± 480.7	0.311
APGAR score (1 min)	7.57 ± 1.11	7.53 ± 1.12	7.51 ± 1.06	0.929
APGAR score (5 min)	8.58 ± 1.14	8.52 ± 1.17	8.47 ± 1.18	0.774
NICU stay (days)	0.55 ± 1.50	0.71 ± 1.66	0.66 ± 1.55	0.733
Estimated fetal weight (g)	2809.2 ± 539.8	2801.5 ± 559.2	2717.2 ± 584.3	0.372

Continuous variables are presented as mean ± standard deviation (SD). Comparisons among the three AFI groups were performed using one-way analysis of variance (ANOVA). A p-value <0.05 was considered statistically significant.

DISCUSSION

Amniotic fluid assessment is an integral component of antenatal fetal surveillance, as alterations in amniotic fluid volume may reflect underlying placental dysfunction, fetal abnormalities, or maternal conditions. The amniotic fluid index (AFI), measured by the four-quadrant technique, is widely used for evaluating amniotic fluid volume and identifying pregnancies at increased risk of adverse perinatal outcomes. The present prospective study evaluated the association between AFI abnormalities and perinatal outcomes among 381 pregnant women.

In the present study, abnormal amniotic fluid volume was observed in a substantial proportion of pregnancies, with oligohydramnios being the most common abnormality (44.9%), followed by polyhydramnios (34.9%). Similar observations have been reported by studies evaluating the relationship between AFI abnormalities and pregnancy outcomes. George S,[8] reported oligohydramnios in 8.3% of pregnancies, whereas other studies involving high-risk pregnancies have demonstrated variable prevalence depending on gestational age, inclusion criteria, and maternal risk factors. The higher proportion of abnormal AFI observed in our study may be attributed to the inclusion of women undergoing evaluation at a tertiary care centre, where high-risk pregnancies are more frequently encountered.

The present study demonstrated a significant association between AFI category and fetal distress ($p = 0.027$). This finding supports the role of AFI assessment as an important component of fetal surveillance. Reduced amniotic fluid volume may contribute to fetal compromise by decreasing the protective cushioning effect around the umbilical cord, increasing the likelihood of cord compression and variable fetal heart rate decelerations. Similar findings were reported by Dobariya et al,[9] who observed increased rates of caesarean delivery due to fetal distress and lower Apgar scores among pregnancies complicated by oligohydramnios. Chaudhary et al,[10] also reported a higher incidence of non-reactive NST, meconium-stained liquor, and operative delivery among women with reduced AFI, although some neonatal outcomes did not reach statistical significance.

The relationship between low AFI and increased obstetric intervention has been widely described. Previous studies have demonstrated that oligohydramnios frequently leads to increased induction of labour and caesarean delivery, primarily due to concerns regarding fetal compromise. Singhal et al,[11] reported significantly higher rates of labour induction, caesarean delivery, and intrapartum fetal distress among women with AFI <5 cm compared with those with normal AFI. Similarly, Bhagat and Chawla,[12] observed increased caesarean delivery rates for fetal distress and lower birth weight among women with oligohydramnios. These findings emphasize that abnormal AFI values influence clinical decision-making and may increase obstetric interventions.

However, in the present study, no significant association was observed between AFI category and neonatal mortality ($p = 0.846$). This finding is consistent with studies suggesting that although abnormal AFI is associated with increased intrapartum complications and interventions, it does not always translate into increased neonatal mortality when appropriate fetal monitoring and timely obstetric management are available. Singhal et al,[11] and Chaudhary et al,[10] similarly reported no significant difference in neonatal mortality between low AFI and normal AFI groups.

The present study also found no statistically significant differences in neonatal birth weight, Apgar scores at 1 and 5 minutes, NICU stay, and estimated fetal weight among normal AFI, oligohydramnios, and polyhydramnios groups. These findings are comparable with Nabhan and Abdelmoula,[13] who reported that although AFI measurement resulted in increased detection of oligohydramnios and higher rates of intervention, it did not significantly improve major neonatal outcomes. Similarly, Magann et al,[14] suggested that while AFI may identify pregnancies at risk of intrapartum complications, its ability to predict all adverse neonatal outcomes is limited.

Contrary to our findings, several studies have reported significant associations between oligohydramnios and adverse neonatal outcomes. Milani et al,[15] observed increased rates of respiratory distress, NICU admission, low birth weight, and low Apgar scores among pregnancies with oligohydramnios. Mohan et al. [16] also reported increased NICU admissions and composite adverse neonatal outcomes among isolated oligohydramnios cases. Differences between these studies and the present study may be explained by variations in study population, gestational age at diagnosis, severity of oligohydramnios, maternal risk factors, and differences in neonatal care facilities.

The assessment of amniotic fluid should therefore be interpreted along with other fetal surveillance parameters, including cardiotocography, Doppler velocimetry, fetal growth assessment, and maternal clinical factors. Sharma et al,[17] demonstrated that combining AFI with umbilical artery Doppler improves prediction of adverse perinatal outcomes, with Doppler parameters showing better predictive accuracy compared with AFI alone. This highlights that AFI should be considered as part of a comprehensive fetal assessment rather than an isolated predictor of neonatal outcome.

The present study has several strengths, including its prospective design, relatively large sample size, and evaluation of multiple maternal and neonatal outcomes. However, certain limitations should be acknowledged. The study was conducted at a single centre, which may limit generalizability.

Additionally, variations in timing of AFI assessment, underlying maternal conditions, and management decisions may influence perinatal outcomes.

CONCLUSION

Overall, the findings of this study indicate that abnormal AFI is associated with increased risk of fetal distress, emphasizing the importance of regular amniotic fluid assessment during antenatal surveillance. However, AFI abnormalities alone may not reliably predict all neonatal outcomes, and clinical management should incorporate additional fetal monitoring parameters to optimize maternal and neonatal outcomes.

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