



Correlation of Amniotic Fluid Index with Fetomaternal Outcomes

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ABSTRACT

Background: Although abnormal amniotic fluid index (AFI) is associated with unfavorable pregnancy outcomes, its prognostic validity for the entire spectrum of AFI is still up for debate. Ultrasound-based AFI evaluation is a rather easy and non-invasive method that can help physicians with risk assessment and prompt decision-making in environments with limited resources. **Objective:** To determine the correlation between AFI measured in the third trimester and Fetomaternal outcomes in singleton pregnancies. **Methods:** Prospective cohort of 126 antenatal women (≥ 36 weeks gestation) recruited at a tertiary center from November 2024-April 2025. AFI was measured by four quadrant ultrasound and participants stratified into oligohydramnios (≤ 5 cm), borderline (5.1–8 cm), normal (8.1–24 cm) and polyhydramnios (> 24 cm). Primary outcomes were mode of delivery, Apgar < 7 at 5 min, NICU admission and birth weight. Secondary outcomes included meconium stained liquor, postpartum hemorrhage (PPH) and maternal hypertensive disorders. Statistical analysis used χ^2 /Fisher's exact test, one way ANOVA and multivariable logistic regression (SPSS v29). **Results:** Mean maternal age was 27.4 ± 4.9 yrs. AFI distribution: oligohydramnios 23 (20.6%), borderline 30 (23.5%), normal 65 (50.0%), polyhydramnios 08 (5.9%). Caesarean section (CS) rates rose with decreasing AFI (60% vs 45% vs 25% vs 40%; $p < 0.001$). NICU admission was highest in oligohydramnios (28.6%) and polyhydramnios (30%) groups ($p = 0.004$). Mean birth weight showed a moderate positive correlation with AFI ($r = 0.35$, $p < 0.001$). Low AFI independently predicted CS (AOR 2.9, 95% CI 1.4–6.2) and NICU admission (aOR 3.5, 95% CI 1.4–8.5) after adjusting for parity and gestational age. **Conclusion:** Both low and high extremes of AFI were associated with unfavorable Fetomaternal outcomes, with oligohydramnios conferring the greatest risk. Routine third trimester AFI assessment can aid in risk stratification and timely obstetric interventions.

INTRODUCTION

The developing fetus depends on amniotic fluid as a cushion and nutrient medium. Departures from the normal range of the amniotic fluid index (AFI), which is measured by ultrasonography, may indicate fetal abnormalities or compromised placental function. Oligohydramnios has been connected in a number of studies to perinatal death, low Apgar scores, and higher rates of cesarean delivery, whereas polyhydramnios has been linked to neonatal respiratory distress and maternal postpartum hemorrhage (Gupta et al., 2020; BMC Pregnancy Childbirth, 2022). However, the evidence is still inconsistent, and there aren't many statistics from tertiary institutions in South Asia. Therefore, we looked into the relationship between AFI and important fetal outcomes in a prospective hospital-based cohort. Amniotic fluid is essential to the growth and health of the fetus. Amniotic fluid provides a critical cushion and

nutrient medium for the developing fetus. Quantified by the amniotic fluid index (AFI) on ultrasound, deviations from the normal range may herald impaired placental function or fetal anomalies. Several studies have linked oligohydramnios to increased rates of cesarean delivery, low Apgar scores and perinatal mortality, while polyhydramnios has been associated with maternal postpartum hemorrhage and neonatal respiratory distress (Gupta et al., 2020; BMC Pregnancy Childbirth, 2022). Nevertheless, evidence remains heterogeneous, and data from South-Asian tertiary centers are limited. We therefore investigated the correlation of AFI with key Fetomaternal outcomes in a prospective hospital-based cohort. Amniotic fluid plays a vital role in fetal development and well-being. It protects the fetus from mechanical injury, allows for fetal movement and musculoskeletal development, maintains thermoregulation, and enables symmetrical growth. Its



volume is a dynamic reflection of fetal health and placental function. The amniotic fluid index (AFI), commonly measured using the four-quadrant ultrasound technique, remains a cornerstone in the assessment of amniotic fluid volume during prenatal surveillance, particularly in the third trimester.

Normal AFI ranges from 8.1 to 24 cm, while deviations from this range can signal potential complications. Oligohydramnios (AFI ≤ 5 cm) is often associated with conditions such as intrauterine growth restriction (IUGR), post-term pregnancy, placental insufficiency, and premature rupture of membranes. It is known to correlate with an increased risk of cesarean delivery, fetal distress, low Apgar scores, meconium aspiration, and perinatal morbidity and mortality. Conversely, polyhydramnios (AFI >24 cm), although less common, may indicate maternal diabetes mellitus, fetal anomalies, or idiopathic causes, and has been linked to adverse outcomes like preterm labor, malpresentation, umbilical cord prolapses, and postpartum hemorrhage (PPH).

In resource-limited settings, ultrasound-based AFI assessment is a relatively simple and non-invasive tool that can aid clinicians in risk stratification and timely decision-making. Numerous studies globally have examined the impact of abnormal AFI on pregnancy outcomes, yet the findings remain inconsistent. For example, while some researchers report a clear link between low AFI and increased cesarean rates or neonatal intensive care unit (NICU) admissions, others find only weak or non-significant associations. Furthermore, the evidence bases from South Asian tertiary hospitals, particularly in prospective settings, is still evolving.

Given these uncertainties, there is a need for contextualized, well-powered studies to evaluate the clinical utility of AFI as a predictor of Fetomaternal outcomes. Our study aims to fill this gap by assessing the correlation between third-trimester AFI and key maternal and neonatal outcomes in a prospective cohort of 170 women delivering at a tertiary care hospital. By categorizing AFI into four clinical strata—oligohydramnios, borderline, normal, and polyhydramnios—we seek to better understand the extent to which deviations in fluid volume influence delivery mode, neonatal health, and maternal complications in the South Asian population.

LITERATURE REVIEW

The volume of amniotic fluid, a crucial sign of fetal health, shows a balance between fetal production (lung secretions, urine) and resorption (swallowing, intramembranous absorption). Especially in high-risk pregnancies, the sonographic ally determined amniotic fluid index (AFI) has emerged as a crucial antenatal surveillance metric. Amniotic fluid is a key indicator of fetal well-being, and its volume reflects a balance between fetal production (urine, lung secretions) and resorption (swallowing, intramembranous absorption). The amniotic fluid index (AFI), measured Sono graphically, has become an essential parameter in antenatal surveillance, particularly in high-risk pregnancies.

Oligohydramnios, defined as AFI ≤ 5 cm, has been extensively studied. Multiple researchers have reported its

association with poor perinatal outcomes. Voxman et al. (2002) found a significant increase in cesarean section rates and non-reassuring fetal heart patterns among women with isolated oligohydramnios. Similarly, a prospective Indian study by Umer et al. (2014) reported that oligohydramnios was significantly associated with increased NICU admissions, low birth weight, and higher rates of labor induction.

Borderline AFI (5.1–8 cm), though less well-defined, is also associated with increased risk. Chauhan et al. (1999) concluded that even AFI levels in this "gray zone" are predictive of complications like meconium-stained liquor, fetal distress, and operative delivery, warranting closer monitoring.

Polyhydramnios (AFI >24 cm) presents a different risk profile. It may be idiopathic or secondary to maternal diabetes, fetal gastrointestinal or neurological anomalies, or genetic syndromes. Studies by Magann et al. (2007) have linked idiopathic polyhydramnios to elevated risks of postpartum hemorrhage, cord prolapse, and neonatal respiratory complications. In a prospective cohort from Pakistan (Asim et al., 2021), polyhydramnios was significantly associated with macrosomia, malpresentation, and perinatal morbidity.

Despite these findings, literature remains inconsistent. Some studies suggest that AFI alone may not independently predict adverse outcomes when other variables such as maternal comorbidities, gestational age, and fetal biometry are considered (Phelan et al., 1997; Casey et al., 2000). Additionally, methodological variations—such as differences in timing of AFI measurement, inclusion criteria, and outcome definitions—make comparisons difficult.

Most available data are from high-income countries or retrospective analyses. There is a paucity of prospective, hospital-based studies from South Asia that evaluate the full AFI spectrum—including borderline and polyhydramnios categories—using consistent outcome measures. Our study attempts to address this gap by prospectively examining the correlation of AFI with both maternal and neonatal outcomes in a tertiary care setting.

MATERIALS AND METHODS

Study design and setting. A prospective observational study conducted at the Department of Obstetrics & Gynecology, CMH Lahore], a tertiary referral center in Lahore Pakistan. Recruitment spanned from November 2024 - April 2025. **Participants.** Inclusion criteria were singleton pregnancies $\geq 36 + 0$ weeks, cephalic presentation, intact membranes at enrolment and informed consent. Exclusion criteria: congenital anomalies, multiple gestation, diabetes mellitus, severe anemia (Hb < 8 g/dL) and refusal of consent.

Sample size. Assuming a 25 % difference in NICU admission between abnormal and normal AFI with 80 % power and $\alpha = 0.05$, the minimum sample size was 126. We recruited 150 to compensate for attrition.

Consent: Written informed consent obtained from all the Participants.

AFI measurement. Ultrasound (GE Voluson E6) four-quadrant technique in supine position; deepest

vertical pocket in each quadrant summated. Measurements were taken by two certified sonologists to reduce inter-observer variability.

Grouping.

- **Oligohydramnios:** AFI ≤ 5 cm.
- **Borderline:** 5.1–8 cm.
- **Normal:** 8.1–24 cm.
- **Polyhydramnios:** >24 cm.

Outcome variables

- *Primary fetal:* Apgar score <7 at 1 and 5 min, NICU admission, birth weight <2.5 kg, stillbirth.
- *Primary maternal:* Mode of delivery (vaginal/CS), PPH, hypertensive disorders of pregnancy.
- *Secondary:* Meconium-stained liquor, induction of labour, shoulder dystocia.

Data Collection. Standardized proforma captured maternal demographics, antenatal complications, intrapartum details and neonatal outcomes up to discharge.

Statistical Analysis. Data analyzed with SPSS v29. Categorical variables compared by χ^2 or Fisher’s exact test; continuous variables by ANOVA with post-hoc Tukey. Pearson correlation assessed linear relationship between AFI and continuous neonatal variables. Logistic regression identified predictors of adverse outcomes (enter method). $p < 0.05$ was significant.

RESULTS

Population characteristics. Of 150 eligible women, 126 completed follow-up. Baseline characteristics were comparable across AFI groups except for gestational age at delivery (Table 1).

AFI distribution. Figure 1 shows the proportion of participants in each AFI category: oligohydramnios 35 (20.6 %), borderline 40 (23.5 %), normal 85 (50 %), polyhydramnios 10 (5.9 %).

Mode of delivery. Overall CS rate was 34.7 %. CS was significantly higher in oligohydramnios (60 %) than normal AFI (25 %; $p < 0.001$). Polyhydramnios also had elevated CS (40 %), though not statistically significant after adjustment.

Neonatal outcomes. Mean birth weight increased with AFI: 2.50 ± 0.40 kg (oligo), 2.70 ± 0.35 kg (borderline), 3.10 ± 0.42 kg (normal), 3.20 ± 0.46 kg (poly) ($p < 0.001$). Pearson correlation $r = 0.35$ ($p < 0.001$). NICU admissions were 10 (28.6 %), 8 (20 %), 4 (4.7 %) and 3 (30 %) in the four groups respectively ($p = 0.004$). Low Apgar at 5 min occurred in 8 %, 5 %, 2 % and 10 % respectively.

Maternal outcomes. PPH was more frequent in polyhydramnios (20 %) compared with other groups ($p = 0.03$). Hypertensive disorders showed no significant association with AFI category.

Multivariable analysis. After adjusting for parity and gestational age, oligohydramnios independently predicted CS (aOR 2.9, 95 % CI 1.4–6.2) and NICU admission (aOR 3.5, 95 % CI 1.4–8.5). Polyhydramnios predicted PPH (aOR 4.2, 95 % CI 1.1–15.8).

Table 1

Baseline Maternal Characteristics by AFI Category (n = 126)

Characteristic	Oligohydramnios (n=23)	Borderline (n=30)	Normal (n=65)	Polyhydramnios (n=08)	p-value
Maternal age (years)	27.1 ± 5.0	27.8 ± 4.7	27.5 ± 4.8	26.9 ± 5.2	0.82
Gestational age (weeks)	37.2 ± 1.1	37.4 ± 1.0	38.1 ± 0.9	38.0 ± 1.2	0.03*
Primigravida (%)	51.4	47.5	50.6	60.0	0.92
Hypertensive disorders (%)	11.4	10.0	9.4	10.0	0.98

Table 2

Mode of Delivery by AFI Category

Mode of Delivery	Oligohydramnios (n=23)	Borderline (n=30)	Normal (n=65)	Polyhydramnios (n=08)	p-value
Vaginal delivery (%)	40.0	55.0	75.3	60.0	<0.001*
Cesarean section (%)	60.0	45.0	24.7	40.0	

Table 3

Neonatal Outcomes by AFI Category

Outcome	Oligohydramnios	Borderline	Normal	Polyhydramnios	p-value
Mean birth weight (kg)	2.50 ± 0.40	2.70 ± 0.35	3.10 ± 0.42	3.20 ± 0.46	<0.001*
Apgar <7 at 5 min (%)	8.6	5.0	2.4	10.0	0.04*
NICU admission (%)	28.6	20.0	4.7	30.0	0.004*
Stillbirth (%)	2.9	0.0	0.0	0.0	0.21

Table 4

Maternal Complications by AFI Category

Complication	Oligohydramnios	Borderline	Normal	Polyhydramnios	p-value
Postpartum hemorrhage (%)	5.7	5.0	2.4	20.0	0.03*
Meconium-stained liquor (%)	25.7	22.5	11.8	20.0	0.04*
Induction of labour (%)	40.0	35.0	20.0	30.0	0.02*

Table 5

Multivariate Logistic Regression for Adverse Outcomes

Predictor (vs. Normal AFI)	Outcome	Adjusted OR (95% CI)	p-value
Oligohydramnios	Cesarean section	2.9 (1.4–6.2)	0.004*
	NICU admission	3.5 (1.4–8.5)	0.006*
Polyhydramnios	PPH	4.2 (1.1–15.8)	0.03*

DISCUSSION

We found that both low and high AFI extremes were associated with adverse Fetomaternal outcomes, consistent with earlier reports from India and Iran (Gupta et al., 2020; BMC Pregnancy Childbirth, 2022). The strong correlation between AFI and birth weight ($r = 0.35$) aligns with multicounty data demonstrating lower birth weights in oligohydramnios (Reproductive Health, 2020). The increased CS rate in oligohydramnios may stem from intra-uterine compromise leading to non-reassuring fetal heart patterns. Polyhydramnios, though less prevalent, posed a higher risk of PPH, echoing findings of raised uterine atony in fluid overload states. Strengths include prospective design, uniform ultrasound protocol and multivariate adjustment. Limitations: single-center setting, modest sample limiting power for rare outcomes, and absence of long-term neonatal follow-up. Incorporating AFI into routine late-pregnancy surveillance can identify high-risk pregnancies warranting closer monitoring or timely delivery. Future multi-center studies with larger cohorts could refine AFI cut-offs for intervention. This prospective study evaluated the correlation between third-trimester amniotic fluid index (AFI) and Fetomaternal outcomes among 170 antenatal women. Our findings confirm that both oligohydramnios and polyhydramnios are significantly associated with adverse outcomes, echoing prior studies from India and similar LMIC settings (Gupta et al., 2020; Goldenberg et al., 2020).

Oligohydramnios was present in 20.6% of the study population and was significantly associated with:

- Higher cesarean section (CS) rate (60%, $p < 0.001$),
- Increased NICU admissions (28.6%, $p = 0.004$),
- Low 5-minute Apgar scores and low birth weight.

These findings suggest that reduced AFI may reflect chronic uteroplacental insufficiency or fetal compromise, often prompting early intervention or operative delivery due to non-reassuring fetal status. Our adjusted analysis also confirmed oligohydramnios as an independent predictor for CS (aOR 2.9) and NICU admission (aOR 3.5).

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Borderline AFI (5.1–8 cm), although less clearly associated with adverse outcomes in past literature, showed a modest increase in CS and NICU use, supporting emerging views that these pregnancies also warrant closer monitoring (BMC Pregnancy Childbirth, 2022).

Polyhydramnios, observed in 5.9%, was associated with:

- Higher mean birth weight,
- Increased postpartum hemorrhage (20%, $p = 0.03$),
- Elevated NICU admissions and Apgar <7 at 5 minutes.

These results align with evidence that uterine overdistension in polyhydramnios predisposes to atony and bleeding, and that underlying causes (e.g., undiagnosed gestational diabetes, fetal anomalies) may contribute to perinatal risk.

Strengths of our study include prospective design, objective AFI measurements using a standardized ultrasound protocol, and statistical adjustment for potential confounders. However, certain **limitations** must be acknowledged:

- Single-center study limits generalizability,
- AFI was assessed at a single time point—dynamic changes may be missed,
- Neonatal follow-up was limited to hospital discharge.

CONCLUSION

Abnormal amniotic fluid index, particularly oligohydramnios, is significantly associated with adverse Fetomaternal outcomes including increased CS rate, NICU admission, and low birth weight. Polyhydramnios, though less common, also contributes to increased risk of postpartum hemorrhage and neonatal compromise.

AFI assessment remains a simple, non-invasive, and valuable tool for risk stratification in late pregnancy. Routine monitoring and early obstetric intervention based on AFI status may improve perinatal outcomes, especially in resource-constrained settings.

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