e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(1); 1762-1767

Original Research Article

Impact of Amniotic Fluid Index Severity on Mode of Delivery and Neonatal Intensive Care Unit Admission in Pregnancies with Oligohydramnios: A Prospective Cohort Study

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Received: 01-12-2025 / Revised: 20-01-2026 / Accepted: 30-01-2026

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Conflict of interest: Nil

Abstract

Background: Amniotic fluid volume is an important component of fetal surveillance, but the clinical significance of different degrees of reduced amniotic fluid index (AFI) is not uniform. This secondary analysis examined whether pregnancies with markedly reduced AFI had poorer obstetric and early neonatal outcomes than those with borderline low AFI.

Aim: To compare mode of delivery, neonatal intensive care unit (NICU) admission and perinatal outcome between pregnancies with AFI <5 cm and AFI 5-8 cm.

Methods: This prospective cohort study included 80 pregnant women beyond 28 weeks of gestation who were enrolled at Sri Chamarajendra Maternity Hospital, Hassan Institute of Medical Sciences, over 18 months. For the present analysis, participants were stratified as AFI <5 cm (n=62) or AFI 5-8 cm (n=18). Categorical outcomes were compared using the chi-square test as reported in the present study. Unadjusted risk ratios (RRs) with 95% confidence intervals (CIs) were additionally calculated from the published contingency counts.

Results: Caesarean delivery occurred in 51/62 (82.3%) women with AFI <5 cm and 8/18 (44.4%) women with AFI 5-8 cm; the overall distribution of mode of delivery differed significantly by AFI category (p=0.008). The crude RR for caesarean delivery in the AFI <5 cm group was 1.85 (95% CI 1.09-3.14). Among 72 live births, NICU admission was required for 46/58 (79.3%) neonates in the AFI <5 cm group compared with 3/14 (21.4%) in the AFI 5-8 cm group (p<0.001), corresponding to a crude RR of 3.70 (95% CI 1.35-10.18). Perinatal outcome at birth (live birth, intrauterine death or stillbirth) was not significantly associated with AFI category (p=0.149). Overall, 49/72 (68.1%) live-born neonates required NICU care, and eight neonatal deaths were recorded.

Conclusion: Within this cohort of pregnancies with reduced amniotic fluid, AFI <5 cm was associated with substantially greater use of caesarean delivery and NICU care than AFI 5-8 cm. The absence of a significant difference in perinatal mortality, together with the management-dependent nature of delivery decisions, indicates that AFI should be interpreted alongside gestational age, fetal surveillance findings and maternal clinical status rather than as an isolated trigger for intervention.

Keywords: Amniotic fluid index; oligohydramnios; borderline low AFI; caesarean delivery; NICU admission; perinatal outcome.

DOI: 10.25258/ijcpr.18.1.299

Introduction

Amniotic fluid reflects a dynamic interaction between fetal urine production, fetal swallowing, transmembranous movement and placental function. In the third trimester, a reduction in measurable amniotic fluid can accompany placental insufficiency, hypertensive disease, fetal growth restriction, membrane rupture, fetal anomalies or post-term pregnancy. It can also be detected in otherwise uncomplicated pregnancies. Because the same ultrasound finding may arise in very different clinical settings, the prognostic meaning of a low AFI depends on both its severity and the accompanying maternal and fetal findings.[1-4] An AFI at or below approximately 5 cm has traditionally been used to identify oligohydramnios, whereas values between about 5 and 8 cm are frequently described as borderline or marginally reduced. These categories are clinically relevant because they often prompt different levels of surveillance and intervention. Evidence from trials and systematic reviews also shows that the method used to assess amniotic fluid can influence how often oligohydramnios is diagnosed and how often labour is induced, without necessarily producing parallel improvements in neonatal outcomes.[2,3]

Previous studies have generally compared oligohydramnios with pregnancies having normal fluid volume. Fewer studies have examined risk gradients within the low-AFI spectrum itself, particularly in mixed-risk populations from Indian tertiary hospitals. Several comparative reports suggest that outcomes worsen as AFI falls, with higher rates of fetal distress, operative delivery, low birth weight and NICU admission among women with AFI around or below 5 cm.[5-10]

However, these associations may be modified by gestational age, fetal growth, maternal comorbidity and the fact that knowledge of AFI can directly influence the decision to deliver. The present study prospectively enrolled women with reduced amniotic fluid and recorded detailed maternal, fetal surveillance and neonatal data. The present secondary analysis was therefore designed with a narrower clinical question: whether the severity of reduced AFI itself was associated with mode of delivery and early neonatal outcome. This distinction is important both for clinical interpretation and for avoiding the assumption that every pregnancy with a borderline low AFI carries the same risk as one with a markedly reduced AFI.

Materials and Methods

Study Design and Setting: This was a prospective cohort study conducted in the Department of Obstetrics and Gynaecology, Sri Chamarajendra Maternity Hospital, Hassan Institute of Medical Sciences, Hassan, Karnataka, over an 18-month period.

The present study enrolled 80 newly diagnosed pregnant women with low amniotic fluid after approval from the Institutional Ethics Committee. Written informed consent was obtained from participants before enrolment.

Participants: Pregnant women beyond 28 weeks of gestation with oligoamnios/low amniotic fluid who were willing to participate were eligible. Women with multiple gestation, intrauterine death already present at hospital admission, hemodynamic instability, chorioamnionitis, antepartum haemorrhage, a known fetal anomaly, or a requirement for immediate emergency intervention at presentation were excluded.

Clinical Assessment and AFI Grouping: After enrolment, demographic details, obstetric history, general and obstetric examination findings, routine laboratory investigations, admission testing and relevant comorbidities were recorded. Ultrasound assessment included AFI, biophysical profile and obstetric Doppler evaluation. For this study, the exposure of interest was the AFI category recorded in the present study: markedly reduced AFI (<5 cm) versus borderline low AFI (5-8 cm). Sixty-two women were in the AFI <5 cm category and 18 were in the AFI 5-8 cm category.

Clinical management was not identical between the two AFI categories. Women with AFI 5-8 cm were generally managed conservatively with serial surveillance, with induction considered after 37 completed weeks when appropriate. Women with AFI <5 cm underwent closer surveillance with non-stress testing and modified biophysical profile, and delivery was based on obstetric indications. A non-reassuring fetal heart rate pattern accompanied by major Doppler abnormalities could lead to immediate caesarean delivery irrespective of gestational age. This management pathway is important when interpreting the observed association between AFI and mode of delivery.

Outcomes: The primary neonatal outcome for the present analysis was admission to the neonatal intensive care unit among live-born infants. Secondary outcomes were mode of delivery, perinatal status at birth (live birth, intrauterine death or stillbirth), Apgar scores, indications for NICU admission and early neonatal death. Maternal and neonatal denominators were kept separate: all 80 pregnancies contributed to delivery and perinatal-status analyses, whereas NICU and Apgar analyses were restricted to the 72 live births.

Statistical Analysis: The present study data were entered in Microsoft Excel and analysed using IBM SPSS version 20. Categorical variables were summarised as frequencies and percentages and were compared using the chi-square test; a p value of 0.05 or less was considered statistically significant. For this study, unadjusted risk ratios with 95% confidence intervals were additionally calculated from the present study contingency tables for two clinically interpretable comparisons: caesarean versus non-caesarean delivery and NICU admission versus no NICU admission. These effect estimates are exploratory and unadjusted for potential confounders.

Results

Eighty women were included. Most were young, primigravid and from lower or lower-middle socioeconomic groups. Preeclampsia and anaemia were the most frequent recorded comorbidities, while 47.5% had no listed comorbidity. Most pregnancies had reached at least 37 weeks at the time represented in the study data. AFI was <5 cm in 62 women (77.5%) and 5-8 cm in 18 (22.5%).Participant flow and the denominators used for delivery and neonatal analyses are shown in Figure 1.

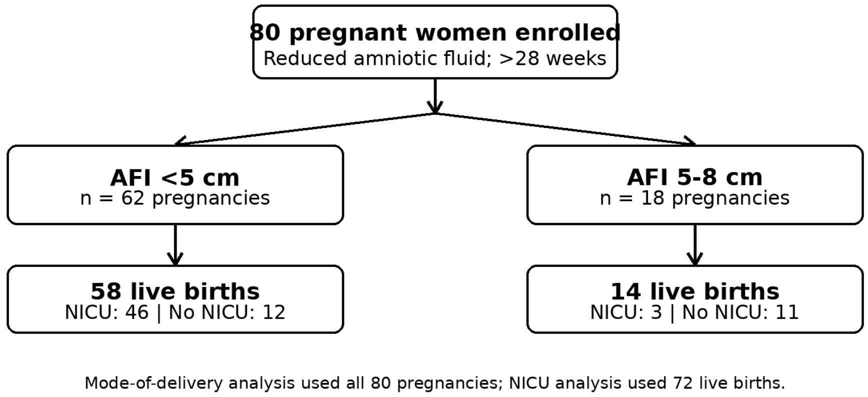

Figure 1: Participant flow and outcome denominators in the present study

Table 1: Demographic and obstetric profile of the study cohort (n=80)

Characteristic	n (%)
Age ≤25 years	39 (48.8)
Age 26-30 years	25 (31.3)
Age >30 years	16 (20.0)
Primigravida	48 (60.0)
Multigravida	32 (40.0)
Preeclampsia	19 (23.8)
Anaemia	12 (15.0)
Antepartum eclampsia	4 (5.0)
Hypothyroidism	4 (5.0)
Hyperthyroidism	2 (2.5)
Gestational diabetes mellitus	1 (1.3)
No recorded comorbidity	38 (47.5)
Gestational age >37 weeks	57 (71.3)
Gestational age 34-37 weeks	13 (16.3)
Gestational age <34 weeks	10 (12.5)
AFI <5 cm	62 (77.5)
AFI 5-8 cm	18 (22.5)

Percentages are calculated from the raw counts in the present study; minor differences from rounded thesis percentages may occur.

Mode of delivery differed across AFI strata. In the AFI <5 cm group, 51 of 62 women (82.3%) underwent lower-segment caesarean section, compared with 8 of 18 (44.4%) in the AFI 5-8 cm group. The four-category distribution of delivery mode was statistically significant (p=0.008). When delivery was dichotomised as caesarean versus non-caesarean for effect-size estimation, AFI <5 cm was associated with a crude 1.85-fold risk of caesarean delivery (95% CI 1.09-3.14).

Table 2: AFI category and mode of delivery (n=80)

AFI category	FTVD	Instrumental	LSCS	PTVD
AFI <5 cm (n=62)	8 (12.9)	1 (1.6)	51 (82.3)	2 (3.2)
AFI 5-8 cm (n=18)	4 (22.2)	2 (11.1)	8 (44.4)	4 (22.2)
Total	12 (15.0)	3 (3.8)	59 (73.8)	6 (7.5)

Overall association between AFI category and the four-category mode of delivery: p=0.008 (chi-square, as reported in the present study). Crude RR for LSCS with AFI <5 cm versus AFI 5-8 cm: 1.85 (95% CI 1.09-3.14). FTVD, full-term vaginal delivery; LSCS, lower-segment caesarean section; PTVD, preterm vaginal delivery.

There were 72 live births. Of these, 58 followed pregnancies with AFI <5 cm and 14 followed pregnancies with AFI 5-8 cm. NICU admission was required for 46/58 (79.3%) neonates in the AFI <5 cm group and 3/14 (21.4%) in the AFI 5-8 cm group (p<0.001). The crude risk of NICU admission was 3.70 times higher in the AFI <5 cm group (95% CI 1.35-10.18).

Table 3: AFI category and NICU admission among live births (n=72)

AFI category	NICU not required	NICU required
AFI <5 cm (n=58)	12 (20.7)	46 (79.3)
AFI 5-8 cm (n=14)	11 (78.6)	3 (21.4)
Total	23 (31.9)	49 (68.1)

p<0.001 (chi-square, as reported in the present study). Crude RR for NICU admission with AFI <5 cm versus AFI 5-8 cm: 3.70 (95% CI 1.35-10.18). NICU, neonatal intensive care unit.

At birth, 72 pregnancies resulted in live birth, five were classified as intrauterine deaths and three as stillbirths. The distribution of these outcomes was not significantly different between AFI categories (p=0.149).

The present study documented five intrauterine deaths: two associated with congenital malformations, one with cord prolapse and two with severe fetal growth restriction accompanied by reversal of end-diastolic flow.

Because fetal anomaly at initial presentation was an exclusion criterion, the timing of recognition of the two anomalies should be verified against the case records before journal submission.

Table 4: AFI category and perinatal status at birth (n=80)

AFI category	Intrauterine death	Live birth	Stillbirth
AFI <5 cm (n=62)	3	58	1
AFI 5-8 cm (n=18)	2	14	2
Total	5 (6.3%)	72 (90.0%)	3 (3.8%)

Overall association: p=0.149. Percentages in the total row are based on n=80.

Among the 72 live-born neonates, 13 (18.1%) had a 1-minute Apgar score <4, four (5.6%) had a score of 4-6, 37 (51.4%) had a score of 6-8 and 18 (25.0%) had a score >8. At five minutes, 11 (15.3%) had a score <4, six (8.3%) scored 4-6, eight (11.1%) scored 6-8 and 47 (65.3%) scored >8. Forty-nine neonates required NICU admission. The leading recorded reasons were low birth weight (18/49, 36.7%), preterm birth (10/49, 20.4%), acute respiratory distress syndrome (9/49, 18.4%), meconium aspiration syndrome (7/49, 14.3%), the category labelled “TTP” in the present study (3/49, 6.1%), and fetal anomaly (2/49, 4.1%). Eight neonatal deaths were recorded among the 72 live births (11.1%); causes listed were sepsis in three, hypoxic-ischaemic encephalopathy stage III in three, and refractory shock in two. The present study text reports 10.96% for neonatal death; the 11.1% figure used here is the arithmetic proportion 8/72.

Table 5: Early neonatal morbidity among live births

Outcome	Frequency
NICU admission	49/72 (68.1%)
Low birth weight as NICU indication	18/49 (36.7%)
Preterm birth as NICU indication	10/49 (20.4%)
Acute respiratory distress syndrome	9/49 (18.4%)
Meconium aspiration syndrome	7/49 (14.3%)
TTP	3/49 (6.1%)
Fetal anomaly as NICU indication	2/49 (4.1%)
Neonatal deaths	8/72 (11.1%)
Death due to sepsis	3/8 (37.5%)
Death due to HIE stage III	3/8 (37.5%)
Death due to refractory shock	2/8 (25.0%)

HIE, hypoxic-ischaemic encephalopathy. The source present study uses the abbreviation “TTP” without an unambiguous expansion; authors should confirm the intended diagnosis before submission.

Discussion

This analysis found a clear clinical gradient within pregnancies already identified as having reduced amniotic fluid. Women with AFI <5 cm had a markedly higher frequency of caesarean delivery and their live-born infants were substantially more likely to require NICU admission than those with AFI 5-8 cm. In contrast, the distribution of live birth, intrauterine death and stillbirth did not differ significantly between AFI categories. These findings suggest that the severity of low AFI is more closely associated with short-term obstetric intervention and neonatal morbidity than with mortality in a cohort of this size.

The higher operative-delivery rate in the lower-AFI group is consistent with earlier literature. Bachhav and Waikar reported that a low AFI at term was associated with more fetal distress and operative intervention.5 Gaikwad and colleagues compared pregnancies beyond 28 weeks with AFI ≤5 cm against those with AFI 5.1-8 cm and similarly observed a higher adverse-outcome burden and caesarean rate in the lower-AFI group.[6] A meta-analysis by Shrem et al. found that isolated oligohydramnios at term was associated with higher rates of induction and caesarean delivery than normal-fluid pregnancies, although evidence that intervention itself improves neonatal outcomes was limited.[7]

The association with NICU admission was even more pronounced in the present cohort. Nearly four-fifths of live-born infants after pregnancies with AFI <5 cm required NICU care, compared with approximately one-fifth in the 5-8 cm group. The crude RR of 3.70 has a wide confidence interval because the borderline group was small, but the direction is consistent with systematic evidence. Rabie et al. reported increased NICU admission among pregnancies with oligohydramnios, including both complicated and uncomplicated populations.[8] More recent Indian data also indicate that even borderline AFI can be accompanied by increased fetal distress and NICU utilisation compared with normal AFI, with risk appearing to rise as AFI decreases.[9]

The neonatal morbidity profile helps explain the high NICU use. Low birth weight and prematurity together accounted for more than half of the recorded indications, with respiratory morbidity and meconium aspiration contributing further. This pattern supports a broader interpretation of low AFI as a marker that often coexists with placental dysfunction, fetal growth problems or earlier delivery rather than as a single independent disease process. In the source cohort, maternal comorbidities were common, particularly preeclampsia and anaemia. These factors may contribute to both low fluid volume and neonatal morbidity and cannot be separated from AFI using the aggregated data available for this analysis.

The lack of a statistically significant relationship between AFI category and perinatal status at birth should not be interpreted as evidence of equal mortality risk. Only eight non-live births were recorded, leaving limited statistical power for mortality comparisons. In addition, several deaths had specific causes, including congenital malformations, cord prolapse and severe fetal growth restriction with abnormal umbilical flow. These events illustrate why AFI alone has limited specificity for determining prognosis.

An important interpretive issue is that AFI was not merely an observed exposure; it also influenced clinical management. Women with AFI <5 cm underwent more intensive surveillance and could be delivered promptly when testing was non-reassuring. Therefore, the association between AFI and caesarean delivery is partly management mediated. It would be inappropriate to interpret the crude RR as proof that low AFI biologically causes caesarean delivery. By contrast, NICU admission is a less direct management endpoint and may capture the better neonatal burden associated with the clinical circumstances surrounding a markedly low AFI.

The method used to measure amniotic fluid also deserves attention. Randomized trials and systematic reviews comparing AFI with the single deepest vertical pocket have shown that AFI can diagnose oligohydramnios more often and increase induction without a clear improvement in perinatal outcome.[2,3] Contemporary interpretation should therefore avoid treating a single AFI value as an isolated mandate for delivery. The present results are most useful as evidence of risk stratification within the study's own AFI-based management framework, rather than as a comparison of AFI with other fluid-assessment methods.

Strengths and Limitations: The strengths of the study include prospective data collection, clinically relevant outcome recording and the availability of distinct AFI strata within the same institutional cohort. Reporting denominators separately for pregnancies and live-born neonates, and presenting effect sizes with confidence intervals, improves interpretability beyond p values alone.

Several limitations are important. First, the cohort was small and the AFI 5-8 cm subgroup contained only 18 women, producing imprecise estimates. Second, there was no normal-AFI comparison group. Third, maternal comorbidities, gestational age, fetal growth, Doppler findings and other confounders could not be adjusted for using the aggregate tables available for this study. Fourth, AFI influenced the surveillance and delivery pathway, creating confounding by indication for mode-of-delivery analyses. Fifth, neonatal outcomes were short-term and long-term neurodevelopment was not assessed.This study should therefore be submitted only with explicit disclosure and citation of the related report, and the cover letter should explain that the present paper is a focused secondary analysis of AFI severity with distinct effect-size and perinatal-outcome emphasis.

Conclusion

Among pregnancies with reduced amniotic fluid in this prospective cohort, an AFI <5 cm identified a subgroup with substantially greater caesarean-delivery and NICU utilisation than an AFI of 5-8 cm. Perinatal mortality did not differ significantly between the two AFI categories, although the number of deaths was small. These findings support viewing AFI severity as one component of risk assessment rather than a stand-alone determinant of delivery. Decisions should integrate gestational age, maternal disease, fetal growth, cardiotocography/biophysical surveillance and Doppler findings.

Declarations: Ethics approval and consent to participate: The parent prospective cohort was initiated after approval from the Institutional Ethics Committee/Review Board of Hassan Institute of Medical Sciences, Hassan, and written informed consent was obtained.

Funding: Self-funded study.

Conflict of interest: Nil.

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