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To compare the diagnostic performance of Amniotic Fluid Index (AFI) and Single Deep Pocket (SDP) in detecting Oligohydramnios, and to evaluate their association with perinatal outcomes in term singleton pregnancies.

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ABSTRACT

BACKGROUND & OBJECTIVE: Term oligohydramnios is linked with fetal distress, cesarean delivery and neonatal complications. Amniotic Fluid Index (AFI) and Single Deepest Pocket (SDP) are the most commonly used ultrasound techniques to measure amniotic fluid volume, but their diagnostic accuracy is unclear. To compare the sensitivity and specificity of AFI and SDP for the diagnosis of Oligohydramnios, and to assess the relationship between AFI, SDP and perinatal outcomes in term singleton pregnancies.

METHODOLOGY: This comparative cross-sectional study was conducted at the Department of Radiology, PINUM Hospital, Faisalabad, from 16 April 2025 to 16 January 2026, over nine months. A total of 100 women with singleton, low-risk pregnancies at ≥ 37 weeks were included. Amniotic fluid volume was measured during the same ultrasound session using AFI and SDP. AFI ≤ 5 cm and SDP < 2 cm were considered Oligohydramnios. Maternal and neonatal outcomes were recorded. Data were analyzed using an independent t-test and Chi-square test; $p \leq 0.05$ was considered significant.

RESULTS: SDP detected more oligohydramnios cases (24%) than AFI (13%). SDP-defined Oligohydramnios was significantly associated with higher caesarean rates (66.7% vs 31%; $p=0.009$) and neonatal incubation (62.5% vs 33.8%; $p=0.030$). NICU admissions were higher but not statistically significant. Birth weight and Apgar scores were lower in oligohydramnios cases.

CONCLUSION: SDP shows a stronger association with adverse perinatal outcomes than AFI and may be preferred for amniotic fluid assessment in term pregnancies.

KEYWORDS: Oligohydramnios, Amniotic Fluid, Ultrasonography, Pregnancy, Term Birth, Caesarean Section.

INTRODUCTION

Amniotic fluid is a protective biological fluid enclosed within the amniotic sac and mainly composed of water and protein, carbohydrates, lipids, phospholipids, enzymes, hormones, electrolytes, and waste products^[1]. It is formed by fetal membranes as the fetus increases and fulfils the protective function as a cushion; in addition to this, the antibacterial properties have been observed to minimize the risk of intrauterine infection^[2,3]. Amniotic fluid helps in the exchange of nutrients, water, and biochemical substances between the mother and fetus, and includes different cells of the fetus whose presence is essential to growth and development. The volume of the amniotic fluid grows in a slow but steady manner as gestation progresses, and peaks at the gestation period of about 34 weeks, after which it can decrease^[4,5].

Oligohydramnios, which is traditionally defined as an amniotic fluid index (AFI) of 50 or less or a single deepest pocket (SDP) of 20 cm or less, is a serious obstetric problem that is linked to high rates of perinatal complications, such as fetal distress, meconium aspiration, low Apgar scores, higher rates of cesarean section, and neonatal intensive care units^[6,7]. The poor cushioning and compression of the umbilical cord cause adverse effects, as they hamper the process of fetal adaptation and oxygenation during labour^[8]. Based on several observational studies, the independent risk factor of perinatal morbidity is Oligohydramnios, which underlines the necessity of the sonographic diagnosis being made correctly to help inform the clinical intervention^[9].

Antepartum fetal surveillance must include the use of ultrasound estimation of amniotic fluid volume, since it cannot be directly measured in normal clinical practice^[7,10].

How to cite this: Gill OQ, Bukhari H, Saleem MS, Parveen K. To compare the diagnostic performance of Amniotic Fluid Index (AFI) and Single Deep Pocket (SDP) in detecting Oligohydramnios, and to evaluate their association with perinatal outcomes in term singleton pregnancies. *Journal of University Medical & Dental College*. 2026; 17(3):1299-1304



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Sonographic techniques are used to offer objective estimates that can be used to stratify at-risk fetuses and make decisions that include when to deliver or to increase monitoring. Amniotic Fluid Index (AFI) of four quadrants of amniotic fluid, the largest vertical fluid pocket without fetal parts or cord, is recognized as one of the two most commonly used techniques^[11,12]. The two methods are both supported for use in clinical practice, though they vary in levels of complexity. The AFI has long been popular because of its extensive evaluation of fluid distribution throughout the uterine cavity. It has proven to be very sensitive in certain environments, hence applicable in the detection of clinically significant small volumes of fluid^[14,15]. According to the various studies, though, AFI is known to diagnose more women with Oligohydramnios than with SDP, and thus more interventions are made, like labour induction, which have no associated improvement in neonatal outcomes. As an example, in a multicentre trial with a large patient count, AFI identified Oligohydramnios almost five times more often than SDP, but there was not a significant difference in neonatal intensive care admissions or other perinatal outcomes in the groups^[16,17]. These results indicate that AFI is sensitive but less specific, which can lead to unwarranted clinical interventions.

The SDP measure is less technically demanding and dwells on the largest vertical pocket of fluid. It has been shown that SDP can miss the positives of Oligohydramnios in comparison to AFI, and this suggests fewer unnecessary inductions and obstetric surgery^[18]. Similar outcomes of SDP and AFI in perinatal contexts have been indicated in meta-analyses and randomized trials, although the rate of oligohydramnios diagnosis with SDP was significantly lower. The relative selectivity in relation to equivalent postpartum outcomes is the rationale behind the recommendation to use SDP as a primary mode of screening during prenatal care in many cases (especially low-risk pregnancies), to prevent excessively identifying untenable diagnoses, yet also preventing the under-diagnosis of foetuses at very real risk^[19].

The comparative analyses between the use of AFI and SDP and the actual measure of amniotic fluid or perinatal outcomes show subtle diagnostic identity^[20]. Although both procedures are very sensitive (>90%) in identifying normal fluid volumes, SDP has been found to have a high positive predictive value of identifying Oligohydramnios in certain studies, whilst AFI may identify excessive amounts of fluid better. Notably, the pooling of data in several trials demonstrates that there is no evident preference for either method to help avoid the adverse neonatal events like poor Apgar values, umbilical cord pH anomalies, or hospital admissions to the NICU. These results highlight that diagnostic performance and the clinical context of a particular method should be taken into account, but no particular method is better than another^[18].

Even though many studies have been conducted, there is still no clear opinion on the best sonographic mode to be used in the measurement of amniotic fluid. Differing evidence on sensitivity, specificity, and prediction of perinatal

outcome has led to differences in the clinical practice guidelines across the world. Several studies have noted that AFI is prone to overdiagnosing Oligohydramnios, which escalates interventions, but SDP may miss some cases, yet give the same neonatal outcome. Hence, an intensive comparative analysis of AFI and SDP in relation to the diagnosis of Oligohydramnios and to predict the outcomes in Oligohydramnios of preterm birth is necessary in order to specify the application of clinical practice, minimize inappropriate interventions, and enhance mother-infant care. This study aimed to compare the diagnostic accuracy of Amniotic Fluid Index (AFI) and Single Deepest Pocket (SDP) in identifying Oligohydramnios and also to determine their relationship with perinatal outcomes in term singleton pregnancies.

METHODOLOGY

The present study was designed as a comparative cross-sectional investigation conducted at the Department of Radiology, PINUM Hospital, Faisalabad. The study was carried out over a period of nine months from 16 April 2025 to 16 January 2026, during which data were systematically collected and analyzed to compare the variables of interest across the selected study groups. The Institutional Review Board of PINUM Hospital gave the required ethical approval (Date: 16-11-25 FIHS/2026/1165). All the participants gave informed written consent before enrolment, and ethical approval by the Institutional Review Board was obtained. The purposive sampling technique was used to recruit 100 pregnant women.

The study was conducted on pregnant women aged between 18 and 40 years with singleton and low-risk pregnancy at a gestation age of not less than 37 weeks of pregnancy that was confirmed by the last menstrual period or early ultrasound, and whose membranes were intact. Women who had undergone more than one gestation, whose membranes were prematurely ruptured, and for whom there were known congenital foetal defects, whose foetuses died before delivery, or whose conditions were inherited medical disorders like diabetes mellitus, chronic hypertension, or preeclampsia were excluded.

Obstetric ultrasound was performed on all participants in the supine position with a convex transducer of a frequency of 35 MHz. The amniotic fluid volume was measured with the Amniotic Fluid Index (AFI), and the Single Deepest Pocket (SDP) was measured in the same examination session. In the AFI measurement, a vertical line running along the midline (linea nigra) and a horizontal line at the same height as the umbilicus were used to divide the uterus into four quadrants. The deepest vertical pocket of amniotic fluid that had no foetal parts and umbilical cord was measured using the transducer perpendicular to the abdomen of the mother, and the total of the four readings was added to get the AFI value. AFI of 5 cm or less was a positive diagnosis of Oligohydramnios. In the case of the SDP technique, the uterus was scanned to establish the presence of a single largest vertical pocket of amniotic fluid that is devoid of foetal structures and umbilical cord, and a diameter of less than 2 cm was regarded as a sign of oligohydramnios.

AFI vs SDP in Oligohydramnios

Perinatal outcomes, including mode of delivery, Apgar scores at 1 and 5 minutes, neonatal birth weight, need for neonatal incubation, and admission to the neonatal intensive care unit (NICU), were recorded using a structured data collection sheet. Data were analyzed using SPSS version 26. Quantitative variables were expressed as mean $\pm$ standard deviation and compared using the independent Student's t-test, while categorical variables were analyzed using the Pearson Chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 100 pregnant women with singleton term pregnancies were included in the study. Maternal demographic and obstetric characteristics, ultrasound assessment of amniotic fluid volume using Amniotic Fluid Index (AFI) and Single Deepest Pocket (SDP), and perinatal outcomes were analyzed. Participants were categorized into normal, Oligohydramnios, and polyhydramnios groups based on both assessment methods. Differences in classification between AFI and SDP were observed. Associations involving the amniotic fluid status and mode of delivery, neonatal outcomes, and Apgar scores were examined. The significance of observed associations was statistically analyzed, and findings were provided in the table I through VI.

Table-I: Maternal attributes of study subjects (n = 100).

Variables	Characteristic	n (%)
Age (years)	Mean $\pm$ SD	30.64 $\pm$ 5.30
Gestational age (weeks)	Mean $\pm$ SD	39.0 $\pm$ 0.85
Hemoglobin (g/dL)	Mean $\pm$ SD	11.84 $\pm$ 0.88
Gravidity	G1	36 (36)
	G2	29 (29)
	G3	35 (35)
Parity	P0	31 (31)
	P1	33 (33)
	P2	36 (36)
Membrane status	Intact	63 (63)
	Ruptured	37 (37)
Maternal medical disorder	Yes	18 (18)
	No	82 (82)

Table-I shows the baseline maternal and obstetric characteristics of the analyzed population. The average maternal age was 30.64 $\pm$ 5.30 years, and the average gestational age at assessment was 39.0 $\pm$ 0.85 weeks. Among the participants, the level of gravity and parity was balanced. Mean haemoglobin was 11.84/0.88 g/dL. Most female

participants had a complete membrane during ultrasound inspection, and most of them did not have any related maternal-based medical conditions.

Table-II: AFI and SDP ultrasound assessment of amniotic fluid (n = 100).

Parameters	Minimum	Maximum	Mean $\pm$ SD
Q1_AFI	0.6	9.6	3.68 $\pm$ 1.99
Q2_AFI	0.5	10.9	4.13 $\pm$ 2.34
Q3_AFI	0.5	8.8	3.63 $\pm$ 1.88
Q4_AFI	0.6	10.4	4.32 $\pm$ 2.30
AFI	3.0	37.3	15.76 $\pm$ 8.08
SDP	0.8	10.9	4.84 $\pm$ 2.28

Table-III: Maternal Outcomes by AF Category.

Variables	Categories	n (%)
Outcomes by AF	Normal	81(81.0)
	Oligohydramnios	13(13.0)
	Polyhydramnios	6(6.0)
Outcome by SDP	Normal	71(71.0)
	Oligohydramnios	24(24.0)
	Polyhydramnios	5(5.0)

A summary of the descriptive statistics of the measurements of the amniotic fluid using AFI and SDP is presented in Table-II. The individual AFI quadrants were between 3.63 and 4.32 cm in terms of the mean values. The total mean of AFI was equal to 15.76 in comparison with SDP equal to 4.84. The table demonstrates that the data on the amniotic fluid measurements among the study population are variable and range widely.

Table-III presents the division of the participants into the normal, oligohydramnios group and polyhydramnios group using AFI and SDP classifications. When AFI was used, 81% of the women were identified to have normal amniotic fluid, 13% was oligohydramnios and 6% was polyhydramnios. Conversely, SDP reported a greater percentage of cases of oligohydramnios (24) and slightly lower percentage of normal (71), which means that there are variations in the diagnostic classification of the two.

AFI perinatal outcomes are summarized in Table-IV. In cases of oligohydramnios or polyhydramnios, caesarean section was performed in 57.9 percent compared to 35.8 percent in the normal AFI group (p = 0.077). Neonatal incubation was observed in 36.8 percent of oligohydramnios/polyhydramnios cases, while NICU admission occurred in 31.6 percent. None of these associations was statistically significant.

Table-IV: Perinatal outcomes by AFI outcomes.

Variable	Outcome by AFI	Normal (n=81) n(%)	Oligohydramnios/Polyhydramnios (n=19) n(%)	Total (n=100) n(%)	P-Value
Mode of Delivery	NVD	52 (64.2)	8 (42.1)	60 (60.0)	0.077
	CS	29 (35.8)	11 (57.9)	40 (40.0)	
Neonatal Incubation	Yes	33 (40.7)	7 (36.8)	40 (40.0)	0.755
	No	48 (59.3)	12 (63.2)	60(60.0)	
NICU Admission	Yes	28 (34.6)	6 (31.6)	34(34.0)	0.804
	No	53 (65.4)	13 (68.4)	66(66.0)	

Table-V: Perinatal Outcomes by SDP Outcomes.

Variable	Outcome by AFI	Normal (n=71) n(%)	Oligohydramnios/ Polyhydramnios (n=29) n(%)	Total (n=100) n(%)	P-Value
Mode of Delivery	NVD	49 (69.0)	11 (37.9)	60 (60.0)	0.004
	CS	22 (31.0)	18 (62.1)	40(40.0)	
Neonatal Incubation	Yes	24 (33.8)	16 (55.2)	40(40.0)	0.048
	No	47 (66.2)	13 (44.8)	60(60.0)	
NICU Admission	Yes	21 (29.6)	13 (44.8)	34(34.0)	0.144
	No	50 (70.4)	16 (55.2)	66(66.0)	

Table-VI: Comparison of birth weight and Apgar score by AFI and SDP outcome.

		AFI			SDP		
Outcomes by AF		Birth Weight (g)	Apgar_1min	Apgar_5min	Birth Weight (g)	Apgar_1min	Apgar_5min
Normal	n	81	81	81	71	71	71
	Mean± SD	3094.60±307.552	6.93±0.997	8.12±0.914	3172.94±258.154	7.04±0.948	8.23±0.865
Oligohydramnios	n	13	13	13	24	24	24
	Mean± SD	2671.54±106.610	6.92±1.038	8.00±0.816	2651.21±129.856	6.58±1.060	7.79±0.932
Polyhydramnios	n	6	6	6	5	5	5
	Mean± SD	3483.67±86.373	7.33±0.516	8.67±0.516	3477.40±95.031	7.40±0.548	8.60±0.548
Total	n	100	100	100	100	100	100
	Mean± SD	3062.95±331.443	6.95±0.978	8.14±0.888	3062.95±331.443	6.95±0.978	8.14±0.888

Table-V shows the perinatal outcome according to SDP. In SDP-defined cases of oligohydramnios/polyhydramnios, caesarean section was performed in 62.1 percent compared to 31.0 percent in the normal group ($p = 0.004$). Neonatal incubation was observed in 55.2 percent of cases with oligohydramnios/polyhydramnios ($p = 0.048$). NICU admission occurred in 44.8 percent of oligohydramnios/polyhydramnios cases, while 29.6 percent occurred in the normal group ($p = 0.144$).

Table-VI shows the mean birth weight and Apgar's scores for AFI and SDP. The mean birth weight was the lowest in the case with oligohydramnios (2671.54 and 2651.21 g) and the highest in the case with polyhydramnios (3477.40 and 3484.67 g). Apgar scores at 1 and 5 minutes were slightly lower in the case of oligohydramnios in both methods.

DISCUSSION

In this cross-sectional study, we compared the classification of oligohydramnios and perinatal outcomes using the Amniotic Fluid Index (AFI) and Single Deepest Pocket (SDP) methods in 100 singleton pregnancies at term. Our results highlight the significance of the incidence of oligohydramnios diagnosis and its relation to adverse outcomes based on the sonographic approach adopted.

Research indicates a greater frequency of oligohydramnios when diagnosed by SDP (24%) than AFI (13%). This is consistent with existing literature that AFI and SDP vary in their diagnostic criteria, with SDP diagnosing a greater proportion of low fluid cases than AFI. Magann et al. found SDP produces fewer false-positive diagnoses of oligohydramnios than AFI and thereby avoids unnecessary obstetric interventions while ensuring perinatal safety. A systematic review also suggested that AFI overestimates

the prevalence of oligohydramnios, especially in low-risk pregnancies, while SDP offers a more conservative estimate that is consistent with clinical outcomes [21].

These variations in measurement were also seen in perinatal outcomes. AFI-defined oligohydramnios was associated with higher cesarean births (69.2% compared to 35.8% for normal) but without statistical significance ($p=0.069$). Meanwhile, oligohydramnios defined by SDP showed significantly higher rates of cesarean section (66.7% vs 31%; $p = 0.009$) and incidence of infant incubation (62.5% vs 33.8%; $p = 0.030$). It also had a higher but not significant rate of admission to the neonatal intensive care unit (NICU). These are consistent with studies which show that oligohydramnios is associated with operative birth and fetal complications, likely from cord compression and reduced fetal tolerance to labour [22].

The stronger associations with SDP oligohydramnios may suggest that SDP more accurately captures the impact of low fluid. While AFI combines four pockets that may contain small grooves missed by SDP, the largest vertical pocket is more representative of the largest single fluid pocket, possibly better reflecting fetal well-being. One study noted that SDP may be more likely to detect clinically significant oligohydramnios, preventing subsequent labor induction that may occur due to AFI overdiagnosis [23].

In terms of the neonatal state, the mean birth weights of the oligohydramnios-affected AFI and SDP groups were lower than those of the normal fluid groups. These findings corroborate data that diminished amniotic fluid may indicate inadequate placental perfusion and foetal growth retardation [24]. Our examination of the Apgar scores indicated a trend of reduced scores at 1 and 5 minutes in the oligohydramnios groups for both approaches. Although the average reductions

were minimal, they indicate that diminished amniotic fluid levels, regardless of the assessment method, may hinder initial new-born adaption.

Notably, our research can substantiate the idea that SDP can be more efficient in risk stratification relative to AFI and prevent unwanted perinatal incidents. This has significant clinical implications. Excessive use of AFI may raise the rates of induction and caesarean delivery without a corresponding increase in the health of the infant and may lead to higher health care utilisation and maternal morbidity. In comparison, SDP seems to be equally safe and minimizes unnecessary interventions. It advocates some guidelines that recommend SDP, particularly in low-risk term pregnancies.

Although he has made these insightful considerations, there are a number of drawbacks that should be taken into consideration. To begin with, the limited scope of the generalizability can be associated with the purposive sampling and single-centre design. Second, the recording of the perinatal outcomes was prospective, but the observational design does not allow for making any cause-and-effect inferences. Third, this analysis did not control the possible confounders, including maternal BMI or placental pathology, which could affect the amniotic fluid volume and the outcomes. The evidence of the future and larger randomised multicentre studies, including the use of confounding variables, would produce stronger evidence on the best fluid assessment protocols.

This paper shows that SDP can establish a higher rate of oligohydramnios, and it has more associations with caesarean birth and neonatal care requirement than that of AFI. Despite the fact that the two methods are both useful in performing antepartum surveillance, SDP might provide a more clinically relevant ratio of diagnostic accuracy and outcome prediction in the event of low-risk pregnancies. Such results justify the idea of SDP being the method of the first-line screening those better fits to maximise maternal-fetal care with limited unnecessary obstetric interventions.

CONCLUSION

The Single Deepest Pocket (SDP) approach identified a superior rate of oligohydramnios than the Amniotic Fluid Index (AFI) and provided more powerful associations with negative perinatal outcomes, such as an augmented level of caesarean section and infant support in this study. The two methods are equally applicable in measuring the amount of amniotic fluid, yet SDP provides a more clinically important and specific evaluation that does not necessitate the unwarranted practise of interventions without impairing the safety of the neonates. These results render adoption of SDP as a primary screening option for term, low-risk pregnancies, and thus highlight the need to combine sonographic findings with the overall clinical assessment to maximise care provision between the mother and foetus.

ACKNOWLEDGEMENT: None.

CONFLICT OF INTEREST: None.

GRANT SUPPORT AND FINANCIAL DISCLOSURE: None.

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Authors Contributions:

Owais Qadeer Gill: Substantial contributions to the conception and design of the work.

Hassan Bukhari: The acquisition of data for the work.

Muhammad Shahid Saleem: Interpretation of data for the work.

Kausar Parveen: Drafting the work and reviewing it critically for important intellectual content.

Submitted for publication: 22-01-2026

Accepted after revision: 24-08-2026