Volume 3, Number 2, 2026
Pages 1080-1096
Bioscience Insights
ISSN: 3080-3489 (Print)
ISSN: 3080-3497 (Online)
BiosciInsights.com

PREDICTIVE VALUE OF ULTRASONOGRAPHIC AMNIOTIC FLUID VOLUME ASSESSMENT FOR ADVERSE BIRTH OUTCOMES IN HIGH-RISK PREGNANCIES

Kanwal Bano[*1], Muhammad Hashim[2], Sayed Maghfoor Ullah[3], Memoona Zafar[4], Mehwish Kalsoom[5]

[*1]*Ibadat International University, Islamabad, Pakistan*
[2]*NCS University System, Peshawar, Pakistan*
[3]*Institute of Paramedical Sciences, Khyber Medical University, Peshawar, Pakistan*
[4,5]*Iqra University, Chak Shahzad Campus, Islamabad, Pakistan*

[*1]kanwalbano8899@gmail.com

https://doi.org/10.5281/zenodo.23013595

Article Information

Article History

Received:	June 15, 2026
Revised:	August 15, 2026
Accepted:	September 03, 2026
Available Online:	September 28, 2026

Keywords:
amniotic fluid volume; amniotic fluid index; single deepest pocket; oligohydramnios; polyhydramnios; high-risk pregnancy; ultrasonography; neonatal outcome

Abstract

Background: *Abnormal amniotic fluid volume (AFV) is frequently encountered in high-risk obstetric practice and may reflect placental insufficiency, maternal disease, fetal growth disturbance, or congenital pathology. Amniotic Fluid Index (AFI) and Single Deepest Pocket (SDP) are the most widely used semiquantitative ultrasound methods, but their comparative prognostic value remains debated.*

Objective: *To evaluate the relationship between ultrasonographically assessed AFV and adverse birth outcomes in high-risk pregnancies and to compare the clinical contribution of AFI and SDP.*

Methods: *This prospective observational cohort included 81 high-risk pregnant women evaluated at HBS Hospital, Islamabad. AFV was classified as normal (AFI 5-25 cm or SDP 2-8 cm), oligohydramnios (AFI <5 cm or SDP <2 cm), or polyhydramnios (AFI >25 cm or SDP >8 cm). Maternal risk factors, birth weight, Apgar scores, delivery mode, neonatal intensive care unit (NICU) admission, and composite adverse perinatal outcomes were assessed. Statistical analyses described in the thesis included categorical and continuous-variable comparisons, correlation analysis, and binary logistic regression.*

Results: *Forty-nine participants (60.5%) had normal AFV, whereas 16 (19.8%) had oligohydramnios and 16 (19.8%) had polyhydramnios. The thesis reports lower mean 1-minute Apgar scores in oligohydramnios (6.4 ± 1.1) and polyhydramnios (6.8 ± 0.9) than in normal AFV (8.2 ± 0.6). Based on the tabulated outcome counts, NICU admission occurred in 5/49 normal-AFV pregnancies, 9/16*

oligohydramnios pregnancies, and 3/16 polyhydramnios pregnancies. Composite adverse outcome rates were reported as 14.3%, 62.5%, and 56.2%, respectively. In the reported regression analysis, oligohydramnios (OR 3.8, p<0.01), polyhydramnios (OR 2.9, p<0.05), maternal hypertension (OR 4.2, p<0.01), and maternal diabetes (OR 3.5, p<0.05) were associated with adverse neonatal outcomes. AFI was described as the more stable prognostic marker, while SDP added diagnostic value in borderline low-fluid states.

Conclusion: *Abnormal AFV identified a substantially higher burden of adverse perinatal outcomes in this high-risk cohort. AFI and SDP should be interpreted as complementary ultrasound measures, with maternal comorbidity and the underlying etiology of fluid abnormality incorporated into clinical risk stratification.*

1. INTRODUCTION

Amniotic fluid is a dynamic component of the intrauterine environment. It cushions the fetus, minimizes umbilical cord compression, permits fetal movement, contributes to musculoskeletal development, supports pulmonary maturation, and participates in temperature and homeostatic regulation. In later gestation, fetal urine and lung fluid are major contributors to amniotic fluid production, while fetal swallowing and intramembranous pathways contribute to fluid removal. Consequently, marked changes in amniotic fluid volume can serve as clinically visible markers of disrupted maternal-placental-fetal physiology [1].Ultrasound provide the principal non-invasive method for routine AFV assessment. The Amniotic Fluid Index divides the uterus into four quadrants and sums the deepest unobstructed vertical pocket in each quadrant, whereas the Single Deepest Pocket records the largest vertical pocket free of fetal parts and umbilical cord. Thresholds commonly used in clinical practice define oligohydramnios as AFI ≤5 cm or SDP <2 cm and polyhydramnios as AFI approximately ≥24-25 cm or SDP ≥8 cm [1,2]. AFV assessment is incorporated into antenatal surveillance, including the biophysical profile and modified biophysical profile, because persistent low fluid may indicate placental insufficiency or fetal compromise [2].The choice between AFI and SDP remains clinically important. Evidence summarized in the thesis indicates that AFI may diagnose oligohydramnios more frequently and thereby increase intervention rates, whereas SDP can reduce unnecessary intervention without clear worsening of neonatal outcomes [3,4]. Other authors have argued that AFI remains clinically useful, particularly when interpreted with the full obstetric context rather than as an isolated trigger for delivery [5]. These differing views suggest that the value of either method may depend on whether the clinical purpose is diagnostic classification, fetal surveillance, or prediction of neonatal compromise. Oligohydramnios is commonly associated with hypertensive disorders, placental insufficiency, fetal growth restriction, membrane rupture, and post-term pregnancy. It has been linked with fetal distress, low birth weight, low Apgar scores, operative delivery, and NICU admission [6-8]. Polyhydramnios is more heterogeneous. It may be idiopathic or related to diabetes, impaired fetal swallowing, gastrointestinal or neurologic anomalies, chromosomal abnormalities, and other fetal conditions. It is associated with preterm birth, malpresentation, cord prolapse, cesarean delivery, postpartum hemorrhage, respiratory morbidity, and, in severe or non-isolated cases, increased perinatal mortality [9-14].High-risk pregnancies present an additional interpretive challenge because AFV abnormalities frequently coexist with maternal hypertension, preeclampsia, diabetes, fetal growth restriction, congenital anomalies, or adverse obstetric history. In such populations, AFV may function as both a marker of underlying pathology and an independent component of risk stratification. This distinction is particularly important in resource-constrained settings where ultrasound findings often influence the intensity of surveillance and timing of delivery. Evidence from Pakistan and similar South Asian clinical settings remains comparatively limited, particularly for prospective studies evaluating multiple maternal risk factors while directly comparing AFI and SDP. The present study therefore evaluated AFV in a heterogeneous high-risk obstetric cohort and related AFV category to neonatal outcomes, maternal comorbidities, and mode of delivery. The central objective was to determine

whether abnormal AFV is associated with adverse neonatal outcomes and to clarify the complementary clinical roles of AFI and SDP.

2. MATERIALS AND METHODS

2.1 Study design and setting

A prospective observational cohort study was conducted in the Department of Obstetrics and Gynecology, HBS Hospital, Islamabad, a tertiary-care facility providing antenatal, obstetric, and neonatal services. The study period reported in the thesis was June to December 2025. Participants were followed from ultrasound assessment through delivery so that maternal risk factors, AFV status, and immediate neonatal outcomes could be recorded prospectively.

2.2 Study population and sampling

The study population comprised high-risk pregnant women referred for ultrasound assessment of AFV. Non-probability consecutive sampling was used, and eligible women were recruited sequentially until the target sample of 81 participants was reached. High-risk status was based on one or more maternal, obstetric, or fetal factors recorded in the structured study questionnaire, including hypertension, diabetes mellitus, preeclampsia, previous preterm birth, previous stillbirth, intrauterine growth restriction (IUGR), and congenital fetal anomalies.

2.3 Eligibility criteria

Participants were eligible if they were classified as high risk, had a gestational age of at least 28 weeks at ultrasound evaluation, and had complete AFI/SDP measurements, delivery information, and neonatal outcome records. Singleton pregnancies and twin pregnancies without discordant pathology were eligible according to the source thesis. Pregnancies with major congenital anomalies incompatible with life, multifetal pregnancies with discordant pathology, incomplete ultrasound or neonatal outcome data, or absence of informed consent were excluded.

2.4 Ultrasound assessment of amniotic fluid

AFV was assessed by both AFI and SDP. For AFI, the uterus was divided into four quadrants and the deepest vertical pocket without fetal parts or umbilical cord was measured in each quadrant; the four values were summed. For SDP, the largest unobstructed vertical pocket was measured. The thesis classified normal AFV as AFI 5-25 cm or SDP 2-8 cm, oligohydramnios as AFI <5 cm or SDP <2 cm, and polyhydramnios as AFI >25 cm or SDP >8 cm. Examinations were performed by trained sonographers following standard obstetric scanning procedures. AFI is operator dependent, and previously published work has documented meaningful intraobserver and interobserver variability, underscoring the importance of standardized technique [16].

2.5 Maternal and neonatal variables

Maternal variables included age, gravidity/parity, and gestational age at scan, high-risk conditions, and obstetric history. Delivery variables included gestational age at delivery and mode of delivery. Neonatal assessment included birth weight, Apgar scores at 1 and 5 minutes, NICU admission and its indication, and other complications such as respiratory distress or congenital anomaly when recorded. The thesis also constructed a composite adverse perinatal outcome indicating the occurrence of at least one of NICU admission, low Apgar score, or low birth weight.

2.6 Statistical analysis

The thesis reports that statistical analyses were performed in Python 3.10. Categorical variables were summarized as counts and percentages, and continuous variables were summarized using means and standard deviations or medians and ranges according to distribution. Chi-square or Fisher exact tests were used for categorical comparisons, while one-way ANOVA or Kruskal-Wallis tests were used for continuous variables as appropriate. Correlation analyses evaluated relationships among maternal age, gestational age, AFI, SDP, birth weight, Apgar scores, and NICU admission. The thesis further reports binary logistic

regression for predictors of adverse neonatal outcomes. Odds ratios and p-values available in the thesis are reproduced in this manuscript; confidence intervals and the complete covariate specification were not provided in the supplied thesis text.

2.7 Ethical considerations

Written informed consent was obtained from participants, and the thesis contains institutional/administrative permission and consent documentation. An explicit institutional ethics committee name and approval/reference number were not stated in the supplied thesis text; these details should be inserted from the original approval documentation before journal submission.

3. RESULTS

A total of 81 high-risk pregnant women were included. Based on the thesis tabulation, 49 (60.49%) had normal AFV, 16 (19.75%) had oligohydramnios, and 16 (19.75%) had polyhydramnios. The tabulated baseline mean maternal age was 30.11 ± 6.46 years and mean gestational age at scan was 33.17 ± 3.90 weeks. Approximately 42 participants (about 52%) had gravidity of three or more.

Table 1. Baseline demographic and obstetric characteristics

Variable	Value
Total participants	81
Maternal age, years	30.11 ± 6.46
Gestational age at scan, weeks	33.17 ± 3.90
Gravidity ≥3	Approximately 42 (≈52%)
High-risk pregnancy	81 (100%)

Values reproduce the source thesis Table 1. The narrative text elsewhere in the thesis reports different mean maternal age and gestational age values; the raw dataset should be checked before final submission.

3.1 Distribution of amniotic fluid volume

Normal AFV accounted for approximately three fifths of the study population, while low and high AFV states were equally represented. The balanced number of oligohydramnios and polyhydramnios cases allowed descriptive comparison of the two abnormal fluid categories within the high-risk cohort.

Table 2. Distribution of AFV categories

AFV category	n	%
Normal	49	60.49
Oligohydramnios	16	19.75
Polyhydramnios	16	19.75

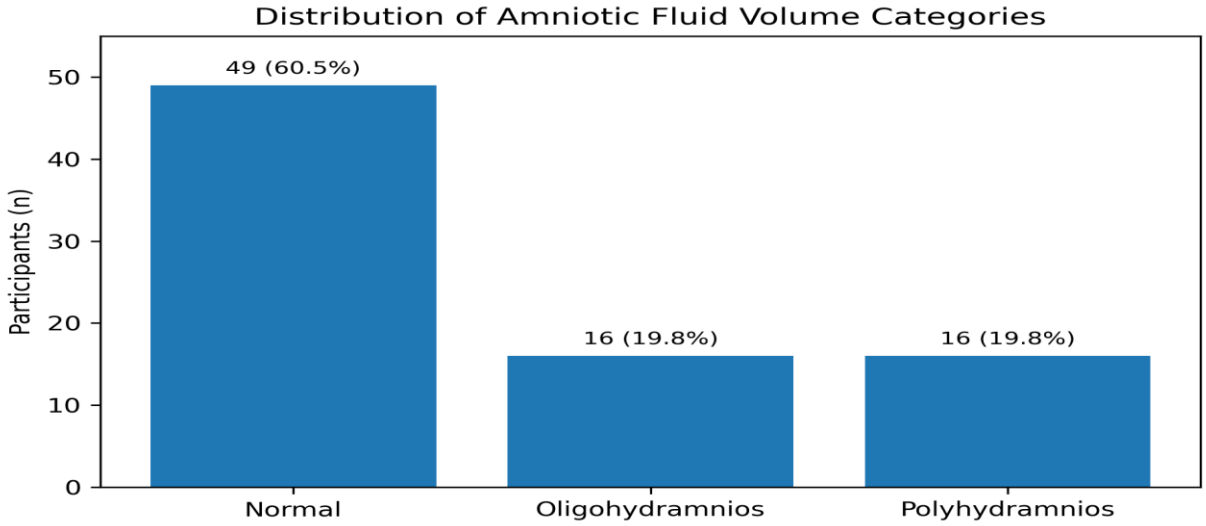


Figure 1. Distribution of amniotic fluid volume categories in the study cohort. Figure regenerated from the tabulated study counts.

3.2 Correlation patterns and fetal growth

The correlation matrix reported in the thesis demonstrated a strong positive relationship between gestational age and birth weight (r=0.75). AFI showed a modest inverse correlation with birth weight (r=-0.251), while maternal age had little correlation with gestational age, AFI, or birth weight. These findings support the expected influence of advancing gestation on fetal weight while illustrating that AFV alone does not explain fetal growth.

Table 3. Correlation matrix reported in the thesis

Variable	Maternal age	Gestational age	AFI	Birth weight
Maternal age	1.000	0.010	0.023	-0.136
Gestational age	0.010	1.000	-0.117	0.750
AFI	0.023	-0.117	1.000	-0.251
Birth weight	-0.136	0.750	-0.251	1.000

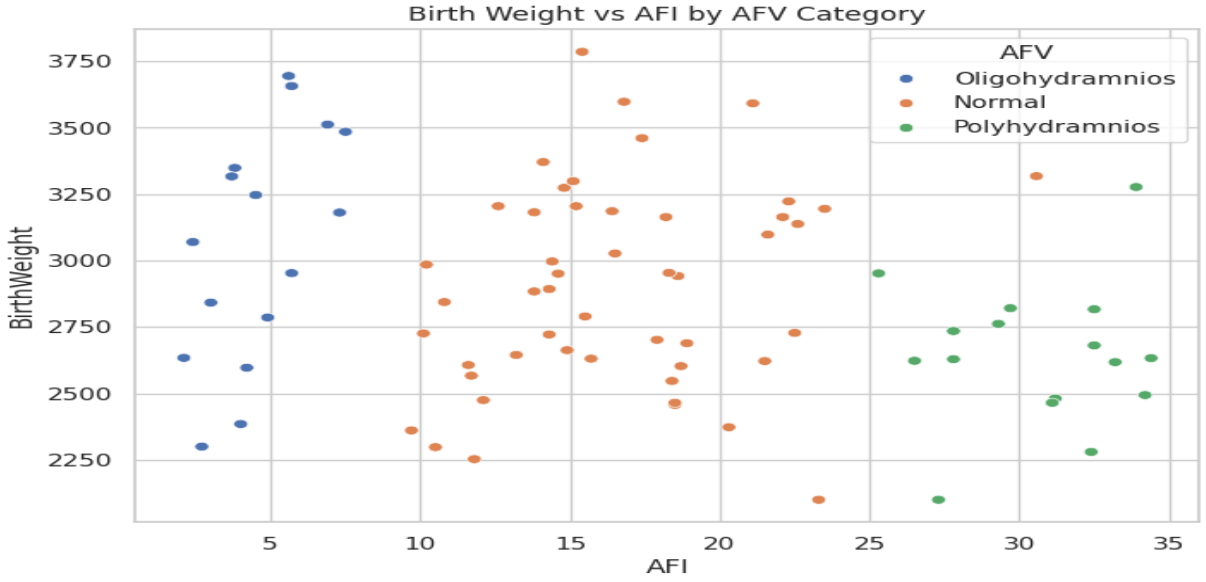


Figure 2. Scatter plot of birth weight versus AFI, stratified by AFV category, reproduced from the study thesis.

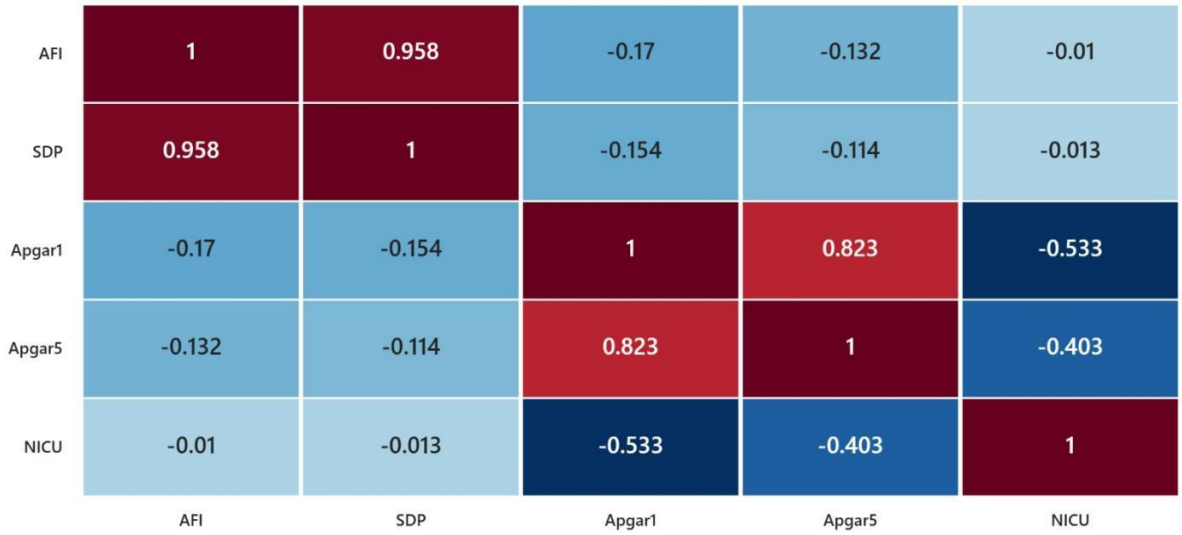


Figure 3. Correlation heatmap from the thesis, depicting relationships among ultrasound and outcome variables.

3.3 Maternal high-risk factors across AFV categories

Maternal high-risk factors were distributed across all AFV groups. Based on the final results table, hypertension was recorded in 10 normal-AFV, 6 oligohydramnios, and 4 polyhydramnios pregnancies. Diabetes was recorded in 5, 2, and 2 cases, respectively. Preeclampsia was present in 7 normal-AFV cases and in 2 cases in each abnormal AFV group. The oligohydramnios group had a proportionally high burden of hypertension relative to its smaller denominator, whereas the polyhydramnios group included diabetes, prior stillbirth, IUGR, and congenital anomalies.

Table 4. Distribution of major maternal high-risk factors across AFV categories

AFV category	HTN	Diabetes	Preeclampsia	Preterm history	Stillbirth	IUGR	Congenital anomalies
Normal (n=49)	10	5	7	7	5	4	6
Oligohydramnios (n=16)	6	2	2	2	1	1	1
Polyhydramnios (n=16)	4	2	2	1	3	2	2

Counts reproduce thesis Table 4. A separate methods paragraph in the source thesis lists different risk-factor counts; Table 4 values were prioritized here and should be verified against the raw dataset.

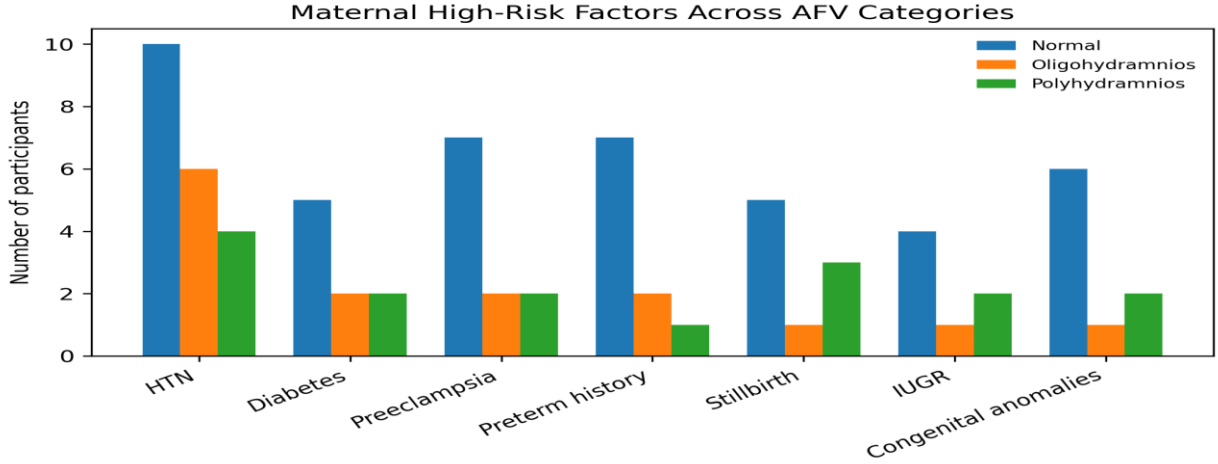


Figure 4. Maternal high-risk factors across AFV categories, regenerated from thesis Table 4.

3.4 Neonatal outcomes

Immediate neonatal condition differed across AFV categories. The thesis narrative reports a mean 1-minute Apgar score of 8.2 ± 0.6 in the normal-AFV group, compared with 6.4 ± 1.1 in oligohydramnios and 6.8 ± 0.9 in polyhydramnios. Exact group-level 5-minute Apgar means were not fully tabulated in the supplied thesis; the source reports that scores were lower in both abnormal AFV groups.

NICU admission data were presented in more than one form in the thesis. To preserve the explicit tabulated outcome counts, the manuscript uses Table 7 of the thesis: NICU admission occurred in 5 of 49 normal-AFV pregnancies (10.2%), 9 of 16 oligohydramnios pregnancies (56.3%), and 3 of 16 polyhydramnios pregnancies (18.8%). These percentages are calculated directly from the tabulated counts. The narrative section of the thesis contains different NICU percentages and should be reconciled against the original dataset before submission.

Table 5. Selected neonatal outcomes by AFV category

Outcome	Normal (n=49)	Oligohydramnios (n=16)	Polyhydramnios (n=16)
Mean Apgar score at 1 min	8.2 ± 0.6	6.4 ± 1.1	6.8 ± 0.9
NICU admission, n (%)	5 (10.2%)	9 (56.3%)	3 (18.8%)
Low birth weight (<2500 g), n	4	6	3
Fetal distress, n	4	3	2

Apgar means are taken from the Results narrative. NICU, low-birth-weight, and fetal-distress counts are taken from thesis Table 7.

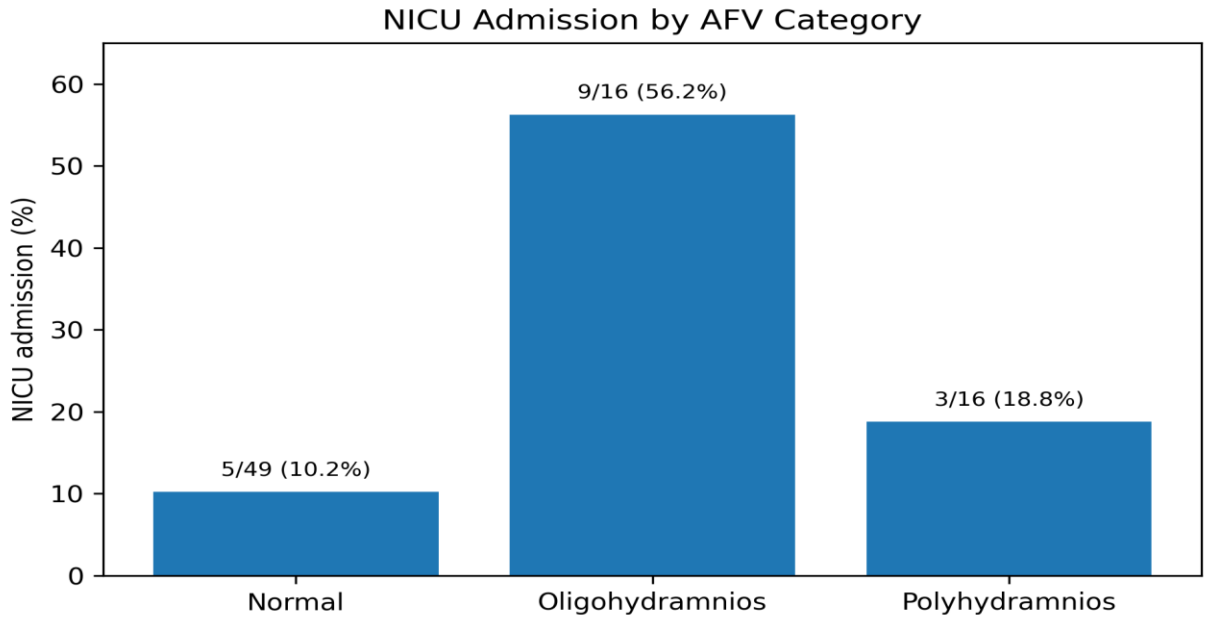


Figure 5. NICU admission by AFV category based on the tabulated outcome counts in the thesis.

3.5 Birth weight and gestational age at delivery

The source thesis reports lower birth weight in pregnancies complicated by abnormal AFV. Mean birth weight was reported as approximately 3.1 kg in the normal-AFV group, 2.5 ± 0.3 kg in oligohydramnios, and 2.7 ± 0.5 kg in polyhydramnios. The unexpectedly lower weight in the polyhydramnios group was interpreted in the thesis in relation to preterm delivery and congenital anomalies rather than diabetic macrosomia alone. Mean gestational age at delivery was reported as 38.2 weeks for normal AFV, 36.1 ± 1.7 weeks for oligohydramnios, and 36.5 ± 1.5 weeks for polyhydramnios.

3.6 Mode of delivery

The final delivery table recorded 31 vaginal and 18 cesarean deliveries among 49 normal-AFV pregnancies, 8 vaginal and 8 cesarean deliveries among 16 oligohydramnios pregnancies, and 11 vaginal and 5 cesarean deliveries among 16 polyhydramnios pregnancies. Thus, the cesarean proportion based on these tabulated counts was highest in the oligohydramnios group (50.0%).

Table 6. Mode of delivery by AFV category

AFV category	Vaginal delivery	Cesarean delivery	Cesarean proportion
Normal (n=49)	31	18	36.7%
Oligohydramnios (n=16)	8	8	50.0%
Polyhydramnios (n=16)	11	5	31.3%

Counts reproduce thesis Table 6. Narrative statements in the thesis describing polyhydramnios as having the highest cesarean rate do not match the tabulated counts and require verification.

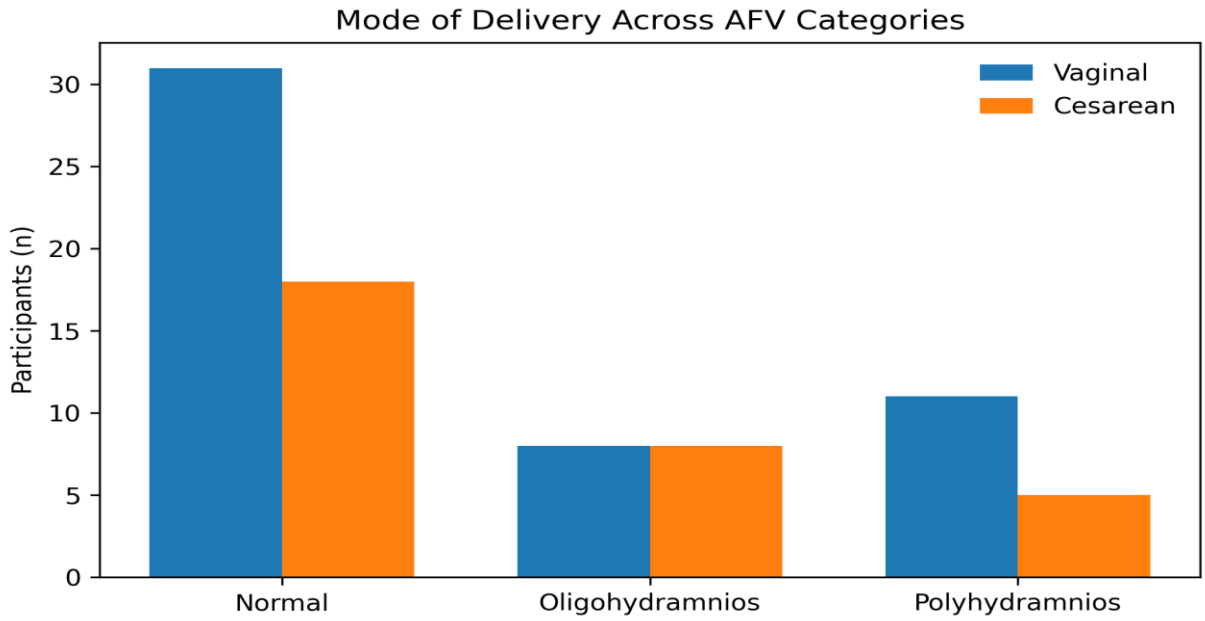


Figure 6. Mode of delivery across AFV categories, regenerated from thesis Table 6.

3.7 Composite adverse perinatal outcomes

The thesis defined a composite adverse outcome as at least one of NICU admission, low Apgar score, or low birth weight. Reported composite adverse outcome rates were 14.3% in normal AFV, 62.5% in oligohydramnios, and 56.2% in polyhydramnios. The marked increase in both abnormal AFV groups supports the use of AFV as a clinically relevant risk marker within a high-risk obstetric population.

Table 7. Adverse pregnancy and neonatal outcomes reported in the thesis

Outcome	Normal (n=49)	Oligohydramnios (n=16)	Polyhydramnios (n=16)
NICU admission	5	9	3
Low birth weight (<2500 g)	4	6	3
Emergency cesarean section	6	5	4
Fetal distress	4	3	2
Composite adverse outcome	14.3%	62.5%	56.2%

The first four outcome rows reproduce thesis Table 7; composite outcome percentages are reported in the Results narrative.

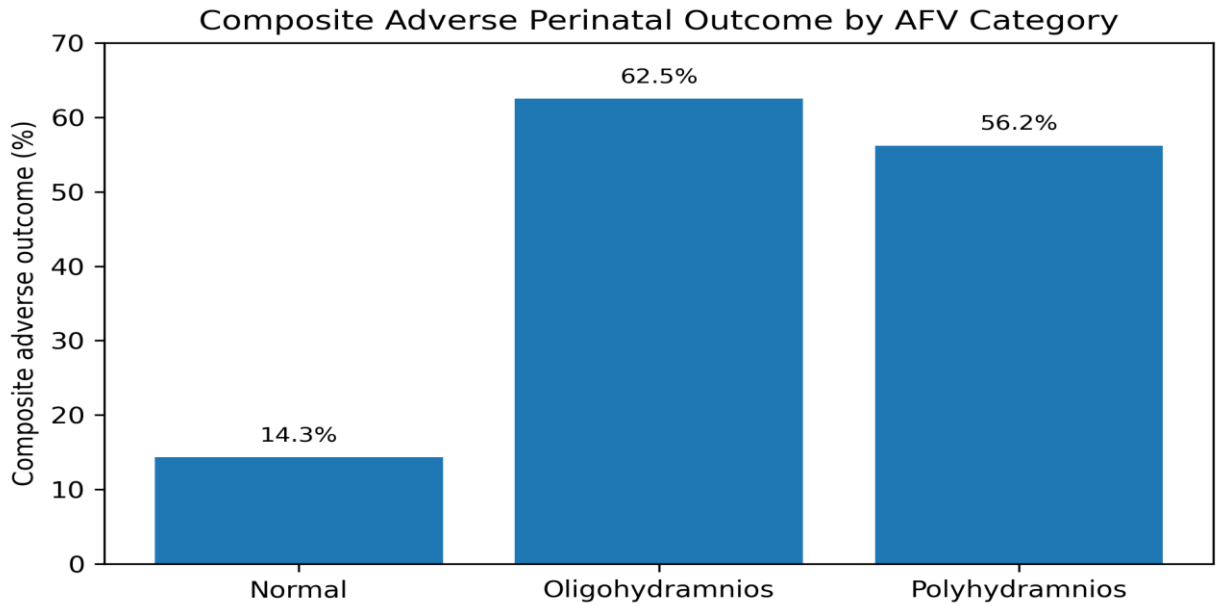


Figure 7. Composite adverse perinatal outcome rates reported for the three AFV categories.

3.8 Reported predictors of adverse neonatal outcomes

Binary logistic regression in the thesis identified both abnormal AFV and maternal comorbidity as predictors of adverse neonatal outcomes. Oligohydramnios was reported with an odds ratio (OR) of 3.8 ($p<0.01$), polyhydramnios with OR 2.9 ($p<0.05$), maternal hypertension with OR 4.2 ($p<0.01$), and maternal diabetes with OR 3.5 ($p<0.05$). The thesis did not provide confidence intervals or the full regression model specification, so these estimates should be interpreted as reported rather than independently re-estimated.

Table 8. Predictors of adverse neonatal outcomes reported in the thesis

Predictor	Odds ratio	Reported p-value
Oligohydramnios	3.8	<0.01
Polyhydramnios	2.9	<0.05
Maternal hypertension	4.2	<0.01
Maternal diabetes	3.5	<0.05

3.9 Representative ultrasound appearances

The thesis appendix contains ultrasound images classified as normal AFV, oligohydramnios, and polyhydramnios. Representative examples are presented in Figure 8, while the complete set of embedded thesis ultrasound images is retained as supplementary plates at the end of this manuscript.



Figure 8. Representative ultrasound images from the thesis: (A) normal amniotic fluid volume, (B) oligohydramnios, and (C) polyhydramnios. Images are reproduced from the thesis appendix and are presented for illustrative classification rather than independent image re-interpretation.

4. DISCUSSION

This prospective high-risk cohort demonstrates a consistent clinical pattern: pregnancies with abnormal AFV carried a greater burden of adverse neonatal outcomes than pregnancies with normal fluid volume. The difference was reflected in lower 1-minute Apgar scores, more low-birth-weight neonates, higher composite adverse-outcome rates, and greater NICU use, particularly in the oligohydramnios group. These findings align with literature describing abnormal AFV as a marker of disturbed maternal-placental-fetal physiology and increased perinatal morbidity [6-12,18].Oligohydramnios showed the strongest adverse profile in the present study. The reported mean 1-minute Apgar score was lowest in this group, and the tabulated NICU count was 9 of 16 pregnancies. The composite adverse outcome rate of 62.5% was also the highest among the three AFV categories. This pattern is biologically plausible because reduced AFV may accompany placental insufficiency, diminished fetal renal perfusion, growth restriction, hypertensive disorders, or membrane rupture. Studies included in the thesis similarly report associations between oligohydramnios and fetal distress, operative delivery, low birth weight, low Apgar scores, and NICU admission [6-8,15].The relationship between oligohydramnios and hypertensive disease is especially relevant in high-risk populations. Hypertension and preeclampsia can reduce uteroplacental perfusion, with secondary effects on fetal renal blood flow and urine production. In the present cohort, hypertension was proportionally common in the oligohydramnios subgroup, and the regression analysis reported maternal hypertension as an independent predictor of adverse neonatal outcome (OR 4.2, $p<0.01$). These findings support interpreting reduced AFV in conjunction with maternal blood pressure, fetal growth, and other markers of placental function rather than as an isolated sonographic measurement.Polyhydramnios also showed an adverse risk profile, although its pattern differed from oligohydramnios. The thesis reports lower mean birth weight in the polyhydramnios group than might be expected in a cohort dominated by diabetic macrosomia, and attributes this to preterm delivery and structural anomalies within the subgroup. This interpretation is consistent with the heterogeneous etiology of polyhydramnios. Diabetes is an important cause through fetal hyperglycemia and polyuria, but impaired fetal swallowing, gastrointestinal obstruction, neurologic conditions, genetic abnormalities, and idiopathic cases can also produce excess fluid [10-14]. Meta-analytic evidence has linked idiopathic polyhydramnios with preterm birth, cesarean delivery, placental abruption, postpartum hemorrhage, low Apgar scores, stillbirth, and perinatal mortality [11,12].The comparative role of AFI and SDP remains clinically nuanced. The thesis concludes that AFI was a more stable predictor of neonatal compromise, particularly in relation to Apgar scores and NICU admission, whereas SDP was useful for identifying borderline low-fluid states when quadrant-based AFI measurement was potentially misleading. This is compatible with the broader literature showing that AFI may classify more pregnancies as oligohydramnios, while SDP may reduce intervention without worsening measured outcomes [3,4]. A pragmatic interpretation is therefore to avoid treating either measure as universally superior. AFI may

provide broader surveillance information, while SDP can be particularly useful when AFI is borderline or technically uncertain. The correlation analysis also illustrates why AFV should not be used as a stand-alone proxy for fetal growth. Gestational age correlated strongly with birth weight (r=0.75), whereas the relationship between AFI and birth weight was modest (r=-0.251). Fetal size reflects gestational age, placental function, maternal disease, nutrition, fetal genetics, and pathology, among other factors. An AFV measurement may therefore contribute to risk recognition without independently explaining fetal weight. Emerging automated ultrasound approaches may eventually reduce operator variability and integrate multiple fetal and placental parameters into more reproducible risk models [17].The mode-of-delivery findings require careful interpretation. The final thesis table showed a cesarean proportion of 50% in oligohydramnios, compared with 36.7% in normal AFV and 31.3% in polyhydramnios. Although abnormal AFV can increase concern for fetal distress, malpresentation, cord complications, and other indications for operative delivery, the decision to perform cesarean section is influenced by many clinical factors. For this reason, delivery mode should be viewed as a management outcome associated with the broader clinical context, not necessarily a direct consequence of AFV alone. Contemporary literature similarly emphasizes that AFV findings should be integrated with fetal testing, gestational age, maternal condition, and the reason for surveillance [2,5,22].From a clinical perspective, the study supports enhanced surveillance when AFV is abnormal, particularly when oligohydramnios coexists with hypertension, fetal growth restriction, or other signs of placental compromise. At the same time, intervention should remain individualized. Evidence summarized in the thesis suggests that maternal hydration may improve AFI in selected oligohydramnios cases [20], while the management of polyhydramnios depends strongly on severity and etiology. The principal contribution of ultrasound AFV assessment is therefore not simply categorization into low, normal, or high fluid states, but improved identification of pregnancies that may require more intensive maternal and fetal evaluation. An important strength of this study is its prospective design in a clinically heterogeneous high-risk population. AFV was assessed using both AFI and SDP, and maternal factors were considered alongside immediate neonatal outcomes. The study also provides locally relevant data from a tertiary-care setting in Islamabad, where evidence on AFV patterns and outcomes is limited. These characteristics improve the practical relevance of the findings for similar resource-constrained obstetric settings. Several limitations must be acknowledged. The sample was relatively small, especially within the oligohydramnios and polyhydramnios subgroups, and the study was performed at a single center. Ultrasound measurement remains operator dependent [16]. Doppler indices, detailed placental parameters, maternal glycemic control, nutritional status, and other confounders were not comprehensively incorporated. The supplied thesis also contains internal discrepancies between some narrative values and final tables, most notably baseline descriptive values, maternal risk-factor counts, NICU percentages, and statements regarding cesarean frequency. The manuscript therefore prioritizes explicit tabulated values where available and flags areas requiring raw-data verification. In addition, confidence intervals and the complete specification of the reported regression model were not available in the thesis text. These issues should be resolved against the original dataset before submission to a peer-reviewed journal.Future multicenter studies should use standardized AFI/SDP protocols, prespecified outcomes, consistent definitions, and multivariable models with complete effect estimates and confidence intervals. Incorporation of fetal Doppler assessment, placental markers, and longitudinal AFV measurements could help determine whether fluid abnormalities contribute independent prognostic information beyond maternal comorbidity. Automated segmentation and measurement methods may also improve reproducibility [17]. Longer neonatal follow-up would be valuable because amniotic fluid disorders may be associated with outcomes beyond the immediate perinatal period [19].

5. CONCLUSION

In this prospective cohort of high-risk pregnancies, abnormal amniotic fluid volume was associated with a greater burden of adverse perinatal outcomes than normal AFV. Oligohydramnios showed the strongest adverse neonatal profile, while polyhydramnios demonstrated a distinct risk pattern influenced by prematurity, congenital abnormalities, and maternal disease. AFI was reported as the more stable prognostic measure, whereas SDP contributed useful diagnostic information in borderline low-fluid

conditions. The findings support a complementary approach in which AFI and SDP are interpreted together with maternal comorbidity, fetal growth, gestational age, and the underlying cause of the fluid abnormality. Before journal submission, the internally inconsistent numerical statements in the source thesis should be reconciled against the original dataset and the regression model should be reported with complete confidence intervals and covariate details.

6. DECLARATIONS

Ethics approval and consent to participate: Written informed consent was obtained from participants. The supplied thesis contains permission and consent documentation; the institutional ethics committee name and approval/reference number should be inserted from the original approval documents before submission.

Consent for Publication

Written informed consent was obtained from all participants prior to their inclusion in the study. Participant confidentiality and anonymity were maintained throughout the research process. All clinical information, ultrasound images, and study data used in this manuscript were anonymized and contain no personally identifiable information. Relevant signed consent forms and supporting documentation are available with the investigators and can be provided to the journal or institutional authorities upon request.

Funding

This research received no specific grant or financial support from any funding agency in the public, commercial, or not-for-profit sectors. The study was conducted as part of the academic research requirements of the investigator, and all research-related activities were completed without external financial sponsorship.

Competing Interests

The authors declare that they have no financial, professional, personal, or institutional conflicts of interest that could have influenced the design, conduct, analysis, interpretation, or reporting of this study.

Data Availability

The data supporting the findings of this study, including the original study records, data collection forms, ultrasound documentation, statistical records, tables, figures, and other relevant supporting materials, are securely maintained by the investigators. De-identified data and supporting documentation may be made available from the corresponding author upon reasonable request, subject to institutional approval, ethical requirements, and protection of participant confidentiality.

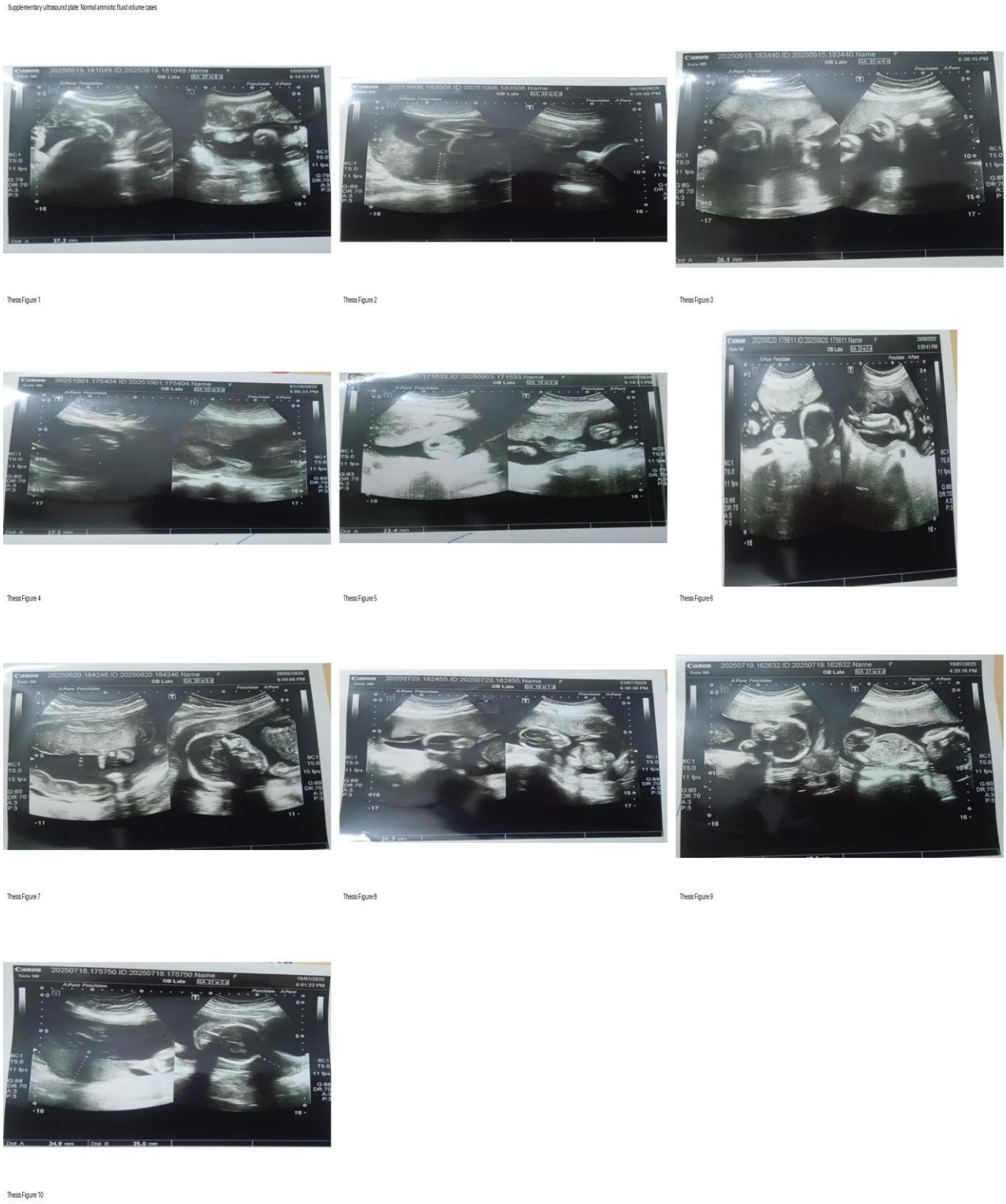
Availability of Supporting Documentation

All supporting documentation related to the study, including participant consent forms, data collection records, ultrasound examination records, institutional permissions, study documentation, and other relevant physical evidence, has been retained by the investigators and is available for verification by the journal, reviewers, or authorized institutional bodies upon reasonable request.

Author contributions:

Supplementary Ultrasound Image Plates

The following plates retain the complete set of ultrasound images embedded in the supplied appendix. Classification labels follow the captions. The source document contains repeated image files for some figure numbers; these repetitions are preserved rather than silently altered.



Supplementary Figure S1. Ultrasound images classified in the thesis as normal amniotic fluid volume cases (thesis Figures 1-10).



Supplementary Figure S2. Ultrasound images classified in the thesis as oligohydramnios cases (thesis Figures 11-23). Source-file repetitions are preserved.

Supplementary ultrasound plate: Polyhydramnios cases



Thesis Figure 24



Thesis Figure 25



Thesis Figure 26



Thesis Figure 27



Thesis Figure 28



Thesis Figure 29



Thesis Figure 30



Thesis Figure 31



Thesis Figure 32



Thesis Figure 33

Supplementary Figure S3. Ultrasound images classified in the thesis as polyhydramnios cases (thesis Figures 24-33).

REFERENCES

Jha P, Raghu P, Kennedy AM, Sugi M, Morgan TA, Feldstein V, et al. Assessment of Amniotic Fluid Volume in Pregnancy. Radiographics. 2023;43(6). doi:10.1148/RG.220146.

American College of Obstetricians and Gynecologists. Indications for Outpatient Antenatal Fetal Surveillance: ACOG Committee Opinion, Number 828. Obstet Gynecol. 2021;137(6):e177-e197. doi:10.1097/AOG.0000000000004407.

Nabhan AF, Abdelmoula YA. Amniotic fluid index versus single deepest vertical pocket as a screening test for preventing adverse pregnancy outcome. Cochrane Database Syst Rev. 2008;(3):CD006593. doi:10.1002/14651858.CD006593.pub2.

Sekhon S, Rosenbloom JI, Doering M, Conner SN, Macones GA, Colditz GA, et al. Diagnostic utility of maximum vertical pocket versus amniotic fluid index in assessing amniotic fluid volume for the prediction of adverse maternal and fetal outcomes: a systematic review and meta-analysis. J Matern Fetal Neonatal Med. 2021;34(22):3730-3739. doi:10.1080/14767058.2019.1691988.

Wax JR, Pinette MG. The amniotic fluid index and oligohydramnios: a deeper dive into the shallow end. Am J Obstet Gynecol. 2022;227:462-470. doi:10.1016/j.ajog.2022.04.016.

Molla M, Mengistu Z, Tsehaye W, Sisay G. Magnitude and associated factors of adverse perinatal outcomes among women with oligohydramnios at 3rd trimester at University of Gondar comprehensive specialized hospital, North West Ethiopia. Front Glob Womens Health. 2022;3:958617. doi:10.3389/FGWH.2022.958617.

Dammer U, Pretscher J, Weiss C, Schneider M, Faschingbauer F, Beckmann MW, Kehl S. Perinatal Outcome in Pregnant Women With Isolated Oligohydramnios Diagnosed With the Single Deepest Pocket Method. In Vivo. 2024;38(2):754. doi:10.21873/INVIVO.13498.

Sgayer I, Kayal RS, Ganem N, Wolf MF, Lowenstein L, Odeh M. Association between borderline amniotic fluid levels and adverse perinatal outcome: systematic review and meta-analysis. Ultrasound Obstet Gynecol. 2025;66(5):562-570. doi:10.1002/UOG.29286.

Bakhsh H, Alenizy H, Alenazi S, Alnasser S, Alanazi N, Alsowinea M, et al. Amniotic fluid disorders and the effects on prenatal outcome: a retrospective cohort study. BMC Pregnancy Childbirth. 2021;21(1). doi:10.1186/S12884-021-03549-3.

Huri M, Di Tommaso M, Seravalli V. Amniotic Fluid Disorders: From Prenatal Management to Neonatal Outcomes. Children. 2023;10(3):561. doi:10.3390/CHILDREN10030561.

Pagan M, Magann EF, Rabie N, Steelman SC, Hu Z, Ounpraseuth S. Idiopathic polyhydramnios and pregnancy outcome: systematic review and meta-analysis. Ultrasound Obstet Gynecol. 2023;61(3):302-309. doi:10.1002/UOG.24973.

Kechagias KS, Triantafyllidis KK, Zouridaki G, Savvidou M. Obstetric and neonatal outcomes in pregnant women with idiopathic polyhydramnios: a systematic review and meta-analysis. Sci Rep. 2024;14(1):5296. doi:10.1038/s41598-024-54840-0.

Horcas-Martín M, Luque-Patiño T, Usandizaga-Prat C, Díaz-Fernández E, Melero-Jiménez V, Vázquez-Fonseca L, et al. Polyhydramnios at Term in Gestational Diabetes: Should We Be Concerned? Children. 2025;12(7):920. doi:10.3390/CHILDREN12070920.

Liu Y, Hu T, Qian Y, Wang J, Hu R, Xiao L, et al. Prenatal diagnosis of chromosomal aberrations by chromosomal microarray analysis and pregnancy outcomes of fetuses with polyhydramnios. J Matern Fetal Neonatal Med. 2024;37(1):2344089. doi:10.1080/14767058.2024.2344089.

Mandal A, Patra KK, Maity NK, Sen D. Intrauterine growth restriction and perinatal outcome among oligohydramnios pregnancies. Asian J Med Sci. 2022;13(8):186-194. doi:10.3126/AJMS.V13I8.43987.

Bruner JP, Reed GW, Sarno AP, Harrington RA, Goodman MA. Intraobserver and interobserver variability of the amniotic fluid index. Am J Obstet Gynecol. 1993;168(4):1309-1313. doi:10.1016/0002-9378(93)90386-W.

Slimani S, Hounka S, Mahmoudi A, Rehah T, Laoudiyi D, Saadi H, et al. Fetal biometry and amniotic fluid volume assessment end-to-end automation using Deep Learning. Nat Commun. 2023;14(1):7047. doi:10.1038/s41467-023-42438-5.

Whittington JR, Ghahremani T, Friski A, Hamilton A, Magann EF. Window to the Womb: Amniotic Fluid and Postnatal Outcomes. Int J Womens Health. 2023;15:117-124. doi:10.2147/IJWH.S378020.

Pariente G, Walfisch A, Wainstock T, Landau D, Sergienko R, Sheiner E. Prenatal exposure to isolated amniotic fluid disorders and the risk for long-term endocrine morbidity of the offspring. Arch Gynecol Obstet. 2020;302(4):873-878. doi:10.1007/S00404-020-05674-4.

Yadav A, Yadav P, Deshmukh KP, Kamath A, Goyal C, Prakash A, Gandhi AP. Effect of oral hydration therapy on amniotic fluid index and maternal-neonatal outcomes in pregnant women with oligohydramnios: a systematic review and meta-analysis. J Perinat Med. 2025;53(7):861-870. doi:10.1515/JPM-2025-0176.

Hassan T ul, Nadeem M, Farasat, Rana MH, Gilani SR, Ghaffar A, Akbar SME. Investigation of the Association of Pre-eclampsia with Oligohydramnios using Ultrasound in Pregnant Women during 32-36 Weeks of Gestation: A Cross Sectional Study. J Mod Health Rehabil Sci. 2024;1:1-5.

Sanchez-Ramos L, Levine LD, Sciscione AC, Mozurkewich EL, Ramsey PS, Adair CD, et al. Methods for the induction of labor: efficacy and safety. Am J Obstet Gynecol. 2024;230(3):S669-S695. doi:10.1016/J.AJOG.2023.02.009.