

ASSESSMENT OF ULTRASOUND-BASED SCREENING FOR OLIGOHYDRAMNIOS AS A PREDICTOR OF PRETERM BIRTH

Khadija Liaquat^{*1}, Zoha Imran², Alishba Ikram³, Fatima Jabeen⁴, Fakiha Ibrahim⁵,
Malaika Abdul Wahab⁶

^{*1,2,3,4,5,6}BS Medical Imaging Technology, Faculty of Allied Health Sciences, Rashid Latif Khan University Lahore,
(same for all)

^{*1}khadeejaanxari@gmail.com, ²zohadanyal4@gmail.com, ³alishbaikram22@gmail.com,
⁴fatimajabeen8801@gmail.com, ⁵fkibrahim9503@gmail.com, ⁶malaikataj1357@gmail.com

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Corresponding Author: *

Khadija Liaquat

Background: Preterm birth is a leading cause of neonatal complications and mortality worldwide. Oligohydramnios, a condition of reduced amniotic fluid, is linked to poor pregnancy outcomes. Ultrasound assessment helps detect low amniotic fluid early in pregnancy.

Understanding this association supports timely intervention to reduce preterm birth risks.

Objectives: To evaluate the effectiveness of ultrasound-based screening for oligohydramnios as a predictive tool for preterm birth & to determine the frequency of cesarean section among pregnant women with ultrasound-diagnosed oligohydramnios.

Methodology: A cross-sectional/observational study was conducted involving pregnant women undergoing routine obstetric ultrasound. Amniotic fluid volume was assessed and oligohydramnios was defined according to established sonographic criteria. Maternal demographics, clinical history, and pregnancy outcomes were recorded. The relationship between reduced amniotic fluid and the incidence of preterm birth was analyzed.

CHAPTER 1

INTRODUCTION

Preterm birth is a major global health problem, with an estimated 13.4 million babies born preterm in 2020, representing approximately 9.9% of all live births worldwide. The burden is particularly high in low- and middle-income countries, where limited access to antenatal care, maternal health services, and neonatal intensive care contributes substantially to adverse outcomes. Preterm birth is the leading cause of mortality among children under five years of age and is

associated with significant short- and long-term complications, including respiratory disorders, neurological impairment, developmental delay, and increased healthcare needs. Early identification of pregnant women at risk of preterm birth is therefore essential for appropriate antenatal surveillance and timely clinical intervention [1,2].

Amniotic fluid plays an important role in normal fetal development and pregnancy maintenance. Its volume is regulated by a dynamic balance between fetal urine production, fetal swallowing,

transmembranous fluid exchange, and other maternal and fetal physiological processes. Oligohydramnios, characterized by abnormally reduced amniotic fluid volume, may occur as a consequence of placental insufficiency, fetal urinary tract abnormalities, premature rupture of membranes, maternal conditions, or other pregnancy-related complications. Reduced amniotic fluid has been associated with adverse pregnancy outcomes, including fetal growth restriction, umbilical cord compression, fetal distress, increased rates of operative delivery, and neonatal complications [3,4].

Ultrasound is the principal non-invasive imaging modality used for assessment of amniotic fluid volume during pregnancy. Quantitative assessment is commonly performed using the amniotic fluid index (AFI) or single deepest vertical pocket (SDP). These techniques provide objective measurements that can be incorporated into routine antenatal assessment and fetal surveillance. Ultrasound is particularly valuable because it is widely available, does not involve ionizing radiation, and permits simultaneous evaluation of fetal growth, fetal anatomy, placental characteristics, and other sonographic markers of pregnancy complications [5,6].

The presence of oligohydramnios may reflect underlying placental dysfunction or compromised fetal well-being, mechanisms that may also contribute to spontaneous or medically indicated preterm birth. Consequently, ultrasound-based identification of reduced amniotic fluid may have potential value as an early predictor of preterm delivery. However, the predictive relationship between oligohydramnios and preterm birth can vary according to gestational age, maternal characteristics, the underlying cause of reduced amniotic fluid, and the ultrasound criteria used for diagnosis [4,7]. Therefore, assessment of the predictive performance of ultrasound-detected oligohydramnios is clinically relevant.

Despite the established use of ultrasound for amniotic fluid assessment, uncertainty remains regarding the extent to which oligohydramnios identified during antenatal screening can reliably

predict subsequent preterm birth. Evaluating this association may help determine whether ultrasound-based amniotic fluid assessment can contribute to risk stratification and closer monitoring of women at increased risk. Therefore, the present study aims to assess ultrasound-based screening for oligohydramnios and determine its potential value as a predictor of preterm birth.

Objectives

- The aim of the study is to assess preterm births due to oligohydramnios using gray-scale ultrasound techniques.
- To determine the frequency of cesarean section among pregnant women with ultrasound-diagnosed oligohydramnios.

Methodology

A cross-sectional observational study was conducted to assess oligohydramnios using grayscale ultrasonography and its potential association with preterm birth. A non-probability convenience sampling technique was used, and a sample size of 157 participants was calculated using WHO version 26 at a 95% confidence level, with an expected prevalence of 27.1% and a margin of error of 7%. The study was conducted over a period of six months at the Radiology Departments of Arif Memorial Teaching Hospital and Hammad Diagnostic Center, Kasur. Pregnant women presenting with oligohydramnios during the third trimester, particularly those with complaints of vaginal discharge, decreased fetal movements, or preterm uterine contractions, were included after obtaining informed consent. Pregnant women without oligohydramnios, non-pregnant women, and patients with maternal conditions such as severe dehydration, use of angiotensin-converting enzyme inhibitors, or chorioamnionitis at enrollment were excluded. Data were collected through a structured questionnaire, clinical interviews, and obstetric ultrasound examinations. Grayscale ultrasonography was performed using a Toshiba ultrasound system with a transducer operating at a frequency range of 3–7.5 MHz. The patients were

examined in the supine position, and ultrasound gel was applied to the abdomen before the transducer was gently moved over the area of interest to obtain appropriate images. Amniotic fluid volume and the severity of oligohydramnios were assessed sonographically, and relevant fetal and maternal findings were documented. Doppler ultrasonography was also used when required to

assess fetal and placental blood flow. The collected data were entered and analyzed using SPSS version 25. Quantitative variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages. The findings were subsequently presented in the form of tables and graphs.

RESULTS

Table 4.1: Frequency distribution of hypertension in participants.

Previous a history of Hypertension	Frequency (n)	Precent %
History of Hypertension	55	35.0
No history of Hypertension	102	65.0
Total	157	100.0

Among the 157 participants, 55 (35.0%) had a history of hypertension while the majority 102 (65.0%) did not. This indicates a roughly 1:2 ratio of hypertensive to normotensive individuals suggesting a generally lower baseline

cardiovascular risk in this cohort. Nonetheless, with over one-third affected, hypertension remains a clinically relevant subgroup that could impact study outcomes.

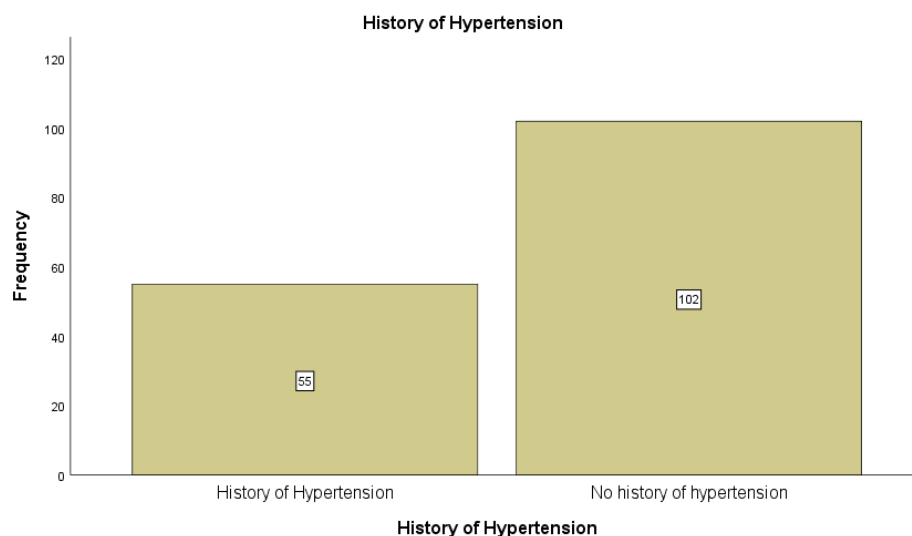


Figure 4.1: Graphical distribution of participants with a history of hypertension.

Table 4.2: Frequency distribution of participants with a history of previous C-section

History of Previous C-Section	Frequency (n)	Percent %
No history of C-Section	108	68.0
History of 1 C-Section	19	12.0
History of 2 or more C-Sections	30	19.0
Total	157	100.0

Among the 157 participants, the majority (68.0%, n=108) had no history of cesarean section while 12.0% (n=19) had one and 19.0% (n=30) had two or more prior C-sections. This means nearly one-third of the women (31.0%) had undergone

at least one previous C-section with recurrent procedures being more frequent than single occurrences

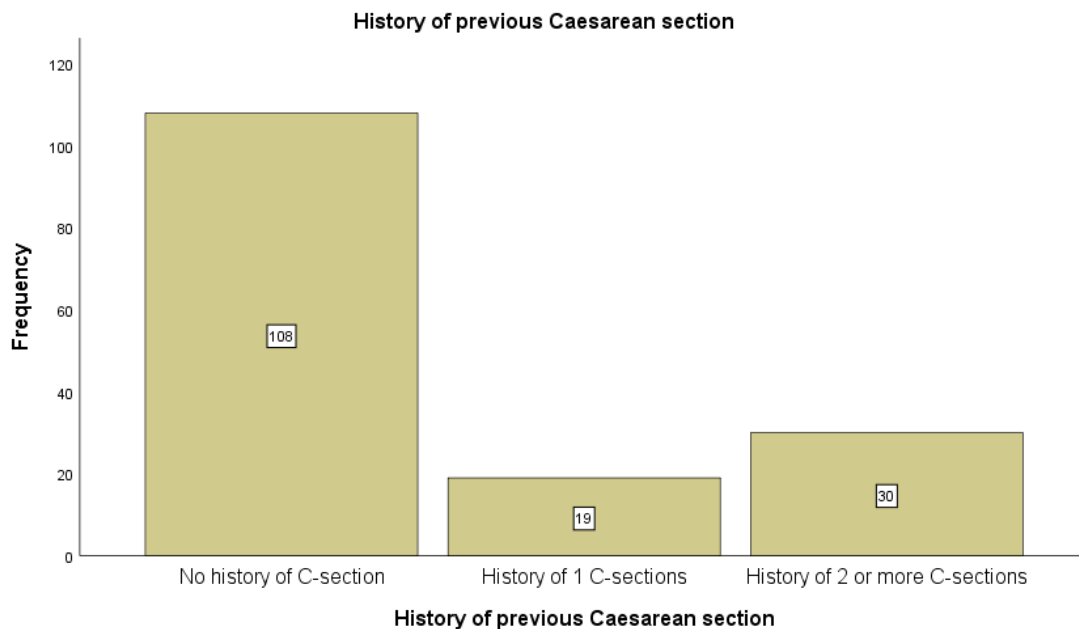


Figure 4.2: Graphical distribution of participants with a history of previous C-section.

Table 4.3: Frequency distribution of participants according to the category of AFI.

AFI Category	Frequency (n)	Percent %
Severe Oligohydramnios (≤ 2 cm)	16	10.2
Oligohydramnios ($> 2-5$ cm)	68	43.4
Borderline AFI (5.1-8 cm)	30	19.1
Normal AFI (8.1-24 cm)	43	27.4
Total	157	100.0

Among the 157 participants the largest group had oligohydramnios ($> 2-5$ cm) at 43.4% ($n=68$) while 10.2% ($n=16$) had severe oligohydramnios (≤ 2 cm) and 19.1% ($n=30$) had borderline AFI. Only 27.4% ($n=43$) had normal AFI meaning nearly three-quarters (72.6%) of the study population presented with some degree of reduced amniotic fluid.

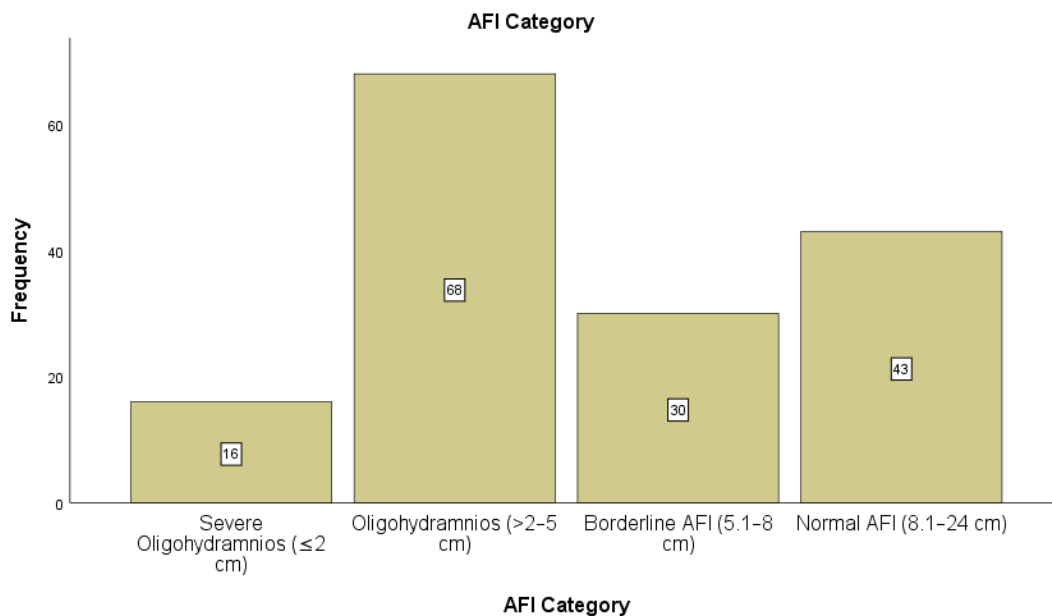


Figure 4.3: Graphical distribution of participants according to AFI category.

Table 4.4: Frequency distribution of participants according to Mode of Delivery.

Mode of Delivery	Frequency (n)	Percent %
Normal Vaginal Delivery (NVD)	34	21.7
Caesarean Section (C-Section)	123	78.3
Total	157	100.0

Among the 157 participants the vast majority 123 women (78.3%) delivered via cesarean section, while only 34 (21.7%) had a normal vaginal delivery. This indicates a more than 3.5-fold higher rate of C-section compared to vaginal

delivery in this cohort. Such a high cesarean rate may reflect obstetric complications, prior uterine scars, or institutional practices, and warrants evaluation of indications to optimize maternal and neonatal outcomes.

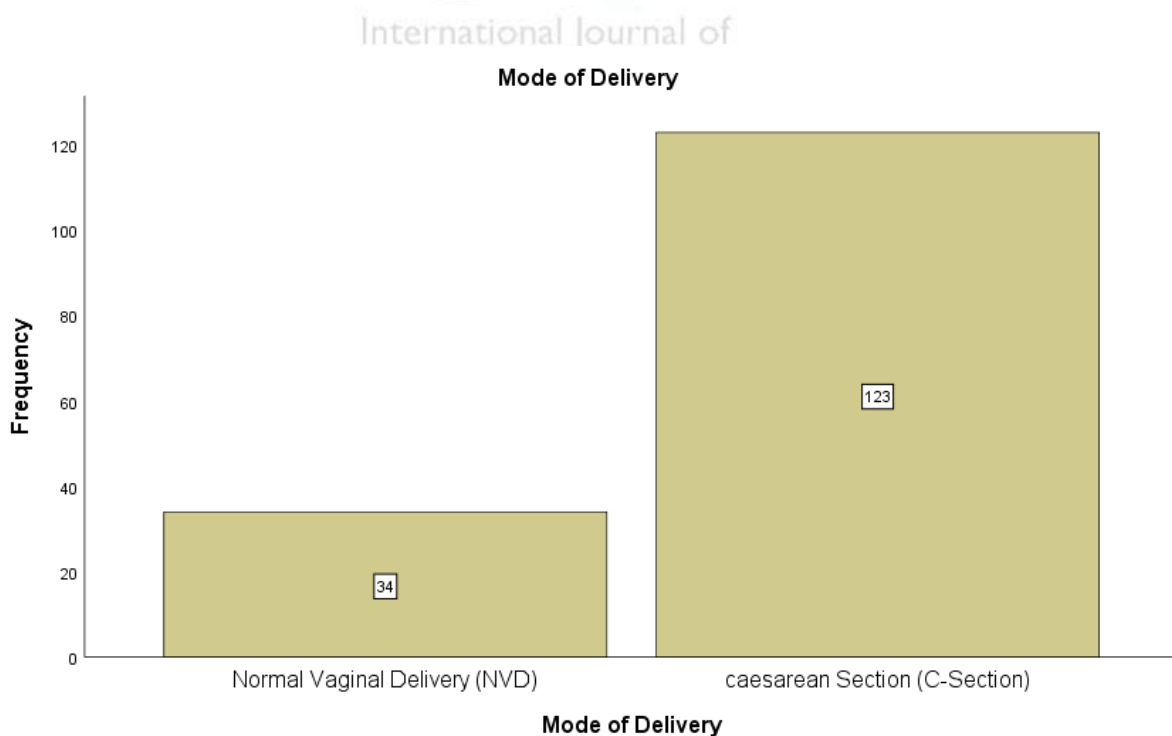


Figure 4.4: Graphical distribution of participants according to Mode of Delivery.

Table 4.5: Frequency distribution of participants according to preterm birth rates

Preterm Birth	Frequency (n)	Percent %
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Late preterm	97	61.8
Very preterm	37	23.6
Extremely preterm	23	14.6
Total	157	100.0

Among the 157 participants, the majority 97 neonates (61.8%) were late preterm while 37 (23.6%) were very preterm and 23 (14.6%) were extremely preterm. This means over one-third (38.2%) of the births occurred before 32 weeks of gestation representing a substantial burden of

moderate-to-severe prematurity. The high proportion of very and extremely preterm infants underscores the need for specialized neonatal intensive care and long-term developmental follow-up in this cohort.

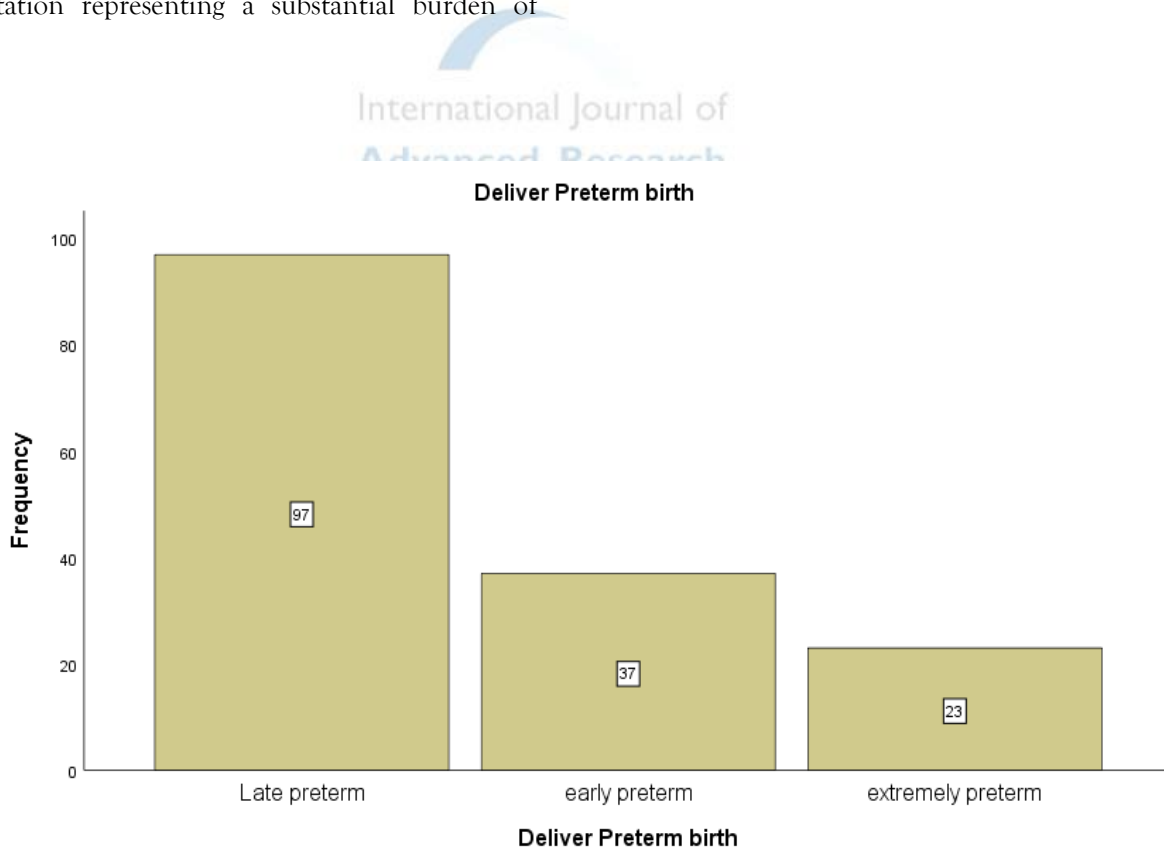


Figure 4.5: Graphical distribution of participants according to preterm birth rates.

Table 4.6: Frequency distribution of Fetal weight at Birth.

Fetal weight at Birth	Frequency (n)	Percent %
Low (<1.9 kg)	55	35.0
Normal (2.0-3.9 kg)	98	62.4
High (≥ 4.0 kg)	4	2.5
Total	157	100.0

Among the 157 neonates, the majority 98 (62.4%) had normal birth weight (2.0–3.9 kg), while 55 (35.0%) were low birth weight (<1.9 kg) and only 4 (2.5%) were high birth weight (≥ 4.0 kg). This indicates that over one-third of the infants had low birth weight, which is a significant proportion

and reflects a high-risk neonatal population. The very low rate of macrosomia (2.5%) suggests that excessive fetal growth was not a major concern in this cohort, but the substantial low-birth-weight burden demands careful nutritional support and neonatal monitoring.

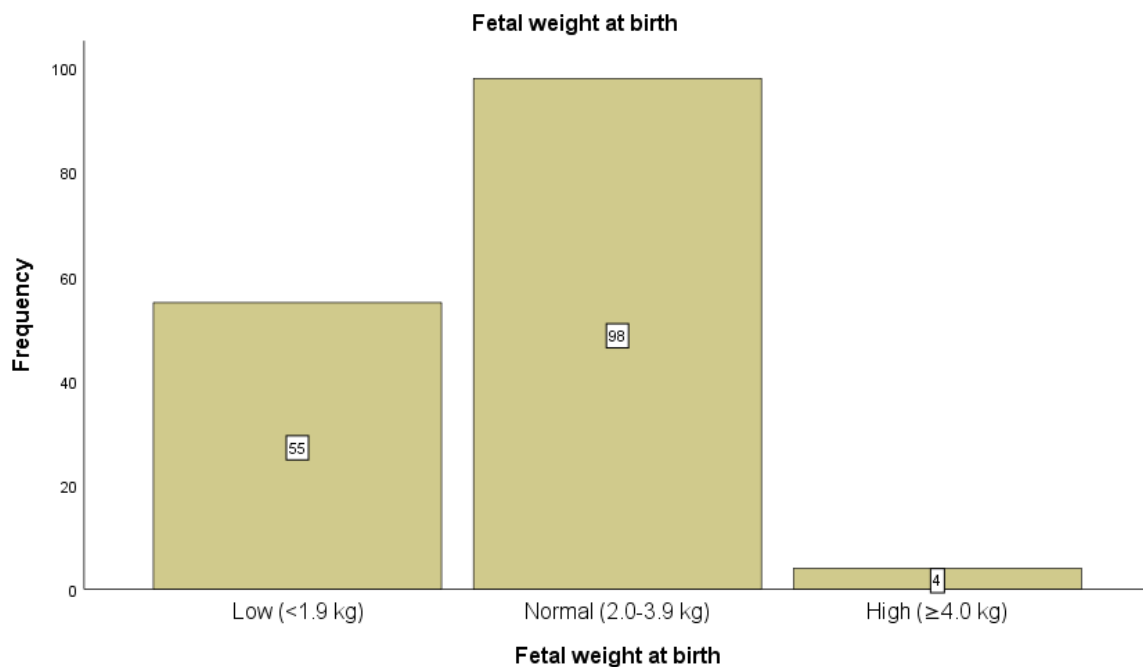


Figure 4.6: Graphical distribution of Fetal weight at Birth.

Table 4.7: Chi-Square Test for Association Between Variables.

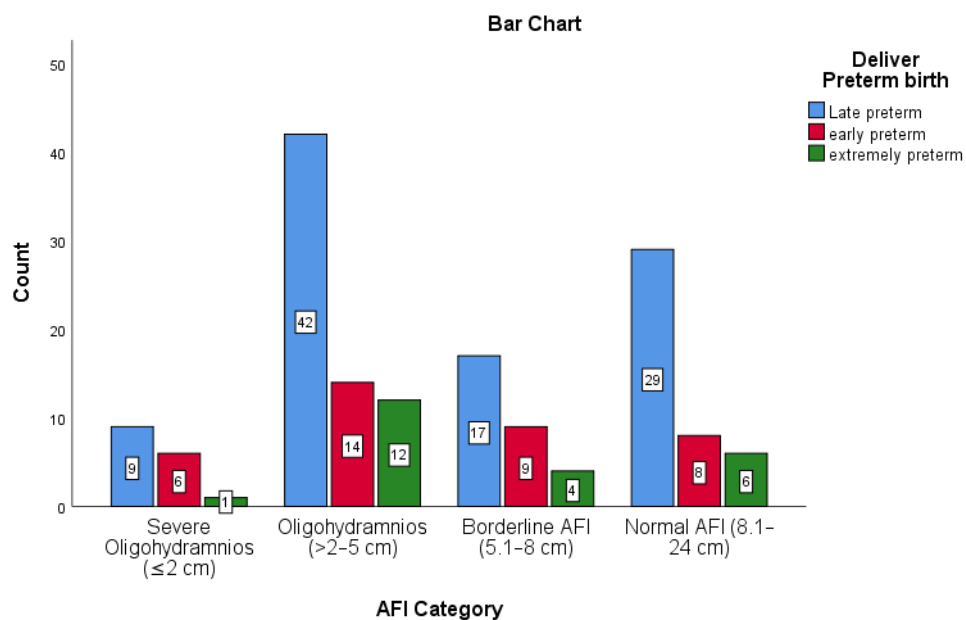
Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	264.217 ^a	10	.003
Likelihood Ratio	204.207	10	.003
linear-by-linear association	130.178	1	.000
N of Valid Cases	157		

INTERPRETATION

This p-value is less than 0.05, so the association between the variables is statistically significant. The Linear-by-Linear Association ($p < .001$) suggests a strong linear trend in the relationship. There is strong evidence of a significant association between the two categorical variables. Among women with oligohydramnios ($>2-5$ cm), late preterm births were the most frequent ($n=42$),

while extremely preterm births were the least common ($n=12$) in this category. Across all AFI categories late preterm births consistently outnumbered early and extremely preterm births indicating that most deliveries in this cohort occurred during the late preterm period regardless of amniotic fluid status.

Table 4.7: Correlation Between Preterm Birth and AFI Category.



CHAPTER 5**DISCUSSION**

Oligohydramnios identified on ultrasound remains an important antenatal finding because it may reflect placental insufficiency, fetal compromise, premature rupture of membranes, or other maternal-fetal conditions that can culminate in early delivery. In the present topic, ultrasound-based screening is clinically useful not only for documenting reduced amniotic fluid but also for identifying pregnancies that warrant closer surveillance for preterm birth risk. The literature consistently shows that oligohydramnios is a marker of increased obstetric intervention and adverse neonatal outcome, especially when it occurs with other risk factors such as preterm labor, fetal growth restriction, or membrane rupture [1, 4, 5, 7].

The value of ultrasound in this setting lies in its noninvasive and repeatable nature. Amniotic fluid volume is usually assessed by the amniotic fluid index (AFI) or the single deepest pocket/vertical pocket (SDP/DVP), and oligohydramnios is commonly defined as AFI ≤ 5 cm or SDP < 2 cm [8-11]. However, evidence has shown that AFI tends to diagnose more cases of oligohydramnios than SDP, which can increase the rate of induction and operative delivery without clearly improving neonatal outcomes [2, 3, 8, 9]. This is an important issue for screening programs because a test that overdiagnoses low fluid may increase intervention burden without adding meaningful predictive value for preterm birth [2, 3, 11].

Across studies, pregnancies with oligohydramnios have shown higher rates of preterm delivery and neonatal admission, although the strength of association varies depending on whether oligohydramnios is isolated or accompanied by other pathology. In the multi-country prospective study by Figueroa and colleagues, oligohydramnios was associated with worse fetal, neonatal, and maternal outcomes in low- and middle-income settings, supporting the view that low fluid is a clinically relevant warning sign [4]. Similarly, Kim et al. reported that oligohydramnios in women with preterm labor

and intact membranes was associated with evidence of intra-amniotic inflammation and a shorter interval to delivery, which strengthens the biological link between low amniotic fluid and preterm birth [5].

The predictive usefulness of oligohydramnios also depends on timing. In preterm premature rupture of membranes, low fluid volume is often associated with a shorter latency to delivery and may reflect the severity of membrane disruption or ascending infection [6]. This means that ultrasound-detected oligohydramnios can function as an indirect marker of impending preterm birth rather than a stand-alone cause of prematurity. For this reason, it should be interpreted together with cervical assessment, membrane status, fetal growth, Doppler findings, maternal symptoms, and laboratory indicators when available [5, 6, 10, 11].

At term, the evidence is more mixed. Zhang et al. found that isolated oligohydramnios was not associated with impaired fetal growth or adverse perinatal outcomes in otherwise uncomplicated pregnancies [6]. Other reports have similarly shown that isolated oligohydramnios may mainly increase the rate of induction and cesarean delivery rather than clearly worsening neonatal conditions. [7, 15]. These findings do not negate its importance, but they do show that oligohydramnios is best viewed as a risk marker whose significance becomes stronger when combined with prematurity, rupture of membranes, growth restriction, or abnormal fetal testing [4-7, 15].

The mechanism connecting oligohydramnios to preterm birth is biologically plausible. Amniotic fluid is largely produced by fetal urine later in gestation, so reduced fluid may indicate diminished placental perfusion, fetal renal perfusion, or chronic fetal stress [8, 10]. In these situations, the fetus may be exposed to a higher risk of cord compression, non-reassuring fetal heart rate patterns, and urgent delivery [7, 9, 12]. Therefore, ultrasound screening for oligohydramnios can improve obstetric decision-making by identifying pregnancies that need

enhanced surveillance, hydration strategies, corticosteroid consideration, or timely delivery depending on gestational age and maternal-fetal status [12-19].

Management-focused studies also show that intervention can modify the sonographic finding, although not always the underlying risk. Maternal hydration may transiently improve AFI, and systematic review evidence suggests that hydration strategies can increase measured fluid volume, particularly in isolated oligohydramnios [13-19]. Nevertheless, improvement in AFI does not automatically mean the underlying fetal or placental issue has resolved. This is why hydration should be considered an adjunct to surveillance rather than proof that the pregnancy is no longer at risk for preterm birth [13, 14, 16-19].

From a public-health perspective, ultrasound screening for oligohydramnios is especially relevant in settings where preterm birth contributes substantially to neonatal morbidity and mortality and where early referral can change outcomes. When performed as part of antenatal care, ultrasound can identify women who need closer follow-up and tertiary-level obstetric support. The challenge is to balance sensitivity and specificity: AFI may be more sensitive for low fluid, but SDP appears to reduce unnecessary intervention and is supported by comparative trial and review evidence [2, 3, 10, 11].

Overall, the literature supports ultrasound-based assessment of amniotic fluid as a useful component of preterm birth risk evaluation, but not as an isolated predictor. Oligohydramnios should prompt a structured assessment for preterm labor risk, membrane rupture, fetal growth restriction, and placental dysfunction. Its predictive value is strongest when it occurs with other abnormal findings. While isolated late-pregnancy oligohydramnios has a more variable association with adverse outcomes [1-7, 10, 11].

In conclusion, ultrasound screening for oligohydramnios is clinically meaningful because it helps identify pregnancies at higher risk of preterm birth and related neonatal complications. The overall evidence favors careful interpretation

of AFI or SDP within the broader clinical picture, with SDP often preferred to avoid unnecessary diagnosis and intervention. [1-19].

Conclusion

This study concludes that ultrasound-based screening for oligohydramnios is an effective and reliable method for identifying pregnancies at increased risk of preterm birth. Reduced amniotic fluid volume detected through ultrasonography was found to be significantly associated with adverse pregnancy outcomes, particularly preterm delivery. Early detection of oligohydramnios can therefore assist healthcare professionals in timely monitoring and clinical management of high-risk pregnancies.

The findings also highlight the importance of routine antenatal ultrasound examinations in improving maternal and fetal outcomes.

In conclusion, incorporating ultrasound-based assessment of oligohydramnios into standard prenatal care protocols may enhance early risk prediction and support better obstetric decision-making.

LIMITATIONS

The study may include a relatively small number of participants, which can reduce the statistical power and limit the generalizability of the findings to the wider pregnant population. If conducted at one hospital or diagnostic center only, the results may not accurately represent different geographical regions, healthcare settings, or populations with varying maternal risk factors. The study may focus primarily on preterm birth outcomes without evaluating long-term neonatal complications or maternal outcomes, which restricts the broader clinical interpretation of the findings.

RECOMMENDATIONS

- Regular ultrasound assessment of amniotic fluid volume should be incorporated into antenatal care, especially in high-risk pregnancies, to allow early detection of oligohydramnios.

- Pregnant women diagnosed with oligohydramnios should receive close clinical and sonographic monitoring to reduce the risk of preterm birth and related complications.
- Educational programs should be conducted to increase awareness among pregnant women regarding the importance of antenatal visits and timely ultrasound examinations.

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