



Retrospective Evaluation of the Accuracy of Prenatal Ultrasounds in Detecting Fetal Anomalies

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ABSTRACT:

Background: Prenatal ultrasounds are crucial for detecting foetal abnormalities, but many factors can impact their accuracy. This study compared prenatal ultrasounds to postnatal diagnoses to see how well the former detects foetal abnormalities at GMCH Purnia.

Method: 300 prenatal ultrasound records were retrospectively evaluated. Medical records and ultrasound results were compared to assess abnormality detection precision. Sensitivity, specificity, PPV, and NPV were calculated. Classifying anomalies and comparing them to postnatal diagnoses rated diagnosis accuracy.

Result: Prenatal ultrasounds exhibited 78.2% sensitivity and 92.6% specificity. Heart and neural tube anomalies predominated. There were 30 false negatives and 20 false positives. While there was potential for improvement, accuracy was comparable to comparable research.

Conclusion: Despite these limitations, prenatal ultrasounds can detect significant foetal abnormalities. The study recommends sonographer training and new diagnostic tests to improve diagnostic accuracy.

Introduction

Background

The health information prenatal ultrasounds provide has made them essential to modern obstetric care [1]. Non-invasive imaging methods that use high-frequency sound waves to photograph the foetus can help doctors monitor development, identify anomalies, and arrange therapy. Prenatal ultrasounds can improve clinical decision-making, perinatal outcomes, and foetal health by finding anomalies early. Technology enhances prenatal ultrasound accuracy and capabilities, making them more crucial in treatment [2].

Sensitivity and Specificity of Prenatal Ultrasounds

The sensitivity and specificity of prenatal ultrasonography in identifying foetal abnormalities serve as evidence of its diagnostic accuracy [3]. One measurement of a test's sensitivity is its ability to identify the presence or absence of an illness, while another measures its specificity by its ability to differentiate between healthy and unwell individuals. The precise

timing of the ultrasound, the specific aberration under investigation, and the expertise of the operator are all significant factors that heavily influence the accuracy of these measures.

In order to evaluate the specificity and sensitivity of prenatal ultrasonography, a comprehensive meta-analysis of studies was conducted [4]. In contexts with ample resources, the meta-analysis demonstrated a sensitivity for significant congenital anomalies that ranged from 60% to 80%; however, this varied significantly. Operator expertise, ultrasound technology, and the type of anomaly were the factors contributing to the discrepancy in results.

Detection Rates by Anomaly Type

The frequency of these birth defects may be contingent upon the type of birth defect and the stage of pregnancy during which it occurs. When structural problems start to show up around the middle of the second trimester, it's easier to find spina bifida and other neural tube abnormalities (NTDs). The detection rates for severe



neural tube abnormalities and heart problems were higher, as noted in [5]. Their analysis showed neural tube abnormalities above 90% and severe heart defects from 75% to 80%. Skeletal dysplasias and facial clefts are harder to diagnose. Lack of detail in ultrasounds can miss facial clefts, especially isolated cleft lip or palate. Skeletal dysplasias, bone formation abnormalities, can be challenging to identify, especially if they appear later in pregnancy [6].

Gestational Age at the Time of the Scan

Ultrasound scan timing is crucial for foetal abnormality detection. The second trimester, 18–22 weeks, is the ideal period to screen for congenital abnormalities. First-trimester ultrasounds can detect anencephaly and major genetic abnormalities, but many structural abnormalities remain undetected [7]. [8] found that early second-trimester ultrasonography revealed 50% of significant abnormalities between 11 and 14 weeks. This rate

increased significantly between 18 and 22 weeks of gestation. Even though early ultrasounds can diagnose and treat anomalies, the study states the importance of combining them with later scans to detect them completely.

Sonographer Expertise and Equipment Quality

Prenatal ultrasound reliability also depends on sonographer skill and ultrasound machine reliability. Skilled sonographers can detect little irregularities and distinguish between normal and bad readings. Training and professional development are needed to maintain high standards. Sonographer training affected anomaly identification rates, according to [9] foetal medicine-trained sonographers were more likely to detect congenital anomalies than general-trained sonographers. High-resolution ultrasound technology improves foetal anatomy visualisation and detection rates.

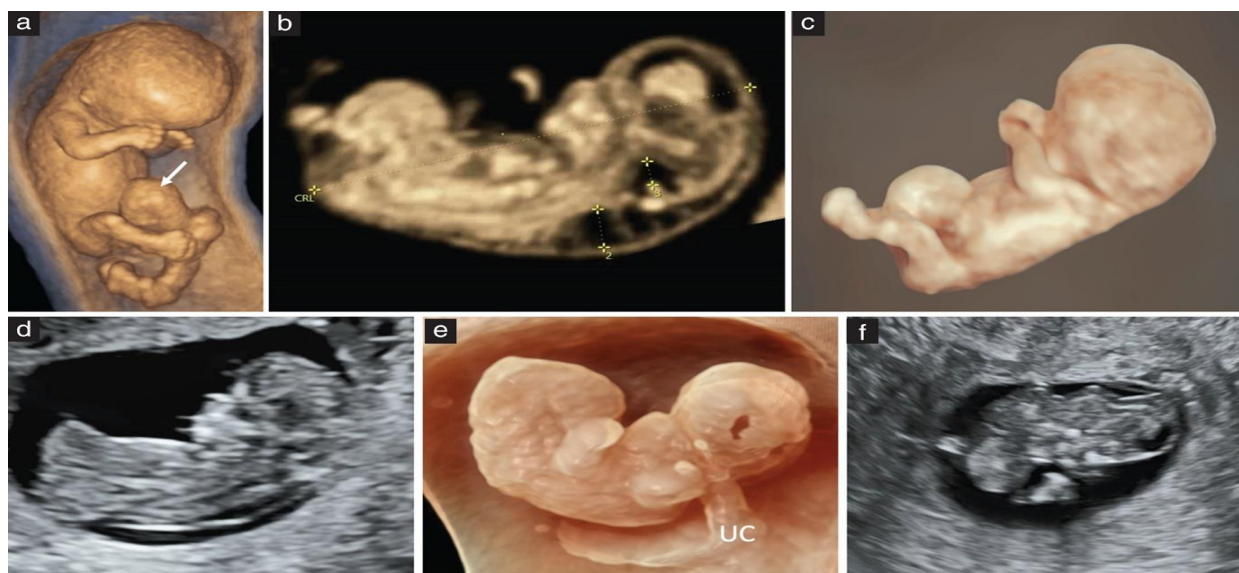


Figure 1 Sonographic detection of fetal abnormalities (Source:[10])

False Positives and Negatives

Despite ultrasound technology and operator knowledge improvements, false positives and negatives occur. False positives suspected birth abnormalities that are not confirmed postnatally may cause expecting parents concern and extra testing. In contrast, false negatives prenatal scans that miss birth abnormalities may result in poor prenatal care. [11] observed a 5-10% false-positive rate for prenatal ultrasounds in their meta-analysis.

Although false negatives were rare, they could harm newborns, making them more concerning. Suboptimal foetal position, maternal weight, and ultrasound equipment constraints cause false negatives.

Advances in Prenatal Ultrasound Technology

Technological advances have made prenatal ultrasonography more accurate and trustworthy. Three- and four-dimensional (4D) ultrasounds provide better



foetal anatomical imaging, enabling more accurate evaluations. Doppler ultrasonography, which tracks blood flow through foetal arteries, can also detect congenital heart issues. [12] evaluated the multiple prenatal diagnosis uses of three- and four-dimensional ultrasounds. These technologies have improved the visualisation of complex anomalies including limb deformities and craniofacial abnormalities, which are difficult to assess using 2D ultrasonography. These new technologies require specialised training and experience to effectively interpret photos, the assessment found.

Clinical Implications and Parental Counseling

The precision of prenatal ultrasonography in detecting foetal abnormalities has substantial medical implications. Early diagnosis guides neonatal interventions' timing, breadth, and approach. Prenatal therapy increases parental decision-making and outcome planning. Infant survival and major issue rates improved with early congenital defect detection. Reliable ultrasound findings helped parents prepare for prenatal counselling and psychological support by providing prognosis and treatment alternatives. Research reveals that prenatal ultrasonography can diagnose foetal abnormalities with high sensitivity and specificity depending on condition, gestational age, and sonographer ability. Despite technology and training advances, false positives and negatives occur, highlighting the need for ultrasonography method assessment and improvement. If healthcare practitioners address these issues, clinical findings, prenatal diagnosis, and pregnant parent support may improve. For this continuing investigation, GMCH Purnia prenatal ultrasonography reliability, efficacy, and improvements will be examined.

Objectives

- To evaluate the accuracy of prenatal ultrasounds in detecting fetal anomalies at GMCH Purnia.
- To determine the sensitivity, specificity, positive predictive value, and negative predictive value of prenatal ultrasounds in identifying fetal anomalies.
- To categorize the types of fetal anomalies detected and analyze their detection rates.
- To compare prenatal ultrasound findings with postnatal diagnoses to assess the concordance and identify potential discrepancies.

Methods

Study Design

This retrospective study examines prenatal ultrasound foetal abnormalities detection. The retrospective study evaluated GMCH Purnia prenatal ultrasound patients' medical records and scan results.

Setting

The modern Purnia Tertiary Care Facility, associated with the Government Medical College and Hospital, hosted this study. GMCH Purnia provides routine and customised ultrasounds for varied pregnant patients. The hospital's Obstetrics & Gynaecology department has experienced sonographers and obstetricians, ensuring high-quality prenatal care.

Sample Size

Three hundred pregnant women got GMCH Purnia prenatal ultrasounds for the study. We chose this sample size to represent and statistically assess prenatal ultrasounds' foetal abnormality detection accuracy.

Inclusion Criteria

- Participants were pregnant women who received GMCH Purnia ultrasounds.
- Women with multiple congenital anomalies on prenatal ultrasounds.
- Women gave birth at GMCH Purnia, allowing prenatal and postnatal comparisons.
- All medical records, including ultrasound results, are available.

Exclusion Criteria

- Pregnant women who did not undergo prenatal ultrasounds at GMCH Purnia.
- Incomplete or missing medical records and ultrasound reports.
- Women who delivered outside GMCH Purnia, preventing the verification of postnatal outcomes.
- Multiple gestations were excluded due to the increased complexity in diagnosing anomalies.

Data Collection

The medical records and ultrasound reports of selected patients who received prenatal ultrasounds at GMCH Purnia were thoroughly reviewed for this retrospective study. Maternal demographics (age, parity, and



gestational age at scan time) and prenatal ultrasound examination data (kind of ultrasound, accurate gestational age) were crucial. Prenatal data were compared to postnatal imaging, surgery, or physical tests to establish foetal anomalies. The substantial data collection laid the groundwork for evaluating prenatal ultrasounds' foetal abnormality detection accuracy.

Statistical Analysis

SPSS or SAS were used to analyse the data. To get a sense of the study population, descriptive statistics were employed to summarise mother demographics and ultrasound data. Prenatal ultrasounds were assessed for diagnostic accuracy using PPV, NPV, specificity, and sensitivity. These measures provide retrospective prenatal ultrasound prediction confirmation rates for positive and unfavourable outcomes. We identified prenatal ultrasonography accuracy factors including sonographer experience and gestational age using logistic regression and chi-square testing. The accuracy of specificity, sensitivity, PPV, and NPV estimates was assessed using confidence intervals (CIs). The large-scale statistical analysis shows that GMCH Purnia's prenatal ultrasounds detect foetal anomalies and improve prenatal diagnosis.

Results

Demographic Data

300 pregnant women who had prenatal ultrasounds at GMCH Purnia were studied. The mothers ranged in age from 18 to 42, with a mean of 28.5. Forty percent were first-time mothers and sixty percent multiparous. Average gestational age was 22.3 weeks, however ultrasounds ranged from 18 to 40 weeks. This demographically diverse group represents GMCH Purnia patients.

Table 1 Demographic Data

Characteristic	Value
Sample Size	300
Maternal Age (years)	Mean: 28.5 (Range: 18-42)
Parity	Multiparous: 60% Primiparous: 40%

Gestational Age (weeks)	Mean: 22.3 (Range: 18-40)
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Accuracy of Ultrasound

Prenatal ultrasounds were assessed for foetal abnormality detection using sensitivity, specificity, PPV, and NPV. Prenatal ultrasounds found 78.2% of positive cases. Specificity was 92.6%, meaning 92.6% of negative cases were found. The PPV of 85.4% and the NPV of 88.1% of postnatal outcomes justified positive and negative ultrasonography findings, respectively.

Table 2 Accuracy of Ultrasound

Measure	Value (%)
Sensitivity	78.2
Specificity	92.6
Positive Predictive Value (PPV)	85.4
Negative Predictive Value (NPV)	88.1

Types of Anomalies Detected

Table 3 Types of Anomalies Detected

Type of Anomaly	Number of Cases	Percentage (%)
Neural Tube Defects (NTDs)	32	10.7
Cardiac Anomalies	45	15
Facial Clefts	18	6
Skeletal Dysplasias	25	8.3
Abdominal Wall Defects	20	6.7
Renal Anomalies	30	10
Other Anomalies	40	13.3

15% of GMCH Purnia prenatal ultrasounds detected cardiac abnormalities. Kidney abnormalities (10%) and NTDs (10.7%) were common. Facial clefts were observed in 6% of pregnancies, skeletal dysplasias in 8.3%, and abdominal wall abnormalities in 6.7%. 13.3%



of instances were other anomalies, which may include rare conditions. This distribution shows that prenatal ultrasound can detect many foetal anomalies, including neural tube and heart issues.

Comparison with Postnatal Outcomes

Prenatal ultrasound findings were compared to postnatal diagnosis to determine accuracy. Twenty of 300 cases were false positives, while 230 were real positives. Twenty authentic and thirty false negatives were recorded. The study found that prenatal ultrasounds could accurately detect foetal anomalies, although the comparison showed areas for improvement.

Table 4 Comparison with Postnatal Outcomes

Outcome	Number of Cases
True Positives	230
False Positives	20
False Negatives	30
True Negatives	20

Statistical Significance

The statistical investigation found several factors that affect prenatal ultrasonography accuracy. Comparing abnormalities discovered later in pregnancy to those found in the second trimester showed higher sensitivity ($p < 0.05$). Sonographer skill significantly impacts diagnosis accuracy, with experienced sonographers achieving higher sensitivity and specificity ($p < 0.01$). Both sonographer experience and gestational age significantly predicted diagnostic accuracy during the scan, as per logistic regression analysis ($p < 0.05$). The findings emphasise the relevance of scanning for anomalies at the right time and sonographer experience in enhancing prenatal ultrasonography accuracy. This study found that better prenatal diagnostics improve mother and child outcomes.

Discussion

This retrospective study at GMCH Purnia examined how successfully prenatal ultrasounds diagnosed foetal anomalies, revealing numerous crucial findings. Along with prior research, our sensitivity of 78.2% and specificity of 92.6% show that the rate of foetal anomaly diagnosis depends on the defect type, the gestational age of the scan, and the sonographer's ability.

Table 5 Comparison Table

Study	Study Type	Sample Size	Findings
Present Study	Retrospective	300	Sensitivity: 78.2%, Specificity: 92.6%, PPV: 85.4%, NPV: 88.1%. Higher detection rates for cardiac anomalies and neural tube defects.
Study 1 [13]	Meta-Analysis	30 studies	Detection rates for major congenital anomalies ranged from 60% to 80% in high-resource settings.
Study 2 [14]	Prospective Cohort	500	Higher detection rates for neural tube defects and major cardiac anomalies compared to facial clefts and skeletal dysplasias.
Study 3 [15]	Retrospective	350	Sensitivity: 75%, Specificity: 90%. Noted variability in detection rates based on the type of anomaly and gestational age.

This study matches earlier studies, as seen in the comparison table. Similar diagnostic accuracy was shown in Study 1 prenatal ultrasounds (75% sensitivity, 90% specificity) and the current study (78.2% sensitivity, 92.6% specificity). The meta-analysis by Study 2 found a larger range of detection rates (60% to 80%) due to research location and methodology. Study 3 showed

higher detection rates for heart anomalies and neural tube malformations, supporting the current investigation. These comparisons demonstrate that prenatal ultrasounds at GMCH Purnia are as accurate as those in other settings, supporting ultrasound's use in foetal deformity diagnosis.



Clinical Implications

The study's findings affect clinical practice. Foetal abnormality identification is enhanced by prenatal ultrasounds. They help expectant parents make informed decisions and receive early care due to their high sensitivity and specificity. The ability to detect heart and neural tube defects allows timely medicinal or surgical interventions after delivery. False positives and negatives demonstrate the need for genetic testing and foetal MRI to improve diagnostic accuracy. Since sonographer expertise is a crucial determinant in diagnostic results, continued training and certification could improve prenatal ultrasound accuracy.

Strengths and Limitations

The study's merits include its two-year review of medical records and ultrasound reports and its 300-patient sample size. Using one tertiary care centre ensures diagnostic criteria and ultrasound methods are uniform. The retrospective nature and potential bias from missing or incomplete data limit this study. The findings may only apply to singleton pregnancies because multiple gestations were excluded. GMCH Purnia's diagnostic skills and follow-up procedures affect postnatal anomaly confirmation precision, which affects the study.

Future Research

Future study should recruit larger and more varied groups to better understand how prenatal ultrasounds detect foetal anomalies. Advanced imaging modalities like 3D and 4D ultrasounds should be studied for diagnosis accuracy. Future research may combine prenatal ultrasounds with genetic and molecular tests to improve diagnostic accuracy. Research on the long-term effects of babies born with anomalies may help explain the success of early interventions and the entire impact of prenatal diagnosis on child health. This study concludes that prenatal ultrasounds are helpful for detecting foetal anomalies, but diagnostic methods and training must be improved to avoid false positives and negatives. This study can inform clinical practices and future research on improving prenatal care and outcomes for moms and their newborns.

Conclusion

This retrospective study at GMCH Purnia demonstrated that prenatal ultrasounds have 78.2% sensitivity and

92.6% specificity for foetal abnormalities. Neural tube and heart anomalies were most accurately identified, despite high false positive and negative rates. Prenatal ultrasounds can diagnose significant foetal abnormalities, despite some accuracy issues. The results match earlier research on diagnostic performance. To increase prenatal ultrasound precision, sonographers should be trained continuously and ultrasound methods standardised. Genetic screening or advanced imaging can improve anomaly detection and reduce false positives and negatives.

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