

Ultrasound-Based Assessment of Placental Characteristics and Fetal Well-Being in Second and Third Trimester Pregnancies: A Hospital-Based Cross-Sectional Study in Faisalabad

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Keywords: obstetric ultrasonography; placental maturity; fetal well-being; amniotic fluid index; fetal growth; Faisalabad; pregnancy

Received on 22 Feb 2026

Accepted on 24 Mar 2026

Published on 31 Mar 2026

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Abstract

Background: Ultrasonography is a vital non-invasive imaging modality for assessing the placental morphology and fetal well-being during the period of pregnancy. Sonographic assessment of placental location, placental maturity, placental grade, amniotic fluid, fetal growth, fetal presentation and fetal cardiac activity provide important information for identifying pregnancy requiring closer antenatal surveillance. This research observed the sonographic characteristics of the placenta and selected fetal well-being indicators among pregnant females attending a tertiary-care hospital in Faisalabad.

Objective: The present study aims at describing the sonographic characteristics of the placenta and assess selected maternal and fetal parameters among women in the second and third trimesters of pregnancy.

Methodology: The study employed an observational cross-sectional method at Madinah Teaching Hospital, Faisalabad over a period of four months. A sample of 80 pregnant women was selected using convenient sampling technique and women in the second and third trimesters were

included whereas multiple pregnancies and women with previous pregnancy complications were excluded from the study. A standardized data collection proforma and obstetric ultrasonography were used for data collection. Moreover, placental location, placental grade according to the Grannum

classification, placental maturity according to gestational age, amniotic fluid index (AFI), fetal growth pattern, fetal presentation and fetal heart activities were recorded. The collected information was analyzed on SPSS version 26.0 through descriptive statistics and chi-square test.

Results: 60.0% respondents age group was 21–30 years and multigravida women constituted 60.0% of the sample whereas 40.0% respondents were primigravida. 76.3 % participants reported regular antenatal care. Anterior placentation was the most frequent placental location as reported by 33.8% respondents which were followed by posterior and fundal locations 30.0% each. Moreover, the Grade I placenta was frequently observed sonographic grade as reported by 36.3% respondents. 90.0% women reported Placental maturity as appropriate for gestational age while Normal AFI was observed in 90.0% pregnancies. The Fetal growth was appropriate for gestational age in 86.3% pregnancies while Cephalic presentation was observed in 77.5% cases. Normal fetal heart activity was documented in 93.8%. Hypertension was the most frequently reported pregnancy-related complication 40.0% followed by gestational diabetes 26.3% and anemia 15.0%.

Conclusion: The study highlighted predominantly normal sonographic placental and fetal findings among inspected second and third-trimester pregnancies. Grade I placenta and maturity appropriate for gestational age were the most common placental findings while most fetuses reported normal growth, AFI, presentation and cardiac activity. Moreover, the hypertension, gestational diabetes, premature placental maturation, oligohydramnios, small-for-gestational-age growth and abnormal fetal cardiac activity were explored in a proportion of participants despite these generally favorable findings. Therefore, routine obstetric ultrasonography may contribute early identification and monitoring of pregnancies demanding increased clinical attention.

Introduction

The placenta is an important organ that helps fetal growth and development throughout pregnancy, facilitates maternal–fetal exchange of oxygen and nutrients and contributes to endocrine and immune functions. So development of normal placental and maturation are vital components of a healthy pregnancy whereas an abnormal placental development or function may be associated with impaired fetal growth and adverse maternal or fetal conditions (Begum et al., 2020).

As a non-invasive, readily available and safe for both mother and fetus, ultrasonography is widely used in obstetric practice because (Rumack et al., 2011) as obstetric ultrasound permits assessment of placental location, morphology, maturity, amniotic fluid, fetal growth, fetal presentation and fetal cardiac activity which are important indicators of fetal well-being (Schiffer et al., 2021). The placental maturation is accompanied by progressive sonographic changes. Grannum classification is commonly employed to categorize placental appearance into Grades 0–III based on echogenicity and calcification patterns (Grannum et al., 1979). The premature placental maturation has been associated in some studies with hypertensive disorders, fetal growth restriction, and oligohydramnios, although increasing placental grade is generally a physiological feature of advancing gestation (Montan et al., 1986; Patel & Pajai, 2021).

Moreover, amniotic fluid and fetal growth assessment are also important components of obstetric ultrasound. Oligohydramnios is linked with placental insufficiency and adverse perinatal outcomes (Mohammed & Ahmed, 2024) while small-for-gestational-age fetuses may highlight impaired intrauterine growth (Gaccioli et al., 2017).

Association between placental appearance and fetal well-being have received considerable attention as premature placental maturation has been conversed in relation to conditions such as placental insufficiency, fetal growth restriction, hypertensive disorders, oligohydramnios and other adverse pregnancy outcomes

however, the clinical importance of placental grading may vary according to gestational age, maternal characteristics, population and clinical setting.

The assessment of amniotic fluid and fetal growth provides important information about the intrauterine environment in addition to placental grading. Oligohydramnios may point out reduced fetal well-being or placental dysfunction whereas small-for-gestational-age fetal growth may reflect restricted fetal growth or other maternal and placental factors. Fetal presentation and cardiac activity are also routinely examined during obstetric ultrasound.

The local evidences describing the combined sonographic characteristics of the placenta and fetal well-being indicators remains confined in many Pakistani hospitals despite the widespread use of ultrasound in antenatal care. Therefore, the focus of this research is on the sonographic profile of pregnant women attending Madinah Teaching Hospital, Faisalabad, with particular attention to placental characteristics and selected fetal parameters.

MATERIALS AND METHODS:

This observational cross sectional designed study was conducted at Madinah Teaching Hospital Faisalabad. The collection of data and study activities were conducted over a period of four months. Sample of the study consisted of 80 pregnant women which was selected through convenient, non-random sampling. Women in the second and third trimesters of pregnancy were eligible for inclusion and those with multiple pregnancies and women with previous pregnancy complications were excluded. Moreover, a standardized proforma was used to record demographic and obstetric information i.e. maternal age, gravidity, antenatal care status, placental location, placental grade, placental maturity and fetal characteristics and ultrasonographic examination on a Toshiba ultrasound machine equipped with a 3–5 MHz curvilinear transabdominal probe was conducted to assess the placental and fetal parameters. Placental grading was evaluated according to the Grannum classification. The collected data also included amniotic fluid index, fetal growth pattern, fetal presentation and fetal heart activity. Apart from this, present research followed the ethical requirements of The University of Faisalabad as written informed consent was obtained from participants whereas privacy, confidentiality, dignity and anonymity were maintained throughout the research process. Participants were informed that they could discontinue participation without penalty. Furthermore, the collected data were analyzed through SPSS version 26.0 and frequencies and percentages were calculated for categorical variables. The chi-square test was applied to examine the association between placental grading and placental maturity according to gestational age. A p-value below 0.05 was considered statistically significant.

RESULTS & DISCUSSION

Table 1. Maternal characteristics of participants

Variables	Category	Frequency	Percentage
Age	<20 years	15	18.8
	21–30 years	48	60.0
	31–40 years	17	21.3
Gravidity	Primigravida	32	40.0

	Multigravida	48	60.0
Antenatal care	Regular	61	76.3
	Irregular	17	21.3

The above table highlights the maternal attributes of respondents. The sample size of the present study was 80 pregnant women. 60% respondents age group was 21–30 years comprising 48 participants. 21.3% women were aged 31–40 years and 18.8% respondents were younger than 20 years. Regarding gravidity, 60.0% participants were multigravida while 40.0% women were primigravida. Regular antenatal care was reported among 76.3% whereas 21.3% respondents had irregular antenatal care. Two records contained coded values of 3.00 and 4.00 each representing 1.3% of the sample.

Table 2. Pregnancy-related complications

Pregnancy-related status	Frequency	Percentage
No reported complication	15	18.8
Hypertension	32	40.0
Gestational diabetes	21	26.3
Anemia	12	15.0
Total	80	100.0

Table 2 depicts the pregnancy related complication as hypertension was the most frequently recorded pregnancy-related complication affecting 40.0% respondents. Gestational diabetes was reported in 26.3% respondents. The anemia was reported by 15.0% while 18.8% participants did not report pregnancy-related complication. So the predominance of hypertension in the study population is clinically important because hypertensive disorders can require enhanced maternal and fetal surveillance.

Table 3. Placental location

Placental location	Frequency	Percentage
Anterior	27	33.8
Posterior	24	30.0
Fundal	24	30.0
Lateral	5	6.3
Total	80	100.0

The above table illustrates the placental location. According to this table, the most frequent placental location was anterior which was observed in 33.8% participants. Posterior and fundal placentas were each found in 30.0% females. The lateral placentation was identified in 6.3% respondents.

Table 4. Placental grading according to Grannum classification

Placental grade	Frequency	Percentage
Grade 0	25	31.3
Grade I	29	36.3
Grade II	20	25.0
Grade III	6	7.5
Total	80	100.0

Table 4 explains the placental grade. According to the Grannum classification, Grade I was the most frequently examined placental grade occurring in 36.3% respondents. Grade 0 was observed in 31.3% while Grade II in 25.0% and Grade III in 7.5%. Grades 0 and I accounted for 67.6% of the observed placental grades, whereas Grade III was relatively uncommon.

Table 5. Placental maturity according to gestational age

Placental maturity	Frequency	Percentage
Appropriate for gestational age	72	90.0
Premature maturation	8	10.0
Total	80	100.0

This table presents that placental maturity was appropriate for gestational age in 90% participants. While 10.0% respondents reported premature placental maturation.

Table 6. Amniotic fluid index

AFI status	Frequency	Percentage
Normal	72	90.0
Oligohydramnios	8	10.0
Total	80	100.0

According to this table, normal amniotic fluid volume was documented in 90.0% women while oligohydramnios was observed in 10.0% females.

Table 7. Fetal growth pattern

Fetal growth	Frequency	Percentage
Appropriate for gestational age	69	86.3
Small for gestational age	11	13.8
Total	80	100.0

Table 7 indicates that most fetuses 86.3% were classified as appropriate for gestational age (AGA) whereas eleven fetuses (13.8%) were categorized as small for gestational age (SGA).

Table 8. Fetal presentation

Presentation	Frequency	Percentage
Cephalic	62	77.5
Breech	18	22.5
Total	80	100.0

The above data shows that Cephalic presentation was observed in 77.5% pregnancies whereas 18 fetuses (22.5%) were in breech presentation.

Table 9. Fetal heart activity

Fetal heart activity	Frequency	Percentage
Normal	75	93.8
Abnormal	5	6.3
Total	80	100.0

According to this table, normal fetal heart activity was observed in 93.8 % cases while abnormal fetal heart activity was documented in 6.3 % cases.

Table 10. Association between placental grading and placental maturity

Placental grade	Appropriate for GA	Premature maturation	Total
Grade 0	22	3	25
Grade I	26	3	29
Grade II	18	2	20
Grade III	6	0	6
Total	72	8	80

A chi-square test was conducted to assess the relationship between placental grade and placental maturity according to gestational age. Pearson chi-square analysis produced $\chi^2 = 0.782$ with 3 degrees of freedom and $p = 0.854$. Therefore, no statistically significant association was identified between placental grading and placental maturity according to gestational age in this sample. These findings illustrate the value of comprehensive obstetric ultrasound rather than depending on a single placental parameter. Placental location, placental grade, maturity, AFI, fetal growth, presentation and cardiac activity give complementary information. In the present sample, most parameters were within generally favorable categories, while a subset of women demonstrated potentially important maternal or fetal abnormalities.

CLINICAL IMPLICATIONS

- Firstly, placental assessment should be considered as part of a comprehensive obstetric ultrasound examination rather than as an isolated parameter.
- Secondly, placental maturity should always be interpreted in relation to gestational age. A placental grade that is physiologically expected at one gestational age may be considered advanced at another.
- Thirdly, assessment of AFI and fetal growth is particularly important because oligohydramnios and SGA status were identified in 10.0% and 13.8% of the study population, respectively.
- Fourth, fetal heart activity and presentation should be documented because abnormalities may influence subsequent clinical management.
- Finally, maternal conditions such as hypertension and gestational diabetes were common in the present sample.

These findings reinforce the need of incorporating ultrasound findings with the maternal clinical history rather than interpreting placental characteristics in isolation.

LIMITATIONS

1. The sample size was relatively small with only 80 respondents.
2. The participants were selected through convenient non-random sampling from a single hospital which limits the generalizability of the findings to other populations and healthcare settings.
3. The study employed a cross-sectional design limiting conclusions regarding temporal relationships between placental changes and pregnancy outcomes.
4. The ultrasound assessment is operator-dependent and differences in examination technique may influence placental grading and other sonographic observations.

5. Importantly, the chi-square analysis contained several cells with expected frequencies below five, particularly because only eight participants demonstrated premature placental maturation.

Therefore, the non-significant association between placental grade and maturity should be interpreted cautiously.

RECOMMENDATIONS

- Larger multicenter studies should be conducted to validate the findings in different populations and healthcare settings.
- Future research should recruit larger numbers of women with premature placental maturation to improve statistical power.
- Prospective longitudinal studies should follow placental changes across different gestational ages rather than relying on a single ultrasound assessment.
- Future studies should examine specific associations between placental grade and clinically relevant outcomes such as birth weight, preterm birth, fetal growth restriction, mode of delivery, NICU admission and Apgar score when these data are available.
- Standardized ultrasound protocols should be encouraged to reduce operator-related variation in placental assessment.
- Maternal conditions such as hypertension and gestational diabetes should be incorporated into future multivariable analyses to determine whether they independently influence placental maturation and fetal well-being.
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CONCLUSION

This hospital-based study highlighted that most pregnant women had sonographically favorable placental and fetal findings. Grade I was the most frequently examined placental grade. 90.0% of women had placental maturity appropriate for gestational age. Most pregnancies also illustrated normal amniotic fluid volume, appropriate fetal growth, cephalic presentation and normal fetal heart activity. At the same time, clinically relevant findings were identified i.e. hypertension, gestational diabetes, premature placental maturation, oligohydramnios, small-for-gestational-age fetal growth, breech presentation and abnormal fetal heart activity. The statistical analysis did not reflect a significant association between placental grade and placental maturity according to gestational age; however, the small sample and low expected frequencies limit the strength of this conclusion. The findings support the role of comprehensive obstetric ultrasonography in documenting placental characteristics and fetal well-being and in identifying pregnancies that may require closer antenatal surveillance. Larger prospective studies are needed to determine the independent predictive value of individual placental and fetal ultrasound parameters.

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