The Research of Medical Science Review
ISSN: 3007-1208 & 3007-1216 Volume 3, Issue 7, 2025

SCREENING OF INTRAUTERINE GROWTH RESTRICTION WITH UTERINE ARTERY DOPPLER BETWEEN 20-24 WEEKS GESTATION IN HIGH-RISK PREGNANT WOMEN IN MNCH FAISALABAD

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DOI: https://doi.org/10.5281/zenodo.16750302

Keywords
Intrauterine Growth Restriction, Uterine Artery Doppler, High-Risk Pregnancy, Pulsatility Index, Second Trimester

Article History
Received on 20 April 2025
Accepted on 10 June 2025
Published on 05 July 2025

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Abstract

Objectives: *To measure frequency of intrauterine growth restriction (IUGR) with uterine artery Doppler between 20–24 weeks gestation in high-risk pregnant women.*

Study Settings: *Department of Gynecology, DHQ/Allied Hospital, Faisalabad.*

Duration of Study: *January 2024 to June, 2024.*

Data Collection: *A descriptive cross-sectional study was conducted on 94 antenatal women with singleton pregnancies between 20–24 weeks gestation, identified as high-risk based on prior obstetric or medical history. All participants underwent uterine artery Doppler ultrasound, assessing pulsatility index (PI), resistance index (RI), and presence of uterine notching. IUGR was diagnosed based on Doppler indices (PI >1.45, RI >0.65, and/or uterine notching) and confirmed by follow-up.*

Results: *The mean age was 27.56 ± 4.59 years. IUGR was diagnosed in 7.4% of cases. Uterine notching was present in 20.2% of participants. Although various clinical and obstetric factors were assessed, no statistically significant associations with IUGR were identified.*

Conclusion: *Uterine artery Doppler between 20–24 weeks gestation serves as a useful screening tool for early detection of IUGR in high-risk pregnancies. Routine second-trimester Doppler screening may improve perinatal outcomes by facilitating timely surveillance and intervention.*

INTRODUCTION

Ultrasound diagnosis of fetal weight below the 10th percentile defines intrauterine growth restriction (IUGR), whereas small for gestational age (SGA) is a postnatal term applied to newborns with birth weights below the 10th percentile.[1-3] The WHO wants to reduce the number of babies born with low weight by 30% before 2025. Currently, about 20 million babies are affected, with a global rate of 14.6%, although this varies by region. Since the causes are complex, experts recommend focusing on issues like premature birth and poor fetal growth.[4] More than 50% of stillbirth babies are often linked with IUGR and about 10% of perinatal mortality is attributed to undetected IUGR.[5] Placental insufficiency, maternal diabetes mellitus, hypertension, infection, pre-eclampsia and low-socioeconomic status are well-established risk factors for IUGR. The most widely reported complication of

pregnancy is IUGR which is associated with perinatal morbidity, mortality and neurologically impaired development.[6]

The underlying cause of IUGR is often an increase in vascular resistance within the placental bed, leading to reduced diastolic blood flow in the maternal-fetal circulation, while systolic flow remains relatively less affected.

Reduced diastolic flow relative to systolic output on Doppler imaging causes a noticeable rise in key indicators like the systolic/diastolic ratio and pulsatility index, which are markers of placental dysfunction.[7-8] For the assessment of intrauterine growth restriction (IUGR), commonly utilized Doppler studies include uterine artery, umbilical artery, middle cerebral artery, cerebro-placental ratio (CPR), ductus venosus, and aortic isthmus Doppler evaluations.[9]

Significant vascular events in pregnancy can be anticipated through the use of uterine artery Doppler, making it a useful screening tool. Throughout gestation—from implantation to delivery—tracking vascular changes in the uteroplacental circulation can offer important insights for diagnosing pregnancy-related disorders. Screening high-risk women with uterine artery Doppler in the second trimester can be helpful. If the UTARI is above the 90th percentile after 20 weeks, it may suggest the baby isn't growing well. UAD is more effective than just relying on medical history when predicting preeclampsia and SGA babies, especially at 22–24 weeks.[10]

Among 100 pregnant women studied for Doppler abnormalities between 16–24 weeks, 19 showed abnormal flow. These women had a significantly higher incidence of preeclampsia (84.2%) and IUGR (42%) compared to those with normal Doppler results.[11]

Using Doppler ultrasound on the uterine arteries can help spot early signs of preeclampsia and fetal growth problems. The purpose of the study is to screen IUGR with uterine artery Doppler between 20 to 24 weeks gestation in high-risk pregnant women. The findings of the study will help to recommend uterine artery Doppler in routine to detect IUGR at early stage to reduce neonatal morbidity and mortality.

METHODOLOGY

This descriptive cross-sectional study was conducted at the Department of Gynecology, DHQ/Allied Hospital, Faisalabad, over a period of six months following the approval of the research synopsis. A total of 94 antenatal women were included in the study. The sample size was calculated using the WHO sample size calculator, with a confidence level of 95%, an anticipated frequency of intrauterine growth restriction (IUGR) on uterine artery Doppler (PI) of 42%, and a margin of error of 10%. A non-probability consecutive sampling technique was employed to select the study participants.

Inclusion criteria comprised pregnant women between 20 to 24 weeks of gestation who were considered high-risk based on a history of preeclampsia, eclampsia, IUGR, stillbirth, abruptio placentae, or pre-existing medical conditions such as diabetes mellitus, renal disease, epilepsy, and hypertension. Additionally, women with clinically suspected IUGR based on small fundal height were also included. Women with multiple gestations or fetuses with major congenital anomalies were excluded from the study. The study commenced after obtaining approval from the Institutional Ethical Review Committee and CPSP. Informed consent was obtained from each participant after briefing them about the objectives of the study and assuring confidentiality of their information. Eligible patients were enrolled, and their demographic and clinical characteristics, including age, parity, body mass index (BMI), and relevant medical history (such as chronic hypertension, renal disease, diabetes mellitus, preeclampsia, fetal growth restriction (FGR), intrauterine death (IUD), family history of preeclampsia, and epilepsy) were documented. Gestational age was confirmed by the last menstrual period (LMP) or first-trimester ultrasound where available.

All participants underwent uterine artery Doppler ultrasound using color Doppler (Power Vision) with a 4 MHz convex array probe. Uterine artery flow velocity waveforms were evaluated for the presence of uterine notch, pulsatility index (PI), and resistance index (RI). IUGR was diagnosed according to operational criteria: the presence of a uterine artery notch, PI greater than 1.45, and RI greater than 0.65. Participants were followed until delivery, and

all findings were recorded in a predesigned proforma (Annexure). Data were analyzed using SPSS version 25.0. Quantitative variables such as age, gestational age, weight, height, BMI, PI, and RI were expressed as mean ± standard deviation. Categorical variables such as parity, history of chronic hypertension, renal disease, diabetes mellitus, preeclampsia, FGR, IUD, family history of preeclampsia, epilepsy, and the outcome variable (IUGR on uterine artery Doppler) were reported as frequencies and percentages. Effect modifiers such as gestational age, BMI, and the aforementioned clinical conditions were controlled by stratification. The chi-square test was applied post-stratification to determine the statistical significance of associations, and a p-value ≤ 0.05 was considered statistically significant.

RESULTS:

Table 1: Demographic Characteristics:

Demographic Characteristics of high risk pregnant women in MNCH (n=94)

Variable	Group	Count	Percent
Age	18-30	70	74.5%
	>30	24	25.5%
	Mean±sd: 27.56 ± 4.59		
Gestational Age (Weeks)	20-22	64	68.1%
	23-24	30	31.9%
	Mean±sd: 21.69 ± 1.35		
BMI	≤25	41	43.6%
	>25	53	56.4%
	Mean±sd: 25.75 ± 4.08		
Parity	Primigravida	34	36.2%
	Multigravida	60	63.8%

This table presents the demographic profile of 94 high-risk pregnant women registered at MNCH. The majority (74.5%) of the participants were aged between 18 and 30 years, while 25.5% were older than 30. The mean age of the study population was 27.56 ± 4.59 years, indicating a relatively young cohort. Gestational age at presentation ranged from 20 to 24 weeks, with most women (68.1%) between 20–22 weeks, and 31.9% between 23–24 weeks. The mean gestational age was 21.69 ± 1.35 weeks. Regarding body mass index (BMI), 43.6% of the participants had a BMI ≤25, and 56.4% had a BMI >25, with an average BMI of 25.75 ± 4.08, suggesting a tendency toward overweight status in this population. As for parity, 36.2% were primigravida (first pregnancy), while the majority (63.8%) were multigravida, having experienced one or more previous pregnancies.

Table 2: Clinical Characteristics:

Table 2

Clinical Characteristics of high risk pregnant women in MNCH (n=94)

Variable	Group	Count	Percent
Chronic Hypertension	Yes	24	25.5%
	No	70	74.5%
Renal Disease	Yes	6	6.4%
	No	88	93.6%
Diabetes Mellitus	Yes	10	10.6%
	No	84	89.4%

Epilepsy	Yes	7	7.4%
	No	87	92.6%

This table outlines the clinical background of the participants. Chronic hypertension was present in 25.5% of the women, whereas the remaining 74.5% had no history of hypertension. Renal disease was observed in 6.4% of the patients, with the vast majority (93.6%) being unaffected. Similarly, 10.6% of women had diabetes mellitus, and 7.4% had a known diagnosis of epilepsy. The rest of the participants (89.4% and 92.6%, respectively) did not report these comorbidities. These findings reflect a substantial burden of chronic illness among high-risk pregnancies, particularly hypertension.

Table 3: Obstetric History:

Table 3

Obstetric History of high risk pregnant women in MNCH (n=94)

Variable	Group	Count	Percent
Preeclampsia History	Yes	33	35.1%
	No	61	64.9%
FGR History	Yes	18	19.1%
	No	76	80.9%
IUD History	Yes	11	11.7%
	No	83	88.3%
Family History of Preeclampsia	Yes	16	17.0%
	No	78	83.0%

This table provides details regarding previous obstetric outcomes. A notable 35.1% of women had a history of preeclampsia in a prior pregnancy, indicating a significant risk factor for current pregnancy complications. History of fetal growth restriction (FGR) was reported by 19.1% of participants, while 11.7% had experienced intrauterine death (IUD). Furthermore, 17.0% of the women reported a family history of preeclampsia. These indicators point to the relevance of prior obstetric events and familial trends in identifying patients at high risk during pregnancy.

Table 4: Ultrasound Findings:

Table 4

Ultrasound Findings of high risk pregnant women in MNCH (n=94)

Variable	Group	Count	Percent
Notch	Present	19	20.2%
	Absent	75	79.8%
IUGR	Yes	7	7.4%
	No	87	92.6%

Ultrasound assessments revealed that 20.2% of the women had uterine artery notching—a known marker of poor placental perfusion—while 79.8% did not exhibit this finding. Intrauterine growth restriction (IUGR) was diagnosed in 7.4% of the women, whereas 92.6% had normal fetal growth according to ultrasound parameters. These results emphasize the value of sonographic evaluation in the early

detection and management of pregnancy-related complications.

Table 5:
Frequency of IUGR on Ultrasound Findings of high risk pregnant women in MNCH (n=94)

Variable	Group	Group-A (Count %)	Group-B (Count %)	Total (Count %)	Chi-Square p-value
Age	18–30	5 (7.1%)	65 (92.9%)	70 (100.0%)	0.848
	>30	2 (8.3%)	22 (91.7%)	24 (100.0%)	
Gestational Age	20-22	5 (7.8%)	59 (92.2%)	64 (100.0%)	0.844
	23-24	2 (6.7%)	28 (93.3%)	30 (100.0%)	
BMI	≤25	5 (12.2%)	36 (87.8%)	41 (100.0%)	.123
	>25	2 (3.8%)	51 (96.2%)	53 (100.0%)	
Parity	Primi Gravida	4 (11.8%)	30 (88.2%)	34 (100.0%)	0.230
	Multi Gravida	3 (5.0%)	57 (95.0%)	60 (100.0%)	
Chronic Hypertension	Yes	2 (8.3%)	22 (91.7%)	24 (100.0%)	0.848
	No	5 (7.1%)	65 (92.9%)	70 (100.0%)	
Renal Disease	Yes	1 (16.7%)	5 (83.3%)	6 (100.0%)	0.374
	No	6 (6.8%)	82 (93.2%)	88 (100.0%)	
Diabetes Mellitus	Yes	0 (0.0%)	10 (100.0%)	10 (100.0%)	0.343
	No	7 (8.3%)	77 (91.7%)	84 (100.0%)	
Preeclampsia History	Yes	3 (9.1%)	30 (90.9%)	33 (100.0%)	0.655
	No	4 (6.6%)	57 (93.4%)	61 (100.0%)	
FGR History	Yes	0 (0.0%)	18 (100.0%)	18 (100.0%)	0.181
	No	7 (9.2%)	69 (90.8%)	76 (100.0%)	
IUD History	Yes	2 (18.2%)	9 (81.8%)	11 (100.0%)	0.149
	No	5 (6.0%)	78 (94.0%)	83 (100.0%)	
Family History Preeclampsia	Yes	0 (0.0%)	16 (100.0%)	16 (100.0%)	0.213
	No	7 (9.0%)	71 (91.0%)	78 (100.0%)	
Epilepsy	Yes	0 (0.0%)	7 (100.0%)	7 (100.0%)	0.435
	No	7 (8.0%)	80 (92.0%)	87 (100.0%)	

presents the frequency of intrauterine growth restriction (IUGR) observed in high-risk pregnant women across different maternal and obstetric factors. Among women aged 18–30 years, 7.1% showed evidence of IUGR on ultrasound, while those above 30 years had a slightly higher frequency of 8.3%. This difference, however, was not statistically significant. Similarly, when stratified by gestational age at the time of ultrasound, 7.8% of those assessed between 20–22 weeks had IUGR, compared to 6.7% in those scanned at 23–24 weeks, indicating no meaningful association.

Body mass index (BMI) appeared to show a trend toward significance, as women with a BMI of 25 or below had a higher rate of IUGR (12.2%) than those with a BMI above 25 (3.8%), though this finding did not achieve statistical significance. Parity was also examined, with 11.8% of primigravida women showing IUGR, compared to 5.0% among multigravida, again reflecting a higher rate but no statistically significant difference. Chronic hypertension was present in 24 women, of whom 8.3% had IUGR. Among women without hypertension, 7.1% were affected, showing nearly identical rates with no significant relationship. Women with renal disease had a higher IUGR rate of 16.7%, compared to 6.8% in those without renal issues, but the p-value did not suggest a statistically significant association.

Interestingly, none of the women with diabetes mellitus were found to have IUGR, while 8.3% of non-diabetics did. Despite this contrast, the difference did not reach significance. A history of preeclampsia showed slightly higher IUGR rates (9.1%) than those without such a history (6.6%), but the association was weak. Notably, among women with a prior history of fetal growth restriction (FGR), none had IUGR in the current pregnancy, whereas 9.2% of those without prior FGR history did. Regarding history of intrauterine death (IUD), IUGR was observed in 18.2% of those with such a history compared to 6.0% of women without, suggesting a possible trend but lacking statistical significance. A similar pattern was seen with family history of preeclampsia, where no IUGR cases were found among affected families versus 9.0% in those without, though the sample size for this group was small. Lastly, none of the women with epilepsy had IUGR, while 8.0% of those without epilepsy did, again indicating no significant association.

DISCUSSION

In this study, uterine artery Doppler between 20 and 24 weeks of gestation was employed as a screening tool to identify high-risk pregnancies for intrauterine growth restriction (IUGR). The detection rate of IUGR was 7.4%, and although some trends were observed with maternal comorbidities and obstetric history, none achieved statistical significance. These findings align with the emerging literature advocating the utility of uterine artery Doppler in early pregnancy risk stratification, particularly in resource-limited settings.

Our IUGR prevalence (7.4%) is notably lower than that reported by **Majeed et al. (2020)**,[12] who observed a 25.56% frequency of IUGR among women with gestational hypertension. The difference may be attributed to differences in population risk profiles, as Majeed's study[12] focused specifically on hypertensive pregnancies, while our cohort included broader high-risk categories. Similarly, **Hafeez et al. (2024)**[13] showed a significant association between diastolic notch at 24 weeks and IUGR in hypertensive women (35.37%), further underscoring the predictive potential of Doppler in specific subgroups. The Doppler indices used in our study (PI >1.45 and RI >0.65) are supported by findings from **Ouda et al. (2022)**,[14] who reported excellent predictive accuracy for IUGR with PI ≥1.63 (sensitivity 83%, specificity 91.6%). Our study showed less dramatic results, which might reflect variations in equipment sensitivity, operator technique, or gestational age at screening. Several studies reinforce the importance of combining Doppler findings with biochemical or maternal clinical markers. **Plasencia et al. (2007)**[15] and **Mohammed et al. (2022)**[16] found that combining uterine artery PI with biomarkers like PAPP-A or β-hCG significantly improves prediction. Although our study did not incorporate biochemical screening, this limitation identifies an area for future research in developing multifactorial predictive models. Furthermore, **Jie et al. (2023)**[17] demonstrated that abnormal Doppler findings alone—despite normal PAPP-A—were associated with adverse outcomes, validating our study's approach in using Doppler indices as standalone markers. This is especially relevant in low-resource settings where access to biochemical markers may be limited.

Our findings are in line with **Rajasekaran and Krishnan (2022)**,[18] who also found that second-trimester uterine artery Doppler abnormalities were significantly associated with preeclampsia and FGR. They emphasized the 20–24-week window as an optimal time for Doppler screening—a recommendation that reinforces the timing used in our study. Interestingly, while **Bertholdt et al. (2020)**[19] and **Lausman & Kingdom (2013)**[20] advocate for first-trimester screening using more advanced indices or combined protocols, their suggestions may not yet be feasible in all clinical environments. Our study suggests that even second-trimester Doppler screening retains meaningful predictive value. The contribution of maternal characteristics such as age, BMI, and parity was less definitive in our findings, though **Londero et al. (2020)**[21] identified maternal age, nulliparity, and bilateral notching as significant second-trimester risk factors for IUGR. While trends in our data hinted at higher IUGR rates in primigravida and lower BMI groups, statistical significance was not achieved, potentially due to limited sample size. From a clinical implementation perspective, the recommendation by **Anderson & Sadler (2023)**[22] for routine Doppler screening in high-risk pregnancies mirrors our study's

conclusion. Their work showed that integrating uterine artery Doppler into antenatal care improved maternal and neonatal outcomes, a position that aligns with our findings and reinforces the call for early screening protocols.

Lastly, **Martins et al. (2020)**[23] and **Bernstein & Divon (2023)**[24] emphasized the need for a standardized, evidence-based approach to IUGR diagnosis and management. Our study contributes to this narrative by offering empirical data supporting the inclusion of uterine artery Doppler at 20–24 weeks in clinical guidelines, particularly for populations with a history of adverse pregnancy outcomes.

Limitations of our study include the modest sample size and lack of long-term neonatal outcomes, which limits generalizability and clinical extrapolation. Furthermore, absence of serial Doppler or integration with biochemical markers may have reduced the predictive sensitivity. Future studies should aim for multicenter trials incorporating a combination of clinical, sonographic, and biochemical markers.

In summary, our findings support the role of uterine artery Doppler analysis as a practical, non-invasive tool for early detection of IUGR among high-risk pregnancies in the second trimester. While not definitive in isolation, its integration into routine antenatal screening may aid in timely intervention and improved perinatal outcomes.

CONCLUSION: Uterine artery Doppler between 20–24 weeks gestation serves as a useful screening tool for early detection of IUGR in high-risk pregnancies. Routine second-trimester Doppler screening may improve perinatal outcomes by facilitating timely surveillance and intervention.

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