International Journal of Health Sciences and Research
Volume 14; Issue: 8; August 2024
Website: www.ijhsr.org
Original Research Article *ISSN: 2249-9571*

Effect of Maternal Body Mass Index on Umbilical Artery Doppler Changes in Pregnancies with Fetal Growth Restriction

Chinthapally Udaya Sri[1], Sangeeta Shah[2], Disha Shah[3], Mrinalini Mitra[4], Shravani Bijjala[5]

[1]Department of OBGY, [2]Department of Radiology,
Gandhi Medical College, Hyderabad, India.

Corresponding Author: Dr. Sangeeta shah

DOI: https://doi.org/10.52403/ijhsr.20240823

ABSTRACT

BACKGROUND: FGR (fetal growth restriction) represents a condition where a fetus fails to reach its expected growth potential during pregnancy. FGR is defined as EFW or Abdominal Circumference <10th percentile for gestational age (1). Increased maternal BMI is linked to abnormalities in umbilical artery Doppler indices, including pulsatility index (PI), resistance index (RI), and systolic/diastolic ratios (2). The complex relationships between maternal BMI, umbilical artery Doppler findings, and pregnancy outcomes is an intriguing area for investigation. This study is aimed at understanding the association between umbilical artery Doppler changes in pregnancies with fetal growth restriction with maternal BMI and fetal outcomes.
AIM: To study the effect of maternal body mass index on umbilical artery doppler changes in pregnancies with fetal growth restriction and fetal outcomes.
METHODOLOGY: This prospective observational study, conducted over 18 months, includes about 50 antenatal women of gestational age 28-36 weeks with FGR attending the OPD in Gandhi Hospital. The BMI of the participants was noted at the booking visit in the first trimester. They are followed up with 1-2 weekly umbilical artery doppler until delivery. Abnormal umbilical artery Doppler findings and delivery outcomes were compared across normal and elevated BMI categories.
RESULTS: In this study, women with elevated BMI had abnormal umbilical artery Doppler parameters. Lower birthweights and higher rates of C-sections were associated with higher maternal BMI.
CONCLUSION: Increasing maternal BMI shows a positive correlation with abnormal UA Doppler findings in FGR. An additional risk factor for FGR may be an elevated maternal BMI and umbilical artery Doppler might be a good indicator to predict pregnancy outcomes.

Keywords: FGR, doppler, BMI

INTRODUCTION

A developing fetus that does not grow to its predicted capacity during pregnancy is said to have intrauterine growth restriction (IUGR) also known as FGR (Fetal growth restriction). FGR is defined as either an EFW <10th percentile for gestational age or an AC <10th percentile for gestational age(1). Increased maternal BMI is linked to abnormalities in umbilical artery Doppler

indicators, including, pulsatility index (PI), resistance index (RI) and systolic/diastolic ratios (2). The complex relationships between maternal BMI, umbilical artery Doppler findings and pregnancy outcomes is an intriguing area for investigation. Obesity, identified by high BMI, is often associated with reduced placental function, leading to insufficient blood flow in the umbilical artery (3). Obese mothers may suffer from a chronic inflammatory condition that alters blood vessel structure and damages the inner lining, affecting blood flow regulation in the placenta (4). Doppler ultrasound, a non-invasive imaging technique, enables us to assess these changes by measuring velocity waveforms in the umbilical artery. This study is aimed at understanding the association between umbilical artery Doppler in pregnancies with fetal growth restriction with maternal BMI and fetal outcomes.

MATERIALS & METHODS

STUDY DESIGN: Prospective observational study

DURATION OF STUDY:18 months.

SAMPLE SIZE: 50

STUDY SUBJECTS: Antenatal patients presenting to Gandhi Hospital with a gestational age between 28 and 36 weeks gestation and EFW<10th percentile.

INCLUSION CRITERIA:

Females of age group b/w 18 and 35 years.

Patients with gestational age between 28+0 and 36 weeks gestation and EFW<10th percentile.

EXCLUSION CRITERIA:

Females less than 18 and more than 35 years of age

Fetuses with structural and/or chromosomal abnormalities were retrospectively excluded from the final analysis. Maternal medical conditions causing IUGR like chronic hypertension overt DM, CKD, heart diseases, smoking and substance abuse, genetic disorders, severe malnutrition and infections(viral and protozoal) have been excluded.

METHODOLOGY OF STUDY:

About 50 antenatal women of gestational age 28-36 weeks with FGR attending OPD in Gandhi Hospital are considered for the study. BMI was recorded for all these subjects at their booking visit in the first trimester.

• They were then divided into two groups, GROUP A included those with normal BMI(18.5-24.9) and GROUP B included those with elevated BMI(>25). Both GROUP A and GROUP B had 25 subjects each. All the subjects were followed up with 1-2 weekly umbilical artery Doppler

• UA Doppler parameters are compared with normal and elevated BMI groups.

STATISTICAL ANALYSIS:

Data was entered into Microsoft Excel (Windows 7; Version 2019) and analyzed using the Statistical Package for Social Sciences (SPSS) for Windows software (version 22.0; SPSS Inc, Chicago). Descriptive statistics. The mean and standard deviation (SD) were calculated for continuous variables, while frequencies and percentages were determined for categorical variables. Unpaired t-tests and chi-square tests were used to compare clinical outcomes in women with FGR having normal and elevated BMI. The level of significance was set at 0.05.

RESULT

TABLE 1: MATERNAL DEMOGRAPHICS

CHARACTERISTIC	BMI GROUP		P VALUE
	GROUP A (N=25)	GROUP B (N=25)	
Mean age	25.76	26.08	0.6
parity	1	2	0.3
socioeconomic status	4	3	0.3

Mean gestational age at enrolment	32.4	31.96	0.1
Mean EFW	7.5	6.9	0.1
Mean BMI	21.9	31.9	<0.0001

The mean age among the normal BMI group was 25.76 and in the elevated BMI group was 26.08. The difference between both groups is not statistically significant at p=0.6. The mean parity in the normal BMI group is 1, while in the elevated BMI group it is 2, with no statistically significant difference (p=0.3). The mean SES in the normal BMI group is 4 and in the elevated BMI group is 3, also with no statistically significant difference (p=0.3). The mean gestational age at enrollment is 32.24 weeks in the normal BMI group and 31.96 weeks in the elevated BMI group, with no statistically significant difference (p=0.1). The mean EFW is 7.5 in the normal BMI group and 6.9 in the elevated BMI group, with no statistically significant difference (p=0.1). The mean BMI in the normal BMI group is 21.9, while in the elevated BMI group it is 31.9, showing a statistically significant difference (p=0.0001).

TABLE 2: COMPARISON OF UMBILICAL ARTERY DOPPLER CHANGES.

PARAMETER	BMI GROUP		P VALUE
	GROUP A (N=25)	GROUP B (N=25)	
Elevated UAPI	2	22	<0.00001
Elevated UARI	3	21	<0.00001
Elevated UAS/D	5	19	0.00007
AEDF/REDF	2	8	0.03

In this study, 22 out of 25 subjects in the elevated BMI group had increased umbilical artery PI values, which was statistically significant ($p < 0.00001$). Additionally, 21 subjects in the elevated BMI group had increased umbilical artery RI values, also with a statistically significant p-value ($p < 0.00001$). Elevated S/D ratios were observed in 19 out of 25 subjects in the elevated BMI group, with a significant p-value of 0.00007. Furthermore, 8 out of 25 subjects in the elevated BMI group had absent or reversed end-diastolic flow, compared to only 2 subjects in the normal BMI group, with a significant p-value of 0.03.

TABLE 3: COMPARISON OF MATERNAL AND NEONATAL OUTCOMES.

CHARACTERISTIC	BMI GROUPS		P VALUE
	GROUP A	GROUP B	
Gestational age at delivery in weeks	38.9	37.3	<0.00001
Cesarean section	11	16	<0.0001
Vaginal delivery	14	9	<0.0001
Birth weight in kg	2.4	2	<0.0001
APGAR	9.6	9.4	0.3
NICU admissions	6	10	0.2
Perinatal mortality	1	3	0.29

Obese patients were delivered earlier, at an average gestational age of 37.3 weeks, compared to 38.9 weeks for patients with a normal BMI. Vaginal deliveries are more common in the normal BMI group, whereas cesarean deliveries are more frequent in the elevated BMI group. In the elevated BMI group, 16 out of 25 subjects underwent cesarean sections, with a statistically significant p-value of <0.0001. The mean birth weight in the elevated BMI group was 2 kg, compared to 2.4 kg in the normal BMI group, with a significant p-value of <0.0001. The mean APGAR score was 9.4 in the elevated BMI group and 9.6 in the normal BMI group, with a p-value of 0.3, which is not statistically significant. NICU admissions were higher in the elevated BMI

group, but this difference was not statistically significant (p=0.2). Perinatal mortality was also higher in the elevated BMI group, though this difference was not statistically significant (p=0.29).

DISCUSSION

In this study, the average age of participants was 25.92 ± 4.04 years. The mean age for the normal BMI group was 25.76 years, while for the elevated BMI group it was 26.08 years, with no statistically significant difference between the groups. In contrast, a study by Cody et al.,(2021)(5) reported that the average age of subjects was 30 years.

The mean gestational age at enrollment in the normal BMI group was 32.24 weeks, compared to 31.96 weeks in the elevated BMI group, with no statistically significant difference. Similarly, Cody et al..,(5) observed mean gestational ages of 30 weeks in the normal BMI group, 29 weeks in the overweight group, 30 weeks in obese class 1, and 28 weeks in obese class 2.

In this study, the mean BMI was 21.9 in the normal BMI group and 31.9 in the elevated BMI group. Cody et al..,(5) reported that 64% of subjects had a normal BMI while 36% had an elevated BMI, which was further divided into overweight, obese class 1, and obese class 2.

Regarding Doppler ultrasound findings, 8% of subjects in the normal BMI group had increased umbilical artery PI values, compared to 88% in the elevated BMI group. In the elevated BMI group, 84% had increased umbilical artery RI values and 76% had elevated S/D ratios, with statistically significant p-values. Cody et al..,(5) did not analyze Doppler parameters separately but found abnormal umbilical artery Doppler values in 45% of the normal BMI group, 46% in the overweight group, 45% in the obese class 1 group, and 81% in the obese class 2 group, which aligns with our findings.

The incidence of absent or reversed end-diastolic flow increased with BMI category in our study, with 8% in the normal BMI group and 32% in the elevated BMI group, showing a significant difference (p=0.03). Cody et al..,(5) found 4% of normal BMI patients and 10% of overweight, 11% of obese class 1, and 25% of obese class 2 patients had absent or reversed end-diastolic flow, which is comparable to our results.

In this study, the mean gestational age at delivery was 38.9 weeks for the normal BMI group and 37.3 weeks for the elevated BMI group, showing a statistically significant difference. Cody et al..,(5) reported mean gestational ages of 38.1 weeks in the normal BMI group, 37.5 weeks in the overweight group, 37.2 weeks in the obese class 1 group, and 35.5 weeks in the obese class 2 group, similar to our findings.

Vaginal deliveries were more frequent in the normal BMI group, while cesarean deliveries were more common in the elevated BMI group, with 64% undergoing c-sections in the elevated BMI group, a statistically significant finding. Cody et al..,(5) also noted that higher maternal BMI was associated with fewer spontaneous vaginal deliveries and a higher rate of elective cesarean sections (41%) in the obese class 2 group.

The mean birth weight in the normal BMI group was 2.4 kg, compared to 2 kg in the elevated BMI group, with this difference being statistically significant. Sarno et al..,(2015)(6) found no significant difference in birth weight across BMI categories in uncomplicated pregnancies, while Alizzi et al.., (2018)(7) noted slightly elevated birth weights in babies born to obese women, though the difference was not statistically significant.

The mean APGAR score was 9.6 for the normal BMI group and 9.4 for the elevated BMI group, with a p-value of 0.3, which is not statistically significant. Alizzi et al..,(7) found that babies born to obese women had significantly lower APGAR scores at 5 minutes compared to those born to women with normal BMI.

In our study, NICU admission rates were 24% for the normal BMI group and 60% for the elevated BMI group. Cody et al..,(5) reported NICU admission rates of 25% in

the normal BMI group, 30% in the overweight group, 39% in the obese class 1 group, and 47% in the obese class 2 group.
Perinatal mortality was 12% in the elevated BMI group in our study, compared to 3% in the study by Cody et al..,(5)

CONCLUSION

The Pulsatility index (PI) in the umbilical artery (UA) Doppler is a crucial predictor of adverse pregnancy outcomes in cases of fetal growth restriction (FGR), as it reflects resistance in the fetoplacental circulation. Maternal obesity has emerged as a significant additional risk factor among various maternal comorbidities influencing placental insufficiency in both early and late-onset FGR.
Research indicates a correlation between increasing maternal body mass index (BMI) and adverse outcomes in FGR. Specifically, a higher maternal BMI (ranging from 25 to 40) is associated with abnormal UA Doppler velocimetry, which in turn is linked to poorer delivery outcomes. This suggests that maternal obesity exacerbates the challenges posed by FGR by further compromising placental function and fetal well-being.
Further research is needed to fully understand the mechanisms underlying this correlation and to develop effective interventions.
The current evidence underscores the importance of monitoring and managing maternal weight and UA Doppler parameters in pregnancies complicated by FGR to improve outcomes.

Declaration by Authors

Ethical Approval: Approved
Acknowledgement: None
Source of Funding: None
Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Cunningham FG, Leveno KJ, Bloom SL, Spong CY, Dashe JS, Hoffman BL, Sheffield JS. Williams Obstetrics. 26th ed. New York: McGraw-Hill Education; 2022.
2. Maged AM, Moety GA, Mostafa WA, Tohamy AE. (2019). Correlation between Maternal Body Mass Index and Umbilical Artery Doppler Indices in Low-Risk Pregnancies. Journal of Maternal-Fetal & Neonatal Medicine, 32(19), 3202-3208. doi: 10.1080/14767058.2018.1457716.
3. Nelson, S. M., Matthews, P., & Poston, L. (2010). Maternal Obesity and Maternal and Neonatal Health: A Call for Action. *Obesity Reviews*, 11(7), 589-599.
4. Catalano, P. M., & Shankar, K. (2017). Obesity and Pregnancy: Mechanisms of Short Term and Long Term Adverse Consequences for Mother and Child. *BMJ*, 356, j1.
5. Cody, F., Mullers, S., Flood, K., Unterscheider, J., Daly, S., Geary, M., Kennelly, M. M., McAuliffe, F. M., O'Donoghue, K., Hunter, A., Morrison, J., Burke, G., Dicker, P., Tully, E., Malone, F. D. (2021) 'Correlation of maternal body mass index with umbilical artery Doppler in pregnancies complicated by fetal growth restriction and associated outcomes', International Journal of Gynaecology and Obstetrics. doi: 10.1002/ijgo.13586
6. Sarno L, Maruotti GM, Saccone G, Morlando M, Sirico A, Martinelli P. Maternal body mass index influences umbilical artery Doppler velocimetry in physiologic pregnancies. Prenat Diagn. 2015 Feb;35(2):125–8.
7. Alizzi, Fadia J; Ahmad, Ban1. Impact of Maternal Body Mass Index on Umbilical Artery Indices and Neonatal Outcome. Mustansiriya Medical Journal 17(2):p 93-97, Jul–Dec 2018. | DOI: 10.4103/MJ.MJ_29_18

How to cite this article: Chinthapally Udaya Sri, Sangeeta Shah, Disha Shah, Mrinalini Mitra, Shravani Bijjala. Effect of maternal body mass index on umbilical artery doppler changes in pregnancies with fetal growth restriction. *Int J Health Sci Res.* 2024; 14(8):162-166. DOI: *https://doi.org/10.52403/ijhsr.20240823*

******