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Research Article

Influence of Maternal Body Mass Index on Fetal Ultrasound Biometry

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ABSTRACT

The worldwide prevalence of obesity has increased almost multiple times in recent decades. This study aims to estimate and evaluate the correlation between the body mass index (BMI) of pregnant women and the weight as well as the biometric parameters of the fetus. In the present study, from 245 pregnant women who participated, 210 participants of pregnant women were enrolled in a private clinical center in Erbil Governorate in the Kurdistan Region, Iraq. The data were collected from December 2022 to September 2023. 210 participants were enrolled, and their ages ranged from 17 to 45 years, with a means ± SD of 30.89 ± 6.317 years, 17.1% of participant's ages were <25 years, 52% were between 25 and 34 years, and 30% were 35 years and more. The relation between maternal BMI and fetal weight in grams for <2000, between 2000 and 3000, and more than 3000 g was statistically significant with a $P = 0.027$, while the association between maternal BMI and fetal gender statistically was not significant. According to our result in the present study, BMI was not statistically significant with fetal parameters. These findings show the relationship between the fetal weight and the mother's BMI is statistically significant. However, there is no significant relationship between maternal age and all maternal BMI categories. In addition, in the third trimester of pregnancy, not all categories of the mother's BMI have an impact on fetal biometry.

Keywords: Body mass index, pregnant women, fetal weight, Obesity, ultrasound biometry

INTRODUCTION

Obesity and overweight have become more prevalent in recent years to become an important issue for worldwide health. It is the most prevalent health condition among women of reproductive age.[1] Maternal overweight and obesity during pregnancy are contributing factors to birth complications and adverse outcomes also have an important effect on health-care burden.[2]

The prevalence of obesity has increased globally almost multiple times in recent decades.[3] The World Health Organization (WHO) has described this issue as a "global epidemic," and maternal obesity is a common risk factor observed in obstetric practice. Obesity has been related to an increased risk of health problems and maternal and perinatal morbidity and mortality during pregnancy and childbirth. Pregnant women with a high body mass index (BMI) are more likely to have a variety of complications during pregnancy, such as miscarriage, stillbirth, gestational diabetes, preeclampsia, induced labor, cesarean section, and wound infection.[4,5]

High maternal BMI is linked to a number of unfavorable pregnancy outcomes, making weight management before and during pregnancy essential for favorable results.[6]

Maintaining an appropriate BMI during pregnancy significantly prevents the risk of both early and late complications in the pregnancy process, as well as possible birth complications in neonates. Obesity is prevalent among women living in industrialized countries. In developed countries, approximately 30–40% of adult women are suffering from obesity. Obesity is a health problem that impairs everyday activities and in obese women, quality of life is significantly impaired.[7]

Nearly one-fourth of women in their generative years are obese or overweight. According to guidelines established by the WHO, Obesity is determined by calculating BMI using the following formula: BMI (kg/m^2) = body weight (kg)/body height (m^2). Body built-in individuals with BMI <18.5 kg/m^2 are regarded as being underweight., BMI 18.5–24.9 kg/m^2 normal

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weight, BMI 25–29.9 kg/m^2 overweight, and BMI ≥30 kg/m^2 are considered obese. Obesity can be categorized into three degrees: BMI 30.0–34.9 (first degree); BMI 35–39.9 (second degree); and BMI ≥40 (third degree or extreme obesity). The main benefit of BMI is its simplicity of calculation. The drawback is the inability to distinguish between high muscle mass and obesity as the underlying reason for elevated body weight.[8]

It is recommended before pregnancy or early in pregnancy to work on establishing healthy eating behaviors and exercising as much as possible, and this aids in reducing excessive gestational weight gain (GWG) and helps to alleviate pregnancy-related and long-term issues for women and their offspring.[9]

Research has demonstrated that maternal overweight, a notable health concern during pregnancy, has an impact on the weight of the infant.[10]

Maternal BMI was observed to be connected with fetal weight gain and neonatal brain connectivity measures.[11]

It was found that women with high BMI their fetuses had longer bone lengths, compared to fetuses of nonobese women, starting from the 21st week of pregnancy.[12]

Maternal obesity reduced the precision of sonographic fetal weight estimation. Physicians need to be aware of the ultrasound device's limits to estimate the weight of the fetus, especially for pregnant women who suffer from excessive obesity.[13]

Ultrasound fetal biometric measurements in women with a high BMI can be confirmed by repeated measurements when performed by trained sonographers.[14]

Sonographic is accurate when comparing the fetal weight in the third trimester to neonatal birthweight at increasing BMI categories.[15]

Obtaining clear ultrasound images of the fetus is more challenging in obese pregnant women compared to women of normal weight.[16-18] Consequently, obese women have a lowered antenatal detection rate for congenital anomalies, which leads to a decrease in antepartum diagnoses and an increase in the number of liveborn and stillborn complications associated with pregnancies to obese mothers. The faster study's data analysis shows that obesity has a detrimental impact on the efficacy of second trimester genetic sonography, resulting in a notably greater rate of missed diagnoses for several minor markers and a reduced probability of identifying common anomalies in the obese population.[18]

The current study aims to determine and evaluate the relationship between pregnant women's BMI and both fetal weight and biometric measurements.

MATERIALS AND METHODS

In the present study, from 245 pregnant women who participated, 210 participants of pregnant women were enrolled in a private clinical center in Erbil Governorate in the Kurdistan Region, Iraq. The data were collected from December 2022 to September 2023.

The BMI of 210 pregnant women was calculated depending on measuring the height in meters and weight in kilograms, from which the BMI was obtained according to the formula weight/height^2.

This study included all pregnant women who were referred to these centers and who fulfilled the inclusion criteria. Here are the criteria that were used for inclusion: Age range of 17–45 years and gestational age was in the third trimester.

The 210 Participants were divided into four groups depending on their BMI, in accordance with standards set out by the WHO and the National Institutes of Health guidelines: Normal weight, BMI 18.5–24.9 kg/m^2; overweight, BMI 25.0–29.9 kg/m^2; obese class I, BMI 30.0–34.9 kg/m^2; and obese class II, BMI 35.0–39.934.9 kg/m^2. For all participants, the fetal weight was measured in grams and the four biometry parameters (biparietal diameter [BPD], Femur length [FL], Head circumference [HC], and abdominal circumference [AC]) were measured in millimeters based on the ultrasound image.

Ultrasound examination was performed transabdominally (Low-frequency curved probe (3–10 MHz) and ultrasound machine (Philips 550 and Samsung sonoAce R7) to measure and estimate Fetal growth monitoring.

The Statistical Package for the Social Sciences statistical software was used for all statistical analyses. Version (26) was used to analyze the data and measure the mean, standard deviation, and frequency for maternal age, and gestational age. The Chi-square test was used for parametric data. The data that were collected were displayed using relative

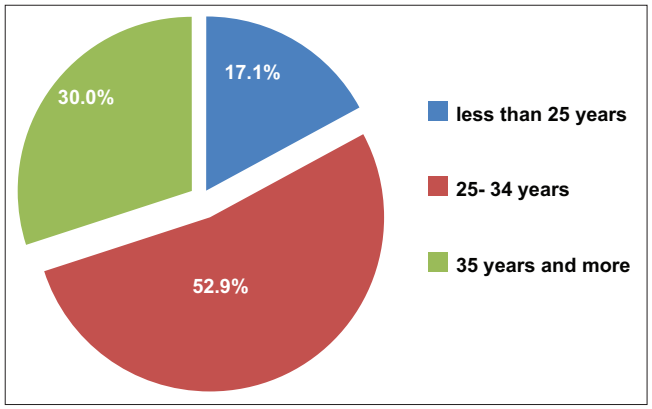

Figure 1: Age groups of the participants

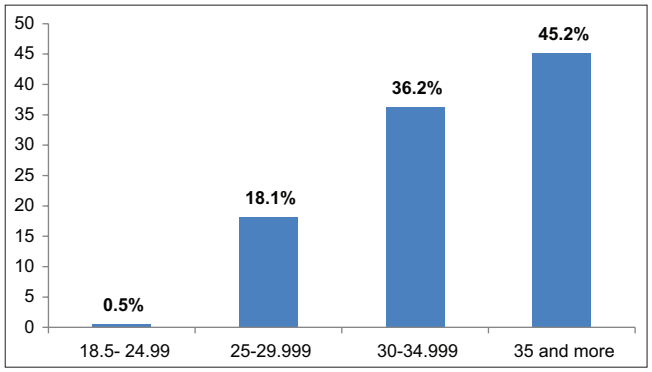

Figure 2: Body mass index categories of the participants

Table 1: Association of BMI categories to some maternal parameters

Variables	Body mass categories (No. and%)				*P*-value*
	Normal weight 18.5–24.999	Overweight 25–29.999	Obesity class 1 30–34.999	Obesity class 11 35 and more	
Age groups in years					0.323
<25	1 (2.8)	5 (13.9)	16 (44.4)	14 (38.9)	
25–34	0 (0.0)	21 (18.9)	42 (37.8)	48 (43.2)	
35 years and more	0 (0.0)	12 (19.0)	18 (28.6)	33 (52.4)	
Maternal educational level					0.483
Illiterate	1 (2.0)	11 (22.4)	17 (34.7)	20 (40.8)	
Primary	0 (0.0)	18 (19.8)	34 (37.4)	39 (42.9)	
Graduates**	0 (0.0)	9 (12.9)	25 (35.7)	36 (51.4)	
Family history					0.171
Yes	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)	
No	1 (0.5)	38 (18.3)	74 (35.6)	95 (45.7)	
Mode of delivery					0.660
Normal delivery	1 (1.3)	12 (15.4)	28 (35.9)	37 (47.4)	
Cesarean section	0 (0.0)	23 (20.7)	42 (37.8)	46 (41.4)	
Both	0 (0.0)	3 (14.3)	6 (28.6)	12 (57.1)	
Parity of the mothers					0.308
Primipara	0 (0.0)	13 (18.3)	31 (43.7)	27 (38.0)	
Multipara	1 (0.7)	25 (18.0)	45 (32.4)	68 (48.9)	
Total	1 (0.5)	38 (18.1)	76 (36.2)	95 (45.2)	210 (100.0)

*: Fischer's exact test. **: Including those who graduated from institutes and colleges. BMI: Body mass index

Table 2: Association between maternal BMI and fetal weight and gender

Variables	Body mass categories (No. and%)				*P*-value*
	Normal weight 18.5–24.999	Overweight 25–29.999	Obesity class 1 30–34.999	Obesity class 11 35 and more	
Fetal weight in grams					
<2000	1 (100.0)	10 (26.3)	20 (26.3)	16 (16.8)	0.027
2000–3000	0 (0.0)	21 (55.3)	34 (55.3)	37 (38.9)	0.027
3000 and more	0 (0.0)	7 (18.4)	22 (18.4)	42 (44.2)	0.027
Fetal gender					0.586
Male	1 (1.2.0)	15 (17.9)	35 (41.7)	33 (39.3)	
Female	0 (0.0)	22 (18.3)	39 (32.5)	59 (49.2)	
Unknown	0 (0.0)	1 (16.7)	2 (33.3)	3 (50.0)	
Total	1 (0.5)	38 (18.1)	76 (36.2)	95 (45.2)	210 (100.0)

*: Fischer's exact test. BMI: Body mass index

numbers and median values (the measure of variability). All estimates were adjusted for the following potential confounders: maternal age (maternal age (<20, 20–29, or ≥30 years), educational level (did or did not complete high school), smoking during pregnancy (yes or no), and chronic hypertension.[19]

RESULTS

In this cross-sectional study, 210 participants were enrolled, and their ages varied from 17 to 45, with a means ± SD of 30.89 ± 6.317 years, 17.1% of participants their age were <25 years, 52% were between 25 and 34 years, and 30% were 35 years and more years and more as shown in (Figure 1).

BMI of the present study was classified into four groups, 0.5% of the participants have normal weight, 18.1% were overweight, 36.2% were obese class I, and 45.2% were obese class II as shown in (Figure 2).

In Figure 3. The education of the participants, 23.3% were illiterate, 43.3% had primary education, and 33.3% had graduated.

Table 1 illustrates the association of BMI categories with some maternal parameters including the age groups, maternal educational level, family history, mode of delivery, and parity of the mothers.

The relation between maternal BMI and fetal weight in grams for <2000, between 2000 and 3000, and more than 3000 g was statistically significant with a $P = 0.027$, However, there was no statistically significant correlation found between the mother's BMI and the gender of the fetus (Table 2).

According to our result in the present study, BMI was not statistically significant with fetal parameters as shown in Table 3.

DISCUSSION

The general population's obesity rate is positively correlated with the proportion of overweight pregnant women. According to research by Kanagalingam and Forouhi Scotland's obesity prevalence has risen from 9.4% to 18.9% during 12 years.[20] 0.5% of the participants have normal weight, 18.1% were overweight, 36.2% were obese class I, and 45.2% were obese class II.

In this study, the relationship between maternal age was studied they were divided depending on their age into three groups, <25, 25–34, and 35 years and over, as well as according to their body weight into three groups: Normal weight. 18.5–24.999 Overweight, 25–29.999 Obesity class 1, 30–34.999 Obesity class 11, and 35 and more. Maternal age and all maternal BMI categories did not significantly correlate, according to the results of the Fischer exact test.

Both the age and BMI of overweight/obese are the most common medical complications of pregnancy, Women with a BMI of overweight or obese and over 35 years of age had a 2.45-fold increased risk of developing gestational diabetes mellitus (GDM). In contrast, women who combined three risk factors—being over 35 years of age, being overweight or obese, and experiencing excessive GWG during the second trimester—had a 3.38-fold increased risk of developing GDM.[21]

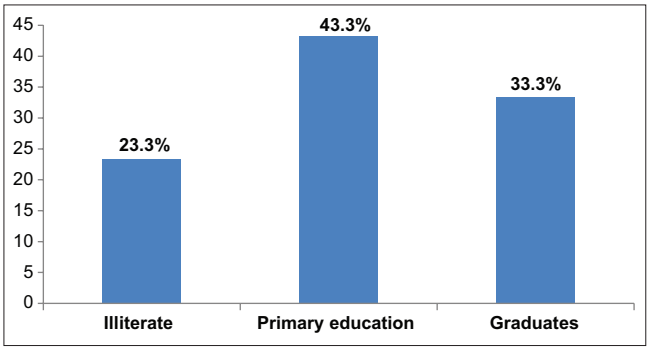

Figure 3: Educational status of the participants

According to the result of the current study, fetal growth was calculated by using ultrasound examination in the third trimester of pregnancy, and the effect of maternal obesity on fetal growth was analyzed by applying Fisher's exact test, and the relationship between maternal BMI and fetal weight was significant. This is consistent with the study that Increasing maternal BMI was favorably correlated with third trimester fetal growth.[22]

Furthermore, the results of this research are compatible with the results that Fetuses of fat mothers weighed more than fetuses of non-obese women as early as 32 weeks gestation.[23]

There is limited research on how maternal BMI affects early fetal growth, with some studies indicating that maternal BMI does not have a substantial impact on early fetal growth.[24]

While in another study found that high Maternal BMI is associated with reduced fetal size in early pregnancy and extends the length of pregnancy.[25]

An analysis of variance test was used in this study to examine the connection between the mother's BMI and the fetus's biometric measurements of the FL, BPD, HC, and AC. In terms of parameters, there is no significant difference between the BMI groups that belong to the same trimester. These results showed that fetal biometry is not affected by all maternal BMI categories in the third trimester of pregnancy.

These are similar to the results that brought together obese mothers with different values of BMI and observed the effect of Obesity on fetal biometric parameters of HC, BPD, AC, and FL and discovered that there was a significant difference observed between trimester and months while there was no significant difference observed between BMI groups. This led to the belief that fetal parameters are not affected by maternal BMI. It has been observed that there is a direct correlation between the growth of maternal body mass and the development of fetal parameters. Increased maternal weight gain during pregnancy may have adverse impacts on fetal development.[26]

Another study demonstrated a statistically significant relationship between maternal visceral adiposity and fetal biometric measures during the second trimester of pregnancy.

Table 3: Association between maternal BMI and some fetal parameters

Fetal parameters in mm	Body mass categories (Mean±SD)				*P*-value*
	Normal weight 18.5–24.999	Overweight 25–29.999	Obesity class 1 30–34.999	Obesity class 11 35 and more	
Biparietal diameter	1.000	1.631±0.488	1.0±0.472	1.768±0.424	0.132
Femur length	1.000	1.631±0.488	1.684±0.467	1.768±0.424	0.146
Head circumference	1.000	1.763±0.430	1.723±0.450	1.842±0.366	0.067
Abdominal circumference	1.000	1.578±0.500	1.671±0.472	1.663±0.475	0.411

*: Analysis of variance test. BMI: Body mass index

The correlation remained even after accounting for gestational age, across groups of obese, nonobese, gestational diabetes, and non-diabetic women. There was no significant difference in the correlation coefficient between the groups of individuals who were previously obese and those who were not obese.[27-29]

CONCLUSION

Based on the present study, we found that the relationship between maternal BMI and fetal weight was statistically significant, while there was no significant relation between maternal age and all maternal BMI categories, as well as fetal biometry, not affected by all maternal BMI categories in the third trimester of pregnancy. It is necessary to conduct new studies on pregnant women at different stages of pregnancy in the first, second, and third trimesters to have a more comprehensive study while examining BMI to monitor the effect of maternal obesity on fetal growth rates with larger sample sizes.

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