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Body Mass Index Before and After Pregnancy Associated With Maternal and Neonatal Complications

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Abstract

Objective: The aim of this study is evaluate the effects of weight before and during pregnancy on maternal and neonatal complications.

Materials and Methods: In this cohort study, the statistical population was pregnant women. After collecting all the primary information, the relationship between pre-pregnancy body mass index (BMI) and weight gain during pregnancy with preterm delivery and maternal complications such as diabetes and pre-eclampsia were studied.

Results: From a total of 1400 pregnant women, who were recruited for this study, 897 were referred to Bushehr's Persian Gulf Martyrs Hospital; statistical analysis was performed on the participants. BMI before pregnancy had no significant relationship with the number of previous abortions ($P=0.3$). No significant relationship was found between BMI before pregnancy and gestational diabetes during pregnancy ($P=0.53$), preeclampsia ($P=0.26$), or preterm delivery ($P=0.55$). Weekly weight gain was significantly less in mothers without preterm birth than mothers with preterm birth ($P=0.002$), but there was no significant difference in overall weight ($P=0.99$). BMI had a significant impact on low birth weight (LBW) in infants ($P=0.003$). The impact of pre-pregnancy BMI on Apgar scores was significant ($P=0.043$). The mother's BMI and weekly weight gain (without adjusting for confounding variables) as well as weight gain after adjusting for confounding variables had no significant effect on the mother's risk of developing gestational diabetes. The mother's age was the only confused variable (adjusted odds ratio [OR] = 1.09, $P=0.004$). Pre-pregnancy BMI had a significant impact on the chances of Small for gestational age (SGA) infants ($P=0.03$), but no significant effect on the chance of large for gestational age (LGA) births ($P>0.05$).

Conclusion: High BMI during pregnancy has an adverse outcome in pregnancy.

Keywords: Pregnancy, Body mass index, Preeclampsia, Preterm labor, Gestational diabetes, Apgar score

Introduction

Overweight or obesity in women of childbearing age is a critical public health problem, particularly in developing countries (1). Improving the health of mothers, fetuses, and infants is a key goal for the health of a population. It has been shown that obese women are exposed to maternal and child health risks at the beginning of pregnancy (2). Weight and its fluctuations during pregnancy have been considered and discussed in scientific articles for many years by researchers. Unnatural maternal weight is one of the important issues that can have a large role in the health and reproductive health of a society (3). The prevalence of over weight women is rising from 7% to 46% (4). Unfortunately, the prevalence of obesity is on the rise, stemming from socio-economic status and quality of life. Different numbers have been reported for the prevalence of lightweight women according to different societies which vary from 2% to 35% (5).

Complications attributable to maternal weight are mother's insufficient weight during pregnancy, preeclampsia, gestational diabetes, multiple birth, infant macrosomia, increased caesarean section, non-cephalic presentation, and hemorrhage during delivery, postpartum thrombophlebitis, urinary tract infection, dysfunctional labor, shoulder dystocia, and fetal asphyxia at birth (3,4,6-9). Low weight can result in maternal complications including anemia, premature rupture of membranes, low Apgar scores, low birth weight (LBW), preterm delivery, increased prenatal mortality (6,10-14).

This study examined the effects of weight before and during pregnancy on maternal and neonatal complications.

Materials and Methods

The statistical population of this cohort study was pregnant women who referred to Abolfazle clinic and Persian Gulf Martyrs Hospital in Bushehr in 2015-2016. Inclusion criteria was singleton pregnancy in which the fetus had no congenital anomalies; exclusion criteria were multiple pregnancy, cervical insufficiency, congenital anomalies, history of diabetes, hypertension, and medical conditions

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such as heart, kidney, liver, thyroid, or other acute, chronic diseases.

Information regarding gravida, para, previous miscarriage, diabetes, preeclampsia and complications of delivery as well as the history of previous preterm delivery and infant birth weight were collected from participating women at the first prenatal visit and in subsequent visits. For the current pregnancy, before pregnancy rates of infant gender, Apgar scores, birth weight, gestational age, preeclampsia, gestational diabetes, anemia, and other pregnancy complications were considered. In addition, lifestyle information such as smoking before and during pregnancy (ETS), maternal age, and even mother's education level was recorded. Maternal body mass index (BMI) was calculated using pre-pregnancy height and weight values, and participants were then divided into four groups of thin, normal weight, overweight, and obese. Thin women were those with a BMI <18.5 kg/m^2; women with a normal weight had a BMI equivalent to 18.5 to 25 kg/m^2; overweight women had a BMI of 25-30 kg/m^2; and obese women had a BMI >30 kg/m^2.

Finally, after all the information was collected, the relationship of pre-pregnancy BMI and weight gain during pregnancy with preterm delivery and maternal complications such as diabetes and pre-eclampsia were studied.

Results

Of the 1400 pregnant women recruited for this study, 897 of them were referred to Bushehr Persian Gulf Martyrs Hospital for delivery, and statistical analysis was performed for these people.

Table 1 shows the patients' demographics and fertility. Only nine of the patients (1%) had hypothyroidism during pregnancy, and one was diagnosed with thrombocytopenia. The prevalence of anemia in mothers was 1.2% (11 people) and hypothyroidism was seen in none of the mothers.

Pre-pregnancy BMI has a direct relationship with maternal age ($P=0.0001$) (Table 2). Pre-pregnancy BMI has a direct relationship with maternal parity ($P=0.0001$), but no significant relationship with the number of previous abortions ($P=0.3$). Moreover, there was no significant relationship between the education levels of mothers and BMI ($P=0.16$) (Table 3).

No significant relationship between pre-pregnancy BMI and gestational diabetes ($P=0.53$), preeclampsia ($P=0.26$), or preterm delivery ($P=0.55$) was seen; however, thin women (9.1%) and obese women (8.4%) had a higher prevalence of gestational diabetes. The overall weight gain of thin ($P=0.014$), normal weight ($P=0.006$), and overweight mothers ($P=0.04$) who had no problems with preterm birth was significantly higher than that of mothers with the problem of preterm birth, but weekly weight gains did not differ significantly ($P>0.05$); however, the weekly weight gain of overweight women without preterm birth was significantly less than that of mothers with preterm birth ($P=0.002$). No significant difference was seen in overall weight ($P=0.99$).

At all BMI levels, total and weekly weight gain women with and without preeclampsia were not significantly different ($P>0.05$).

BMI had a significant impact on overall LBW ($P=0.003$). To control for confounding factors on the relationship of BMI on LBW, Age, height, maternal education level and smoking, in addition to the weekly weight gain input into the model. The results showed that after adjusting for

Table 1. Distribution of Pregnant Women in Terms of Demographic and Reproductive in Martyrs Hospital in Persian Gulf in Bushehr in 2015-2016

Variable	Number	Percent
Education		
School	298	33.20
Diploma	413	46
University	186	20.80
Smoking		
Yes	6	0.70
No	891	99.30
Gravid		
1-2	351	39.10
3	432	48.20
≥4	114	12.70
Abortion		
0	739	82.40
1	127	14.20
≥2	31	3.50
Preterm labour		
Yes	7	0.80
No	890	99.20
Gestational age		
<34	46	5.1
34-36	153	17.1
≥37	698	77.8
Weight gain		
Sufficient	24	2.70
Insufficient	142	15.88
Over	731	81.50

Table 2. Variable Distribution of the Mothers Index Her Body Mass Before Pregnancy in Bushehr Martyrs Hospital in Persian Gulf in 2015-2016

Variable	Body Mass Index (Mean ± SD)				F	*P* Value
	Thin	Normal	Obese	Excessive		
Weight gain						
Weekly	0.57 ± 0.19	0.49 ± 0.19	0.46 ± 0.18	0.42 ± 0.21	7.61	0.0001
Total weight						
Gain	15.25 ± 4.99	13.82 ± 5	12.90 ± 4.53	11.71 ± 5.04	8.09	0.0001
Mother age	24.51 ± 5.98	26.98 ± 5.50	28.35 ± 6.11	29.88 ± 7.13	12.32	0.0001

Table 3. Distribution of Maternal Variables (Parity, Abortion, Education Level) Based on Body Mass Index Before Pregnancy Martyrs Hospital in Persian Gulf in 2015-2016

Variable	Body Mass Index (Mean ± SD)				χ2	*P* Value
	%Thin	%Normal	%Overweight	%Obese		
Parity	0	1	1	1	28.68	0.0001
Abortion	0	0	0	0	3.60	0.30
Education					13.05	0.16
School	25.9	31.8	34.6	41.7		
Diploma	46.3	45.20	48.20	44		
University	27.8	22.9	17.10	14.30		

these variables still in the mother's risk of LBW, thin, overweight and obese, respectively, 48.2, 72.1, 42.2 are equal to mothers with normal BMI (Table 4).

Generally, the impact of pre-pregnancy BMI on Apgar score was significant ($P=0.043$). The effect of BMI with consideration given to the confounding variables (age, height, education level, and smoking)and mother's weekly weight gain on Apgar scores was assessed, and it became clear that only lean mothers ($P=0.037$, odds ratio [OR] = 3.18) and obese women ($P=0.037$, OR = 2.89) have significantly greater chances of having babies with Apgar score below 8 (Table 5).

The impact of the mother's BMI did not significantly affect the chance of preterm delivery ($P>0.05$), But the chances of preterm birth in women with excessive weekly weight gain was 51.1% times that of mothers with normal weight (p=0.043) After controlling for BMI and weight gain, and other confusing variable for example height, smoking, our results showed that weekly weight gain is meaningful variable on preterm labor ($P=0.01$). Even so, only mothers with excessive weekly weight gain had a greater chance of preterm labor ($P=0.026$, OR = 1.59) and BMI does not have a significant effect on premature delivery (Table 6).

The mother's pre-pregnancy BMI and both raw and adjusted (for confounding variables) weight gain during pregnancy had no significant effect on the risk of pre-eclampsia ($P>0.05$).

The mother's BMI and raw weekly weight gain as well as after adjusting for confounding variables had no significant effect on the risk of gestational diabetes in the mother. The mother's age was the only variable that confused our results (adjusted OR = 1.09, $P=0.004$).

Pre-pregnancy BMI had a significant impact on the chances of Small for gestational age (SGA) infants ($P=0.03$). After adjusting for confounding variables such as age, height, education level, and smoking in mothers, thin women (OR = 2.43; $P=0.03$) and obese women (OR = 2.91, $P=0.001$) have a higher chance of having an SGA baby than mothers with normal BMI (Table 7).

The pre-pregnancy BMI and raw and adjusted (for confounding variables) weight gain of the mother during pregnancy had no significant effect on the chance of a large for gestational age (LGA) birth ($P>0.05$).

Discussion

The present study investigated the effects of BMI before pregnancy and weight gain during pregnancy on maternal and neonatal complications. After eliminating the confounding variables of the mother, it was generally found that weekly weight gain has a significant effect on pre-

Table 4. The Effect of Maternal BMI Before Pregnancy, the Incidence of LBW Babies Born in Martyrs Hospital in Persian Gulf 2015-2016[a]

Body mass index	OR	*P* Value	95% CI
Normal	1		
Thin	2.48	0.016	1.18-5.21
Over weight	0.91	0.72	1.09-2.1
Obese	1.59	0.026	1.30-4.51

[a]Adjusted for age, height, education level, smoking and amount of weight gain during the second quarter and third weeks of mother.

Table 5. The Effect of Maternal BMI Before Pregnancy, the Chance of Having a Baby With an Apgar Score Below 8 Babies Born in the Martyrs Hospital in Persian Gulf in 2015-2016[a]

Body mass index	OR	*P* Value	95% CI
Normal	1		
Thin	3.18	0.037	1.07-9.41
Over weight	1.24	0.63	0.51-3.03
Obese	2.89	0.041	1.04-8.03

[a]Adjusted for age, height, education level, smoking and amount of weight gain during the second quarter and third weeks of mother.

Table 6. Weekly Levels of Maternal Weight Gain on Preterm Delivery in Pregnant Women at the Hospital in Martyrs Hospital in Persian Gulf 2015-2016[a]

Weight Gain Weekly	OR	*P* Value	95% CI
Sufficient	1		
Insufficient	0.91	0.72	0.55-1.49
Excessive	1.59	0.026	1.05-2.40

[a]Adjusted for age, height, education level, smoking and amount of weight gain during the second quarter.

Table 7. The Effect of Maternal BMI Before Pregnancy, the Chances of SGA Birth Babies Born in Martyrs Hospital in Persian Gulf 2015-2016[a]

Body mass index	OR	*P* Value	95% CI
Normal	1		
Thin	2.43	0.03	1.09-5.40
Over weight	1.38	0.21	0.82-2.34
Obese	2.91	0.001	1.02-5.58

[a]Adjusted for age, height, education level, smoking and amount of weight gain during the second quarter and third weeks of mother

mature delivery and with excessive weekly weight gain, mothers run a greater risk of preterm labor; preterm delivery had no significant effect on BMI. While similar studies have been done on many of these confounding factors, their effects have still not been explained.

The findings of this study indicate that BMI has no effect on premature delivery, whereas Brokowski and Mielniczuk (15) suggest in their study that the risk of preterm labor in women with a higher than normal BMI is higher than in women with a normal BMI. Doherty et al (16) reported a significant statistical relationship between some undesirable consequences of pregnancy in mothers with higher than normal pre-gestational BMI, but the risk of preterm delivery in women with a higher than normal BMI was not higher than that in women with a normal BMI. In another study by Briese et al (17), the researchers concluded that the risk of preterm birth in women with obesity is reduced. A study by Ehrenberg et al (18) obtained the result that obese are less likely to give birth earlier than 35 weeks. Conversely, results of the current study showed that only 257 women in the study were overweight and their BMIs were within the normal range, yet a woman with lower than normal BMI has an increased risk of premature birth.

The chances of an overweight woman having an SGA birth were not higher than those of a woman with a normal BMI. After adjusting for confusing listed on the birth of SGA infants in mother's lean and obese mothers were not more than mothers with normal weight. The impact of pre-pregnancy BMI and weekly weight gain during pregnancy on LGA taking into account confounding factors and without these factors had no significant correlation.

According to the current findings, Apgar score below 8 in lean and obese mothers was 3.55 and 2.67 times against mothers with normal BMI.

The findings of the current study suggest that the effect of BMI on LBW is significant; It was 1.75 times bigger in overweight mothers and 2.25 times bigger in obese mothers compared with normal BMI. Moreover, this relation stayed significant after controlling the effect of BMI on LBW in terms of weekly weight gain.

The results obtained for SGA, LGA, Apgar scores, and LBW have not been reported in other similar studies, and achieving such results indicates the accuracy and extent of the current study.

Two studies carried out by Spuy et al (19) reported that preeclampsia may occur if it has occurred in the mother's previous pregnancies; Chesly (20), however, stated in his study that low weight women are more likely to develop eclampsia, but this result was not true for preeclampsia. Brown (21) stated in his study that preeclampsia occurs in about half of the lightweight women compared with normal weight women. He further said in his study that this factor increases in two mentioned groups. The study of Patel et al has concluded that preeclampsia is more likely to occur in heavyweight mothers compared with normal weight mothers. The current study suggests that there is no significant relation between pre-gestational BMI and the risk of preeclampsia or preterm delivery (22-26).

Another factor examined in this study was gestational diabetes. Based on the obtained results, there is no relation between pre-gestational BMI and this disease or with preterm birth, but it is noteworthy that the current study found age to be among those factors which affect occurrence of gestational diabetes.

The factors investigated in this study have not been examined in other similar studies, and this in itself shows the superiority of the current study in terms of its results and the extent of items considered.

Conclusion

High BMI during pregnancy causes adverse outcomes in pregnancy.

Ethical Issues

The local ethics committee approved the study.

Conflict of Interests

None.

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