

The Effect of Increased Maternal Body Mass Index on Pregnancy Outcome : A Comparative, Prospective Study

Original
Article

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ABSTRACT

Aim: This study aimed to investigate the impact of increased body mass index (BMI) of pregnant women on maternal and neonatal outcomes.

Study Design: This is a clinical article prospective study.

Materials and Methods: In a prospective study, a total of 300 pregnant women were recruited. Women were divided into normal-weight group (BMI 18-24.9Kg/m²), overweight group (BMI 25-29.9Kg/m²), and obese group (BMI \geq 30 Kg/m²). All women were followed-up until delivery for maternal and neonatal outcomes.

Results: The obese women had a significantly higher incidence of gestational hypertension than normal-weight women (43.3% versus 15.6%, $p = 0.002$); the incidence of albuminuria was significantly higher in obese women than normal-weight women (11.3% versus 2%; $p = 0.001$). The incidences of gestational diabetes in obese and overweight women were 13.4% and 13.2%, respectively; these incidences were significantly higher than normal weight group 0.1% ($p = 0.004$). Likewise, the incidence of miscarriage was higher in obese and overweight women (4.1% and 9.4%, respectively) than normal-weight women 2% ($p = 0.003$). We found that Apgar scores at the 1st and 5th minute after birth were significantly lower in neonates of obese and overweight women ($p = 0.004$). Likewise, the rate of NICU admission was higher in neonates of obese and overweight women ($p = 0.002$).

Conclusion: In conclusion, there is an obvious impact of increased BMI on the risks of adverse pregnancy outcomes, including both maternal and neonatal outcomes.

Key Words: Body mass index, fetal outcomes, maternal outcomes, obstetrics outcomes, obesity

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INTRODUCTION

Despite being a globally-recognized disease with many hazardous consequences, the prevalence of obesity continues to rise exponentially in both developed and developing countries^[1]; recent global figures demonstrated a triple rise in prevalence of obesity in the past few decades affecting up to 650 million adults by the end of 2016^[2]. In the Middle East and North Africa region (MENA), nearly 20% of the total population suffers from obesity^[3]. Obesity contributes to a wide range of adverse health consequences, including insulin resistance and hyperglycemia, diabetes, cardiovascular diseases, sleep disorders, metabolic abnormalities, osteoarthritis, and overall mortality^[4,5]. Obesity has a profound impact on the national and global economy levels; as it significantly increases the rate of outpatient visits, hospitalizations, and overall medical costs^[6]. In addition, obesity, as a major cause of disability, has a negative impact on workforce productivity and work/school attendance^[7].

Maternal obesity is a challenging situation for obstetricians. Previous reports demonstrated that obesity affects up to 60% of the women in the childbearing period in some countries of the MENA region^[8]. Pre-pregnancy obesity has many hazardous effects on mother and fetus health. Antenatally, it significantly increases the risk of gestational diabetes, gestational hypertension and preeclampsia, thrombotic events, and, eventually, abortion^[9]. Moreover, Obese pregnant women have a higher risk of instrumental delivery or cesarean delivery (CD) compared to women with normal weight^[10]. The risks of postpartum hemorrhage, infection, and prolonged hospital stay increase significantly in obese pregnant women^[11]. The hazardous effects of obesity are not limited to the mothers, but affect the fetal and neonatal outcomes as well; maternal obesity is an independent predictor of fetal growth restriction, stillbirth, low APGAR scores, needs for resuscitation, neonatal intensive care (NICU) admission, and neonatal mortality^[10]. Additionally, maternal obesity exerts negative effects on child health as well^[11].

Body mass index (BMI) is the universally accepted, anthropometric measure for diagnosis of obesity and assessment of its severity. Obesity is diagnosed when the BMI is more than 30Kg/m²^[12], while overweight is identified as a BMI ranging from 25 to 30Kg/m²^[2]. Recent reports indicated that increased BMI is a predictor of overall mortality and cardiovascular diseases^[13]. Nonetheless, little data is available regarding the hazardous effect of increased BMI on pregnancy outcomes. Thus, we aimed to study whether increased BMI has negative effects on maternal and neonatal outcomes.

PATIENTS AND METHODS

The Institutional Review Board (IRB) of Beni-Suef University hospitals reviewed and approved the study protocol before initiation of the study (IRB No. 2612/18). All eligible women, who agreed to participate, signed written informed consent before commencement of the study. We followed the instructions of the STROBE statement in writing and reporting of our study findings^[14].

In a prospective, observational study, a total of 300 pregnant women were recruited from the outpatient clinics of Beni-Suef General Hospital from June 2017 to June 2018. We included pregnant women aged > 18 years old with a gestational age <17 weeks and had no documented hypertension. Based on their BMI, we divided them into a normal-weight group (BMI 18-24.9Kg/m²), overweight (BMI 25-29.9Kg/m²), and obese group (BMI ≥30Kg/m²). In addition, we excluded women with pre-gestational diabetes mellitus, history of cardiovascular diseases, and/or history of previous complicated pregnancy. Eligible women were recruited using non-probability, consecutive sampling technique.

At the initial antenatal care (ANC) visit, we collected the following data from pregnant: age, gravidity, parity, and gestational age based on the last menstrual period (LMP) or first trimester ultrasound. We performed general examination including blood pressure measurement, anthropometric parameters, including weight, height, and waist circumference to calculate BMI and examination for edema. Abdominal, pelvic examinations, laboratory testing including complete blood picture (CBC), urine analysis, and fasting blood glucose (FBS) and abdominal

ultrasonography were also done.

Then, all study participants were followed up until delivery per the guideline of Beni-Suef General Hospital. The decision regarding the mode of delivery was solely based on the obstetric indications and the local hospital guidelines and protocols.

The primary outcome was to assess the association between BMI and maternal/fetal outcomes throughout the study's period. The maternal outcomes included the risk of cesarean deliveries, preterm delivery, miscarriage, impaired glucose tolerance or gestational diabetes, hypertensive disorders of pregnancy, and postpartum complications. The diagnosis of gestational diabetes and hypertensive disorders of pregnancy was based on the American Diabetes Association and International Society for the Study of Hypertension in Pregnancy, respectively^[15,16]. The neonatal outcomes included neonatal birth weight, prematurity, need for NICU admission, perinatal death, birth injuries, congenital anomalies, and APGAR score at 1 and 5 minutes.

STATISTICAL ANALYSIS

The statistical analysis was performed using SPSS version 22.0. categorical variables were presented as number and percentage while numerical variables were described as mean ± standard deviation (SD). Tests of significance (student's t-test, or Mann Whitney's test) were used for quantitative variables according to the normality of the data, and Chi-square test was used for qualitative variables. A *P-value* < 0.05 was considered statistically significant.

RESULTS

A total of 300 women with a mean age of 27 years old were divided according to their BMI into normal-weight group (N =150 women), overweight group (N =53 women), and obese group (N=97women; Figure 1). The three studied groups were comparable in terms of age (*p* =0.49), residence (*p* =0.57), marital status (*p* =0.87), occupation (*p* =0.81), and level of education (*p* =0.12). However, obese women had a significantly higher rate of multiparity than normal-weight women (82.5% versus 37.3%, respectively; *p* =0.002; Table 1).

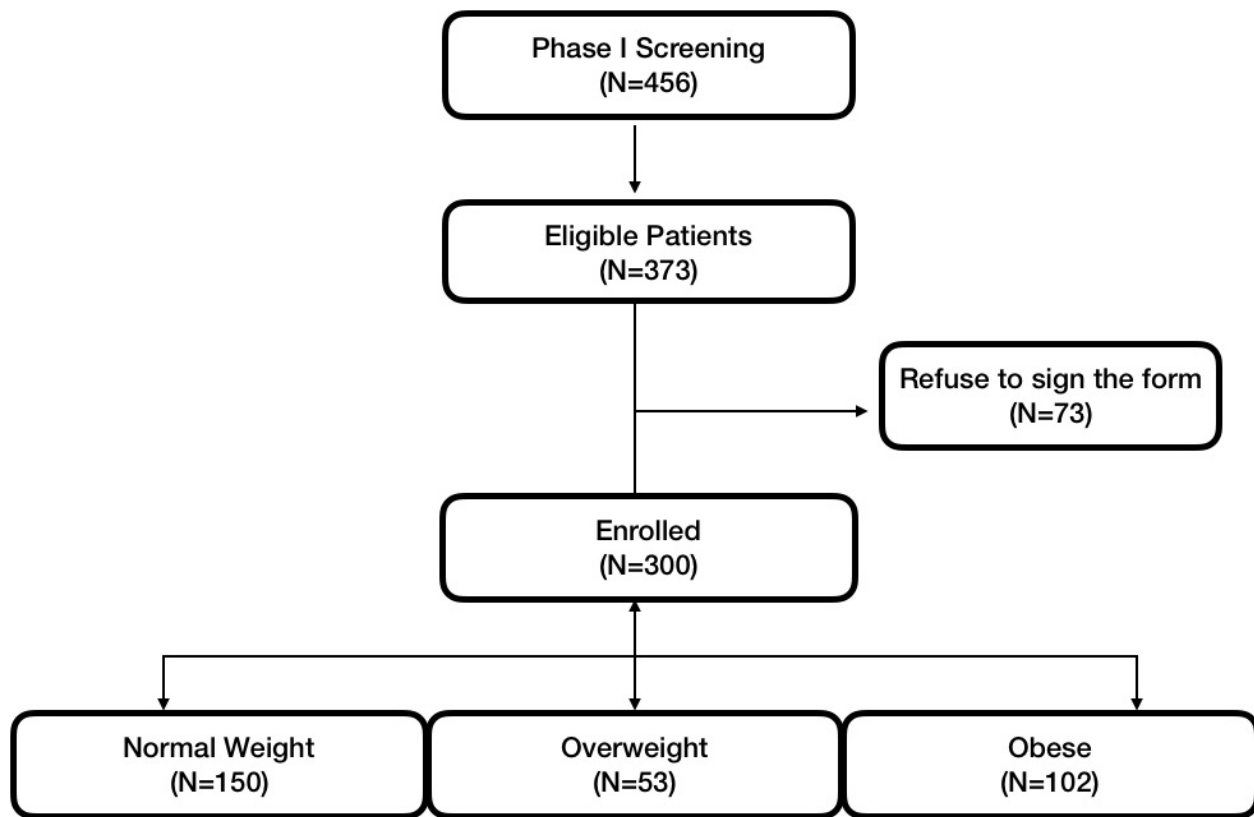


Table 1: Baseline characteristics of the included women

Variables	BMI			<i>P</i> -value
	20-24.9 N=150	25-29.9 N=53	> or=30 N=97	
Age (in years) Mean (27)	20	32	29	0.492
Gravidity	1	11(20.8%)	17(17.5%)	0.002
	2-3	44(29.3%)	32(33%)	
	>or=4	12(8%)	48(49.5%)	
Residency	Urban(191)	38(71.7%)	64(66%)	0.571
	Rural(109)	15(28.3%)	33(34%)	
Marital Status	Married (294)	51(96.2%)	96(99%)	0.87
	Divorced(5)	2(1.3%)	1(1%)	
	Widowed(1)	1(0.7%)	0(0.0%)	
Occupation	Yes (23)	7(13.2%)	10(10.3%)	0.81
	No education(239)	44(83%)	74(76.3%)	
Education	Primary school(43)	6(11.3%)	10(10.3%)	0.12
	High education(18)	3(5.7%)	13(13.4%)	

The overall percentage of women who had gestational hypertension in pregnancy was 22.2%; obese women had a significantly higher incidence of gestational hypertension than normal-weight women (43.3% versus 15.6, respectively; $p = 0.002$); however, the difference between overweight women with and normal weight women was not significant. The incidence of albuminuria was significantly higher in obese women than normal-weight women (11.3% versus 2%; $p = 0.001$). The incidences of gestational diabetes in obese and overweight women were 13.4% and 13.2%, respectively; these incidences were significantly higher than normal weight group were 0.7% ($p = 0.004$). Likewise, the incidence of miscarriage was higher in obese and overweight women than normal-weight women (Table 2).

The incidence of vaginal delivery was significantly higher in the normal weight group (85.7%) than the overweight (62.5%) and obese women

groups (54.8%; $p = 0.001$). However, the incidence of emergency cesarean deliveries (CD) was not different between studied groups ($p = 0.175$). Likewise, the incidence of postpartum hemorrhage was comparable between studied groups ($p = 0.42$; Table 2).

Neonatal Apgar scores at the 1st and 5th minute of birth were significantly lower in neonates of obese and overweight women compared to neonates of normal-weight women ($p = 0.004$). Likewise, the rate of NICU admission was higher in neonates of obese and overweight women ($p = 0.002$). The average neonatal birth weight was 3267 grams. The macrosomic babies accounted for 12.2% of all delivered babies from all groups (35/300); 85.7% of macrosomic babies in obese/overweight group (20.8% of overweight women and 21.5% of obese women, compared to only 3.4% of normal weight group are macrosomic). Obese women had a significantly higher incidence of shoulder dystocia ($p = 0.004$; Table 3).

Table 2: Maternal Outcomes of the Included Women

Variables	BMI			P value	
	20-24.9 N=150	25-29.9 N=53	>or=30 N=97		
FBS	≤ 110mg Count(279)	149(99.3%)	46 (86.8 %)	84(86.6%)	0.004*
	> 110mg Count(21)	1 (0.7%)	7(13.2%)	13 (13.4%)	
Miscarriage		3(2%)	5 (9.4%)	4 (4.1%)	0.003
Type of delivery	NVD(207)	126(85.7%)	30(62.5%)	51(54.8%)	0.001
	CS(81)	21(14.3%)	18(37.5%)	42(45.2%)	
Type of CS	Elective(57)	14 (66.7%)	12(66.7%)	31(73.8%)	0.175
	Emergency(24)	7(33.3%)	6(33.3 %)	11(26.2%)	
Postpartum Hemorrhage		26(17.7%)	14(29.2%)	12(12.9%)	0.48

Table 3: Neonatal Outcomes of the included women

Variables	BMI			P value
	20-24.9 N=150	25-29.9 N=53	≥30 N=97	
APGAR_1min > 7 count (256)	143(97.3%)	40(83.3%)	73(78.5%)	0.004
APGAR_5min>7 count (260)	144(98 %)	42(87.5%)	74(97.6%)	0.003
Neonatal ICU admission	3(2 %)	6 (12.5%)	19(20.4%)	0.002
	N=147	N=48	N=93	
Macrosomia(35 macrosomic babies)	5 (3.4%)	10 (20.8%)	20 (21.5%)	0.004
Congenital Anomalies	2(1.4%)	1 (2.1%)	0(0.0%)	0.451
Shoulder dystocia	0(0.0%)	0(0.0%)	2 (2.2%)	0.004

DISCUSSION

The current body of evidence appears to be consistent regarding the impact of severe maternal obesity on pregnancy outcomes; however, little data is available regarding the impact of overweight and obesity on these outcomes. Our results demonstrated that the overweight and obese, pregnant women were at increased risks of gestational hypertension, albuminuria, gestational diabetes, and risk for CD. Moreover, fetuses of overweight and obese women were more prone to lower Apgar scores, NICU admission, macrosomia, and shoulder dystocia than fetuses of normal-weight women.

The current body of evidence highlights linear relationship between the body adipose tissue and hypertensive disorders in pregnancy; previous studies reported a nearly two-fold increase in the risk of hypertensive disorders for each 5-7 Kg/m² increase in maternal BMI^[17]. While the exact pathogenic mechanisms of this association are unclear, many authors hypothesized that the excessive release of inflammatory mediators among obese women and the associated endothelial dysfunction are potential contributors to the development of hypertensive disorders during pregnancy^[18]. In our cohort, we observed a progressive increase in the risk of gestational hypertension with higher maternal BMI. In a 2016 report by Van Der Linden *et al.*, the risk of gestational hypertension increased progressively with higher BMI^[19]. This was also in accordance with a 2017 report by Miao *et al.*^[20].

Obesity is an established, independent, risk factor for hyperglycemia and DM, which led to the development of diabetes concept. In the setting of maternal obesity, excessive adipose tissue results in overproduction of adipocytokines, which, in return, induces insulin resistance, impaired response to insulin, and dyslipidemia^[21]. These factors can subsequently lead to the development of gestational diabetes and other metabolic disorders^[9]. Our findings were in line with two previous reports that indicated a significant correlation between higher BMI and a higher risk of gestational diabetes^[22, 23].

As expected, the higher prevalence of metabolic disorders among obese women was reflected on maternal outcomes at delivery. We observed that women with higher BMI experienced higher risks of miscarriage and CD. Such findings were in line with Miao *et al.*^[20], Cheung *et al.*^[24], and Al-Hakmani *et al.*^[25] studies. The role of obesity in increasing the risk for CD is unclear; however, this association potentially stems from the higher possibility of dysfunctional labor among obese than non-obese women, which is manifested by prolonged labor and impaired cervical dilatation^[26].

Infants of obese women are characterized by excessive fat mass and macrosomia, which, in return, increase the risk of adverse neonatal outcomes^[21]. This study revealed that neonatal Apgar scores at 1st and 5th minute of birth were higher in normal weight than overweight and obese women. We also found that NICU admission was significantly higher in overweight and obese women than

normal weight women. Moreover, fetuses of overweight and obese women were more prone to macrosomia and shoulder dystocia than fetuses of normal-weight women. This is agreed with Madi *et al.*, study^[27], which reported an increased incidence in NICU admission between babies of obese women group (17.1%) compared to normal weight group (15.9%). In our study, there was a non-significant difference between obese/ overweight group and normal weight group regarding risk of birth defects. This was also in accordance with Miao *et al.*^[20] and Al-Hakmani *et al.*^[25] studies.

One of the limitations of this prospective study, as well as previous studies, is the possible confounding by several factors. These include patient-related factors, as well as a diversity of definitions and assessment methods of adverse obstetric outcomes. The recruitment of the patients from one center and the lack of preplanned sample size calculation are another limiting factors in the present study, which might have affected the generalizability and the confidence in our findings.

CONCLUSION

In conclusion, there is an obvious impact of increased BMI on the risks of adverse pregnancy outcomes, including both maternal and neonatal outcomes. Both overweight and obesity significantly increase the risk of gestational DM, gestational hypertension, need for CD, NICU admission, macrosomia, and shoulder dystocia. Further studies are needed to characterize the effect of potential confounding factors on the impact of BMI on pregnancy outcomes and to investigate the exact pathogenesis behind the negative role of increased BMI on both mother and fetus.

CONFLICT OF INTEREST

There are no conflicts of interests.

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