Original article

Mothers pre-pregnancy body mass index, weight alterations and neonatal birth weight

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Abstract

Background: In order to clarify the association between maternal body mass index and gestational weight gain with maternal and fetal complications.

Methods: In this descriptive cross-sectional investigation, pregnant women with 18-30 years of age referring to health care centers in sari, Mazandaran, Iran were enrolled

Results: In this study 400 pregnant women were examined. The mean ± SD age of study population was 27.8 ± 4.8 years. 125 participants (31.3%) were presented with low IOM and 77 patients (19.3 %) were high IOM.

The mean weight of fetal birth weight was 3.2±0.4 kg. Weights of 377 newborns were between 2500 to 4000 gr. 8 cases (2%) had low birth weight and 15 cases (3.8%) were over than 4000 gr. The mean ± SD of newborns length was 49.6 ±5.6 cm. The mean ± SD of head circumflex of newborns was 34.4± 3.6 cm. There was no significant association between mothers BMI and infant head circumflex, height and weight.

There was no significant correlation between macrosomia and mothers IOM (p=0.07).

There was no significant association between infants' weight and mothers IOM (p=0.3).

There was significant correlation between BMI and IOM (p=0.000). Preterm delivery was noted in 6 women (6.5%) with BMI more than 29 and in 1 participant (1.2%) with BMI of 26.1 to 29. There was significant association between BMI and preterm birth (p=0.001). Gestational diabetes mellitus was noted in 6 women with BMI more than 29 (p=0.000). Gestational diabetes mellitus was reported in 6 women with normal IOM (p=0.04). Preeclampsia was noted in 3 women with BMI of 26.1 to 29 (p=0.04).

Conclusion: Pregravid overweight or gaining weight will increase the risk of overweight birth.

Keywords: *body mass index, weight, birth weight*

Introduction

The incidence of obesity has risen over the past several decades and in spite of advancements in modern medicine, it remains a risk factor for morbidity and mortality in western countries [1–3].The increasing prevalence of obesity worldwide has prompted the World Health Organization (WHO) to designate obesity as one of the most important global health threats (4). The epidemic is especially pronounced in young people, including women of reproductive age. (5)

Prepregnancy obesity is an independent risk factor for maternal and neonatal morbidity and mortality. (5,6)The origin of this epidemic is unhealthy lifestyle – high energy and high-fat diet, physical inactivity and smoking.

Approximately 47% of United States women are currently overweight (7). Obesity among American pregnant women ranges from 18.5% to 38.3%, depending on the study-cohort and cut-off point used (8). The prevalence of obesity in pregnant women ranges from1.8% to 25.3%, using WHO criteria [body mass index (BMI) >30 kg/ m^2].

The disadvantages of maternal obesity start even before conception. There is a higher prevalence of polycystic ovary syndrome among obese women. Deep venous thrombosis and pulmonary embolism are the leading causes of maternal mortality in the UK (9).

Optimal nutrition and weight gain in pregnancy are important for securing, protecting and promoting the health of women and newborns (10,11) .Maternal pre-pregnancy nutritional status and body mass index (BMI) and pregnancy weight gain also affect the outcome of pregnancy, survival of the newborn, health status later in life, normal adult weight and no obesity(10,12,13).

During the critical time of pregnancy, the inappropriate body weight, either excessive or insufficient, could be related to important problems for maternal and neonatal outcomes, they are included fetal death, preeclampsia, gestational diabetes, macrosomia, multifetal pregnancy caesarean section, malpresentation, obstetric bleeding, postpartum thrombophelebitis, urinary tract infection, dysfunctional labor, shoulder dystocia and fetal asphyxia at birth (14-17). GWG has also been thoroughly studied as a predictor of adverse pregnancy outcomes, mainly because of the belief that it is potentially modifiable after conception. Low gain is associated with anemia, premature rupture of membranes (PROM), low apgar score, low birth weight (LBW), small-for-gestational age (SGA) infant, preterm delivery and increase of perinatal mortality(16, 18,19,20,21), whereas high gain is associated with greater risks of macrosomia (19,20,22), cesarean section (23,24), and excess postpartum weight retention (25,26,27).

Consequently, various recommendations have been made about weight gain during pregnancy [1,5]. In 1990, the Institute of Medicine (IOM) published gestational weight gain guidelines to help reduce adverse pregnancy outcomes [28]. For women with a BMI < 19.8 kg/m2, a weight gain of 28–40 lb was recommended; with a BMI 19.8–24.9 kg/m2, a weight gain of 25–35 lb; with a BMI 25.0–29.9 kg/m2, a weight gain of 15–25 lb; and with a BMI > 29.9 kg/m2, a weight gain of at least 15 lb with no upper limit (1,3). This report confirmed a strong association between weight gain during pregnancy and infant size [1, 5].

However, weight gain in most pregnant women is not within the range recommended by IOM, and is considered to be too low or too high compared with current standards [1,5]. Furthermore, information on patterns of weight gain in pregnant women from developing countries is scarce [1,5].

Maternal and neonatal complications associated with BMI and GWG (gestational weight gain) are of public health importance because they add to the disease burden in women and children and increase medical costs. However, understanding these associations is also complex, because both BMI and GWG are closely linked to lifestyle factors, diseases, and genetic traits that are also correlated with the outcome of pregnancy. In addition, pregnancy outcomes (eg, birth weight) may be in the causal pathway between GWG and other pregnancy outcomes (eg, cesarean delivery), which also complicates the interpretation of these relations.

This study was performed in order to determine the correlation between maternal body mass index and gestational weight gain with maternal and fetal complications in patients receiving prenatal care.

Method

In this descriptive cross-sectional study, pregnant women in their first trimester with 18-30 years of age referring to health care centers in sari, Mazandaran, Iran were enrolled. Exclusion criteria included irregular prenatal care, multi-fetal pregnancy and systemic diseases which affect the pregnancy including hypertension, diabetes mellitus and history of preeclampsia. After consent confirm of volunteer patients 400 women were enrolled in the study. In the initial information was collected on maternal age and demographic status, education, parity, gestational weight gain, maternal height and past history of premature delivery were recorded.

The BMI classification used for this study has previously been used to examine the relationship between body fat and pregnancy outcomes. The BMI has become the standard measure for clinicians to use in classifying patients as overweight or obese because it is highly correlated with percentage ofbody fat and because morbidity and mortality increases with increasing BMI. Based on BMI values participants were divided to four groups including low weight (<19.8 kg) , normal weight (19.8-26 kg) ,over weight (26.1-29) and fatty (26.1-29).

These four groups were matched based on age, number of previous pregnancies and education level. Then participants were weighted every time they referred to health centers.

The SPSS software program was used for statistical analysis and P<0.05 was considered as statistically significant. The T Test and one way ANOVA were used to compare the means and the association between the two qualitative variables was assessed by Chi-Square test. This study was approved and supervised by the Ethics Committee of Mazandaran University of Medical Sciences.

Results

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Results

In this study 400 pregnant women were enrolled in the study. The mean ± SD age of study population was 27.8 ± 4.8 years. 259 women (64.8 %) required cesarean delivery.

The mean ± SD weight (before pregnancy) and length of mothers were 64 ±12.7 kg and 158.4± 5.9 cm, respectively. Total gestational weight gain was 11.3 ±**4**kg.

108 (27 %) participants had unplanned pregnancy. Preterm birth was observed in 7 cases (1.8%) and post term birth was recorded in 2 cases (0.5 %).

42(10.5%) participants were underweight, 183(45.8%) were of normal weight, 83 (20.8%) were overweight and 92 (23%) were obese (table 1).

Table 1. Baseline characteristic of study population based on BMI

BMI	**number**
19/8>	42(%10/5)
26-19/8	183(%45/8)
29-26/1	83(%20/8)
29<	92(%23)

Table2. The number of cases according to IOM

IOM	**number**
low	125(31.35)
normal	198(49.5%)
high	77(19.3%)

125 participants (31.3%) were presented with low IOM and 77 patients (19.3 %) were high IOM table 2.

The mean weight of Neonatal birth weight was 3.2±0.4 kg. Weights of 377 newborns were between 2500 to 4000 gr. 8 newborns (2%) had low birth weight and 15 cases (3.8%) were over than 4000 gr.

The mean ± SD of newborns length was 49.6 ±5.6 cm. The mean ± SD of head circumflex of newborns was 34.4± 3.6 cm.

The association of newborns height, weight and Head circumflex are summarized in table 3. There was no significant correlation between mothers BMI and infant head circumflex, height and weight.

Table 3.correlton of infants' characteristics and mothers BMI

Head circumflex		**height**		**weight**		**Infant features / BMI**
SD± M	**no**	**SD± M**	**no**	**SD± M**	**no**	
33/1±7/5	4	49/6±7	4	3/2±0/4	42	19/8>
34/4±3/8	18	49/4±5/1	183	3/2±0/4	18 3	26-19/8
34/6±1/3	83	49/7±5	83	3/2±0/3	83	29-26/1
34/9±1/3	92	49/9±6/2	92	3/3±0/3	92	29<
0/07		0/8		0/2		**P-value**

Macrosomia in infants were observed in two mothers (1.6 %) with low IOM, 7 (3.5%) with normal IOM and 6 (7.8%) with high IOM. There was no significant association between macrosomia and mothers IOM (p=0.07).

Table 4. The correlation between BMI and IOM

P-value	**IOM**				
	high	**nl**	**low**		
/0000	3(%7/1)	(%26/2) 11	(%66/7) 28	19/8>	**BMI**
	(%18/6) 34	(%53/6) 98	(%27/9) 51	26-19/8	
	(%14/5) 12	(%62/7) 52	(%22/9) 19	29-26/1	
	(%30/4) 28	(%40/2) 37	(%29/3) 27	29<	

LBW infants were noted in 3 mothers (2.4 %) with low IOM, 5 (2.5%) with normal IOM. there was no

significant association between infants' weight and mothers IOM (p=0.3).
There was significant correlation between BMI and IOM (p=0.000) table 4.

Women with BMI < 19.8 kg/m2 had the lowest rate of cesarean section (32 cases), and the most cesarean interventions were performed among subjects categorized as a group with 19.8-26 kg/m2. Table 5

Table 5. The correlation of BMI and type of delivery.

P-value	Type of delivery			
	cesarean	nl		
/087 0	32(%67/2)	10(%26/8)	19/8>	BMI
	117(%63/9)	66(%36/1)	26-19/8	
	46(%55/4)	37(%44/6)	29-26/1	
	64(%69/6)	28(%30/4)	29<	

Preterm delivery was noted in 6 women (6.5%) with BMI more than 29 and in 1 participant (1.2%) with BMI of 26.1 to 29. There was significant association between BMI and preterm birth (p=0.001).
Preterm delivery was recorded in 1 woman with low IOM, 5 women with normal IOM and 1 participant with high IOM (p=0.48).
Gestational diabetes mellitus was noted in 6 women with BMI more than 29 (p=0.000). Gestational diabetes mellitus was reported in 6 women with normal IOM (p=0.04).
Preeclampsia was noted in 3 women with BMI of 26.1 to 29 (p=0.04). Preeclampsia was reported in 1 woman with low,1 in normal and 1 in high level of IOM (p=0.6)

Discussion

The relationship between pre-pregnancy BMI and fetal growth is biologically plausible, although the direct pathway by which pre-pregnancy BMI influences infant birth weight is not known. In a review of the relationship between maternal BMI, energy intake and pregnancy outcomes, Neggers and Goldenberg [29] found that prepregnancy weight consistently predicted most neonatal measurements compared to other maternal factors [29]. The authors hypothesized a complex interaction of genetics, maternal nutrition, gestational weight gain and other factors for this relationship, likely mediated through maternal nutritional pathway [29]. This notion of complex interaction among multiple maternal factors is supported by work performed by other investigators. Kramer et al. [30] attributed temporal trends of increasing infant birth weight and preterm birth to a combination of factors, including increased maternal adiposity, reduced cigarette smoking and changes in socio-demographic factors .

Birth weight plays an important role in infant mortality and morbidity, childhood development, and adult health [31]. Thame et al. [32] documented relationships between birth weight, childhood growth, and blood pressure, suggesting early programming of blood pressure in pregnancy [32]. Reduced birth weight is related to the risk of type-2 diabetes and ischemic heart disease in later life [33]. In addition, LBW results in increased healthcare expenditures due to extended hospital stays for preterm delivery. At the other end of the birth weight spectrum, macrosomia increases the risk of c-section delivery, delivery complications (i.e. shoulder dystocia), and subsequent childhood obesity [33-35].
During late pregnancy, hypertension, gestational diabetes, and preeclampsia were all considerably more common in overweight and obese women than in normal-weight women. The additional risk contributed by GWG was modest, except that preeclampsia was strongly associated with higher weight gains and gestational diabetes was strongly associated with low weight gains. We found that prepregnancy BMI was by far the strongest predictor of the outcomes under study. The contribution of GWG was modest except for infant size at birth. We found, as have others (36-38), that GWG was associated with complications during late pregnancy, such as preeclampsia and gestational diabetes. However, any causal interpretation of the association between total weight gain and these complications is limited. Stamnes Koepp UM (39) et al revealed that Offspring birth weight increased with both increasing maternal pre-pregnant BMI and maternal weight gain during pregnancy in all categories of maternal pre-pregnancy BMI. But in our study there was no significant correlation. Stuebe AM et al (40) showed that among 1250 participants with untreated mild gestational glucose intolerance, pregravid BMI was correlated with increased gestational birthweight, and neonatal fat mass. In another study in china Liu Y et al (41) showed that Being overweight or obese and having a high weight gain besides being underweight and having a low weight gain, were correlated with increased risks for adverse pregnancy outcomes.
In conclusion our study showed that there was association between prepregnancy overweight risks of overweight birth.

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