

*Full Length Research Paper*

# The effect of maternal body mass index on the delivery route in nulliparous women

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Body mass index (BMI) is widely used to categorize the degree of obesity and to guide recommendations for weight gain during pregnancy, to examine the relationship between the maternal body mass index of nulliparous women and the route of delivery in a sample of Iranian Kurdish women, a cross sectional descriptive study was conducted, at Beasat Hospital in Sanandaj, the capital of Kurdistan province, west of Iran. The study sample consisted of 980 nulliparous women with spontaneous labor. Results showed that there is a significant association between cesarean section and higher maternal BMI. The cesarean section rate rose from 30% in women with normal BMI to 56% in the women with  $BMI \geq 35$ . Overweight women should be given information about risk of cesarean section before conception and be encouraged to reduce their weight.

**Key words:** Body mass index, cesarean section, nulliparity.

## INTRODUCTION

Body mass index (BMI) is used to measure obesity and it is defined as the ratio of body weight in kilograms divided by the square height in meters (World Health Organization, 2000). BMI is widely used to categorize the degree of obesity and to guide recommendations for weight gain during pregnancy (Bell et al., 2011). Obesity is an epidemic not only in developed countries but also in the developing world. Furthermore, obesity is becoming an increasingly common problem, both in general population and in women of the reproductive age (Catalano, 2007). There is a growing body of evidence suggesting that obese pregnant women are at greater risk of a number of maternal and fetal complications of pregnancy, including pre-eclampsia, cesarean section intrauterine death (Cedergren, 2004; Dempsey et al., 2005), induction of labor and anesthetic complications (Robinson et al., 2005). Heslehurst et al. (2007) conducted a systematic

review to ascertain the impact of BMI on pregnancy outcomes. The results indicate that labor complications in heavier women may lead to cesarean births.

Despite the abundance of research investigating pregnancy outcomes in obese women, no study has been done regarding this issue in Kurdish women. Therefore, we aimed to examine the relationship between the maternal BMI of nulliparous women and the route of delivery in Sanandaj, Northwest Iran.

## MATERIALS AND METHODS

This cross sectional study was conducted at Beasat Hospital in Sanandaj. Nine hundred and eighty nulliparous women with a spontaneous of labor were enrolled. Written informed consent was obtained from the participants. We included term primigravida women with a singleton fetus and cephalic presentation who were

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**Table 1.** Maternal, fetal, and labor characteristics of the study population, with crude CD rate.

Variable	No.	%	Crude CD rate, %
<b>First-trimester BMI, kg/m<sup>2</sup></b>			
<25	556	56.7	30.9
25- <30	317	23.3	36.0
30-<35	88	9.0	40.9
>35	19	1.9	56.9
Mean $\pm$ SD	24.7 $\pm$ (4.06)		
<b>Maternal age</b>			
<20	151	15.4	23.8
20-24	400	40.8	27.3
25-29	303	30.9	41.6
30-34	99	10.1	46.5
>35	27	2.8	59.3
Mean $\pm$ SD	24.4 $\pm$ (4.7)		
<b>Oxytocin</b>			
No	477	48.7	36.9
Yes	503	51.3	31.2
<b>Origin</b>			
Rural	348	35.5	27.3
Urban	632	64.5	37.7

willing to participate. The exclusion criteria were pre- and post-term labor, fetal distress and disproportion of the pelvis and head. Maternal height and first-trimester weight, as written in the patients' medical records, were used to calculate BMI. It was calculated for each patient by using the formula kg/m<sup>2</sup>. The women were grouped into four categories with respect to their BMI: normal (< 25), overweight (25  $\leq$  30), obese (30  $\leq$  35) and morbidly obese ( $\geq$  35) (World Health Organization, 2000). Data regarding the patients' demographic and labor characteristics including maternal age, educational level, place of residence (urban versus rural), oxytocin induction of labor (yes/no) and mode of delivery (vaginal versus caesarean section) were obtained (Table 1).

Data were analyzed using statistical package for social sciences (SPSS) software, version 18. A P value < 0.05 was considered as statistically significant. Descriptive analysis and multivariable regression was used to calculate odd ratios (OR) with 95% confidence intervals (CI).

## RESULTS

The study sample consisted of 980 singleton pregnancies in nulliparous women. The mean age of the women was 24.4  $\pm$  4.7 years (range: 16 to 40 years). Six hundred and thirty two (64.5%) women lived in urban area. 873 (80%) had a BMI < 30. 88 (9%) women were obese, with a BMI between 30; 35, and 19 (1.9%) women were morbidly obese with a BMI  $\geq$  35. Overall, 583 (59.5%) women had

vaginal deliveries and 397 (40.5%) had unplanned cesarean births. A significant association between cesarean section and higher maternal BMI was found. The cesarean section rate rose from 30% in women with a normal BMI to 56% in women with a BMI  $\geq$  35 (Table 1). In the logistic regression model, the OR for all cases of cesarean delivery increased significantly from 1.0 to 3.1 (95% CI: 1.21 to 7.78) within the same two groups of women. For 51.3% of the deliveries, oxytocin was used to induce labor. The cesarean section rate was 31.2% in the women with oxytocin induction; while in women whose labor was not induced with oxytocin, the cesarean section rate was 36.9% ( $p < 0.05$ ).

The rate of cesarean section also increased from 41.6% in women 25 to 29 years of age to 59.3% in women > 35 years of age (Table 1). In the logistic regression model, the OR for all cases of cesarean delivery increased significantly from 2.3 to 4.6 (95% CI: 1.98 to 10.9) within the same two groups of women. It was found that an increase in BMI increased the risk of cesarean section for suspected fetal distress (SFD). The OR for fetal distress rate increased from 1.0 in women with a normal BMI to 3.18 in women with a BMI  $\geq$  35. In the logistic regression model, the OR for SFD cesarean delivery increased but not significantly from 1.0 to 3.18

**Table 2.** Risk for cesarean delivery in total, due to suspected fetal distress or failure to progress in spontaneous labor, at term with a single cephalic presentation.

Variable n=980	CD due to FTP		CD due to SFD		CD in total	
	95% CI	OR	95% CI	OR	95% CI	OR
<b>First – trimester BMI, kg/m<sup>2</sup></b>						
25	1.0		1.0		1.0	
25-30	1.28	0.82-2	1.92	1.23-9	1.2	0.94-1.68
30-35	0.84	0.37-1.91	2.86	1.55-5.28	1.54	0.98-2.45
35	2.6	0.83-8.07	3.18	1.0-10.0	3.1	1.21-7.78**
<b>Maternal age, years</b>						
20	1.0		1.0		1.0	
20-25	1.02	0.55-1.86	1.6	0.65-4	1.2	0.78-1.86
25-30	0.83	0.43-1.59	5.4	2.52-12.76	2.3	1.47-3.53**
30-35	1.2	0.53-2.58	5.4	2.05-14.07	2.8	1.61-4.78**
35	0.68	0.15-3.12	4.2	1.1-16.0	4.6	1.98-10.9**
<b>Origin</b>						
Rural	1.0		1.0		1.0	
Urban	0.98	0.64-1.50	3.28	1.92-5.6	1.6	1.2-2.14**
<b>Oxytocin</b>						
No	1.0		1.0		1.0	
Yes	27.9	10.1-76.5	0.39	0.26-0.60	0.77	0.59-1.02

Odds ratios and 95% confidence intervals are mutually adjusted all variables in the model. BMI, body mass index; CD, cesarean delivery; CI, confidence interval; FTP, failure to progress; OR, odds ratio; SD, standard deviation; SDF, suspected fetal distress.

(95% CI: 1.0 to 10.0) within the same two groups (Table 2). Furthermore, with respect to failure to progress in labor (FTP), the OR increased from 1.0 in women with a BMI normal to 2.6 in women with a BMI  $\geq$  35. In the logistic regression model, the OR for FTP cesarean delivery increased even not significantly from 1.0 to 2.6 (95% CI: 0.83 to 8.07) within the same two groups (Table 2).

## DISCUSSION

Obesity is an epidemic not only in developed countries but also in the developing world. Our findings suggest that an increased BMI is associated with an increased risk of perinatal complications, including cesarean section. These findings are consistent with other studies (Bergholt et al., 2007; Graves et al., 2006; Mantakas and Farrell, 2010; Kominiarek, 2010; Vahratian et al., 2004). Ehrenberg et al. (2004) showed that obesity exerts significant influence on the route of delivery.

In this investigation, we restricted our population to nulliparous woman at term to ensure a homogenous group

as possible. The risk of cesarean section increased from 30.9% in women with BMI < 25 to 56.9% in women with BMI  $\geq$  35. This is consistent with a prior study including 6509 nulliparous women that showed the cesarean section rate rose from 18.2% in women with a normal BMI (20 to 25) to 40.6% in the morbidly obese women (BMI > 40) (Mantakas and Farrell, 2010). The exact causes of the increased cesarean section rates amongst obese women could not be identified from the obtained data and it was not possible to confirm exactly why obese women were experiencing more cesarean section. The increased cesarean section rate could be attributable to a variety of factors, including delay in the first stage of labor, unsuccessful induction of labor, fetal macrosomia, fetal distress and the obstetrician's decision.

Vahratian et al. (2004) studied the impact of BMI on the outcome of pregnancy. They found that labor progression in overweight and obese women is slower than women with a normal weight. In our study, an increase in BMI significantly increased the risk of cesarean delivery in total cases but not for suspected fetal distress and failure to progress cases when analyzing them separately.

According to Cnattingius et al. (1998), the presence of excess intra-abdominal adipose tissue itself could mechanically obstruct the progression of labor, contributing to a failure to progress. In addition, if progression of labor is mechanically obstructed, this could over time compromise feto-placenta circulation and cause fetal distress.

Zhang et al. (2007) found that the myometrium in obese women contracted with less force and frequency and had less  $\text{Ca}^{2+}$  flux than that of women with a normal weight. They concluded that obesity may impair the ability of the uterus to contract in labor. The exact mechanism of dysfunctional labor in obese women is not completely understood. Elevated cholesterol level has been shown to decrease uterine contractility, and obese women are more likely to have elevated cholesterol levels than women with a normal weight (Wray, 2007). This elevation in cholesterol may result in the higher incidence of dysfunctional labor in obese women and subsequent cesarean section.

In this study, the increased risk of cesarean section in obese women could also be a consequence of difficulty and lack of facilities for accurate monitoring of the progress of labor and fetal condition in our center. Without accurate monitoring of progression in labor, the risk of cesarean section may have increased. Moreover, the outcomes may have been influenced by differences in the decision-making processes leading to detected progress of labor and the monitoring of obese woman among different obstetricians. Another contributing factor to the increased cesarean section rate was maternal age. Maternal age of more than 30 years was found to increase the chance of a cesarean delivery. Bergholt et al. (2007) also found an association between maternal age and cesarean delivery. According to Toro et al. (2002), the physiological mechanism resulting in efficient uterine action in nulliparous women could be affected by maternal age. This could be the result of increased incidence of anatomical age-related alteration in uterine contractility.

The most important finding of our study was the cesarean rate (41%) in 980 births in our center which is different from WHO standards and recommendations (2008). This finding confirms the importance of understanding the causes or contributing factors and presenting approaches for avoiding or reducing cesarean section. Studies show that obese and overweight women were more likely to be induced and required a cesarean section compared with women with a normal BMI (Athukorala et al., 2010; Demont-Heinrich et al., 2009; Kominiarek et al., 2010; Mantakas and Farrell, 2010; Park et al., 2011).

In contrast to another study, the findings of the present study showed that the rate of cesarean section was lower in the women whose labor was induced. This may be related to the obstetrician's decision for cesarean section before using oxytocin for induction. One of the limitations

of the study was the insufficient number of morbidly obese women ( $n = 19$ ) to analyze the effects of morbid obesity separately. Moreover, there is the failure to collect reliable data on the indication for cesarean section. It would be valuable to explore how the indications for cesarean section in obese women compare with those of women with a normal weight.

In the present study, the authors found a correlation between the delivery route and increased BMI which could be important from a clinical point of view concerning the management of vaginal deliveries among overweight, obese and morbidly obese women. Therefore, overweight women should be given information about risk of cesarean section before conception and be encouraged to reduce their weight.

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