

Full Length Research Paper

Effect of Maternal Body Mass Index on Labor Progress in Nulliparous Women

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Abstract

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 meters¹. BMI is widely used to categorize the degree of obesity and to guide recommendations for weight gain during pregnancy². 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, induction of labor and anesthetic complications. **Aim of the work:** The aim of the present study is to investigate the effect of maternal body mass index on labor progress in nulliparous women. **Patients and method:** Prospective observational comparative (cohort) study to evaluate the impact of maternal body mass index on labor progress in nulliparous women by comparing labor pattern in underweight and obese nulliparous women to those with normal range BMI. Study was conducted at Obstetrics and Gynecology department of AL-Azhar University hospital (New Damietta) and Damietta General hospital (Ministry of health and population) during the period from June 2017 to May 2018. **Results:** Labor progressed more slowly with increasing admission BMI. These effects were significant for the active phase of labor (i.e. 4 to 10 cm cervical dilatation) and overall were more pronounced for nulliparas as BMI increases. The mean traverse times to progress from 4 cm to 10 cm was (4.09) hours for BMI < 18.5 kg/m² compared to (5.36) hours for BMI 18.5-29.9 kg/m² and (6.08) hours for BMI ≥ 30.0 kg/m². **Conclusion:** Maternal BMI increases labor progresses more slowly and labor duration increases

Keywords: BMI, Nullipara.

Introduction

Obese pregnant women are at increased risk for maternal and perinatal complications, and the risks are amplified with increasing degrees of maternal obesity⁴. Among the adverse effects on the fetus are an increased risk of childhood and adult obesity⁵. Obstetric providers should be aware of these risks and modify patient care before pregnancy, during pregnancy, and postpartum to optimize maternal and offspring outcomes⁶.

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 age⁷. In 2006, the recommendations of The Institute of Medicine conference on the impact of pre-pregnancy weight on the maternal and neonatal health were that: Further researches should be done to study that influence⁸. The aim of the present study is to investigate the effect of maternal body mass index on labor progress in nulliparous women.

Patients and methods

Prospective observational comparative study was conducted on 279 pregnant nulliparous women at term during labor to evaluate the impact of maternal body mass index on labor progress in nulliparous women by comparing labor pattern in underweight and obese nulliparous women to those with normal range BMI. Study was conducted at Obstetrics and Gynecology department of AL-Azhar University hospital (New Damietta) and Damietta General hospital (Ministry of health and population) during the period from June 2017 to May 2018.

Inclusion Criteria:

1. Nulliparous women in active labor.
2. Their ages ranged between 20-40 years.
3. Full term pregnancy “between 37 completed weeks-42 weeks”.
4. All participants carrying singleton viable fetus, cephalic (vertex) presentation, occipito- anterior position.

Exclusion Criteria:

1. Ruptured membranes before onset of active labor.

2. Pregnant women with inadequate pelvis or cephalopelvic disproportion.
3. Women with any medical disorder.(diabetes mellitus, severe hypertension, preeclampsia, cardiac, renal or endocrinal disorders)
4. All inductions of labor. (Stripping of membranes, amniotomy, oxytocin infusion, prostaglandins...)
5. Conditions requiring urgent delivery. (Placenta previa, abruptio placentae, cord prolapse, etc...)

In this study, women with pregnancy complications have been excluded as they did not fulfill the inclusion criteria for the study. Only healthy (low risk pregnancy) women with a normal pregnancy and a spontaneous onset of labor remain. Females were assigned in one of the following 3 groups based on their body mass index (BMI) .and each group contained 93 women.

Group A: include the pregnant women with a BMI < 18.5 kg/m²(underweight group). (Study group)

Group B: include the pregnant women with a BMI 18.5-29.9 kg/ m² (normal range group). (Control group)

Group C: include the pregnant women with a BMI ≥ 30.0 kg/m² (obese group)

Study group

Labor management protocols including the timing and frequency of cervical examinations performed during labor were fixed. Data on labor progression (repeated, time-stamped cervical dilatation, consistency of cervix, cervical effacement and head station) were collected. The median duration of labor by each centimeter of cervical dilatation was computed for normal weight (body mass index [BMI] 18.5–29.9 kg/m²), underweight (BMI < 18.5 kg/m²), and obese (BMI ≥ 30.0 kg/m²) women and used as a measurement of labor progression.

Outcomes Measured

- A. Intrapartum eventsexamined: include “Cervical dilatation, Consistency of cervix, cervical effacement and head station every hour during labor”, duration of active phase in hours, duration of 2nd stage in hours, failure of progress of labor and mode of delivery.
- B. Post partum events examined: include “Fetal weight”.

Results

Table (1) below represents the baseline Characteristics of Term, Nulliparous Women according to Their Admission BMI, We noticed that the mean maternal age in obese women was greater than the mean in the normal range group women that was also greater than the mean in underweight women, while the mean of maternal height in obese women was less than the mean in the normal range group women that was also less than the mean in underweight women. We found that the mean gestational age was nearly similar between the three groups.

Table 1. Baseline Characteristics of Term, Nulliparous Women according to Their Admission BMI.

Characteristic	BMI categories (Kg/m ²) at admission			Total	p value
	Underweight group < 18.5	Normal range group 18.5 - 29.9	Obese group ≥ 30		
Total	93	93	93	279	
Maternal age, y , mean (SD)	22.8 (1.98)	24.4 (3.25)	26.2 (2.3)	24.49 (2.99)	0.005
Maternal weight (Kg) at admission, mean (SD)	55.9 (1.96)	73.6 (8.85)	90.4 (7.45)	73.4 (14.54)	0.005
Maternal height,m , mean (SD)	1.74 (0.02)	1.69 (0.05)	1.66 (0.06)	1.7 (0.06)	0.005
Gestational age, WK , mean (SD)	38.1 (0.15)	38.8 (0.69)	38.8 (0.69)	38.6 (0.67)	1.000

Results showed that the incidence of intrapartum CS increase with increased maternal BMI: (30 %) for BMI < 18.5 kg/m², (41%) for BMI 18.5-29.9 kg/m² and (56.5%) for BMI ≥ 30 kg/m². In addition, CS for labor abnormalities increased as BMI increased (p-value 0.005). We found that the mean fetal birth weight increase with increased maternal BMI: (2.69 kg) for BMI < 18.5 kg/m² (underweight group), (3.0 kg) for BMI 18.5-29.9 kg/m² (normal range group) and (3.4 kg) for BMI ≥ 30 kg/m² (obese group). So as BMI increased, so did the fetal birth weight.

We noticed that labor progressed more slowly with increasing BMI at time of admission. These effects were significant for the active phase of labor (i.e. 4 to 10 cm cervical dilatation) and overall were more pronounced for nulliparas as BMI increases. The mean traverse times to progress from 4 cm to 10 cm was (4.09) hours for BMI < 18.5 kg/m² compared to (5.36) hours for BMI 18.5-29.9 kg/m² and (6.08) hours for BMI ≥ 30.0 kg/m².

We found that the mean rate of cervical dilatation was (1.53 cm/hr) for BMI < 18.5 kg/m² compared to (1.23 cm/hr) for BMI 18.5-29.9 kg/m² and (1.08 cm/hr) for BMI ≥ 30.0 kg/m². We found that the average duration of the 2nd stage of labor was (1.69) hours for BMI < 18.5 kg/m² compared to (1.78) hours for BMI 18.5-29.9 kg/m² and (1.89) hours for BMI ≥ 30.0 kg/m². Differences in the second stage length did not clearly persist in the adjusted analysis suggesting that other factors besides BMI

(i.e. birth weight) may play a role in the second stage of labor in nulliparas. Finally, we found that overall labor duration increased with increasing admission maternal BMI. Data were statistically described in terms of mean \pm standard deviation (\pm SD), median and range, or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was done using one way analysis of variance (ANOVA) test with post-hoc multiple 2-group comparisons. For comparing categorical data, Chi square (χ^2) test was performed. Exact test was used instead when the expected frequency is less than 5. p values less than 0.05 was considered statistically significant.

Discussion

In a smaller prospective study of nulliparas at term where BMI categories were determined by the pre-pregnancy weight, the authors reported that obese and overweight gravidas were not only admitted earlier in labor, had more inductions, and required more oxytocin, but also had a longer median duration of labor in progressing from 4–10 cm compared to normal BMI gravidas (7.9, 7.5, and 6.2 hours respectively) (Muir et al., 2018). This reflects a similar pattern described in the current study.

Carlson et al., 2017 found that obese women have longer labors, are more likely to have inadequate contraction patterns during the first stage of labor and are more likely to receive oxytocin for labor induction and augmentation. This finding agreed with the present study which revealed that BMI was a significant predictor of labor duration in nulliparas women.

Our results showed that cervical dilatation had a negative correlation with maternal BMI. As we found that the mean rate of cervical dilatation was (1.53 cm/hr) for BMI < 18.5 kg/m² compared to (1.23 cm/hr) hours for BMI 18.5 - 29.9 kg/m² and (1.08 cm/hr) hours for BMI \geq 30.0 kg/m². We found that the average duration of the 2nd stage of labor was (1.69) hours for BMI < 18.5 kg/m² compared to (1.78) hours for BMI 18.5-29.9 kg/m² and (1.89) hours for BMI \geq 30.0 kg/m².

Finally, we found that overall labor duration increased with increasing admission maternal BMI and as BMI increased, so did the fetal birth weight. (Sharadha et al., 2016) found a significantly higher rate of arrest of dilatation in obese when compared to lean women. They concluded that the nearly three-fold higher frequency of arrest of dilatation was not explainable by the small difference in birth weight between the two groups. Few studies have addressed the specific impact of BMI on labor progression (Vahratian et al., 2004) (Nuthalapaty et al., 2004). The purpose of the current study was to characterize labor progression in gravidas with respect to their BMI at labor admission. If differences in labor patterns based on maternal BMI are found, this may help optimize labor management and ultimately impact the CS rate.

In this large study of contemporary labor practices across Obstetrics and Gynecology department of AL-Azhar University hospital (New Damietta) and Damietta General hospital (Ministry of health and population), We noticed that the mean maternal age and weight in obese women was greater than the mean in the normal range group women that was also greater than the mean in underweight women, while the mean of maternal height in obese women was less than the mean in the normal range group women that was also less than the mean in underweight women. We found that labor progressed more slowly with increasing admission BMI. These effects were significant for the active phase of labor (i.e. 4 cm to 10 cm cervical dilatation) and overall were more pronounced for nulliparas as BMI increases. The mean traverse times to progress from 4 to 10 cm was (4.09) hours for BMI < 18.5 kg/m² compared to (5.36) hours for BMI 18.5-29.9 kg/m² and (6.08) hours for BMI \geq 30.0 kg/m².

Other investigations reported similar findings with respect to labor progression and maternal weight. In a smaller prospective study of nulliparas at term where BMI categories were determined by the prepregnancy weight, the authors reported that obese and overweight gravidas were not only admitted earlier in labor, had more inductions, and required more oxytocin, but also had a longer median duration of labor in progressing from 4–10 cm compared to normal BMI gravidas (7.9, 7.5, and 6.2 hours respectively) (Ellekjaeret et al., 2017). This reflects a similar pattern described in the current study. (Sharadha et al., 2016) found a significantly higher rate of arrest of dilatation in obese when compared to lean women. They concluded that the nearly three-fold higher frequency of arrest of dilatation was not explainable by the small difference in birth weight between the two groups.

Prior studies have speculated on the potential etiology for the differences in labor progression with increasing BMI (Gunnarsson et al., 2017). Increased fetal size or greater induction rates seem to be accused but these factors can be controlled in the study design or analysis. It is possible that there is an underlying pharmacological mechanism such as decreased responsiveness to oxytocin or even an endocrinological alteration to explain these differences. An in vitro study which evaluated leptin effects on human myometrium noted a physiologic inhibitory effect on contractility, suggesting that leptin may play a role in the dysfunctional labor process associated with maternal obesity (Hajagos-Tóth et al., 2017). We found during the study that intrapartum CS increased with BMI in nulliparas (30 %) for BMI < 18.5 kg/m², (41.1%) for BMI 18.5-29.9 kg/m² and (56.5%) for BMI \geq 30 kg/m². In addition, CS for labor abnormalities increased as BMI increased (P < 0.005). (Li et al., 2017) documented a linear association between maternal prepregnancy BMI and cesarean delivery in almost 17,000 term deliveries in France, while controlling for other risk factors for cesarean delivery. The explanation for this finding is unknown, but several theories have been proposed, including greater fetal size, soft tissue obstruction to labor, poor uterine contractility, more frequent inductions as a result of pregnancy complications, or care-giver biases (Hajagos-Tóth et al., 2017). Robertson et al., 2017 found that obesity (body mass index \geq 30 kg/m²) increased the likelihood of primary caesarean delivery before (OR = 2.01, 95% CI 1.39-2.90) and after (OR = 2.12, 95% CI 1.86-2.42) the onset of labor. This finding agreed with the present study which revealed that BMI but not weight gain was a significant predictor of cesarean delivery in nulliparas women. Another study found that women whose body mass index (BMI) was greater than 30 were six times more likely to have a cesarean section for cephalopelvic disproportion (and /or) failure to progress (Kawakita et al., 2016). (Vinturache et al., 2017) found that there is a linear rise in CS as maternal body mass index

(BMI) increases. It was noted that there was a higher rate of emergency cesarean section in obese group compared with both normal weight group and underweight group. This could be explained by the increased numbers of normal weight women who had vaginal delivery. This result comes in agreement with a randomized controlled study done by Agrawal et al., (2016) who investigated the effect of pre-pregnancy body mass index and pregnancy outcome. The results of this study was that obese women were more likely to be delivered by cesarean section compared with normal weight women, and also with a retrospective observational study at University of Lübeck done by Neumann et al., (2017) who reported that, The incidence of cesarean delivery rise significantly with an increased in BMI.

Women with a BMI > 35 kg/m² had 3 times greater chance of cesarean delivery than women with a BMI < 25 kg/m². This results come in agreement also with other investigations done By Xiong et al,(2016), Ellekjaeret et al., (2017), Moussa et al., (2016), An et al., (2017), Carlson et al., (2017), and Kawakita et al., (2016) who have found similar adverse outcome related to increasing maternal weight. Although most investigations that refer to maternal weight used a prepregnancy weight to calculate BMI and determine weight categories, we used admission BMI for our study since weight most proximate to delivery would have a greater impact on labor and delivery patterns. We determined that as maternal BMI increases labor progresses more slowly and labor duration increases. Based on our data, the effect of BMI on labor progression is clearly pronounced in nulliparas women. We suggest that obstetric providers take this information into consideration before intervening with a CS for abnormal labor, especially in nulliparas in whom delivery route may have a major impact on future pregnancy outcomes.

Similar to other studies that have suggested greater patience in the labor process (Rosenbloom et al., 2017), consideration should be given to extending the traditionally considered upper limits for duration of labor based upon maternal BMI. The study results highlights the concept that contemporary labor practices should take into account the changing profiles of obstetrical populations particularly increasing BMI. Allowing for a slower progression in labor for obese nulliparas prior to intervening with a CS has the important potential of decreasing the number of CS performed for labor abnormalities. Further, changing labor practices in the obese nulliparas may impact additional perinatal outcomes such as decreasing infectious and other operative morbidities.

Conclusion

Maternal BMI increases labor progresses more slowly and labor duration increases. Based on our data, the effect of BMI on labor progression is clearly more pronounced in nulliparas. There is a linear rise in CS rates as maternal body mass index (BMI) at time of admission increases. On the other hand, underweight women cope poorly with their pregnancy. They had significantly higher rates of cardiac/respiratory problems, anemia, premature rupture of membranes (PROM) and endometritis but were less prone to develop preeclampsia. Prematurity, a low-birth-weight infant, IUGR births and low Apgar scores were significantly more frequent in the infants of underweight women. Finally, the health and economic impacts of rising rates of obesity and underweight in women of reproductive age are of significant public health importance regarding their risk factors and adverse outcomes.

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