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Original article

Effects of gestational weight gain and body mass index on obstetric outcome

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ABSTRACT

Abstract It is already known that maternal overweight, obesity, and morbid obesity are associated with adverse obstetric and neonatal outcomes. To assess the prevalence of overweight and obesity, and the impact of body mass index (BMI) on maternal and neonatal outcomes in Turkey. The study population consisted of 698 singleton pregnancies whose height and weight follow up were performed from the first trimester of pregnancy and whose deliveries were monitored in Trabzon, Turkey in July 2014–June 2015. The data obtained during the study were evaluated using SPSS 21 package program. The differences in variables were assessed by Chi-square-test for categorical data or by One-way Anova test for continuous data. The results were evaluated at a confidence interval of 95% and at a significance level of $p < 0.05$. According to the BMI of the women in the study, 68.8% were in normal weight, 20.6% were overweight, 3.9% were obese, and the majority was in the 20–29 age group and 8–15.9 kg. The rate of cesarean, instrumental delivery, induction, episiotomy, late breastfeeding, low apgar (<7 at 5 min), neonatal intensive care unit admission requirement, the newborn at 4000 g or more in overweight (BMI 25–29.9) and obese (BMI $\geq$ 30) pregnancies was higher and the first and second phases of labor were longer ($p < 0.05$). The study showed that as the pre-pregnancy body mass index and gestational weight gain increased the rates of cesarean section and interventional delivery increased and the neonatal need for neonatal intensive care unit increased.

1. Introduction

It is reported that nowadays 15–20% of women start pregnancy as obese, 20–40% gain more gestational weight than recommended, and accordingly obesity increases among the women of childbearing age. According to the World Health Organization (WHO) criteria, the prevalence of obesity among pregnant women (BMI > 30 kg/m^2) is between 1.8% and 25.3%. In Turkey, 27.2% of pregnant women are reported to be overweight and obese (WHO, 2018; Daşıkan and Kavlak, 2009). According to the WHO criteria, those whose BMI are lower than 18.5 kg/m^2, between 18.5 and 24.9 kg/m^2, between 25 and 29.9 kg/m^2, and between 30 and 39.9 kg/m^2 are considered as thin, normal weight, overweight and obese respectively (Taşdemir et al., 2015, WHO, 2018). Based on the WHO's obesity classification, in 2009 the Institute of Medicine (IOM) recommended that thin, normal, mildly obese and obese pregnant women should gain 11.5–16 kg, 7.0–11.5 kg, 12.5–18 kg and 9 kg respectively (IOM, 2009; Akgün, 2013).

Excess gestational weight and maternal obesity cause gestational diabetes, hypertensive diseases, preterm labor, birth induction, difficult birth and birth complications, increase in cesarean birth, postpartum hemorrhage, thromboembolism, breastfeeding problems, depression (Lutsiv et al., 2015; Van Der Linden et al., 2016; Poston et al., 2016; WHO, 2018). Prematurity, stillbirth, congenital anomalies, macrosomia, and childhood obesity (Hilliard et al., 2012; Scott-Pillai et al., 2013; Stüber et al., 2015). In a multi-centered prospective study in which 16,000 pregnancies

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were investigated, the comparison of the pregnant women with BMI between 30 and 39.9 kg/m^2 and those with BMI 30 or less showed an increase in the risk of maternal obstetric problems (gestational diabetes, gestational hypertension, preeclampsia) and neonatal outcomes (fetal macrosomia) (Weiss et al., 2004). In another study with 100,000 females with a normal body mass index before pregnancy, those that gained weight less than 11.5 kg during pregnancy were found to have a lower risk of having preeclampsia, unsuccessful induction, head-pelvis inconvenience and delivering a large baby according to cesarean and gestational age (DeVader et al., 2007). In the majority of the previous studies, pre-pregnancy body measurements, gestational weight gain, pregnancy and birth complications, neonatal descriptive information and data regarding complications were obtained based on the patient's file or statements. For this reason, our study was conducted prospectively to determine whether gestational weight gain was below 8 kg (low weight gain) or greater than 16 kg (high weight gain), and the neonatal and obstetric outcomes of maternal BMI by following up pregnant women from the first follow up and to postpartum period.

2. Materials and methods

2.1. Participants and procedures

This study was carried out prospectively between 1 July 2014 and June 2015 in Kanuni Training and Research Hospital, Gynecology and Obstetrics Clinic with the pregnant women whose follow ups and deliveries were conducted in this hospital. A total of 987 pregnancies were observed, but after the exclusion criterion [births at less than 28 weeks of gestation (n = 29); morbid obese (n = 42), multiple pregnancies (n = 35); have severe systemic diseases (47), fetal and placental anomalies (31), and BMI recorded after 16 weeks of gestation (n = 105)] the number of pregnancies and births regularly observed was 698 (69.8%). The pregnancies with pregnancy follow-up from the first trimester (the first third month) were included in the study. The data such as the gestational age, the number of gestations, the number of births, gestational week, body weight before pregnancy, height, body mass index (BMI-kg/m^2), placental anomalies (31), and BMI recorded after 16 weeks of gestation (BMI-kg/m^2), body weight before and at delivery, monthly body weight gains, work status, previous illnesses, the gestational age at delivery and the treatment they hadwere obtained from the pregnant woman herself. Interventions in labor, the duration of labor, time to start breastfeeding, and newborn characteristics were recorded through researchers' follow-up. The duration of labor was evaluated in 3 time periods by measuring with a partograph. The first cervical dilatation is the time from 3 cm to full cervical dilatation (10 cm). The second one is the time from full cervical dilatation to the birth of the fetus and the third one is the time from the birth of the fetus to the birth of the placenta. Cervical dilatation was measured by midwives working in the delivery room.

Exclusion Criteria: The cases without adequate anamnesis, those who had genetic disease in their family or themselves, those who were morbidly obese (BMI > 40 kg/m^2), those who had multiple pregnancies, those who had less than 28 weeks of gestation, those with severe systemic or surgical diseases before pregnancy, and fetal and placental anomalies were not included in the study.

BMI (kg/m^2) was calculated using maternal weight and height data. Women were classified according to the World Health Organization criteria: underweight (BMI < 18.50 kg/m^2); normal weight (BMI 18.50–24.99 kg/m^2; reference group); overweight (BMI 25.0 0–29.99 kg/m^2); obese (BMI 30.00–34.99 kg/m^2) (WHO, 2013) and were divided into three gestational weight gain categories; <8 kg (low weight gain), 8–15.9 kg and 16+ kg (high weight gain). Gestational weight gain was described as the difference between the maternal body weights recorded when the woman attended the delivery room and the one measured during the first visit to the outpatient clinic.

The findings were investigated under the following headings; instrumental vaginal delivery, the rate of cesarean delivery, infant birth weight, requirement of labor augmentation with oxytocin, small and large infants according to gestational weeks, duration of birth, episiotomy rate, average infant birth weight, the incidence of Apgar score (<7 at 5 min), necessity of infant admission to a neonatal unit, and the onset of breastfeeding.

2.2. Statistical analysis

Statistical analysis was performed using Statistics Package for Social Sciences for Windows, version 21.0. The differences in the variables were evaluated by Chi-square-test for categorical data or by One-way Anova test for continuous data. The results were assessed at a confidence interval of 95% and at a significance level of $p < 0.05$.

2.3. Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

3. Results

The prevalence of overweight (BMI 25.00–29.99 kg/m^2) in the participants of the study was 20.6%. Obesity (BMI 30.00–34.99 kg/m^2) existed in 3.9% of them. In addition, 70.8% of the pregnant women gained 8–15.9 kg during pregnancy and 19.9% gained over 16 kg. According to BMI, weight gain in overweight and obese participants was 12.2 and 11.5 kg in average respectively (Table 1).

Maternal characteristics, obstetric and neonatal outcomes of the women according to BMI classification are shown in Table 2.

Table 1
Distribution of women gestational weight gain categories according to maternal BMI class (kg) (n = 698).

BMI and gestational weightgain categories (kg)			n (%)
BMI			
BMI < 18.5 (Underweight)			47 (6,7)
BMI18.5–24.9 (Normal)			480 (68,8)
BMI25-29.9 (Overweight)			144 (20,6)
BMI ≥ 30 (Obese)			27 (3,9)
Gestational weight gain categories (kg)			
<8 kg			65 (9,3)
8–15.9 kg			494 (70,8)
16+			139 (19,9)
BMI	Gestational weight gain Categories (kg)	n (%)	Mean gestational weight gain (SEM)
<18.5	<8 kg	2 (4,3)30	14,81 (0,67)
	8–15.9 kg	(63,8)15	
	16+	(31,9)	
18.5–24.9	<8 kg	36 (7,5)354	12,67 (0,17)
	8–15.9 kg	(73,8)90	
	16+	(18,8)	
25–29.9	<8 kg	17 (11,8)100	12,28 (0,36)
	8–15.9 kg	(69,4)27	
	16+	(18,8)	
≥30	<8 kg	10 (37,0)10	11,59 (1,09)
	8–15.9 kg	(37,0)7	
	16+	(25,9)	

Table 2
Maternal characteristics, obstetric and neonatal outcomes of women with BMI class (n = 698).

Maternal characteristics, obstetric and neonatal outcomes	BMI < 18.5 Mean (%)	BMI 18.5–24.9 Mean (%)	BMI 25–29.9 Mean (%)	BMI ≥30 Mean (%)	*p* value
Age					
≤19	3 (6,4)	35 (7,3)	8 (5,6)	1 (3,7)	X^2 = 20,122
20–29	31 (66,0)	320 (66,7)	75 (52,1)	12 (44,4)	p = **0.003**
≥30	13 (27,7)	125 (26,0)	61 (42,4)	14 (51,9)	
Education					
Primary school and below	17 (36,2)	237 (49,4)	81 (56,2)	17 (63,0)	X^2 = 10,242
Middle-high school	25 (53,2)	213 (44,4)	52 (36,1)	10 (37,0)	p = 0.115
University and over	5 (10,6)	30 (6,2)	11 (7,6)	0 (0,0)	
Parity					
Primigravida	19 (40,4)	202 (42,1)	47 (32,6)	5 (18,5)	X^2 = 9,155
Multigravida	28 (59,6)	278 (57,9)	97 (67,4)	22 (81,5)	p = **0.027**
Gestasyonel week					
≤37	5 (10,6)	25 (5,2)	7 (4,9)	0 (0,0)	X^2 = 4,242
38–41	42 (89,4)	455 (94,8)	137 (95,1)	27 (100)	p = 0.236
Type of delivery					
Vaginal delivery	44 (93,6)	430 (89,6)	44 (30,6)	1 (3,7)	**X^2 = 283,075**
Cesarean section	3 (6,4)	50 (10,4)	100 (69,4)	26 (96,3)	**p = 0.000**
Instrumental delivery					
Yes	5 (10,6)	16 (3,3)	80 (55,6)	26 (96,3)	**X^2 = 318,720**
No	42 (89,4)	464 (96,7)	64 (44,4)	1 (3,7)	**p = 0.000**
Amniotomy					
Yes	12 (25,5)	128 (26,7)	49 (34,0)	5 (18,5)	X^2 = 4,370
No	35 (74,5)	352 (73,3)	95 (66,0)	22 (81,5)	p = 0.224
5.dk Apgar score					
<7 at 5 min	4 (8,5)	22 (4,6)	23 (16,0)	11 (40,7)	**X^2 = 55,316**
8–10 at 5 min	43 (91,5)	458 (95,4)	121 (84,0)	16 (59,3)	**p = 0.000**
Birthweight					
<2500 g	2 (4,3)	43 (9,0)	24 (16,7)	2 (7,4)	**X^2 = 16,564**
2500–3999 g	44 (93,6)	414 (86,2)	115 (79,9)	21 (77,8)	**p = 0.011**
≥4000 g	1 (2,1)	23 (4,8)	5 (3,5)	4 (14,8)	
Induction of labor					
Yes	28 (59,6)	269 (56,0)	119 (82,6)	26 (96,3)	**X^2 = 47,015**
No	19 (40,4)	211 (44,0)	25 (17,4)	1 (3,7)	**p = 0.000**
Episiotomy					
Yes	35 (74,5)	316 (65,8)	104 (72,2)	24 (88,9)	**X^2 = 8,497**
No	12 (25,5)	164 (34,2)	40 (27,8)	3 (11,1)	**p = 0.037**
Breast-feeding					
First half hour	28 (59,6)	358 (74,6)	89 (61,8)	12 (44,4)	**X^2 = 70,234**
First hour	11 (23,4)	86 (17,9)	17 (11,8)	3 (11,1)	**p = 0.000**
First 2 h	6 (12,8)	23 (4,8)	22 (15,3)	8 (29,6)	
First 3 h	1 (2,1)	1 (0,2)	8 (5,6)	1 (3,7)	
Non-breastfed	1 (2,1)	12 (2,5)	8 (5,6)	3 (11,1)	
Requiring admissionto neonatal intensive care					
Yes	1 (2,1)	12 (2,5)	8 (5,6)	3 (11,1)	**X^2 = 8,248**
No	46 (97,9)	468 (97,5)	136 (94,4)	24 (88,9)	**p = 0.041**

The results were assessed at a significance level of p < 0.05.

Table 3
The comparison of average duration of labor with the BMI Class (n = 698).

Duration of labor	BMI <18.5 Mean ± SD	BMI 18.5–24.9 Mean ± SD	BMI 25–29.9 Mean ± SD	BMI ≥30 Mean ± SD	F	*p* value
First stage (from 3 cm dilation to 10 cm dilation	10.83 ± 3.65	9.83 ± 3.91	13.12 ± 3.96	14.82 ± 4.36	5.470	**0.022**
Second stage (from 10 cm dilation to delivery)	17.55 ± 8.95	17.78 ± 9.48	20.44 ± 11.10	25.88 ± 9.97	7.929	**0.000**
Third Stage Time (min) (from the birth of the fetus to the birth of the placenta)	15.87 ± 9.34	15.65 ± 8.19	15.59 ± 9.40	16.77 ± 8.55	0.162	0.922

SD, Standard deviation.
The results were assessed at a significance level of p < 0.05.

The difference between the BMI groups in terms of age and parity was found statistically significant (X^2 = 20,122; p = 0.003 < 0.05; X^2 = 9,155; p = 0.027 < 0.05 respectively). The obese women were a little older, and generally multigravida.

The rate of cesarean (X^2 = 283,075; p = 0.000 < 0.05), instrumental birth (X^2 = 318,720; p = 0.000 < 0.05), induction (X^2 = 47,015; p = 0.000 < 0.05), episiotomy (X^2 = 8,497; p = 0.037 < 0.05), late breastfeeding (X^2 = 70,234; p = 0.000 < 0.05), low apgar (<7 at 5 min) (X^2 = 55,316; p = 0.000 < 0.05) the admission to the neonatal intensive care unit (X^2 = 8,248; p = 0.041 < 0.05) and the newborn at 4000 g or more was found to be higher in overweight and obese pregnancies (Table 2).

The duration of first and second phases in labor in overweight and obese pregnancies lasted longer than that of the thin and normal pregnancies (F = 7.929; p = 0 < 0.05; F = 5.470; p = 0 < 0.05 respectively). The difference between the groups in terms of the duration of the third phase of labor was not statistically significant (F = 0.162; p = 0.922 > 0.05) (Table 3).

4. Discussion

The WHO reports that the prevalence of obesity in pregnancy changes from 1.8% to 25.3% (WHO, 2013).[5] In a retrospective study conducted in 2004–2011 with 30,298 participants in the obstetric population, 2.8% were found thin, 52.5% were normal, 27.8% were overweight and about 17% were obese (Scott-Pillai et al., 2013). In a study carried out with 1252 women in our country, 7.9% of pregnancies were reported to be thin, 60.3% normal, 23.7% overweight and 8.1% obese at the beginning of pregnancy according to BMI groups (Akgün, 2013). In our study, according to the BMI values of WHO, 6.7% were thin, 68.8% were normal, 20.6% were mildly obese, 3.9% were obese, and in the mildly obese, the average weight gain in pregnancy was 12.2 kg and in obese it was 11, 5 kg, higher than the amount recommended by IOM. In a study with 94.696 pregnant women with normal BMI, it was found that 60% of pregnancies did not gain weight in the range recommended by the IOM, 17.8% gained less weight than recommended (<11.4 kg) and 42.8% gained more weight than recommended (>15.9 kg) (DeVader et al., 2007). These results, which show differences between the countries in maternal anthropometric measurements, indicate that body weight gain during pregnancy is not at the desired level, even though they do not exactly correspond to our study results.

There are studies showing that there are differences between the parity and age, and pregnancy body weight gain as well as the ones reporting a positive relationship between them (Wolfe et al., 2011; Scott-Pillai et al., 2013 Akgün, 2013; Yanıkkerem and Mutlu, 2014; Ata and Şahin, 2015). In our study, it was determined that there was no significant difference in terms of education, gestational week, and amniotomy rates among the BMI groups, but multiparas and elderly women in each category of BMI were found to have gained more weight in gestation than primipara and younger women. That is, as the age and parity increase, BMI increases, too. Our study results are consistent with the studies showing a difference between age and parity and BMI.

Studies suggest that women who are overweight and obese in gestation have an increased risk of cesarean (Marchi et al., 2015; Schummers et al., 2015; Pettersen-Dahl et al., 2018) birth due to complications such as dysfunctional action, prolonged labor and shoulder dystocia caused by fetal macrosomia (Lutsiv et al., 2015; Taşdemir et al., 2015; Poston et al., 2016; Liu et al., 2016). It was reported that cesarean delivery rate was 20.7% for normal-weight nulliparous, 33.8% for obese nulliparous and 47.4% for morbid obese nulliparous, and showed that obesity was an independent risk factor for cesarean birth (Weiss et al., 2004). In our study, it was determined that the birth rate of cesarean birth was higher than the other two groups with BMI 25–29.9 and ≥30.

It was suggested that more weight gain than recommended and maternal obesity increased the complications such as induction in labor (Pevzner et al., 2009; Majumdar et al., 2010; Wolfe et al., 2011), episiotomy application (Kabiru and Raynor, 2004; Racz et al., 2016), interventional vaginal delivery (Wolfe et al., 2011; Marchi et al., 2015; Racz et al., 2016), and non-progressive action (Vahratian et al., 2005). Similarly, our study also showed that the rate of induction, episiotomy, and interventions at vaginal birth in pregnancies with mild obesity and obesity were higher than those in normal weight pregnancies. It is thought that overweight and obese women face more interventions during labor due to the increase in intrapartum complication rates.

The most important determinant of newborn weight is maternal body weight gain, which increases by about 260 g in newborn body weight due to maternal body weight gain of 1 kg each. The lower body weight gain than recommended leads to low birth weight (<2500 g) newborns, while the more weight gain leads to high birth weight (>4000 g) (Akgün, 2013). In a study with 126,080 women without hypertension and diabetes mellitus in their pregnancy follow-up, obesity was reported to increase the risk of macrosomia by 1.4-times (Davies et al., 2010). As reviewed by IOM reviewing 35 studies, a strong association was found between body weight gain and newborn body weight in gestation (Viswanathan et al., 2008). In these studies, it is argued that excess maternal body weight gain increases neonatal weight by affecting hypothalamic release of intrauterine fetus, pancreatic islet cells, and adipose tissue. Likewise in our study, we found that the birth weight of newborns in 2.1% of those with thin BMI, 4.8% of those with normal BMI, and 18.3% of those with mildly obese and obese BMI was found as ≥4000 g.

Maternal obesity poses risks for the life of the newborn by increasing the risk for macrosomia, fetal distress and low Apgar score, hypoglycemia, and meconium aspiration (Schuster et al., 2016; Poston et al., 2016; Liu et al., 2016). Studies show that the apgar scores of babies of obese pregnancies are lower than those of thin obese pregnancies and that admission rates for newborn intensive care units are higher in these babies (Apay et al., 2010; Schummers et al., 2015; Liu et al., 2016). In addition, studies indicate that large-born babies remain in the intensive care unit at a higher rate (Hilson et al., 2004; Taşdemir et al., 2015). A retrospective study by Majumdar et al. (2010) showed an increase in the admission of obese mother's infants to the neonatal intensive care unit compared to those who were not. Galtier-Dereure et al. (2000) indicated that the spontaneous breathing time of infants of overweight and obese women was later and the rate of the necessity for neonatal resuscitation and neonatal intensive care was higher. Similarly in our study, we found that babies of BMI ≥ 30 needed intensive care of newborns at higher rates.

Studies suggest that more weight gain than recommended for maternal obesity and pregnancy reduces the likelihood of successfully starting to breastfeed, leads to starting to breastfeed later, and tending to breastfeed less (Hilson et al., 2004; Marchi et al., 2015; Kürklü and Kamarlı, 2016). It is also stated that lactogenesis is delayed due to postpartum complications and it is difficult to breastfeed because of having big breasts (Liu et al., 2010; Ç akmak and Şahin, 2015). Similarly, in our case, it was determined that the rate of starting to breastfeed of overweight and obese pregnant women in the first hour was lower than the other pregnancies.

There are previous studies reporting that compared to normal weight women overweight and obese women have a prolonged duration of labor (Hilson et al., 2004; Vahratian et al., 2005; DeVader et al., 2007; Hilliard et al., 2012; Norman et al., 2012; Scott-Pillai et al., 2013). In a study involving 63,829 nullipar women, Carlhäll et al. (2013) stated that the average duration of labor was longer in obese and overweight women, but the second birth phase was shorter in obese women. Samy et al. (2015) found that the duration of first birth in obese women was longer than that in women with normal BMI, but there was no difference in terms of obese and normal-weight women in the second phase. In our study, the duration of the first and second phases of labor in overweight and obese pregnancies lasted longer than those with thin and normal BMI. These results, which show that maternal obesity and overweight in pregnancy prolong especially the first phase of labor, suggest that maternal obesity and excess pregnancy

weight cause a prolonged duration of labor even though this does not corresponds exactly with our study results.

5. Conclusions

The study results indicated that obesity was an important risk factor for maternal and fetal adverse outcomes. As maternal BMI values and pregnancy weight gain increased, the rate of cesarean and interventions at births, admission to the newborn intensive care unit increased, early onset of breastfeeding decreased, and the first and second phases of labor prolonged. Being pregnant with an ideal BMI and gaining normal weight in gestation will achieve a healthy mother and baby by lowering the weight gain and the complications that the mother and the newborn will suffer.

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Conflict of Interest

The authors declare that there is no conflict of interests.

References

Akgün, N., 2013. Maternal body mass ındex and body weight ıncrease during pregnancy monitoring in relation to perinatal outcomes (Master of Science Thesis). Faculty of Health Sciences Program in Nutritional Sciences, Hacettepe University, Turkey.

Ata, K.K., Şahin, N.H., 2015. The effect of pregestational body mass index on prenatal and neoanatal outcomes. Med. Bull. Zeynep Kamil. 46, 112–117.

Apay, S.E., Kılıç, M., Pasinlioğlu, T., 2010. Labor and postpartum period in obese pregnant. TAF Prev. Med. Bull. 9, 151–156.

Çakmak, V., Şahin, S., 2015. Effect of maternal obesıty on breastfeedıng. Yıldırım Beyazıt Univ. J. Nurs. 2, 1–5.

Carlhäll, S., Källén, K., Blomberg, M., 2013. Maternal body mass index and duration of labor. Eur. J. Obstet. Gynecol. Reprod. Biol. 171, 49–53.

Daşıkan, Z., Kavlak, O., 2009. Maternal obesity: pregnancy complications and management of pregnant women: review. Turkiye Clin. J. Nurs. Sci. 1, 39–46.

Davies, G.A., Maxwell, C., McLeod, L., Gagnon, R., Basso, M., Bos, H., Delisle, M.F., Farine, D., Hudon, L., et al., 2010. Obesity in pregnancy. Int. Gynaecol. Obstet. 32, 165–173.

DeVader, S.R., Neeley, H.L., Myles, T.D., Leet, T.L., 2007. Evaluation of gestational weight gain guidelines for women with normal prepregnancy body mass index. Obstet. Gynecol. 110, 745–751.

Galtier-Dereure, F., Boegner, C., Bringer, J., 2000. Obesity and pregnancy: complications and cost. Am. J. Clin. Nutr. 71, 1242–1248.

Hilliard, A.M., Chauhan, S.P., Zhao, Y., Rankins, N.C., 2012. Rankins effect of obesity on length of labor in nulliparous women. Am. J. Perinatol. 29, 127–132.

Hilson, J.A., Rasmussen, K.M., Kjolhede, C.L., 2004. High prepregnant body mass index is associated with poor lactation outcomes among white, rural women independent of psychosocial and demographic correlates. J. Hum. Lact. 20, 18–29.

Institute of Medıcıne – (IOM), 2009. Weight Gain During Pregnancy: Reexamining the Guidelines. <https://www.nap.edu/.../Report-Brief—Weight-Gain-During> (access: 29 March 2017).

Kabiru, W., Raynor, B.D., 2004. Obstetric outcomes associated with increase in BMI category during pregnancy. Am. J. Obstet. Gynecol. 191, 928–932.

Kürklü, N., Kamarlı, H., 2016. The effect of maternal obesity on breast-feeding. J. Anatolia Nurs. Health Sci. 19, 53–56.

Liu, J., Smith, M.G., Dobre, M.A., Ferguson, J.E., 2010. Maternal obesity and breast-feeding practices among white and black women. Obesity 18, 175–182.

Liu, P., Xu, L., Wang, Y., Zhang, Y., Du, Y., Sun, Y., Wang, Z., 2016. Association between perinatal outcomes and maternal pre-pregnancy body mass index. Obes. Rev. 17, 1091–1102.

Lutsiv, O., Mah, J., Beyene, J., McDonald, S.D., 2015. The effects of morbid obesity on maternal and neonatal health outcomes: a systematic review and meta-analyses. Obes. Rev. 16, 531–546.

Majumdar, A., Saleh, S., Candelier, C.K., 2010. Failure to recognise the impact of 'moderate' obesity (BMI 30–40) on adverse obstetric outcomes. J. Obstet. Gynaecol. 30, 567–570.

Marchi, J., Berg, M., Dencker, A., Olander, E.K., Begley, C., 2015. Risks associated with obesity in pregnancy, for the mother and baby: a systematic review of reviews. Obes. Rev. 16, 621–638.

Norman, S.M., Tuuli, M.G., Odibo, A.O., Cauqhey, A.B., Roehl, K.A., Cahill, A.G., 2012. The effects of obesity on the first stage of labor. Obstet. Gynecol. 20, 130–135.

Pettersen-Dahl, A., Murzakanova, G., Sandvik, L., Laine, K., 2018. Maternal body mass index as a predictor for delivery method. Acta Obstet. Gyn. Scan. 97, 212–218.

Pevzner, L., Powers, B.L., Rayburn, W.F., Rumney, P., Wing, D.A., 2009. Wing Effects of maternal obesity on duration and outcomes of prostaglandin cervical ripening and labor induction. Obstet. Gynecol. 114, 1315–1321.

Poston, L., Caleyachetty, R., Cnattingius, S., Corvalán, C., Uauy, R., Herring, S., Gillman, M.W., 2016. Preconceptional and maternal obesity: epidemiology and health consequences. Lancet Diab. Endocrinol. 4, 1025–1036.

Racz, S., Hantosi, E., Marton, S., Toth, K., Ruzsa, D., Halvax, L., 2016. Impact of maternal obesity on the fetal electrocardiogram during labor. J. Matern. Fetal. Med. 29, 3712–3716.

Samy, M., Sanad, Z.F., Emara, M.A., Abdou, S.A.M., 2015. Effect of obesity on the length of the first and second stages of labor. Menoufia Med. J. 28, 858–863.

Scott-Pillai, R., Spence, D., Cardwell, C.R., Hunter, A., Holmes, V.A., 2013. The impact of body mass index on maternal and neonatal outcomes: a retrospective study in a UK obstetric population, 2004–2011. Br. J. Obstet. Gynaecol. 120, 932–939.

Schummers, L., Hutcheon, J.A., Bodnar, L.M., Lieberman, E., Himes, K.P., 2015. Risk of adverse pregnancy outcomes by prepregnancy body mass index: a population-based study to inform prepregnancy weight loss counseling. Obstet. Gynecol. 125, 133–143.

Schuster, M., Mackeen, A.D., Neubert, A.G., Kirchner, H.L., Paglia, M.J., 2016. The impact of pre-pregnancy body mass index and pregnancy weight gain on maternal and neonatal outcomes (24A). Obstet. Gynecol. 127, 17S.

Stüber, T.N., Künzel, E.C., Zollner, U., Rehn, M., Wöckel, A., Höniq, A., 2015. Prevalence and associated risk factors for obesity during pregnancy over time. Geburtshilfe Frauenheilk 75, 923–928.

Taşdemir, D., Karaman, E., Yıldız, A., Han, A., Karaman, Y., Talay, H., 2015. The effect of obesity on maternal and fetal outcomes in term pregnant women: a case-control study. Istanbul Kanuni Sultan Süleyman Med. J. 7, 73–78.

Van Der Linden, E.L., Browne, J.L., Vissers, K.M., Antwi, E., Agyepong, I.A., Grobbee, D. E., Klipstein-Grobusch, K., 2016. Maternal body mass index and adverse pregnancy outcomes: a Ghanaian cohort study. Obesity 24, 215–222.

Vahratian, A., Siega-Riz, A.M., Savitz, D.A., Zhang, J., 2005. Maternal pre-pregnancy overweight and obesity and the risk of cesarean delivery in nulliparous women. Ann. Epidemiol. 15, 467–474.

Viswanathan, M., Siega-Riz, A.M., Moos, M.K., Deierlein, A., Mumford, S., Knaack, J., Thieda, P., Lux, L.J., Lohr, K.N., 2008. Outcomes of maternal weight gain. Evid. Rep. Technol. Assess (Full Rep). 168, 1–223.

Weiss, J.L., Malone, F.D., Emig, D., Ball, R.H., Nyberg, D.A., Comstock, C.H., Saade, K., Eddleman, K., Carter, S.M., Craigo, S.D., Carr, S.R., D'Alton, M.E., 2004. Obesity, obstetric complications and cesarean delivery rate–a population-based screening study. Am. J. Obstet. Gynecol. 190, 1091–1097.

Wolfe, K.B., Rossi, R.A., Warshak, C.R., 2011. The effect of maternal obesity on the rate of failed induction of labor. Am. J. Obstet. Gynecol. 205, 128–129.

World Health Organization-WHO, 2013. Situations Reports, Obesity and Overweight. <http://www.who.int/mediacentre/factsheets/fs311/en/> (access: 29 March 2017).

World Health Organization-WHO, 2018. Obesity and Overweight. <www.who.int/mediacentre/factsheets/fs311/en/> (access: 15 February 2018).

Yanıkkerem, E., Mutlu, S., 2014. Maternal obesity: consequences and prevention strategies. TAF Prev. Med. Bull. 11, 353–364.