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Association Between Gestational Weight Gain and Maternal and Neonatal Outcomes

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ABSTRACT

The aim of this study is to assess the effect of gestational weight gain according to initial pregnancy body mass index (BMI) on maternal and neonatal outcomes.

This is a retrospective cohort study of 937 pregnant women who were followed up and delivered at Zeynep Kamil Maternity and Childrens' Diseases Education and Research Hospital. Subjects were divided into three groups according to their weight gain during pregnancy: insufficient (n=249), adequate (n= 302) and excess (n=386). We analyzed maternal characteristics such as maternal age, gravida, parity, body mass index (BMI: kg/m2) initial pregnancy weight, gestational weight gain, and we examined the effect of maternal weight gain on the pregnancy outcome as preeclampsia, preterm premature rupture of membranes (PPROM), preterm delivery, gestational age at delivery, delivery type, indications for cesarean delivery, sex of the infant, 1. ve 5. minute Apgar score, admission to the neonatal intensive care unit (NICU).

The mean age of the subjects was 30.04±5.47 years. İnsufficient weight gain was associated with increased risk of PPROM ($p<0.05$), gestational cholestasis ($p<0.05$), having infant with low birth weight (LBW) ($p<0.01$), preterm delivery (<0.01), having infant with smaller than 48 cm lenght ($p<0.01$), 5. minute apgar score <7 ($p<0.01$) intrauterine growth retardation (SGA) ($p<0.01$), and admission to the neonatal intensive care unit (NICU) ($p=0.047$). In women, excess weight gain was associated with increased rates of macrosomia ($p<0.01$) and cesarean delivery for the cephalopelvic disproportion compared to women with insufficient and adequate weight gain.($p<0.05$**)**.

Getting under control of gaining excess weight during pregnancy play an important role in reducing the poor maternal and neonatal outcome.

Key Words: Gestation, Weight gain, Body Mass Index, Low birth weight, Preterm, SGA

Introduction

Pregnancy is a period in which women have significant changes in their body weights. Proper nutrition, additional energy and nutrient intake are necessary for healthy fetal development at pregnancy. Pre-gestational maternal body weight, ethnicity, age, number of births, smoking, socioeconomic level and daily calorie intake are the main reasons for gestational weight gain (1). In addition, weight gain in pregnancy is closely related to maternal body structure and nutritional status. For example, a pregnant woman who is weak at the beginning of her pregnancy should gain more weight than the overweight and obese ones (2). It is known that women who are overweight and obese during pregnancy are more likely to be associated with preeclampsia, gestational diabetes, macrosomia and postpartum hemorrhage (3)

The aim of the study is to evaluate the association between weight gain on pregnancy and maternal and neonatal outcomes.

Materials and Methods

A retrospective study on patients admitted to Zeynep Kamil, Maternity and Childrens' Diseases Education and Research Hospital was performed on hospital admissions between 2014-2017 years. Data was assessed by accessing the files of pregnant women who were followed up for pregnancy and who were delivered at that hospital. Exclusion criteria were: Files with inadequate data, women whose initial pregnancy weight were not known, women with multiple pregnancies and women who have fetal and placental anomalies. 937 pregnants were included in the study. Subjects were analyzed by maternal characteristics as maternal age, gravida, parity, initial pregnancy weight and body mass index (BMI kg/m2), gestational weight gain and also subjects were

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Table 1. Maternal characteristics

		Min-Max	Mean±SS
Age		16 – 46	30.04±5.47
Gestational Weight Gain		-1 – 43	13.09±6.11
BMI at the Beginning of Pregnancy		12.2 – 47.7	24.64±4.39
		N	%
Gravida	1	182	19,4
	2	311	33,2
	≥ 3	444	47,3
Parity	0	236	25,2
	1	411	43,9
	2	210	22,4
	≥ 3	80	8,5

Tablo 2. GWG according to initial BMI of pregnant women

BMI at the Beginning of Pregnancy	Mean±SS	Insufficient (n;%)	Adequate (n;%)	Excessive (n;%)
Underweight (n=45)	17.98±6.37	8; %17.8	17; %37.8	20; %44.4
Normal (n=573)	14.18±5.88	171; 32.7	172; %32.9	180; %34.4
Overweight (n=268)	11.47±5.61	48; %17.9	87; %32.5	133; %49.6
Obese (n=101)	9.6±5.49	22; %21.8	26; %25.7	53; %52.5

examined according to the effect of weight gain in pregnancy on the maternal outcomes such as preeclampsia, PPROM, gestational cholestasis, gestational age at delivery, delivery type, indications for cesarean delivery (fetal distress, cephalopelvic disproportion, failed induction of labor, preeclampsia, placental abruption, presence of previous uterine surgery, others), preterm delivery and neonatal outcomes such as infant birth weight, 1. and 5. minute APGAR score, sex of the newborn, admission to the neonatal intensive care unit (NICU).

BMI was obtained by dividing body weight in kilograms by the square of height in meters (4). Women reported their weight and height at the first prenatal visit and by means of BMI levels they were categorized into four groups: underweight (BMI < 19.8 kg/m2), normal-weight (19.8≤ BMI < 25.2), overweight (26 ≤ BMI < 30) and obesity (BMI ≥ 30) (1).

937 patients included in this study were divided into three groups according to their weight gain during pregnancy: insufficient (n: 249), adequate (n: 302) and excess (n: 386).

Gestational weight gain was calculated by subtracting each woman's pre-pregnancy weight from her weight at delivery. The 2009 IOM GWG recommendation is for underweight, normal weight, overweight, and obese women to gain 12.5–18 kg, 11.5– 16 kg, 7–11.5 kg, and 5–9 kg, respectively (5).

We examined and categorized birth weight as following: infant birth weight <2500 gram as low birth weight; SGA as birth weight below the 10th percentile of mean weight corrected of fetal sex and gestational age (6); infant birth weight >4000gram as macrosomia (7)

Statistical Analyses: All analyses were performed with the statistical program IBM SPSS Statistics22.0. One-way Anova test was used for comparison of the groups with normal distribution in comparison of descriptive statistical methods (Mean, Standard deviation) as well as descriptive statistical methods (Tukey HSD test). Chi-square test was used for comparison of qualitative data. Significance was assessed at $p < 0.05$ level.

Results

The ages of the study population ranged from 16 to 46 with a mean age of 30.04 ± 5.47 (Table1). The groups classified according to the gestational weight gain (weight gain from pregnancy onset till delivery) according to initial BMI of pregnant women. (Table 2). The newborn characteristics

Table 3. Evaluation of Newborn Characteristics According to GWG Groups

		Weight Gain In Pregnancy			
		Insufficient (n;%)	Adequate (n;%)	Excess (n;%)	P Value
Birth weight	<2500	34 (%13.7)	26 (%8.6)	22 (%5.7)	0.002**
	≥2500	215 (%86.3)	276 (%91.4)	364 (%94.3)	
Macrosomic Fetus	Yes	8 (%3.2)	9 (%3)	43 (%11.1)	0.001**
	No	241 (%96.8)	293 (%97)	343 (%88.9)	
Birth Height	< 48	51 (%20.5)	42 (%13.9)	40 (%10.4)	0.002**
	≥ 48	198 (%79.5)	260 (%86.1)	346 (%89.6)	
Sex of the infant	Male	118 (%47.4)	151 (%50)	195 (%50.5)	0.728
	Female	131 (%52.6)	151 (%50)	(%49.5)	
1. min Apgar	< 7	13 (%5.2)	13 (%4.3)	19 (%4.9)	0.873
	≥ 7	236 (%94.8)	289 (%95.7)	367 (%95.1)	
5. min Apgar	< 7	13 (%5.2)	4 (%1.3)	2 (%0.5)	0.001**
	≥ 7	236 (%94.8)	298 (%98.7)	384 (%99.5)	
NICU	Yes	25 (%10)	23 (%7.6)	19 (%4.9)	0.047*

Chi-square test was used **p<0.01
NICU: Neonatal intensive care unit

according to maternal gestational weight gain characteristics are listed in table 3. Insufficient weight gain was associated with increased risk of having LBW infant (p<0.01). In women, excess weight gain was associated with increased rates of macrosomia (p<0.01). In insufficient weight gain group the newborn height <48 cm was significantly higher than the other groups (p<0.01). There was no statistically significant difference between sex of newborn babies according to GWG groups (p> 0.05). There was no statistically significant difference between 1. min Apgar scores according to GWG groups (p> 0.05); In the group with insufficient weight gain in pregnancy, 5. min Apgar score <7 cases were higher than the other GWG groups (p <0.01). The rate of fetal distress indication for cesarean delivery was significantly higher in the group of insufficient weight gain compared to the other groups (p = 0.047) (Table3).

There was a statistically significant difference between gestational age at delivery according to GWG groups (p <0.01) (Table4). As a result of the Post- HocTukey HSD test to determine the group from which the difference originated, gestational age at birth with insufficient weight gain during pregnancy was significantly lower than the adequate and excess weight gain group (p<0.01). Gestational cholestasis rate of pregnants with insufficient weight gain was significantly high compared to the other groups (p <0.05). Percentage of PPROM in insufficient weight gain group was high compared to other groups (<0.05). Oligohydramnios ratio in excess weight gain group was higher compared to the other groups (p<0.05). SGA was higher in the insufficient weight gain group compared to other groups (p<0.01). CPD ratio was higher in the excess weight gain group than the other groups (p<0.05). Preterm delivery rate in the insufficient weight gain group was significantly higher than the other groups (p<0.01) (table4).

Discussion

In this study, we found that the gain or loss of weight in pregnancy was associated with poor maternal and neonatal outcomes. In the case of insufficient weight gain in pregnancy; preterm delivery, SGA, gestational cholestasis, cesarean delivery with the indication of fetal distress, LBW and PPROM rates were increased, whereas gestational age at delivery was decreased. In the group of excess weight gain during pregnancy cesarean delivery, macrosomia, CPD and oligohydramnios rates were increased. Weight gain in pregnancy has been debated for years. In the 1920s, in terms of easy birth it was suggested that the weight gain of the pregnant women should be maximum 6.8 kg (8). Weight gain restriction was proposed in the 1940s, in the belief that weight gain would lead to preeclampsia (9). After 1970's, literature suggested an association between insufficient weight gain and poor perinatal outcomes (10, 11).

Table 4. Maternal and Neonatal outcomes according to the weight gain during pregnancy

	Gestational Weight Gain			
	Insufficient	Adequate	Excess	1p
	Mean±SS	Mean±SS	Mean±SS	
Gestational age at delivery	37.62±3.26	38.17±2.56	38.47±2.13	0.001**
	n (%)	n (%)	n (%)	2p
Preeclampsia	10 (%4)	17 (%5.6)	33 (%8.5)	0.060
Preterm Delivery	48 (%19.3)	43 (%14.2)	39 (%10.1)	0.005**
Gestational Hypertension	9 (%3.6)	10 (%3.3)	17 (%4.4)	0.743
GDM	35 (%14.1)	28 (%9.3)	34 (%8.8)	0.080
Gestational Cholestasis	9 (%3.6)	1 (%0.3)	8 (%2.1)	0.019*
Atony	0 (%0)	0 (%0)	1 (%0.3)	0.489
PPROM	11 (%4.4)	8 (%2.6)	4 (%1)	0.026*
Oligohydramnios	13 (%5.2)	36 (%11.9)	31 (%8)	0.028*
Postterm Pregnancy	13 (%5.2)	12 (%4)	26 (%6.7)	0.280
SGA	21 (%8.4)	12 (%4)	9 (%2.3)	0.001**
Cesarean Section Indication (N=489)				
Presentation abnormality	6 (%4.4)	8 (%5.7)	7 (%3.3)	0.564
Preeclampsia	1 (%0.7)	4 (%2.8)	12 (%5.7)	0.042*
Failed induction of labor	9 (%6.6)	10 (%7.1)	13 (%6.2)	0.942
Fetal distress	22 (%16.1)	18 (%12.8)	29 (%13.7)	0.718
Previous uterine surgery	89 (%65)	79 (%56)	117 (%55.5)	0.173
Plasental abruption	2 (%1.5)	4 (%2.8)	6 (%2.8)	0.675
CPD	3 (%2.2)	11 (%7.8)	22 (%10.4)	0.016*
Other	1 (%0.7)	2 (%1.4)	2 (%0.9)	0.841
Delivery Type				
NSD	112 (%45)	161 (%53.3)	175 (%45.3)	0.067
Ceserean Delivery	137 (%55)	141 (%46.7)	211 (%54.7)	

*[1]Oneway ANOVA test [2]Chi-square test **p<0.01 *p<0.05*
GDM: Gestational Diabetes Mellitus PPROM: Preterm Premature Rupture of Membranes
SGA: Small for Gestational Age CPD: Cephalopelvic Disproportion
NSD: Normal Spontaneous Vaginal Delivery

Studies have shown that body weight gain in gestation depends on sociodemographic characteristics and maternal characteristics such as initial onset BMI, age, parity, education level, ethnic group (1). In parallel of this study, we found that those who were obese according to the level of BMI; the excess weight gain is higher. IOM recommends 12.5-18 kg, 11.5-16 kg, 7.0-11.5 kg, and <7 kg body weight gain in the weak, normal, overweight and obese group, respectively (5). In this study, those who were below the BMI cut-off values, had an average weight of 18 kg and those within the range of BMI cut-off value had an average weight of 14.1 kg. However, according to BMI, the weight gain in overweight and obese subjects is 11.5 and 9.6 kg respectively, which is higher than the amount of recommended IOM cut-off points.

In our study, we found that LBW infants were increased in the pregnants with insufficient weight gain whereas macrosomic fetuses were increased in the pregnants with excess weight gain. Viswanathan et al. reported a strong relationship between body weight gain and newborn body weight during pregnancy as in correlation with our study (12).

Costa had also demonstrated that excessive weight gain during pregnancy was associated with macrosomia as in correlation with our study (13).

The relationship between excess weight gain in the pregnancy and gestational diabetes (14), preeclampsia (15,16), preterm labor (17), cesarean section (18,19) was supported by the studies

available in the literature. De Vader et al. reported the increased maternal complications such as preeclampsia, fetal distress, CPD, induction failure, and cesarean delivery in the patients who gain more weight than the IOM recommendations, whereas SGA was found more in patients with less weight than the recommended body weight (20). However, we did not find any significant difference between the groups in terms of preeclampsia, gestational diabetes, cesarean delivery rate, and we found more preterm labor rate in pregnants with insufficient weight gain during pregnancy. This may be due to the low number of our study population and as because we are a reference hospital. Edwards et al. performed a retrospective study of 1273 subjects with 683 obese and 690 normal body mass indexes and reported no relationship between gestational weight gain differences and pregnancy complications (21).

Obese pregnants or excess pregnancy weight gain are accompanied by an increase in the rates of cephalopelvic disproportion (CPD), prolonged labor (22,23) and macrosomia (24,25). We also find increased rates of CPD and macrosomia in pregnants with more weight gain than recommended.

From the beginning of pregnancy, by keeping body weight under control and by keeping body weight gain within certain limits, many poor outcomes of pregnancy can be prevented. Adequate, regular and careful nutritional support during pregnancy will reduce the poor outcomes that the infant will encounter, and it will help to be a healthy pregnant woman who is the primary objective of obstetrics to achieve healthy newborn infant.

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