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Association of total gestational weight gain and maternal and perinatal outcomes among pregnant patients using the institute of medicine 2009 gestational weight gain guidelines in a tertiary hospital

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Abstract:

BACKGROUND: The aim of the study was to determine the association between total gestational weight gain (TGWG) and maternal and perinatal outcomes based on the Institute of Medicine 2009 gestational weight gain (GWG) guidelines among pregnant patients of the department of obstetrics and gynecology in a tertiary hospital.

METHODOLOGY: Our analysis was carried out in a private hospital in Metro Manila, specifically in a tertiary hospital, in a prospective cohort study that included 565 pregnant women from June 1, 2020, to April 30, 2021. Body mass index (BMI) at initial prenatal visit <14 weeks' age of gestation and upon admission, birth weight, comorbidities were all assessed and recorded. Our main outcome measures were TGWG, perinatal outcomes (small for gestational age, large for gestational age, intrauterine fetal demise, and admission to neonatal intensive care unit), and maternal outcomes (gestational diabetes mellitus, gestational hypertension, preeclampsia/eclampsia, and preterm birth). The baseline anthropometric, maternal and neonatal outcomes were analyzed using mean, standard deviation, range and chi-square test was used to correlate total gestational weight gain against maternal and perinatal outcomes and a *P*-value less than 0.05 was statistically significant.

RESULTS: In this study, the mean BMI was 23.6 kg/m², and based on BMI classification, 8% were underweight, whereas 28.1% and 9% were overweight and obese, respectively. Based on the recommendations of TGWG on each BMI category, using Chi-square test, there was a significant association of having excess GWG and inadequate GWG against maternal and perinatal outcomes.

CONCLUSION: Based on the study, women having excess or inadequate TGWG has effects on maternal and perinatal outcomes. Furthermore, women that are classified as overweight and obese in the first trimester have a higher risk of developing comorbidities.

Keywords:

Gestational weight gain, obesity, overweight, pregnancy

Introduction

Overweight and obesity carry a worldwide population epidemic rate that affects both genders, especially women, most

significantly pregnant women, influencing one's daily routine and activities.^[1-3]

In recent years, increased interest in gestational weight gain (GWG) led to

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the search for an optimal range of values, from the first prenatal visit of the woman until delivery, as it is seen a modifiable risk factor that may lower the incidence of maternal and neonatal adverse outcomes. The proposed guideline is by the Institute of Medicine (IOM) GWG 2009, by measuring prepregnancy body mass index (BMI, a measure of body fat based on weight and height) category and the World Health Organization (WHO) BMI classification for both international and Asian categories.^[4-9] This value can be influenced by demographic status (e.g., age, ethnicity, marital status, socioeconomic status, gravidity and parity, educational level, and occupation), medical conditions (e.g., bronchial asthma, hypertension, Type 2 diabetes mellitus, or any autoimmune diseases), and finally, maternal and fetal adverse outcomes (e.g., maternal: increased risk to develop gestational diabetes mellitus and gestational hypertension; fetal: small or large gestational age).^[10,5,7,11-14,9,15]

However, the most published studies are on Western populations with scarce and scattered data from East Asian countries, and no established local evidence on BMI and GWG is available, which has led to this proposed study.

The significance of the study is to be able to gather and collate local data among obstetric patients from a tertiary hospital using a standardized and validated guideline for those who are excessively gaining weight and diagnosed during prenatal visits with gestational diabetes mellitus and gestational hypertension and referring them to a nutritionist and internist for proper management. Data are then analyzed to see which variables improve maternal and fetal outcomes.

Objectives of the study

General objective

1. To determine the association of total GWG (TGWG) and maternal and perinatal outcomes based on the IOM 2009 GWG guidelines among pregnant patients of the department of obstetrics and gynecology in a tertiary hospital.

Specific objectives

1. To determine the association between TGWG and maternal outcomes among pregnant patients of the department of obstetrics and gynecology in a tertiary hospital
2. To determine the association between TGWG and perinatal outcomes among pregnant patients of the department of obstetrics and gynecology in a tertiary hospital
3. To determine the incidence of underweight, overweight, and obesity among pregnant patients and analyze its relation to maternal and neonatal outcomes.

Methodology

Study design

This study is a prospective cohort study among pregnant patients in a tertiary hospital, department of obstetrics and gynecology.

Setting of the study

The study was conducted in a tertiary hospital, department of obstetrics and gynecology from June 1, 2020, to April 30, 2021.

Study subject and target population

The study included pregnant patients who had their first prenatal checkup <14 weeks' age of gestation for both charity and pay divisions in the department of obstetrics and gynecology and those who were admitted and delivered in the delivery room complex from June 1, 2020, to April 30, 2021. Written informed consents were obtained from all participants. The results and patient information were kept strictly confidential.

Inclusion criteria

- At least 18 years old
- Singleton pregnancy
- Primigravid or multigravid
- ≤ 14 weeks' age of gestation on the first prenatal checkup.

Exclusion criteria

- More than 14 weeks' age of gestation on the first prenatal checkup
- Multifetal pregnancy
- Patients delivered ≤ 29 weeks' age of gestation
- With the previous history of congenital anomaly, stillbirth, intrauterine growth restriction, preterm birth, small and large for gestational age neonate, and assisted reproductive technology
- With noted comorbidities such as hypertension, diabetes mellitus, bronchial asthma, and other medical conditions on the first prenatal checkup
- Confirmed fetal congenital anomalies on ultrasound during pregnancy
- Patients with known uterine tumor and malformation.

Sample size calculation

Using Epi Info 7, the sample size was computed using a 95% confidence level, 80% power, 37% GWG above the guidelines in Asia, and 1.63 risks of large for gestation age (LGA) among neonates from the study by Goldstein *et al.* (2018). The minimum sample size needed is 542 Filipino mothers Figure 1.

Data collection procedure

Participants were screened at our outpatient department during their first prenatal checkup held every Monday,

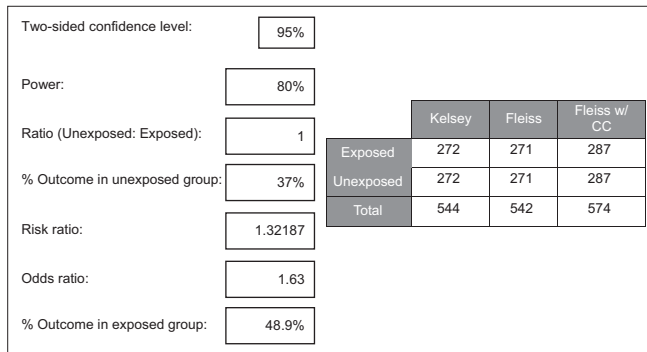


Figure 1: Unmatched cohort and cross-sectional studies (exposed and nonexposed)

Wednesday, and Friday; and also, was interviewed during admission at the delivery room complex. Appropriate informed consent form was discussed and given to the patient. Sociodemographic status of the participants such as age, height, weight, gravidity or parity, occupation, education status, and past medical history were obtained. At the first prenatal checkup and/or during admission, BMI was calculated as the first weight (in kg)/height (in m²). First visit BMI was used as an estimate for the first trimester BMI with the assumption that there was negligible weight gain in the early trimester.^[5] Similarly, on admission of the participants, weight (in kg) and height (in m²) were taken and used to calculate the third trimester BMI. Those participants who met the inclusion criteria were included in the study population and will be followed up postpartum for maternal and perinatal outcomes.

Statistical analysis

Descriptive analysis of the baseline, anthropometric, and maternal and neonatal outcomes will be determined. The continuous variable will be described using mean, standard deviation, and range. The categorical variables will be described using frequency and percentage. Logistic regression will be used to determine the association between the sociodemographic and clinical factors with maternal and neonatal outcomes. The odds ratio and 95% confidence interval will be used to measure the association. A $P < 0.05$ is statistically significant.

Results

There were 565 pregnant women attending prenatal care in a tertiary hospital that was included in this study. The average age of pregnant women was 29.6 years, with 33.5 percent being 25–29 years old; 90.4 percent were Filipinos, with the majority being gravida 1 (60.7 percent), parity 0 (60.7 percent), 71.7 percent employed, 81.8 percent college graduate, 4.4 percent prior smokers, and 0.7 percent present alcohol drinker [Table 1]. Based on World Health Organization (WHO) BMI classification, there were 28.1% overweight and 9% obese among

Table 1: Sociodemographic characteristics of pregnant women attending prenatal care

Demographic factors	n (%)
Maternal age (year), mean (SD)	29.6 (5.4)
Maternal age range (year)	18.00 (49.00)
<25	106 (18.8)
25-29	189 (33.5)
30-34	161 (28.5)
35-40	94 (16.6)
>40	15 (2.7)
Maternal BMI (kg/m ²) first prenatal visit, mean (SD)	23.6 (4.3)
Race	
Filipino	511 (90.4)
Chinese	54 (9.6)
Gravidity	
1	343 (60.7)
2	131 (23.2)
3	59 (10.4)
4	24 (4.2)
5	8 (1.4)
Parity	
0	343 (60.7)
1	131 (23.2)
2	59 (10.4)
3	24 (4.2)
4	8 (1.4)
Maternal employment at the onset of pregnancy	
Employed	405 (71.7)
Unemployed	160 (28.3)
Educational attainment	
Elementary	1 (0.2)
High school graduate	69 (12.2)
College graduate	462 (81.8)
Vocational school graduate	33 (5.8)
Behavioral factors	
Smoking	
Before current pregnancy	25 (4.4)
During current pregnancy	0
Alcohol use	
Before current pregnancy	63 (11.2)
During current pregnancy	4 (0.7)

SD: Standard deviation, BMI: Body mass index

pregnant women included. Majority of participants had normal pre-pregnancy BMI (54.9%) [Table 2].

The TGWG with reference to the IOM recommendations for different BMI groups was significant using Chi-square test with $P = 0.033$.^[4] There were 83% or 15% had excess GWG, and 13% with inadequate GWG. Forty-nine percent of those who had excess GWG were those with a normal prepregnancy BMI and had a mean GWG of 13.3 (3.4) kg [Table 3].

Perinatal outcomes were associated with TGWG with 100% of excess GWG had large for gestational age neonates, and 41% of those were admitted to the neonatal intensive care unit (NICU) [Table 4].

There was a significant association between TGWG and maternal outcomes such as gestational diabetes mellitus, preeclampsia/eclampsia, and preterm birth. Thirty percent of pregnant women included in the study with excess GWG had gestational diabetes mellitus, followed by 9.6% developed gestational hypertension, 1.2% had preeclampsia/eclampsia, and 1.2% had preterm birth [Table 5].

Discussion

According to the IOM and National Research Council in 2009, the newly revised guidelines for GWG in pregnancy were established based on prepregnancy BMI.^[4] Wherein the prepregnancy BMI was categorized into four groups: underweight (<18.5 kg/m²), normal weight (18.5–24.9 kg/m²), overweight (25.0–29.9 kg/m²), and obese (≥ 30.0 kg/m²). Each category has its corresponding weight gain range for the entire duration of pregnancy.

Several studies mentioned prepregnancy weight has a substantial contribution to maternal and neonatal outcomes classified as underweight has been linked to a higher risk of preterm delivery, low birth weight, intrauterine growth restriction, and small gestational age neonates.^[4,1,16-18] On the other hand, classified under overweight or obese also has presented with large gestational age, macrosomic neonates, and in turn, higher risk to undergo labor induction, cesarean, or operative vaginal deliveries. Moreover, studies observed having excess GWG has increased in the development of gestational diabetes mellitus, gestational hypertension, or preeclampsia.^[12,19,20,14,9,21]

In this study, 565 Filipino pregnant were included, and the mean BMI was 23.6 kg/m²; based on BMI classification, there were 28.1% overweight and 9% obese. Using a

Table 2: Distribution of study population based on the World Health Organization body mass index classification

Prepregnancy BMI groups	Study population, n (%)
Underweight (<18.5 kg/m ²)	45 (8.0)
Normal weight (18.5-24.9 kg/m ²)	310 (54.9)
Overweight (25.0-29.9 kg/m ²)	159 (28.1)
Obese (≥ 30.0 kg/m ²)	51 (9.0)

BMI: Body mass index

Table 3: Total gestational weight gain with reference Institute of Medicine recommendations for different body mass index groups

Prepregnancy BMI groups	IOM total GWG (range in kg)	Total GWG (kg), mean (SD)	Inadequate GWG (n=73), n (%)	Normal GWG (n=409), n (%)	Excess GWG (n=83), n (%)	*P
Underweight (<18.5 kg/m ²)	12.5-18	13.7 (4.2)	8 (11.0)	34 (8.3)	3 (3.6)	0.033
Normal weight (18.5-24.9 kg/m ²)	11.5-16	13.3 (3.4)	44 (60.3)	225 (55.0)	41 (49.4)	
Overweight (25.0-29.9 kg/m ²)	7-11.5	9.3 (3.0)	16 (21.9)	119 (29.1)	24 (28.9)	
Obese (≥ 30.0 kg/m ²)	5-9	8.8 (3.7)	5 (6.8)	31 (7.6)	15 (18.1)	

*P>0.05 is statistically significant. IOM: Institute of Medicine, GWG: Gestational weight gain, SD: Standard deviation

Chisquare test with a *P* < 0.05, it was discovered that having an excess GWG was associated with 30.1 percent gestational diabetes mellitus, 9.6 percent gestational hypertension, 1.2 percent preeclampsia and preterm birth, and 100% of neonates were large gestational age, with 41% of these LGA neonates being admitted to the NICU. Meanwhile, inadequate weight gain was also significant of having small gestational weight neonate and preterm birth of 91% and 21.9%, respectively.

These results highlight the importance of proper weight management during pregnancy and further drive the point that excessive weight gain during pregnancy increases the risk for adverse maternal and neonatal outcomes.^[10,5,7,11-13,22-24,14,9] Results also reflected the same concerns and associations between TGWG and adverse outcomes found in different studies. These local data show evidence that these issues are present, and advocacies on specific interventions and policies on weight gain in pregnancy are needed to further drive home the point and effects of TGWG and adverse maternal and neonatal outcomes.

Conclusion

The present study showed that when a pregnant woman is categorized as underweight, overweight, and obese, they are already at risk of having maternal and perinatal outcomes. The data outcome suggests that there is an association between TGWG versus to its maternal outcomes (developing gestational diabetes, gestational hypertension, preeclampsia, and preterm birth) and perinatal outcomes (small or large for gestational age, intrauterine fetal demise, and admission to the NICU). The study also shows that there was a significant percentage of women who has excess GWG even in low-risk pregnancies with a normal prepregnancy BMI and a higher risk of having large for gestational age neonates. As further elaborated above, these local data might jumpstart for other studies to be done on TGWG and other causal effects.

Limitations and recommendations of the study

This study recommends a larger sample size, wherein pregnant women can be classified into low-risk and high-risk groups and can be correlated well with socioeconomic status and levels of support during the

Table 4: Association of total gestational weight gain and perinatal outcomes

Perinatal outcomes	Inadequate GWG (n=73), n (%)	Normal GWG (n=409), n (%)	Excess GWG (n=83), n (%)	*P
SGA	49 (91)	2 (33)	0	0.001
LGA	3 (6)	3 (50)	56 (100)	0.001
Intrauterine fetal demise	2 (4)	1 (17)	0	0.020
Admission to NICU	42 (58)	68 (17)	34 (41)	0.001

*P>0.05 is statistically significant. SGA: Small for gestational age, LGA: Large for gestational age, NICU: Neonatal intensive care unit, GWG: Gestational weight gain

Table 5: Association of total gestational weight gain and adverse maternal outcome

Maternal outcome	Inadequate GWG (n=73), n (%)	Normal GWG (n=409), n (%)	Excess GWG (n=83), n (%)	*P
Gestational diabetes mellitus	5 (6.8)	28 (6.8)	25 (30.1)	0.001
Gestational hypertension	6 (8.2)	17 (4.2)	8 (9.6)	0.074
Preeclampsia/eclampsia	6 (8.2)	2 (0.5)	1 (1.2)	0.001
Preterm birth	16 (21.9)	5 (1.2)	1 (1.2)	0.001

*P>0.05 is statistically significant. GWG: Gestational weight gain

course of pregnancy. In addition, a follow-up study can also be done on the route of delivery against TGWG.^[25] Women, who are at higher risk of developing complicated medical conditions postpartum, can be referred to a specialist for further evaluation and management.

Being a prospective study, there are no physical potential risks to research subjects, however, some personal information of the subjects will be obtained as well as some sensitive information may be asked, so there may be risks associated with loss of privacy.

As this is a prospective study, there are no physical potential benefits to individual research subjects. Potential benefits may be to further study the incidence of excessive GWG based on the IOM 2009 GWG guidelines among pregnant patients in a tertiary hospital at risk of having maternal and perinatal outcomes. Furthermore, this study may also help obstetricians on how to deal with patients at the risk of having maternal and neonatal adverse outcomes and know when to refer to other services for comanagement.

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Conflicts of interest

There are no conflicts of interest.

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