

Maternal characteristics & gestational weight gain

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ABSTRACT

Objectives: The purpose of this study was to examine gestational weight gain (GWG) patterns among a group of racially, ethnically, economically diverse women as it relates to the Institute of Medicine (IOM)/National Academy of Medicine (NAM) Guidelines.

Hypothesis: Body mass index and medical provider type will affect the patterns of gestational weight gain among a group of diverse women.

Methods: This retrospective cross-sectional study from a sample of women (N=4,500) who gave birth between January 1, 2011 and December 31, 2012. There were 1,397 charts of mothers who delivered singleton babies were assessed; 621 cases were randomly selected and 320 met the inclusion criteria. Information on maternal socio-demographic were obtained from the electronic medical record.

Results: The sample skewed towards younger women; approximately 58% were 29 years of age or less. Overall, almost half (43%) of the births were to women who identified themselves as Latina. Over 48% of women received

MediCal Insurance, a type of insurance for low income women. Seventy-one women (25%) reported Spanish as their primary language. More Latina women were receiving MediCal ($p<0.001$), saw a CNM rather than a physician ($p<0.001$), and were single ($p<0.001$). Across racial/ethnic categories there were no significant differences in age or weight gain. Almost half of the participants were either overweight or obese pre-pregnant. More than two-thirds of the sample (69.1%) gained weight outside the recommend range. Pre-pregnancy BMI (Fisher's X^2 10.4; $p=.03$) significantly correlated to GWG within guidelines. The association of having a certified nurse midwife and staying within guidelines demonstrated an interesting trend toward statistical significance ($p=.09$). There was a trending association among those women who gained weight above the guidelines and cesarean delivery ($p=0.07$) and those women who gained weight outside the guidelines had babies weighing significantly more at birth ($p<0.001$).

Conclusion: Women are not adhering to the 2009 IOM/NAM GWG recommendations.

Key Words: Pregnancy; Women; BMI; Electronic health record; Gestational weight gain; Provider type; Race/ethnicity

INTRODUCTION

Healthcare providers are critical facilitators to address the Healthy People 2020 objective of increasing the proportion of mothers who stay within the recommended weight gain parameters during their pregnancies (1). Providers are tasked with developing substantial interventions to decrease the prevalence of adverse outcomes from inappropriate gestational weight gain (GWG) that can lead to ill effects (2,3).

Previous studies have found a direct link to lifelong obesity for women who gain above the weight gain recommendations during pregnancy if they had an overweight or obese pre-pregnancy body mass index (BMI). There is also a link to child obesity and adverse fetal and maternal outcomes if women gain weight below or above GWG recommendations (2,3). In addition, congenital anomalies such as neural tube defects, cardiovascular, septal defects, cleft lip and palate, hydrocephaly, anorectal atresia, and short limb reduction have been associated with maternal overweight and obesity (4).

Despite the knowledge generated from previous research studies, managing gestational weight remains a challenge for healthcare providers and pregnant women (5). Current numbers from the Centers for Disease Control recommend the following as appropriate pregnancy weight gain parameters for mothers pregnant with their first child (6). Interesting to note this study was conducted on 2014 referencing the 2009 IOM GWG Recommendations and is the same GWG guidelines as the CDC.

Women's knowledge about appropriate GWG, attitudes and beliefs about weight, and weight gain, as well as healthcare providers' inaccurate or absent advice regarding GWG can affect the amount of weight women gain during pregnancy. According to the American College of Obstetricians and Gynecologists (ACOG), components of preconception care should include addressing excess weight gain because it significantly increases the likelihood of prematurity and neonatal intensive care unit admissions (7). When discussing routine care as well as specific preconception care, addressing the relationship between maternal obesity and perinatal outcomes is necessary.

In a 2011 study done by Herring, Henry, Klotz, Foster, and Whitaker, on the perceptions of low-income African-American mothers regarding excessive weight gain, results showed mother's perceptions about GWG were either culturally based such as believing that high GWG was attractive and desirable or, as a result of lack of knowledge in stating that overeating and higher weight gains are necessary to meet the fetus' nutritional needs (8).

Brown and Avery argue that weight gain, diet, and exercise advice women receive antenatally is brief and generally not related to weight management (9). Overweight and obese women incorrectly identified weight gain recommendations compared to normal weight and underweight women. Additionally, overweight and obese women tend to overestimate their weight gain during pregnancy, while underweight and normal weight women tend to underestimate their weight gain during pregnancy. According to a study done by Lindsey, Wallington, Greanery et al. a majority of mothers reported that their primary healthcare providers tracked their weight gain during pregnancy but did not provide them with specific information as to whether their weight gain was appropriate (10).

The relationship between maternal characteristics and gestational weight gain were not definitive. However, according to Paul, Graham, and Olsen, a correlation between ethnicity, particularly that of African-American low-income women and White, high-income women along with diet and physical activity was significant (11). The low-income group of this ethnicity were more likely to have a diet of fast foods, fried foods, soda, high fat toppings on vegetables, few fruits and vegetables, and engage in walking only as necessary for activities of daily living. In comparison, the high-income group of White ethnicities, mentioned soothing cravings and nausea with healthy foods, choosing less energy dense foods to satisfy increased appetites, eating small, frequent meals to prevent hunger, bringing lunch from home to avoid overeating at work, and maintaining exercise frequency (11). Depression and pre-pregnancy weight gain has also been studied as a maternal characteristic that may contribute to GWG during pregnancy. According to a study done by Ertel, Silveira, Pekow, Dole, Markenson, Chasan-Taber et al. on 1,090 Hispanic prenatal-care patients. the researchers concluded there was no

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statistically significant association between obesity and elevated depressive symptoms in their chosen population and, further, they did not detect an association between GWG and elevated depressive symptoms (12). Characteristics, as mentioned above, can have an impact on GWG. For example, patients with private health insurance may have a slight advantage as they are generally educated, seek prenatal care early, and have access to quality nutritious foods compared to those who may qualify for MediCal Insurance not Medicare.

Adherence to the 2009 Institute of Medicine (IOM)/National Academy of Medicine (NAM) GWG (Table 1) recommendations that guides this study is a combined effort between the mother-to-be and her healthcare provider (13). Excessive weight gain may result in pregnancy complication such as preeclampsia and increased risk for cesarean birth, as does inadequate weight gain, which puts the fetus at risk for anomalies, prematurity, or even stillbirth (14,15).

Although the potential benefits of obesity screening, as part of preconception counseling, remain unexplored, monitoring maternal BMI gains before and during pregnancy play an important role in assessing obstetric outcomes (16,17). Many obstetricians do not offer GWG guidance to their patients regarding GWG according to pre-pregnancy BMI, even if counseling is occurring (18,19). Research indicates that a higher proportion of obstetrical staff other than midwives reported they did not weigh women at any time during pregnancy, making it impossible to track weight gain or loss (18,20,21). As few as 9% of pregnant women's charts may have documentation of BMI with the potential for high-risk women being overlooked and potentially not referred to appropriate care and counseling (22).

Approximately 70% of pregnant women in the United States fail to comply with the 2009 GWG guidelines, in part due to the healthcare provider's lack of counseling on recommendations about appropriate GWG (23,24). The purpose of this study was to examine GWG patterns among a group of racially, ethnically, economically diverse women and to examine any association between provider type, maternal characteristics and GWG within the 2009 IOM/NAM recommended guidelines.

METHODS

Study design and sample

This retrospective cross-sectional study utilized participants selected from a sample of all women (N=4,500) who gave birth between January 1, 2011 and December 31, 2012 at a large multi-community hospital healthcare system in San Diego County, California; 1,397 charts of mothers who delivered singleton babies were assessed; 621 cases were randomly selected and 320 met the inclusion criteria. Information on maternal socio-demographic (race/ethnicity, age, primary language, MediCal Insurance) and maternal and infant birth data (weight-gain, Medical conditions, gestational age, parity) were obtained from the birth certificates downloaded from the electronic health record (EHR), supplemented with data manually abstracted from the postpartum computerized charting system, which had not yet been incorporated in the system EHR at the time of the study. All study procedures were reviewed and approved by the appropriate institutional review boards and administrators. Inclusion criteria were singleton live birth, data available for pre-pregnancy BMI and GWG greater than or equal to 4 prenatal visits, and full-term births (greater than or equal to 37 weeks' gestation) to mothers 18 years of age or older. The analysis was restricted to singleton births to rule out the increased likelihood of excessive weight gain.

Maternal-gestational weight gain (GWG) is a significant problem in the United States (25). The participants were selected from a variety of

TABLE 1
2009 Institute of Medicine/National Academy of Medicine GWG Guidelines

Pre-pregnancy weight category	Pre-pregnancy BMI cut points	GWG recommended ranges
Underweight	<18.5	28-40 LB (12.5-18.0 KG)
Normal weight	18.5-24.9	25-35 LB (11.5-16.0 KG)
Overweight	25.0-29.9	15-25 LB (7.0-11.5 KG)
Obese	>30.0	11-20 LB (5.0-9.0 KG)

Note: Adapted from Rasmussen KM, Yaktine A, Weight gain during pregnancy: Reexamining the guidelines. In the National Academies Collection: Reports funded by National Institutes of Health (2). Washington, DC: National Academies Press. BMI=body mass index; GWG=gestational weight gain.

ethnicities, parities, ages, and socioeconomic status. Statistics show that there is a correlation between gestational weight gain and obesity later in life both in the mother and her offspring. Here, in San Diego County, where this population was selected at random, there is a high Hispanic representation which has a high incidence of excessive gestational weight gain due to cultural diet high in carbohydrates and fats and lacking in vegetables, vitamins and minerals (11). In the process of doing this research and living in a community with a high incidence of GWG, the researchers found a direct correlation between GWG and the Hispanic population specifically in the low-income group. Factors contributing to GWG included, but not limited to: Social support, mother and partner's feelings about the pregnancy, marital status, and existing medical conditions such as diabetes and hypertension (26). There is a high risk for lack of access to care in the Hispanic population based on rural living areas, along with a lack of primary education, and ease of access to fast-food establishments, cultural diet as stated previously, and lack of establishments that provide fresh fruits and vegetables (11,27). Although significant, other cultures and ethnicities were chosen for our study to provide a more comprehensive view of how GWG affects people across all cultural and socioeconomic boundaries.

Gestational weight gain

Consistent with the IOM/NAM recommendation, GWG was assigned the category of below, within, or exceeding recommendations based on the kilograms gained and pre-pregnancy weight category assigned (underweight, normal, overweight, and obese) (23). Pre-pregnancy weight was determined from women's self-report in the Electronic Health Record (EHR); BMI was calculated using the reported weight and the recorded height from the mother's medical record. GWG was the focus of this study as research shows that excessive weight gain can predispose women to a multitude of health concerns including, but not limited to, hypertensive disorders, gestational diabetes, preterm births, cesarean births, and a link to lifelong obesity in the mother and her child (28). Part of the selection criteria was pre-pregnancy weight and BMI regardless of weight gain before pregnancy as there was no data available to assess this. Instead, the focus was whether or not women were adhering to the GWG guidelines set forth by the 2009 IOM/MAN. Women who had prenatal visits of 4 or more were included in the study.

Demographics

Race and ethnicity were collected within the EHR based on self-report. The sample was categorized as White, Latina, and Other, reflecting the small numbers of women who identified themselves as other than White or Latina. Other covariates included in the analysis were maternal age categorized into four age groups (18-24, 25-29, 30-34, and 35 years or older); insurance status (Medical or private insurance); primary language spoken (English, Spanish, and other), marital status, and provider type (physician or certified nurse midwife).

Data was collected from maternal demographics, birth records, downloaded electronic health records, and labor and delivery summaries. As stated previously, the analysis was limited to singleton births to rule out the increased likelihood of excessive weight gain caused by multiple fetuses.

Clinical characteristics

Maternal clinical characteristics included parity, gestational age, and mode of delivery. Newborn clinical characteristics included Apgar scoring at 1 minute and 5 minutes, size and postpartum complications such as postpartum hemorrhage and postpartum infection (Tables 1-3).

Statistical analyses

Descriptive analysis was performed for the total sample by race/ethnicity, and according to GWG within recommended guidelines. To assess whether demographic variables were associated with GWG Fisher's exact chi-square tests were used with categorical variables and t-tests and ANOVAs for continuous data. All analyses were conducted using SPSS version 23, Chicago, IL.

RESULTS

Maternal demographic factors for the total population by race/ethnicity are shown in Table 2. The sample skewed towards younger women. Approximately 58% were 29 years of age or less. Overall, almost half (43%) of the births were to women who identified themselves as Latina. Almost half (48%) of the women received MediCal insurance. Seventy-one women (25%) reported Spanish as their primary language. More Latina women were receiving MediCal (p<.001), saw a Certified Nurse Midwife (CNM) rather than a physician (p<.001), and were single (p<.001). Across racial/ethnic

TABLE 2
Maternal Demographic Characteristics by Race/Ethnicity

Characteristic	Total		Non-hispanic white		Latina		Other		P value ^a
	N	%	N	%	N	%	N	%	
Age									.27
18-24	70	24.6	24	19.4	39	31.7	7	18.4	
25-29	95	33.3	43	34.7	37	30.1	15	39.5	
30-34	77	27.0	35	28.2	33	26.8	9	23.7	
35+	43	15.1	22	17.7	14	11.4	7	18.4	
Primary language									< .001
English	209	73.3	124	100.0	52	42.3	33	86.8	
Spanish	71	24.9	0	0.0	71	57.7	0	0.0	
Other	5	1.8	0	0.0	0	0.0	5	13.2	
Marital status									< .001
Single	105	36.8	32	25.8	62	50.4	11	27.0	
Married	172	60.4	88	71.0	57	46.3	27	71.1	
Other	8	2.8	4	3.2	4	3.3	0	0.0	
Characteristic	Total		Non-hispanic white		Latina		Other		P value ^a
	N	%	N	%	N	%	N	%	
Payor									< .001
Medical	139	48.8	33	26.6	95	77.2	11	28.9	
Other	146	51.2	91	73.4	28	22.8	27	71.1	
Provider^b									< .001
Certified nurse midwife	39	14.0	5	4.0	33	28.4	1	2.6	
Medical doctor	239	86.0	119	96.0	83	71.6	37	97.4	
Pre-pregnancy BMI									.05
Normal	143	50.2	64	51.6	53	43.1	26	68.4	
Overweight	101	35.4	41	33.1	53	43.1	7	18.4	
Obese	41	14.4	19	15.3	17	13.8	5	13.2	
Weight gain category									.37
Outside recommendation	197	69.1	88	71.0	80	65.0	29	76.3	
Within recommendation	88	30.9	36	29.0	43	35.0	9	23.7	

Note. BMI=body mass index.
^ap value for Fisher's exact chi-squared test. ^bMissing data.

categories there were no significant differences in age or weight gain. To reduce bias, participants were randomly selected from the 4,500 cases in which a final 295 participants met the inclusion criteria with BMI's that fell outside the normal range, inside the normal range, and also, subjects who were overweight or obese.⁷

Maternal characteristics according to weight gain category are presented in Table 3. Almost half of the participants were either overweight or obese before they became pregnant. More than two-thirds of the sample (69.1%) gained weight outside the recommend range. Pre-pregnancy BMI (Fisher's $\chi^2=10.4$, $p=.03$) was significantly correlated to GWG within guidelines. The association of obtaining care from a certified nurse midwife and staying within recommended guidelines demonstrated an interesting trend toward statistical significance ($p=0.09$). There was a trending association among those women who gained weight above the guidelines and cesarean delivery ($p=0.07$) and those women who gained weight outside the guidelines had babies who weighed significantly more at birth ($p<0.001$).

DISCUSSION

The purpose of this study was to examine GWG patterns according to the 2009 IOM/NAM among a group of racially, ethnically, and economically diverse women in relationship to provider type and maternal characteristics. Information gained from a retrospective chart review quantified GWG patterns within this study population and examined variables expected to be correlated to GWG patterns. Previous research indicates at least 40% of pregnant women gain above the recommended IOM/NAM range (29). In this study 52% percent of the women gained more than the recommended amount. The women entered this study more overweight but less obese than previously estimated. Vahratian estimated the prevalence of overweight

and obesity among US women of childbearing age using the 2002 National Survey of Family Growth, and found 24.5% were overweight and 23% were obese, where as in this sample 36% overweight and 14% met criteria for being obese according to their reported pre-pregnancy weight (30).

Due to a variety of environmental, socioeconomic, and educational barriers, low-income urban women are at higher risk for excessive GWG, with the highest rates reported by Latina and African American women (8,11). Within this sample, although there were differences in payor type, which was used as a surrogate for socioeconomic status (SES) by race/ethnicity, there was no difference in either pre-pregnancy weight by race/ethnicity or by pregnancy weight gain pattern and race/ethnicity. Although many of the women received government assistance with adequate prenatal care of having greater than 3 prenatal visits may have mitigated previously identified barriers among the women in this study group. Flegal, Carroll, Kit, and Ogden, reported obesity prevalence in 2009-2010 by race/ethnicity, illustrating 40.7% of Hispanic and 58.6% of Black women were obese compared to 33.4% of White women (28). In this study, 48% of non-Hispanic White women were overweight or obese compared to 57% of Latinas. This study suggests that all women regardless of race/ethnicity need to be monitored carefully, not just minority groups.

This study did not show a significant relationship between mode of delivery and GWG pattern in contrast to previous studies, where excessive GWG and high pre-pregnancy BMI were associated with intrapartum complications. When compared to women with normal pre-pregnancy BMI, adverse effects include increased rates of induction of labor and cesarean deliveries (31). Rates of primary and repeat cesarean delivery are higher in women with excessive GWG and higher pre-pregnancy BMI than in women with normal pre-pregnancy BMI (31-34).

TABLE 3
Maternal Characteristics according to Weight Gain Category

Characteristic	Total		Below Recommendations		Within Recommendations		Exceed Recommendations		P Value ^a
	N	%	N	%	N	%	N	%	
Age									.92
18-24	70	24.6	9	18.4	23	26.1	38	25.7	
25-29	95	33.3	18	36.7	30	34.1	47	31.8	
30-34	77	27.0	13	26.5	22	25.0	42	28.4	
35+	43	15.1	9	18.4	13	14.8	21	14.2	
Primary Language									.48
English	209	73.3	33	67.3	63	71.6	113	76.4	
Spanish	71	24.9	14	28.6	24	27.3	33	22.3	
Other	5	1.8	2	4.1	1	1.1	2	1.4	
Payor									.44
Medical	139	48.8	20	40.8	46	52.3	73	49.3	
Other	146	51.2	29	59.2	42	47.7	77	52.0	
Characteristic	Total		Below recommendations		Within recommendations		Exceed recommendations		P Value ^a
	N	%	N	%	N	%	N	%	
Provider^b									.09
Certified nurse midwife	39	13.7	8	16.3	17	19.3	14	9.5	
Medical doctor	240	84.2	41	83.7	69	78.4	130	87.8	
Pre-pregnancy BMI									.03
Normal	142	49.8	28	57.1	53	60.2	61	41.2	
Overweight	102	35.8	14	28.6	28	31.8	60	40.5	
Obese	41	14.4	7	14.3	7	8.0	27	18.2	
Race/ethnicity									.51
Non-hispanic white	124	43.5	19	38.8	36	40.9	69	46.6	
Latina	123	43.2	21	42.9	43	48.9	59	39.9	
Other	38	13.3	9	18.4	9	10.2	20	13.5	
Mode of delivery									.07
Cesarean	103	36.1	14	28.6	26	29.5	63	42.6	
Vaginal	182	63.9	36	73.5	61	69.3	85	57.4	
Characteristic	Total		Below recommendations		Within recommendations		Exceed recommendations		P Value ^a
	N	%	N	%	N	%	N	%	
Antenatal Complications									.40
No	228	80.0	43	87.8	71	80.7	114	77.0	
Yes	57	20.0	7	14.3	16	18.2	34	23.0	
Characteristic	M	SD	M	SD	M	SD	M	SD	P value ^c
Labor length	10.4	4788.7	10.4	9.1	14.7	14.8	16.2	40.5	.62
Newborn weight in grams	3446.4	430.5	3324.6	388.9	3363.8	350.2	3536.1	467.6	.001
Apgar 1 minute	7.9	1.2	7.8	1.6	7.9	1.2	8.0	1.1	.78
Apgar 5 minutes	8.9	0.6	8.7	1.4	8.9	0.3	9.0	0.3	.10

Note: BMI=body mass index.

p value for Fisher's exact chi-squared test. ^bMissing data. ^cp value for one-way ANOVA.

Furthermore, higher parity was not significantly associated with GWG. This contrasts with studies that report giving birth to one child compared to never having children could double the risk of high GWG and contribute to obesity over 5-10 years and having at least two children could lead to greater increase in obesity (35-37). A recent study by Davis et al. found multiparous women with short inter-pregnancy intervals with or without excessive GWG had increased risk of obesity after childbirth compared to multiparous women with longer inter-pregnancy intervals (38).

Medical insurance did not demonstrate a statistically significant association with GWG patterns. Previous studies have produced mixed results, which may reflect differences in how GWG is measured and reported when examined by women's Medical insurance status/SES, and race/ethnicity. Chasan-Taber et al. reported SES was not associated with excessive GWG, however, other studies reported Hispanic women with government-funded MediCal insurance is a strong indicator of risk for maternal morbidity such as excessive GWG and obesity (39).

Healthcare provider type (Obstetricians and Certified Nurse Midwife) trended toward association with GWG, with a greater proportion of women

who had a certified nurse midwife rather than physician as their provider remained within the weight gain recommendations. Stewart, Wallace, and Allan revealed a higher proportion of obstetrical staff than midwives reported they did not weigh women at any time, (43% vs. 13%, p<0.050) and twenty-two percent of participants in the same study reported not advising because they felt uncomfortable discussing weight and were concerned weight discussion might result in maternal stress (40). Interventional studies and more educational support are needed to help healthcare providers recognize this as an issue to be addressed when caring for women of childbearing age and how to handle weight issues when caring for pregnant women.

One limitation of this analysis is the lack of data about educational level and specific household income, which would provide more information about the effects of socioeconomic factors on GWG. In addition, the lack of generalizability of the findings to all pregnancies presented another limitation to this study. The sample was limited to those who at least 4 prenatal visits, carried the pregnancy to 37 weeks or more, and had a singleton birth. Conversely, if this study included those with no prenatal care, there may have been much more variation in weight gain amounts and increased high-risk pregnancies. Variables that may play a role in GWG were

not considered because they were inconsistently reported (e.g., educational attainment, smoking, illicit drug use, alcohol intake, and eating disorders).

Taken in context, findings from this study illuminate significant challenges adhering to the recommended GWG guidelines and demonstrate that pre-pregnancy BMI is significantly associated with weight gain patterns. In addition, interventional studies are needed to support pregnant women in gaining weight within the GWG recommendations (41-44).

CONCLUSION

This study illustrates, that even among women who are receiving prenatal care, 70% gained weight outside the guidelines recommended for their pre-pregnancy BMI. Women are not adhering to the 2009 IOM/NAM GWG recommendations and subsequently began pregnancy outside of a recommended weight with overweight (35.8%) and obese (14.4%). More research is needed to discern why women gain weight outside the IOM guidelines. The advice women are receiving appears to be ineffective in targeting appropriate weight gains during pregnancy.

More studies are needed to assist in the development of better strategies to help healthcare providers motivate women to gain weight based on the IOM/NAM GWG recommended guidelines. The findings suggest in addition to pre-pregnancy weight, the healthcare provider may influence whether a woman is able to stay within recommended guidelines for GWG. These findings call attention to a possible modifiable factor, the provider, who may influence an individuals' behavior. Personalized interventions may be needed focusing on dietary intake and physical activity as well as potentially psychological counseling to help women achieve their targeted weight gains.

Recommendations for further study include, but not limited to: Additional study on effect of maternal characteristics and gestational weight gain along with mixed method and interventional studies using a control group and target group with an education determinant.

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