

ORIGINAL ARTICLE

Factors Associated with Rates of Gestational Weight Gain among Pregnant Women in Batu Pahat District of Johor state, Malaysia

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ABSTRACT

Introduction: This cross-sectional study determines factors associated with the rates of gestational weight gain (GWG) among women in the second and third trimester of pregnancy. **Methods:** A total of 180 pregnant women (29.2 ± 4.3 years old) attending the maternal and child health clinics in Batu Pahat district were enrolled in the present study between January and February, 2015. Information regarding demographic characteristics, obstetrical history, physical activity, and calorie intake was assessed through direct interview. Anthropometric data were collected from medical records. GWG rates were determined based on 2009 IOM recommendations. **Results:** Of the 180 pregnant women, 37.2% were at their second trimester and 62.8% were at the third trimester of pregnancy. While 53.3% of them had excessive GWG rate, 28.9% have inadequate GWG rate. More than half of the women (56.7%) were normal weight, 21.1% overweight, 14.4% underweight, and 7.8% obese before pregnant. The total mean activity and energy intake of the pregnant women were 195.9 ± 94.2 MET-hour/week and 2365 ± 709 kcal/day, respectively. The multinomial logistic model indicates that women who were overweight or obese at pre-pregnancy were seven times more likely to have excessive GWG rate (OR = 7.44, 95% CI = 2.07-26.66) as compared to women who were pre-pregnancy normal weight. **Conclusions:** About four in every five of the pregnant women had their GWG rates outside the IOM recommendations. Women who were overweight/obese at pre-pregnancy were at-risk of having excessive GWG rate, which underlines the importance of targeting these women for pre-conception counselling on GWG.

Keywords: Gestational weight gain, Pregnancy, Pre-pregnancy BMI, Overweight, Obesity

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INTRODUCTION

Gestational weight gain (GWG) is an important anthropometric indicator for maternal nutritional status (1,2), as well as a predictor for short- and long-term maternal and infant outcomes. Inadequate weight gain during pregnancy is associated with intrauterine growth restriction, prematurity and low birth weight (3-5). In contrast, excessive weight gain during pregnancy is associated with a higher risk of gestational hypertension, gestational diabetes mellitus, preeclampsia, caesarean section delivery, hemorrhages, postpartum weight retention, and large-for-gestational-age (6-9). To optimize maternal and child health, the Institute of Medicine (IOM) (10) has recommended a greater total GWG for women with pre-pregnancy underweight (12.5–18.0 kg) or healthy weight (11.5–16.0 kg), and

less total GWG for pre-pregnancy overweight (7.0–11.5 kg) and obese (5.0–9.0 kg) women.

In developed western countries such as the United State, Canada, Iceland, and Sweden, previous studies reported that almost half of the pregnant women had an excessive rate of GWG while one-fifth of them had an inadequate rate of GWG (11-14). On the other hand, studies done in developed Asian countries such as Japan and Singapore showed that about half of the pregnant women gained weight outside the IOM recommendations with the case of excessive GWG was slightly higher than the case of inadequate GWG (6,15). Similar findings were also reported in developing Asian countries such as China and Malaysia, whereby about half of the pregnant women had excessive GWG (16,17). As in India, about one-third of the pregnant women gained weight inadequately while another one-fifth of them experienced excessive GWG (18).

The etiology of inadequate or excessive GWG is multifactorial. Socio-demographic factors such as

maternal age (16,19), ethnicity (6), educational level (20-22), and household income (16,23-25), obstetrical history such as age at menarche (26), parity (14), and pre-pregnancy overweight and obesity status (27-30), and behavioral factors such as dietary intake (31) and physical activity (23,30) were found to be associated with GWG among pregnant women.

To date, published studies regarding factors associated with GWG among pregnant women in Malaysia are still scarce (27,28). For instance, a study by Noor Farhana et al. (27) was focused on the association of socio-demographic and obstetrical factors with GWG among pregnant women in a rural district in Kelantan. Another local study by Yong et al. (28) was aimed to determine the relationships of socio-demographic, obstetrical, and behavioral factors with GWG rate among pregnant women at three selected urban clinics in Selangor and Negeri Sembilan. Inconsistent findings were reported between these two studies, while only one study (28) had assessed the relationship between behavioral factors and GWG. Behavioral factors such as dietary intake and physical activity are important predictors of GWG (28,31). More researches are needed to better understand the multifactorial etiology of GWG in order to be incorporated as intervention strategies in preventing inappropriate GWG among pregnant women. Hence, the objective of the current study is to determine the socio-demographic, obstetrical, and behavioral factors associated with the rates of GWG among women in their second and third trimester of pregnancy.

MATERIALS AND METHODS

Ethical approvals

Ethical approvals were obtained from the Ethics Committee for Research Involving Human Subjects, Universiti Putra Malaysia (JKEUPM) and Medical Research and Ethics Committee (MREC). Permission to conduct the study was granted by the Institute for Public Health, Johor State Health Department, and Batu Pahat District Health Office.

Study design, setting and subjects

This is a cross-sectional study conducted among pregnant women from seven selected government health clinics located in Batu Pahat district, Johor between January and February 2015. All pregnant women who attended at the selected government health clinics and met the inclusion criteria (Malaysian, aged 18 to 40 years, singleton pregnancy, at second or third trimester, without the history of chronic complications) were invited to take part in the study. A total of 220 pregnant women were recruited. Signed consent was obtained from all pregnant women who agreed to participate in the study. A final sample of 180 pregnant women completed the study, excluding those in the first trimester, less than 18 years old, with gestational diabetes mellitus, and incomplete data.

Anthropometric measurements

The pre-pregnancy body weight was self-reported, while height and the additional antenatal weights were extracted from medical records. Pre-pregnancy BMI (kg/m²) is defined as pre-pregnancy weight in kilograms divided by height in square meters and was then classified into four categories using the WHO 1995 cut-offs; namely, underweight (<18.5 kg/m²), normal weight (18.5-24.9 kg/m²), overweight (25.0-29.9 kg/m²), and obesity (≥30.0 kg/m²) (32). The rates of GWG were calculated as the difference between the last and first measured weight of second and third trimester, respectively (2). Based on the pre-pregnancy BMI, the rates of GWG were then compared to the IOM (2) recommendations to determine the adequacy of weight gain during the specific trimester in their pregnancy. The IOM (2) recommends a weight gain of 0.44-0.58 kg for underweight, 0.35-0.50 kg for normal weight, 0.23-0.33 for overweight, and 0.17-0.27 kg for obese women during the second and third trimesters of pregnancy. Women with the rates of GWG within the range were classified as adequate, while those below or exceeded the recommended range was classified as inadequate and excessive, respectively.

Maternal characteristics

Socio-demographic characteristics of the pregnant women including age, ethnicity, educational level, and monthly household income were obtained through a face-to-face interview by the researchers. Obstetrical history including parity was extracted from their medical record.

Dietary intake

The habitual food intake of the pregnant women in the past three months was assessed by using a semi-quantitative food frequency questionnaire (FFQ) (33). The frequency and portion of the food taken by the pregnant women were obtained by the researcher through a face-to-face interview. Amount of daily food intake was assessed by multiplying the intake frequency per day, serving size, and weight of food (34), and was then entered into the Nutritionist Pro Software for analysis. The energy and nutrient values obtained were compared with the Recommended Nutrient Intakes for Malaysians (RNI) (35) to determine intake adequacy.

Physical activity

Physical activity level was assessed by using the semi-quantitative Pregnancy Physical Activity Questionnaire (PPAQ) (36). The pregnant women were required to report the duration of time they spent for each of the activity listed in the questionnaire (household or caregiving, occupational, and sport or exercise) with the response options ranged from "none", "less than half an hour per day", "half to almost one hour per day", "one to almost two hours per day", "two to almost three hours per day", and "three or more hours per day". The intensity of each activity was determined by assigning a

metabolic equivalent (MET) value to the activities based on the Compendium of Physical Activities (37). Mean energy expenditure per week (MET-hour/week) for each activity was determined by multiplying the duration of time spent in each activity with its intensity. The total physical activity was calculated by summing up the MET-hour/week of each activity.

Data analysis

Data were analysed using IBM SPSS Statistics 22 (SPSS Inc., Chicago, IL, USA). Descriptive analysis such as frequency, mean, standard deviation and percentage were used to describe the data. The chi-square test of independence was used to determine the association between two or more groups of categorical variables such as ethnicity, educational level, monthly household income, parity, pre-pregnancy BMI, and types of activities with GWG rates. One-way analysis of variance (ANOVA) was used to determine the differences in age, energy intake, intakes of carbohydrate, protein, and fat, and total physical activity by GWG categories. Multinomial logistic regression was performed to identify the factors associated with GWG rates. Data were presented as the crude and adjusted odds ratios (OR) with 95% confidence interval (CI). The statistical significance was set at $p < 0.05$.

RESULTS

Characteristics of the pregnant women

Out of the 180 pregnant women, 37.2% were in their third trimester and 62.8% were in their second trimester, with a mean age of 29.2 ± 4.3 years old. More than half of the pregnant women were Malay (72.8%), 23.3% were Chinese, and 3.9% were Indian, respectively. A majority of them received secondary education at their highest level of education (54.4%), while almost half of them had monthly household income between RM1500 to RM3500 (48.3%). More than half of them were multiparous (57.2%). Prior to pregnancy, more than half of the women were normal weight (56.7%), followed by being overweight (21.1%), underweight (14.4%), and obese (7.8%). As for GWG rates, 53.3% of the pregnant women had excessive GWG rate, 28.9% of them had inadequate GWG rate, and 17.8% of them had adequate GWG rate (Table I), with a mean weight gain of 0.5 ± 0.3 kg/week.

The mean daily energy intake of the pregnant women was 2365 ± 709 kcal, which achieved an average of 104.3% of the RNI level for energy (Table I). More than half of the pregnant women (52.8%) exceeded the RNI level for energy intake. In terms of macronutrient intakes, the majority of the pregnant women achieved the recommended intake for carbohydrate (60.0%) and protein (91.7%), respectively. On the other hand, about three in five of them exceeded the recommended intake for fat (61.7%). This indicated that the pregnant women in this study consumed a high-fat diet.

Table I: Characteristics of pregnant women (N = 180)

Characteristics	Mean \pm SD	n (%)
Age (years)	29.2 ± 4.3	
Ethnicity		
Malay		131 (72.8)
Chinese		42 (23.3)
Indian		7 (3.9)
Educational level		
Primary education		7 (3.9)
Secondary education		98 (54.4)
Tertiary education		75 (41.7)
Monthly household income (RM)		
< RM 1500		41 (22.8)
RM 1500 – RM 3500		87 (48.3)
> RM 3500		52 (28.9)
Gestational age (trimester)		
Second		67 (37.2)
Third		113 (62.8)
Parity		
Nulliparous		77 (42.8)
Multiparous		103 (57.2)
Pre-pregnancy BMI (kg/m²)		
Underweight (<18.5)		26 (14.4)
Normal weight (18.5-24.9)		102 (56.7)
Overweight (25.0-29.9)		38 (21.1)
Obesity (≥ 30.0)		14 (7.8)
Gestational weight gain (kg/week)²	0.53 ± 0.33	
Inadequate		52 (28.9)
Adequate		32 (17.8)
Excessive		96 (53.3)
Energy intake (kcal/day)	2365 ± 709	
% RNI	104.3 ± 31.0	
< RNI		85 (47.2)
\geq RNI		95 (52.8)
Carbohydrate intake (g/day)	305.9 ± 95.1	
Percentage energy from carbohydrate	52.2 ± 7.9	
<50%		64 (35.6)
50% – 65%		108 (60.0)
>65%		8 (4.4)
Protein intake (g/day)	92.2 ± 34.2	
Percentage energy from protein	15.6 ± 2.9	
<10%		2 (1.1)
10% – 20%		165 (91.7)
>20%		13 (7.2)
Fat intake (g/day)	87.0 ± 36.3	
Percentage energy from fat	32.6 ± 7.2	
<25%		19 (10.6)
25%-30%		50 (27.8)
>30%		111 (61.7)
Total physical activity (MET-hour/week)	195.9 ± 94.2	
Type of activity		
Sedentary to light		102 (56.7)
Moderate to vigorous		78 (43.3)

Note:

¹Pre-pregnancy BMI was classified using WHO 1955 cut-offs.

²GWG rate was classified based on 2009 IOM classification recommendations based on pre-pregnancy BMI; GWG rate within the recommended range was classified as adequate, while those below or exceeded the recommended range was classified as inadequate and excessive, respectively.

RNI: Recommended Nutrient Intakes

Overall, the total mean activity of the pregnant women was 195.9 ± 94.2 MET-hour/week. More than half of them (56.7%) involved in sedentary to light activity, while 43.3% of them were involved in moderate to vigorous activities weekly (Table I).

Factors associated with the GWG rates

Bivariate analyses were performed to determine the

associated factors of GWG rates; namely, age, ethnicity, educational level, household income, parity, pre-pregnancy BMI, energy intake, intakes of carbohydrates, protein, and fat, total physical activity, and types of activities of the GWG rates. As shown in Table II, pre-pregnancy BMI ($F = 19.880, p < 0.10$) and type of activity ($\chi^2 = 5.370, p < 0.10$) were significantly associated with GWG rates. Further, the multinomial logistic regression model shows that women who were pre-pregnancy overweight or obese were seven times more likely to have excessive GWG rate (OR = 7.44, 95% CI = 2.07, 26.66) as compared to women who were pre-pregnancy normal weight (Table III). No association was found between type of activity and GWG rates.

DISCUSSION

The present study found that a majority of the pregnant women in a semi-urban district of Johor had inappropriate GWG rate (82.2%), and it is higher than the inappropriate GWG rate of 69.8% as reported in the study by Yong et al. (28) among pregnant women in Negeri Sembilan and Selangor. Specifically, the prevalence of excessive GWG rate (53.3%) had doubled the prevalence of inadequate GWG rate (28.9%) in the present study. This finding is in line with the study conducted by Yong et al. (28), whereby the prevalence of excessive GWG rate (44.3%) was doubled the prevalence of inadequate GWG rate (25.5%) too. A high prevalence of excessive GWG rate

Table II: Factors associated with GWG rates (N=180)

Variables	GWG rates			χ^2 / F	p-value
	Inadequate	Adequate	Excessive		
Age (years)¹					
Mean ± SD	28.3 ± 4.8	29.2 ± 4.2	29.6 ± 4.1	1.495	0.227
Ethnicity, n (%)²				1.247	0.870
Malay	36 (27.5)	25 (19.1)	70 (53.4)		
Chinese	13 (31.0)	6 (14.3)	23 (54.8)		
Indian	3 (42.9)	1 (14.3)	3 (42.9)		
Educational level, n (%)²				3.336	0.189
Primary & secondary education	27 (36.0)	13 (17.3)	35 (46.7)		
Tertiary education	25 (23.8)	19 (18.1)	61 (58.1)		
Monthly household income (RM), n (%)²				2.310	0.679
< RM 1500	14 (34.1)	8 (19.5)	19 (46.3)		
RM 1500 – RM 3500	23 (26.4)	13 (14.9)	51 (58.6)		
> RM 3500	15 (28.8)	11 (21.2)	26 (50.0)		
Parity, n (%)²				1.418	0.492
Nulliparous	20 (26.0)	12 (15.6)	45 (58.4)		
Multiparous	32 (31.1)	20 (19.4)	51 (49.5)		
Pre-pregnancy BMI (kg/m²), n (%)²				19.880	0.001*
Underweight (<18.5)	12 (46.2)	4 (15.4)	10 (38.5)		
Normal weight (18.5-24.9)	31 (30.4)	25 (24.5)	46 (45.1)		
Overweight / Obesity (≥25.0)	9 (17.3)	3 (5.8)	40 (76.9)		
Energy intake (kcal/day)¹					
Mean ± SD	2489 ± 781	2264 ± 799	2332 ± 709	1.231	0.294
Carbohydrate intake (kcal/day)¹					
Mean ± SD	313.4 ± 99.6	288.8 ± 94.2	307.3 ± 93.3	0.689	0.503
Protein intake (kcal/day)¹					
Mean ± SD	97.2 ± 36.9	88.5 ± 32.3	90.7 ± 33.4	0.829	0.438
Fat intake (kcal/day)¹					
Mean ± SD	95.0 ± 40.5	84.6 ± 41.4	83.5 ± 31.6	1.792	0.170
Total physical activity (MET-hour/week)¹					
Mean ± SD	203.9 ± 82.0	191.4 ± 85.9	193.1 ± 103.3	0.267	0.766
Type of activity					
Sedentary to light	24 (23.5)	16 (15.7)	62 (60.8)	5.370	0.068*
Moderate to vigorous	28 (35.9)	16 (20.5)	34 (43.6)		

¹Significant difference was determined by one-way ANOVA, $p < 0.10$.

²Significant difference was determined by χ^2 analysis, $p < 0.10$.

Table III: Final multinomial logistic regression model of factors associated with GWG rates (N=180)

Variables	GWG rates			
	Inadequate		Excessive	
	OR	95% CI	OR	95% CI
Pre-pregnancy BMI (kg/m²)				
Underweight	2.433	0.70-8.49	1.33	0.38-4.71
Normal weight	Reference		Reference	
Overweight/Obesity	2.404	0.59-9.80	7.44	2.07-26.66*
Type of activity				
Sedentary to light	Reference		Reference	
Moderate to vigorous	1.170	0.48-2.85	0.52	0.22-1.21

* $p < 0.05$

in the present study might be due to cultural norms that pregnant women must “eat for two” to support growth and development of the infants (38). In contrast to the current finding, Noor Farhana et al. (27) reported that the prevalence of inadequate GWG (54.5%) was higher than the prevalence of excessive GWG (13.0%) among pregnant women in a rural district in Kelantan, Malaysia. The discrepancies of the GWG rates might be due to variations in the characteristics of the population studied and the methods used in GWG calculation. The pregnant women in the study by Noor Farhana et al. (27) were from a rural area and majority of them were Malays (91.2%). In contrast to the present study, adequacy of GWG in Noor Farhana et al. (27) was determined based on total weight gain by calculating the difference between last measured weight before delivery and pre-pregnancy weight.

We examined a number of socio-demographic and obstetrical factors which may associate with the GWG rates. The present study did not find significant associations between age, ethnicity, educational level, monthly household income, and parity with GWG rates. On the other hand, the present study found that more women with pre-pregnancy overweight or obese were found to have excessive GWG rate as compared to the normal weight counterparts ($\chi^2 = 19.880, p < 0.05$). This is in line with the findings of several cohort studies which reported that overweight pregnant women had higher odds of having excessive GWG than other weight status categories (30,31,39). The association between pre-pregnancy overweight or obesity with excessive GWG rate could be due to the secretion of leptin hormone from the fat mass and placenta during pregnancy (40). Overweight or obese women with a higher secretion of this hormone may lead to excessive weight gain during pregnancy (41).

Behavioral factors including dietary intake and physical activity were also assessed in the current study. However, no significant associations were observed between these behavioral factors and the GWG rates (Table II). Previous studies on the associations between behavioural factors and GWG rates have been inconsistent. While some studies have shown significant results (27,41), others have not (42,43). Variations in findings might be due to the differences in study populations and assessment tools in the studies.

This study has several limitations. First, this is a cross-sectional study whereby the causal relationships between the variables were unable to be tested. Secondly, data on pre-pregnancy body weight, dietary intake, and physical activity were self-reported by the pregnant women which might be subjected to recall bias and under or over-reporting. Lastly, the present study was conducted among women from second to the third trimester of pregnancy in Batu Pahat district, Johor. Thus, the results may not be able to be generalized to

the whole population of pregnant women in Malaysia.

CONCLUSION

All in all, more than three-quarters of the women gained inadequate or excessive weight during pregnancy with more than half of them exceeded the IOM recommendations. The present study found that high pre-pregnancy BMI is a significant risk factor for excessive GWG rate. Early prenatal nutritional care and pre-conception counselling focusing on the importance of conceiving at normal weight status and maintain healthy weight gain during pregnancy should be conducted.

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