

PRE-PREGNANCY BMI AND GESTATIONAL WEIGHT GAIN ARE ASSOCIATED WITH 6 MONTHS POSTPARTUM WEIGHT RETENTION

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ABSTRACT

Background: Postpartum weight retention (PPWR) contributes to obesity in women of reproductive age. This study describes the pattern of 6 months postpartum weight retention of pregnant women and its associated factors.

Materials and Methods: A total of 83 pregnant women aged 20 to 44 were recruited from Maternal and Child Health Clinic (MCH) in Seremban, Negeri Sembilan. A set of pre-tested interview-administered questionnaire was used to collect socio-demographic, obstetrical information, dietary intake, physical activity, and postpartum depression. Rate of gestational weight gain (GWG) was calculated as average weekly weight gain in that trimester of pregnancy. Six months PPWR was calculated by subtracting the pre-pregnancy body weight from the 6 months postpartum weight.

Result: The mean total GWG was 11.69 ± 4.98 kg, with 30.1% and 27.7% of women gained inadequate and excessive GWG. One-third (32.5%) of women had retained ≥ 4.55 kg at 6 months postpartum, with a mean of 2.53 ± 4.01 kg. Slightly less than half of women practiced exclusive breastfeeding (44.6%) and had high physical activity level (45.8%). About 90.4% of women had lower risk of postpartum depression. Maternal education ($\chi^2 = 5.52$, $p = 0.02$), pre-pregnancy BMI ($\chi^2 = 4.75$, $p = 0.03$) and higher GWG ($r = 0.41$, $p = 0.001$) were significantly associated with postpartum weight retention.

Conclusion: This study revealed that about 32.5% of women retained at least 4.55kg at 6 months postpartum. Pregnancy and postpartum period are critical times for weight change and a window of opportunity for interventions to reduce the risk of obesity.

Keywords: Pre-pregnancy BMI, gestational weight gain, postpartum weight retention

1.0 Introduction

Postpartum is the period from delivery of the placenta to the return of the reproductive organs to their normal non-pregnant morphologic state. It is also a period of increased vulnerability to weight gain and body composition changes in women. Postpartum weight retention (PPWR) is defined as the difference between postpartum and pre-pregnancy weight (IOM, 2009). PPWR may contribute to the development of obesity and has important implications for both short- and long-term health of women (Rooney, Schauburger, & Mathiason, 2005).

Globally, the prevalence of obesity has more than doubled between 1980 and 2014 (World Health Organization, 2015). Women of childbearing age are at particularly higher risk of weight gain during their reproductive years. High pre-pregnancy body mass index (BMI) and excessive gestational weight gain (GWG) are risk factors for weight retention within the first year postpartum (Ma et al., 2015). On average, women retained between 0.5 to 3 kg at 1 year after birth (Gore, Brown, & West, 2003). Olson et al. (2003) showed that only about 42% of women returned to their pre-pregnancy weight at 1 year after birth. Rode et al. (2012) reported that women who gained within the recommended GWG had retained 0.9 kg, whereas women who gained exceeding the recommendation had retained 2.9 kg at 1 year postpartum.

Studies showed that GWG is associated with PPWR (Ashley-Martin & Woolcott, 2014; Begum et al., 2012; He, Hu, Chen, Wang, & Qin, 2014). Women with excessive GWG were significantly more likely to retain most weight (5.0 kg) than women who gained within inadequate (0.4 kg) and adequate (2.1 kg) GWG ranges, respectively (Ashley-Martin & Woolcott, 2014). Although breastfeeding (BF) has been shown to have many health benefits to both mother and infant (Baker et al., 2008; Krause, Lovelady, & Østbye, 2011; Vinter et al., 2014), its role in PPWR remains controversial. In addition, women with depression during postpartum had a higher risk of > 5 kg weight retention compared to those without depression (Xiao et al., 2014). However, most studies on factors associated with PPWR were conducted in Western population and the study findings were inconclusive.

At present, there is no published information on PPWR and factors associated with PPWR among women in Malaysia. Thus, this study aimed to identify factors associated with PPWR, defined as weight gain at 6 months after delivery. This study could be used as reference data for future researchers to further investigate PPWR in Malaysia. The study findings could also be beneficial for policy makers and health professionals to develop effective strategies for postpartum weight loss.

2.0 Materials and Methods

2.1 Study design, location, and respondents

This cross-sectional study was conducted at Ampang and Senawang Maternal and Child Health Clinics (MCH) in Seremban district, Negeri Sembilan, Malaysia. This study was conducted from January 2015 to February 2015. A total of 83 pregnant women were selected based on a singleton pregnancy, aged 18 – 45 years old, time elapsed since parturition below 6 months at the time of first recruitment, and home address within the catchment area of the

MCH clinics. Women were excluded if they had been diagnosed with physical disabilities or chronic diseases, such as diabetes mellitus, heart disease, renal disease, and HIV before enrolment. Women who met the study criteria were invited to participate in this study. An appointment for home visit was made for an interview session at 6 months postpartum.

2.2 Measurements

An interviewer-administered questionnaire was used to obtain information on socio-demographic factors, dietary intake, infant feeding practices, physical activity, and postpartum depression. Women were also measured for weight and height.

2.2.1 Anthropometric measurements

Weight and height of mothers at 6 months postpartum were measured using a TANITA Digital Weighing Scale and a SECA Body Meter, respectively. Pre-pregnancy body weight and weight at 38 – 40th weeks of gestation were obtained from medical record. Pre-pregnancy body mass index (BMI) was calculated as pre-pregnancy weight (kg) divided by the square of height (m²) and categorized as underweight, normal, overweight and obese (WHO, 1995). PPWR was calculated by subtracting the pre-pregnancy body weight from the measured weight at 6 months postpartum. PPWR was considered low if < 4.55kg and high if ≥ 4.55kg (Lipsky, Strawderman, & Olson, 2012).

Total gestational weight gain (GWG) was defined as the difference between weight measured at 38 – 40th weeks of gestation and pre-pregnancy weight. The total GWG was then categorized as inadequate, adequate or excessive (Institute of Medicine, 2009).

2.2.2 Dietary intake

Two-days 24 hour-dietary recall (1 weekday and 1 weekend) were used to assess the energy and nutrient intakes of women. Detailed descriptions, such as types, preparation methods, portion sizes, frequency, and timing of all foods and beverage intakes were recorded. Vitamin or mineral supplements usage were also recorded. A set of household measurements (e.g. cups, glasses, bowls, plates, spoons, and ladles) was used as visual aids to estimate the portion sizes of food and beverages consumed. The Nutritionist Prof Software (First Data Bank, 2005) and the USDA National Nutrient Database for Standard Reference was selected to analyse energy and macronutrients' intakes. The energy and macronutrient intake of respondents was compared with the Malaysian Recommended Nutrient Intake (RNI) for Malaysian (RNI, 2005) to assess for intake adequacy.

2.2.3 Infant feeding practices

Types of milk feeding was assessed using interviewer-administered questionnaire.

2.2.4 Physical activity

International Physical Activity Questionnaire (IPAQ) was used to assess physical activity across four domains such as leisure-time, domestic, work and transport related physical activity in a typical week (Patterson, 2010). Physical activity level was categorized as low, moderate, or high according to the IPAQ guidelines.

2.2.5 Postpartum depression

A self-report 10-item Edinburg Postnatal Depression Scale (EPDS) was used to screen for postnatal depression (Cox, Holden, & Sagovsky, 1987). Each item was scored from 0 to 3. The score for each item was summed, yielding a possible total score of 30. A score of less than 10 was defined as low probability of depression, 10 to 12 as moderate probability of experiencing depression and a score of 13 and more as high probability of experiencing clinical depression.

2.3 Statistical analysis

Data were analysed using IBM SPSS Statistics version 21. Categorical variables were presented as frequencies and percentages whereas continuous variables were presented as means and standard deviation. Exploratory Data Analysis (EDA) was conducted to determine the normality of continuous data based on skewness value. Pearson's correlation coefficient and Chi-square test of independence were used to determine the associations between socio-demographic factors, infant feeding practices and lifestyle factors with 6 months PPWR, respectively for continuous and categorical variables. Significance level for statistical analysis was set at $p < 0.05$.

3.0 Result

3.1 Characteristics of the respondents

Table 1: Sample characteristics

	n (%)	Mean \pm SD
Age (years)		31.46 \pm 4.79
20 to 24	8 (9.6)	
25 to 29	21 (25.3)	
30 to 34	32 (38.6)	
\geq 35	22 (26.5)	
Ethnicity		
Malay	68 (81.9)	
Chinese	6 (7.3)	
Indian & Others	9 (10.8)	
Education (years)		12.61 \pm 2.30
Lower secondary	5 (6.0)	
Upper secondary	38 (45.8)	
Tertiary	40 (48.2)	
Working Status		
Housewife	41 (49.4)	
Employed	42 (50.6)	
Monthly household income (RM)		3547.55 \pm 2464.87
\leq 1999	18 (21.7)	
2000 to 2999	19 (22.8)	
3000 to 3999	19 (22.9)	
4000 to 4999	12 (14.5)	

≥ 5000	15 (18.1)	
Household size		5.02 ± 1.85
3 to 4	33 (68.7)	
5 to 6	36 (26.5)	
≥ 7	14 (4.8)	
Number of children		2.60 ± 1.56
0 to 1	27 (32.5)	
2 to 3	35 (42.2)	
≥ 4	21 (25.3)	

Table 1 shows the characteristics of the respondents. The mean age of women in this study was 31.46 ± 4.79 years. About 81.9% and 93.9% were Malays and had education above upper secondary level. Less than half of women were housewives (49.4%) and had monthly income in the range of RM2000 to RM3999 (45.8%), household size > 5 (31.3%) and 2 to 3 children (42.2%).

3.2 Anthropometric measurements of the respondents

Table 2: Anthropometric measurements of women

	n (%)	Mean ± SD
Height (m)		1.56 ± 0.06
Pre-pregnancy BMI (kg/m ²)		24.12 ± 5.69
Underweight (< 18.5)	14 (16.9)	
Normal (18.5 – 24.9)	40 (48.1)	
Overweight (25.0 – 29.9)	16 (19.3)	
Obese (≥ 30.0)	13 (15.7)	
Total Gestational Weight Gain (GWG) (kg)		11.69 ± 4.98
Inadequate	25 (30.1)	
Adequate	35 (42.2)	
Excessive	223 (27.7)	
Postpartum Weight Retention (PPWR) (kg)		2.53 ± 4.01
Low (< 4.55)	56 (67.5)	
High (≥ 4.55)	27 (32.5)	

The mean height, pre-pregnancy BMI and total GWG were 1.56 ± 0.06 m, 24.12 ± 5.69 kg/m² and 11.69 ± 4.98 kg, respectively (Table 2). About 19.3% and 15.7% of women were overweight and obese. More than two-third of women gained either adequate (42.2%) or excessive GWG (27.7%). About one-third of women retained at least 4.55 kg at 6 months postpartum.

3.3 Lifestyle factors of the respondents

Table 3: Lifestyle factors of women

	n (%)	Mean \pm SD
Dietary intake		
Energy (kcal)		1635 \pm 519
Percentage energy from carbohydrate		50.36 \pm 10.24
< 55%	63 (75.9)	
55 – 70%	19 (22.9)	
> 70%	1 (1.2)	
Percentage energy from protein		13.23 \pm 3.23
< 10%	9 (10.8)	
10 – 15%	61 (73.5)	
> 15%	13(15.7)	
Percentage energy from fat		36.72 \pm 9.13
< 20%	1 (1.2)	
20 – 30%	21 (25.3)	
> 30%	61 (73.5)	
Infant feeding practices		
Milk feeding at 6 months		
Exclusive breastfeeding	37 (44.6)	
Breast and formula feeding	43 (51.8)	
Formula Feeding	3 (3.6)	
Physical activity		
Physical activity level		
Low	14 (16.9)	
Moderate	31 (37.3)	
High	38 (45.8)	
Postpartum depression		
Low risk	72 (86.7)	4.88 \pm 3.63
Mild risk	7 (8.5)	
High risk	4 (4.8)	

The mean total energy intake was 1635 \pm 519 kcal/day with percentage contributions to total energy from dietary carbohydrate, protein and total fat intake were 50%, 13% and 37% respectively. About 44.6% of women reported to exclusively breastfeed their infants while 51.8% and 3.6% adopted mix feeding (breast milk and infant formula) and formula feeding at 6 months. About 83.1% of women had moderate and high physical activity. Only 4.8% of women had high-risk score for postpartum depression.

3.4 Factors associated with 6 months postpartum weight retention (PPWR)

Table 4: Correlates of 6 months postpartum weight retention (PPWR)

	PPWR		χ^2/ r	p-value
	Low ($< 4.55\text{kg}$) (n=56)	High ($\geq 4.55\text{kg}$) (n=27)		
	n (%)			
Age (years)			-0.189	0.087
20–34	38 (67.9)	23 (85.2)	2.808	0.094
35–49	18 (32.1)	4 (14.8)		
Ethnicity				
Malay	45 (80.4)	23 (85.2)	0.287	0.92
Others	11 (19.6)	4 (14.8)		
Education (years)			-0.198	0.073
Lower secondary	24 (42.9)	19 (70.4)	5.523	0.019*
Upper secondary and above	32 (57.1)	8 (29.6)		
Working Status				
Housewife	27 (48.2)	14 (51.9)	0.096	0.756
Employed	29 (51.8)	13 (48.1)		
Monthly household income (RM)			-0.088	0.428
800–2999	25 (44.6)	12 (44.4)	0.001	0.986
≥ 3000	31 (55.4)	15 (55.6)		
Household size			-0.149	0.178
3–4	21 (37.5)	12 (44.4)	0.367	0.545
≥ 5	35 (62.5)	15 (55.6)		
Number of children			-0.120	0.278
0–1	17 (30.4)	10 (37.0)	1.027	0.598
2–3	23 (41.0)	12 (44.4)		
≥ 4	16 (28.6)	5 (18.6)		
Pre-pregnancy BMI (kg/m^2)			-0.220	0.046*
Underweight to normal	32 (57.1)	22 (81.5)	4.747	0.029*
Overweight to obese	24 (42.9)	5 (18.5)		
Gestational Weight gain (kg)			0.406	0.001*
Inadequate	20 (35.7)	5 (18.6)	4.912	0.086
Adequate	25 (44.7)	11 (40.7)		
Excessive	11 (19.6)	11 (40.7)		
Total energy intake (kcal/day)			-0.005	0.962
$< 75\%$ RNI	30 (53.6)	14 (51.9)	0.022	0.883
$\geq 75\%$ RNI	26 (46.4)	13 (48.1)		
Percentage energy from carbohydrate			-0.003	0.981
< 55	41 (73.2)	22 (81.5)	0.681	0.409
≥ 55	15 (26.8)	5 (18.5)		
Percentage energy from protein			-0.056	0.617
10–15	13 (23.2)	9 (33.3)	0.958	0.328
< 10 or > 15	43 (76.8)	18 (66.7)		
Percentage energy from fat			0.056	0.613
≤ 30	15 (26.8)	7 (25.9)	0.007	0.934

> 30	41 (73.2)	20 (74.1)		
Breastfeeding practices				
Exclusive	26 (46.4)	11 (40.7)	0.239	0.625
Non-exclusive	30 (53.6)	16 (59.3)		
Postpartum depression			0.023	0.835
Lower risk	49 (87.5)	23 (85.2)	0.085	0.771
Mild to higher risk	7 (12.5)	4 (14.8)		
Physical activity level			0.188	0.089
Low	10 (17.9)	3 (11.1)	0.628	0.731
Moderate	21 (37.5)	11 (40.7)		
High	25 (44.6)	13 (48.2)		

* p<0.05

Education level, pre-pregnancy BMI and GWG were significantly associated with 6 months PPWR (Table 4). Most women (70.4%) with PPWR \geq 4.55 kg had lower secondary education, while 57.1% with PPWR < 4.55 kg had education above upper secondary. Pre-pregnancy BMI was negatively correlated with PPWR ($r = -0.220$, $p = 0.046$). In contrast, a positive correlation was found between GWG and PPWR ($r = 0.406$, $p = 0.001$). There was no significant association between dietary intake, breastfeeding practices, postpartum depression and physical activity with PPWR.

4.0 Discussion

In this study, women retained on average of 2.53 ± 4.01 kg after 6 months postpartum, with about one-third of women (32.5%) retained \geq 4.55 kg. The average amount of PPWR in this study was almost similar to that reported in two prospective studies (Brandhagen et al., 2014a; Lyu, Lo, Chen, Wang, & Liu, 2009). A prospective study conducted in Taiwan showed that the average weight retention at 6 months postpartum was 2.40 ± 3.54 kg, with about 48% of women gained more than 2 kg at 6 months postpartum (Lyu et al., 2009). Similarly, Brandhagen et al. (2014) showed that the mean PPWR at 6 months among women who did not exclusive breastfeed and women who did not partial breastfeed were 2.53 ± 5.63 kg and 2.68 ± 6.29 , respectively. However, in a prospective cohort study of Norwegian nulliparous women, Haugen et al. (2014) reported a lower mean with an average weight retention of 1.2 ± 5.0 kg at 6 months postpartum. Nearly 14.5% of women had PPWR more than 5 kg at 6 months postpartum. In contrast, a cross-sectional study in China reported a higher average PPWR with the mean PPWR of 3.52 ± 0.23 kg at 6 – 11 months postpartum (Ma et al., 2015). The comparison between the present study's findings with these studies should be done with caution. Most of these studies had a large sample size and were nationally representative while the present study had only 83 women and the sample was not representative of Malaysian pregnant women.

The present study found that there was a negative correlation between pre-pregnancy BMI and PPWR. This finding was similar to that of Pedersen et al. (2011) in that women with higher pre-pregnancy BMI was associated with lower PPWR at 6 months postpartum. Similarly, a prospective longitudinal cohort study found that pre-pregnancy BMI was a

significant negative predictor of 6 months PPWR (Bogaerts, Van Den Bergh, Witters, & Devlieger, 2013). A study of 151 Taiwanese women also reported a negative association between pre-pregnancy BMI and PPWR at 6 months postpartum (Lyu et al., 2009). However, this association was not significant which could be due to the small sample size and limited variation in pre-pregnancy BMI. The significant negative correlation between pre-pregnancy BMI and PPWR could be explained by the lower total GWG in women with higher pre-pregnancy BMI as compared to underweight and normal weight women (Gunderson, 2009; Morisaki et al., 2017). Thus, as women with higher pre-pregnancy BMI tend to have lower total GWG, this could result in lower PPWR.

In the present study, GWG was positively correlated with 6 months PPWR. This finding was in accordance to previous studies in that women who gained a total GWG that was greater than the IOM recommendation retained an average of 2 to 4.55 kg in the postpartum period than the women who met the total weight gain recommendation (Bogaerts et al., 2013; Haugen et al., 2014; Zanotti, Capp, & Wender, 2015; Zhang et al., 2015). Similarly, a meta-analysis showed that women with excessive GWG had significantly higher PPWR of 3.21 kg (95% CI= 2.79 – 3.62) compared to women with adequate GWG. These findings support the IOM recommendations regarding the importance of achieving an adequate GWG in avoiding short- and long-term high PPWR (IOM, 2009).

Although the underlying mechanisms of association between GWG and PPWR remains unclear, meta-analyses on the association between GWG and PPWR found that women with excessive GWG showed a U-shaped trend of PPWR, in that being higher at the early postpartum, declining by 1 year postpartum and then increasing again in the follow-up periods (Mannan, Doi, & Mamun, 2013; Rong et al., 2015). As PPWR may contribute to the development of overweight and obesity in later life (Melzer & Schutz, 2010), the prevention of PPWR may therefore be of a great public health importance. Thus, interventions promoting healthy diets and physical activity are clearly warranted to address the excessive GWG during pregnancy.

Among the demographic and socio-economic factors, only maternal years of education was found to be significantly associated with 6 months PPWR. Kac et al. (2004) found that women with difficulty or inability to read a letter were 2.1 times more likely to retain ≥ 7.5 kg after 9 months postpartum. Krause et al. (2011) also reported that women with higher education level retained less weight compared to those with lower education level. Similarly, a cohort study of Brazilian women showed that women with more than 8 years of formal education were associated with less PPWR (Zanotti et al., 2015). This finding is also consistent with previous studies of non-pregnant women, which found that women with low education were more likely to develop obesity (Devaux, Sassi, Church, Cecchini, & Borgonovi, 2011; Ogden, Lamb, Carroll, & Flegal, 2010). It is possible that women with higher education level have better nutrition knowledge. Nuss et al. (2017) found that women with higher nutrition knowledge score retained less weight at 1 year postpartum than those with lower nutrition knowledge score. Laz, Rahman, Pohlmeier, & Berenson (2015) showed that nutrition knowledge was positively associated with healthy lifestyle such as exercise, increased fruit and vegetable intake and decreased fat intake. A systematic review of the effectiveness of lifestyle interventions to reduce PPWR has shown that interventions that include both diet and physical activity components were more likely to be successful in promoting healthy postpartum weight (Plight et al., 2013).

The present study did not find any significant association between breastfeeding and physical activity with 6 months PPWR. Similar to the study of Ma et al. (2015), the non-significant association between infant feeding method and PPWR could be due to the short postpartum duration (6 months postpartum) examined for weight change. Rooney & Schauburger (2002) found that breastfeeding was not significantly associated with short-term weight loss (6 months postpartum), but it significantly influenced long-term weight change. The non-significant association between physical activity and PPWR could also be explained by the lack of significant effect of physical activity on short-term weight loss as compared to long-term weight loss. A longer duration of observation may be needed to determine the effects of infant feeding and physical activity on postpartum weight change.

The present study did not find any significant association between energy intake and percentage energy from macronutrients with PPWR. This could be due to under-reporting of energy intake as about 35% of women in the present study were overweight or obese. Thomas et al (2016) showed that overweight or obese pregnant women were more likely to under-report their energy intakes. This reporting bias could result in homogeneity of dietary intake data and subsequently contribute to inaccurate associations between energy intake and percentage energy from macronutrients with PPWR.

5.0 Conclusion and recommendation

The present study found that about 32.5% of women retained weight above 4.55 kg after 6 months postpartum. While pre-pregnancy BMI was negatively correlated with PPWR, GWG was positively correlated with PPWR. As this study only provided limited information on PPWR, future studies should explore other factors such as cultural practices, lifestyle changes, and behavioural factors that may be associated with PPWR as well as examine weight retention at various time points during postpartum period.

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Declaration

Author(s) declared no conflict of interest relevant to this article.

Author's contribution

- Author 1 : Writing of the manuscript
- Author 2 : Data checking and manuscript review
- Author 3 : Data collection, analyses and interpretation

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