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CORRELATION OF PRE-PREGNANCY BMI, SLEEP AND DEPRESSION WITH POSTPARTUM WEIGHT RETENTION AMONG CHILBEARING AGE WOMEN

Wan Noor Fatehah W.Z.[1], Yong H.Y.[1], Zalilah M.S.[1], Zulida R.[2], Barakatun Nisak M.Y.[1,3*],

[1]Department of Nutrition and Dietetics, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia
[2]Department of Obstetrics and Gynaecology, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia
[3]Research Centre of Excellent for Nutrition and Noncommunicable Diseases, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia

[*]*Corresponding author: Barakatun Nisak Mohd Yusof, Department of Nutrition and Dietetics, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor Malaysia. Email: bnisak@upm.edu.my*

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ABSTRACT

Background: Postpartum weight retention (PWR) triggers future obesity among women of childbearing age. Data regarding the influence of postpartum sleep, depression and weight retention is limited. This study aims to determine the correlation of pre-pregnancy BMI, sleep and depression with PWR at 6 months after childbirth of childbearing age women from selected health clinics in Negeri Sembilan.

Materials and Methods: Data were collected from 226 women aged 31 ± 4.6 years old who attended Seremban, Ampangan and Senawang Health Clinics from January to August 2015. Respondents were enrolled in the respective health clinics and the maternal interviews conducted at 6 months after childbirth during a home visit. A set of pre-tested questionnaire was used to collect data for socio-demographic, anthropometric data including pre-pregnancy body mass index (BMI), sleep duration and postpartum depression.

Result: The mean PWR was 2.6 ± 5.3 kg with 27.4% retained more than 5kg. The respondents slept on average 6.1 ± 1.4 hours with 31.9% slept less than 5 hours. The postpartum depression score was 4.1 ± 3.5 which generally categorised as no postpartum depression. However, about 8.8% had postpartum depressive symptoms. About 36.3% of the respondents were either overweight or obese before the pregnancy with a mean pre-pregnancy BMI of 23.9 ± 5.2 kg/m^2. Pre-pregnancy BMI was associated with PWR (r= -0.297, p= 0.001). However, other factors were not associated with PWR.

Conclusion: About one-third of the respondents retained excess weight, and a lower pre-pregnancy BMI was associated with greater weight retention. Appropriate measures that target these groups of women with lower BMI before and throughout pregnancy could alter their weight trajectory, hence reducing the risk of obesity among childbearing age women.

Keywords: Postpartum weight retention, sleep duration, depression, obesity

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1.0 Introduction

Postpartum weight retention (PWR) predicts future development of obesity among childbearing age women (IOM, 2009). Women retain ≥ 0.5 kg at 6 months after childbirth is considered as having an excess PWR (Siega-Riz et al., 2010). The excess PWR poses a threat to reproductive issues including the risk of infertility (Endres et al., 2016), gestational diabetes mellitus (Ehrlich et al., 2012) and pre-eclampsia (Hoff, Cai, Okah, & Dew, 2009) in their next pregnancy.

It is recommended that adults sleep between 7 and 8 hours per night on a regular basis to promote optimal health (Badr et al., 2015). Shorter sleep duration is linked to obesity, coronary artery disease, and type 2 diabetes mellitus (Gunderson et al., 2008). Also, shorter sleep duration was associated with greater PWR (Xiao et al., 2014). In a systematic review of prospective cohort studies, women who had ≤ 5 hours of sleep at 6 months postpartum had a higher risk of retaining ≥ 5 kg excess weight up to 3 years postpartum (Xiao et al., 2014). A similar finding was also observed among women in the United States (Gunderson et al. 2008). Sleep deprived at 6 months postpartum was associated with substantial PWR at one year (Gunderson et al., 2008).

Postpartum depression is a type of mood disorder associated with childbirth, and the symptoms may include extreme sadness, anxiety, changes in sleeping or eating patterns, feeling guilt and reduce in psychomotor activity (American Psychiatric Association, 2000). Postpartum depression reported between 3.5 and 63.3% within Asia countries (Klainin & Arthur, 2009). Postpartum depression was significantly associated with PWR at 6 months postpartum (Biesman et al., 2013). As compared to non-depressive women, women in Denmark and the United States with depression had an increased risk of having excess PWR over 5 kg at one year postpartum (Pedersen et al., 2011; Herring et al., 2008). However, when another study assessed depression and PWR at 6 months, the differences were not significant (Oken et al., 2008), showing that the time-point of assessments after childbirth could play a role in linking depression and PWR.

It is understood that having an excess PWR predicts future obesity. However, data about postpartum sleep and depression are still limited even though these are the two common issues after childbirth. Although studies have determined the factors associated with PWR among Malaysian women (Yong, Zalilah & Jamilah, 2017; Fariza et al., 2015), none of these studies focuses on postpartum sleep and depression. Their studies focused on maternal age, gestational weight gain (GWG), pre-pregnancy body mass index (BMI), parity, physical activity level, and breastfeeding practices. Therefore, this study addresses the gap by determining the association of sleep and depression with 6 months PWR in childbearing age women from selected health clinics in Negeri Sembilan. The findings extend current understanding about PWR and its associated factors which are necessary to develop obesity prevention plan during this critical period.

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2.0 Materials and Methods

2.1 Study design and samples

This cross-sectional study was a part of Seremban Cohort Study (SECOST). A detailed research protocol has been described elsewhere (Yong et al., 2018). The study protocol was approved by the Ethics Committee for Research Involving Human Subjects Universiti Putra Malaysia (JKEUPM) and Ministry of Health Malaysia. Data were collected from women who attended Seremban, Ampangan and Senawang Health Clinics from January to August 2015 using purposive sampling. Women aged between 18 and 46 years old, previously had a singleton pregnancy and had a pre-pregnancy BMI between 18.5 and 40.0 kg/m^2 were enrolled in the study. They were excluded if they are pregnant, had type 2 diabetes, had previous GDM and deformities which limit their ability to perform everyday physical activities. Respondents were enrolled in the respective health clinics, and the maternal interviews were conducted at 6 months after childbirth during a home visit. Respondents were informed about study protocol, and their consent was obtained prior data collection.

2.2 Sample size

The sample size is estimated using a statistical formula for hypothesis testing between two groups comparison (Lemeshow et al., 1990). Based on estimated standard deviation of PWR (4.5 kg), estimated mean of PWR in underweight respondents (5.6kg), estimated mean of PWR in overweight and obese respondents (4.7kg) (Lai et al., 2011), a minimum of 140 women are required to ensure the 95% confidence level with 80% power. We added 40% for non-responses and incomplete questionnaires, therefore, a total of 196 women were recruited for the study.

2.3 Measurements

Socio-demographic data included age, ethnicity, education level, years of education, marital status, occupation, monthly household income and household size. For anthropometric data, weight and height were measured at home using a standard measurement (Mirnalini et al., 2008). Body weight was measured using a digital weighing scale that calibrated before each uses (TANITA HD-314, Tokyo, Japan). The weighing scale was placed on a flat and hard surface. Respondents were measured without shoes, socks and in light clothing and stand in the centre of the scale. Weight was recorded to the nearest 0.1 kg. Two measurements were taken, and the average reading was recorded. Height was measured using a SECA Portable Stadiometer (SECA 213, Hamburg, Germany). The standing height was regarded as the measurement of the maximum distance from the floor to the highest point on the head, as the respondents were looking straight ahead. The head was positioned in the Frankfort horizontal plane, feet together, knees straight, heels, buttocks and shoulder blades in contact with the wall. Two measurements were taken to the nearest 0.1 cm, and the average reading was recorded.

Self-reported pre-pregnancy body weight was also recorded. BMI was calculated as weight (kg) divided by height squared (m^2). Using the standard international adult BMI ranges: underweight (BMI <18.5), normal weight (BMI = 18.5-24.9), overweight (BMI = 25.0-29.9), or obese (BMI >30) were identified (WHO Expert Consultation, 2004). The PWR was

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calculated as the absolute difference between weight that was measured at 6 months postpartum and pre-pregnancy weight (Xuto et al., 2012). PWR was categorised using a priori cut-off points of weight loss, 0 to 5 kg, and more than 5 kg (Xuto et al., 2012).

Sleep duration was assessed at 6 months postpartum based on Xuto et al., (2012). The number of hours of sleep per 24 hours including napping was categorised as less than 5 hours indicate as short sleep duration, between 6 and 7 hours indicate as normal sleep duration and $\geq$ 8 hours indicate as long sleep duration (Gunderson et al., 2008). Postpartum depression was assessed using the translated Malay language of the Edinburgh Postnatal Depression Scale (EPDS) (Cox et al., 1987). The EPDS is a 10-item screening questionnaire that assesses the woman's mood during the past week. This questionnaire has been validated against the Research Diagnostic Criteria for depression with a sensitivity of 86% and a specificity of 78% (Cox & Holden, 2003). Total scores were dichotomised using a cut-point of 10; a score of $\geq$ 10 indicated postpartum depressive symptoms (Usuda, Nishi, Okazaki, Makino, & Sano, 2017).

2.4 Statistical analysis

Data were analysed using SPSS version 22.0 (SPSS Inc, Chicago, IL, USA) and a statistical level of $p < 0.05$ was considered significant. All the variables in this study were normally distributed based on the skewness observation within the value of -2 to +2 (George & Mallery, 2003). The descriptive statistic was shown as means and standard deviations (SD) or proportions (%). The Pearson's product-moment correlation test was used to determine the correlation between the two continuous variables. Independent Samples T-Test was used to compare the means between groups.

3.0 Result

3.1 Characteristics of the respondents

The mean age of the respondents was 31 ± 5 years with half of them (52.0%) aged between 30 and 39 years old (Table 1). Most of them were Malays (92.5%), employed (54.9%) and completed tertiary education level (51.3%). They had a monthly household income of more than RM4000 (38.1%) with a household size of 5 ± 2 people (Table 1). The current weight at 6 months postpartum (60.5 ± 12.9 kg) was significantly higher than the pre-pregnancy weight (57.9 ± 13.1 kg, $p< 0.001$). Similarly, the current BMI at 6 month postpartum (24.9 ± 5.0 kg/m^2) was significantly higher than the pre-pregnancy BMI (23.9 ± 5.2 kg/m^2 kg, $p < 0.001$). About 36.3% of women were either overweight or obese before pregnancy and the proportion increased to 42.5% at 6 months postpartum (Figure 1).

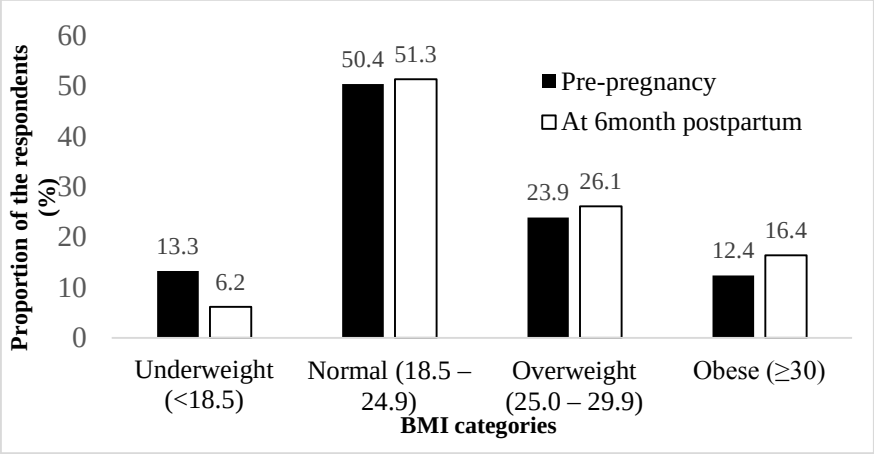

Figure 1: Proportion of the respondents at each of the body mass index (BMI) categories at pre-pregnancy and 6 months postpartum (n = 226).

The mean PWR was 2.6 ± 5.3 kg with 27.4% of them retained the postpartum weight of more than 5 kg. The mean daily sleep duration at 6 months postpartum was 6.1 ± 1.4 hours with 31.9% slept less than 5 hours. The postpartum depression score was 4.1 ± 3.5 indicating no postpartum depression. However, about 8.8% of the respondents had a postpartum depressive symptom (Table 1).

Table 1: Characteristics of the respondents (n = 226)

Characteristics	n	%	Mean ± SD
Socio-demographic			
Age (years)			31.0 ± 4.6
20-29	102	45.0	
30-39	118	52.0	
40-49	6	3.0	
Ethnicity			
Malay	209	92.5	
Non-Malay	17	7.5	
Level of education			
Primary and Secondary	110	48.7	
Tertiary	116	51.3	
Years of formal education			12.8 ± 2.4
Employment status			
Employed	124	54.9	
Housewife	102	45.1	
Household income (RM)			3589.2 ± 2166.6
≤ 1999	50	22.1	
2000 to 2999	45	19.9	
3000 to 3999	45	19.9	
4000 to 4999	42	18.6	
≥ 5000	44	19.5	
Household size (people)			5 ± 2
Anthropometric measurements			
Height (m)			1.56 ± 0.1
≤ 1.45 m	2	2.7	
> 1.45 m	220	97.3	

Pre-pregnancy weight			57.9 ± 13.1[a]
Current weight (at 6 months postpartum, kg)			60.5 ± 12.9[a]
Pre-pregnancy BMI (kg/m^2)			23.9 ± 5.2
Current BMI (at 6 months postpartum, kg/m^2)			24.9 ± 5.0
Postpartum weight retention (PWR)			2.6 ± 5.3
Loss weight	59	26.1	-3.2 ± 3.3[b]
0 – 5 kg	105	46.5	2.0 ± 1.4[b]
More than 5 kg	62	27.4	9.1 ± 3.5[b]
Sleep duration			
Less than 5 hours	72	31.9	6.1 ± 1.4
6 – 7 hours	111	49.1	
More than 8 hours	43	19.0	
Postpartum depression			
No (<10)	206	91.2	4.1 ± 3.5
Yes (≥10)	20	8.8	

[a] Significant variables using Paired-Samples T Test, $p < 0.05$
[b] Mean PWR for each category

Based on the EPDS questionnaire, all of the respondents (100%) never thought of harming themselves. Besides, most of the respondents (85.8%) felt that they were able to laugh and see the funny side of the things and looked forward with enjoyment to things (87.6%). Also, most of them reported that they never felt unhappy when they have difficulty in sleeping (80.1%), never felt sad or miserable (78.3%), never be unhappy that make them crying (69.5%) and half of them (50.4%) were able to cope very well when things have been getting on top of them. However, a small proportion of the respondents (3.1%) blamed themselves unnecessarily when things went wrong, be anxious or worried for no good reason (6.6%) and felt scared or panicky for no excellent reason (5.3%).

3.2 Factors correlated with PWR at 6 months postpartum

Pre-pregnancy BMI was associated with PWR (r= -0.297, p= 0.001). However, other factors were not associated with PWR (Table 2).

Table 2: Bivariate analysis between factors and PWR (n = 226)

Factors	**PWR value**	
	r / t-value	***P*- value**
Socio-demographic characteristics		
Age	- 0.091	0.171
Ethnicity	- 0.079	0.479
Years of formal education	- 0.099	0.137
Employment status	- 0.800	0.425
Household income	- 0.003	0.960
Household size	- 0.073	0.275
Pre-pregnancy BMI	-0.297	0.001*
Sleep duration	- 0.033	0.627
Postpartum depression	- 0.062	0.354

*p< 0.05

It is observed that those slept less than 5 hours retained more weight than those slept more than 5 hours, but the differences were not significant (Table 3). On the other hand, respondents with postpartum depressive symptoms had less PWR compared to respondents without postpartum depression. However, the differences were not significant. Based on pre-pregnancy BMI, underweight and normal weight respondents had a significantly higher PWR than overweight and obese respondents ($p < 0.001$) (Table 3).

Table 3: Differences in postpartum weight retention (PWR) between sleep duration and depression categories (n = 226)

Factors	n (%)	Mean ± SD	t value	P-value
Sleep duration[#]			0.097	0.923
< 5 hours	72 (31.9)	2.64 ± 4.95		
≥ 5 hours	154 (68.1)	2.56 ± 5.41		
Postpartum depression[#]			0.870	0.385
No	206 (91.2)	2.68 ± 5.19		
Yes	20 (8.8)	1.61 ± 6.05		
Pre-pregnancy BMI[^]			7.957	0.001[*]
Underweight	30 (13.3)	3.72 ± 3.88[a]		
Normal weight	114 (50.4)	3.67 ± 4.76[a]		
Overweight	54 (23.9)	1.56 ± 5.73[b]		
Obese	28 (12.4)	-1.07 ± 5.74[b]		

[#]Independent Sample T-test, [^]One-way ANOVA, [*]$p < 0.05$
Different letters indicate significant differences between groups ($p<0.05$)

4.0 Discussion

Weight retention at 6 months postpartum among childbearing age women in this sample was 2.6 ± 5.3kg (95% CI= -15.4- 21.4kg). The results were comparable to other studies in Taiwan (2.4 kg) (Lyu et al., 2009; Huang & Dai 2007) but were relatively higher than women in Norway (1.2 kg) (Haugen, Brantsæter, et al., 2014). However, a study by Fariza et al. (2015) reported that the mean PWR was 3.1 ± 4.8 kg among Malaysian women in Selangor, which was higher than our study. The variation across studies might be due to the different time-point of measuring PWR. Women lost the greatest amount of weight in the first three months after delivery and continued losing weight at a slow and steady rate until 6 months postpartum (Somvanshi, 2002). Inability to lose pregnancy-related weight in an appreciable time of at least 6 months period after delivery is an important indicator of obesity in the middle of life (Bogaerts & Van den Bergh, 2013).

Almost half of the respondents retained within 0.5 - 5 kg at 6 months postpartum. However, about one-third of the respondents (27.4%) retained more than 5kg. The retention rates were lower than those reported among the Thais women (Xuto et al., 2012), in which 36.3% retained more than 5 kg at 6 months postpartum. This finding may be related to the differences in lifestyle behaviours at postpartum including dietary practices that were contributed to PWR, despite having comparable rates of overweight among women in Thailand (52%) and Malaysia (51%) (WHO, 2010).

There are no correlation between socio-demographic characteristics and PWR. Nevertheless, another study among Malaysian women reported that education levels were correlated with PWR at 6 months among Malaysian women (Yong et al., 2017). Also, age was correlated with PWR among Brazilian women (Kac et al., 2004). In this study, pre-pregnancy BMI was associated with PWR. Women who had lower BMI were the ones who retained more weight at 6 months postpartum. Similar results were also observed among women in Denmark (Pedersen et al., 2011) and in Malaysia (Yong et al. 2017). The negative association between pre-pregnancy BMI and PWR explains the possibility of underweight and normal weight women to gain more weight during their pregnancy which caused them to retain more weight at 6 months postpartum. Based on the recommendations, normal weight and underweight women generally should put on more weight than women who were overweight before they became pregnant (IOM, 2009). In this study, the gestational weight gain (GWG) for normal and underweight women were higher than the recommended level (data not shown). Hence, effort should be made to ensure that they should be informed about the risk of postpartum weight retention in relation to GWG. This is necessary to prevent them from adding more weight in the future.

This study observed that women on average slept about 6 hours daily with 31.9% slept less than 5 hours. The sleep duration observed concurs with a study among women in United States (6.7 hours) but more women in their study slept longer than our study (88% vs 31.9%) (Gunderson et al., 2008). Women who slept less than 5 hours of sleep at 3, 6 and 12 months postpartum had two – three time more likely to have substantial weight gain than their counterparts with sufficient sleep hours (Siega-riz et al., 2010; Gunderson et al., 2008). In this study, we did not find any significant correlation between sleep duration and PWR. However, we observed women who slept < 5 hours had relatively higher PWR at 6 months than those slept ≥ 5 hours, which warranted future investigation. Restricted sleep may lead to daytime sleepiness, fatigue and reduce daily activities. An experimental study suggests that short-term sleep restriction cause alterations in the leptin levels (a satiety-promoting hormone) and increases the ghrelin levels (an appetite-promoting hormone), resulting in increased hunger and appetite (Spiegel et al., 2004). Therefore, women tended to eat more and gain more weight.

Postpartum depression has become a centre of concern in mood changes among childbearing women. The average score of EPDS was 4.08 ± 3.52 indicating that women in this study had a low possibility of having postpartum depression. More than 90% of the respondents had a low risk of postpartum depression. Nevertheless, about 8.8% of them presented with some postpartum depressive symptoms. The data were compared to a study conducted in Sabah whose found that about 7.3% of respondents had depression at 6 months postpartum (Mohamad Yusuff, Tang, Binns, & Lee, 2015). Similarly, a Project Viva in the United State also reported that 9.0% of their respondents had depressive symptoms (Ertel et al., 2017). In contrast, a review article reported that Malaysia had the lowest prevalence of postpartum depression among Asian countries, with the prevalence of 3.5% (Klainin & Arthur, 2009). In the present study, postpartum depression was not associated with PWR. A similar finding was reported by previous studies (Ertel et al., 2017; Yong et al., 2017), in that no significant association was observed between postpartum depression and PWR. However, we observed women with a depressive symptom may have lower PWR compared to women with no depressive symptoms.

5.0 Conclusion and recommendation

The present study found that about 27.4% of respondents retained more than 5 kg at 6 months postpartum. Pre-pregnancy BMI was correlated with PWR. However, socio-demographic factors, sleep duration and postpartum depression were not correlated with PWR at 6 months postpartum. A longitudinal study is required to determine the association between sleep duration and postpartum depression with PWR. Future studies should examine weight retention at various time points to optimise understanding of the weight changes over time during the postpartum period.

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Declaration

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

References

Althuizen, E., van Poppel, M. N., de Vries, J. H., Seidell, J. C., & van Mechelen, W. (2011). Postpartum behaviour as predictor of weight change from before pregnancy to one year postpartum. BMC Public Health, 11(1), 165. https://doi.org/10.1186/1471-2458-11-165

American Psychiatric Association. (2000). Diagnostic and Statistical Manual of Mental Disorders (4th ed.; text revision). American Psychiatric Press, Washington, DC.

Badr, M. S., Belenky, G., Bliwise, D. L., Buxton, O. M., Buysse, D., Dinges, D. F., ... & Martin, J. L. (2015). Recommended amount of sleep for a healthy adult: a joint consensus statement of the American Academy of Sleep Medicine and Sleep Research Society. Journal of Clinical Sleep Medicine, 11(06), 591-592.

Biesmans, K., Franck, E., Ceulemans, C., Jacquemyn, Y., Van Bogaert, P. (2013). Weight during the postpartum period:what can health careworkers do? Matern Child Health J; 17:996–1004. http://dx.doi.org/10.1007/s10995-012-1077-9.

Bogaerts, A. F. L., & Van den Bergh, M. (2013). Anxiety during early pregnancy predicts postpartum weight retention in obese mothers. Obesity (Silver Spring, Md.), 21(9), 1942–9. https://doi.org/10.1002/oby.20352

Cox, J., & Holden, J. (2003). Perinatal mental health: A guide to the Edinburgh Postnatal Depression Scale (EPDS). Royal College of Psychiatrists.

Cox, J. L., Holden, J. M., & Sagovsky, R. (1987). Detection of postnatal depression: development of the 10-item Edinburgh Postnatal Depression Scale. The British journal of psychiatry, 150(6), 782-786.

Ehrlich, S. F., Hedderson, M. M., Feng, J., Davenport, E. R., Gunderson, E. P., & Ferrara, A. (2012). Change in Body Mass Index Between Pregnancies and the Risk of Gestational Diabetes in a Second Pregnancy, 117(6), 1323–1330. https://doi.org/10.1097/AOG.0b013e31821aa358

Endres, L. K., Straub, H., Mckinney, C., Plunkett, B., Minkovitz, C. S., Schetter, C. D., … Shalowitz, M. U. (2015). Postpartum Weight Retention Risk Factors and Relationship to Obesity at One Year. Obstetric and Gynecology,125(1), 144–152. https://doi.org/10.1097/AOG.0000000000000565

Ertel, K. A., Huang, T., Rifas-Shiman, S. L., Kleinman, K., Rich-Edwards, J., Oken, E., & James-Todd, T. (2017). Perinatal weight and risk of prenatal and postpartum depressive symptoms. Annals of Epidemiology, 27(11), 695–700.e1. https://doi.org/10.1016/j.annepidem.2017.10.007

Fariza, F., Khadijah, S., Sharifa Ezat, W. P., Shuhaila, A., Noor Shaheeran, A. H., Azah, A. S., Nor Izzah, A. S., Ruhaini, I. (2015). Predictors of postpartum weight retention among urban Malaysian mothers: a prospective cohort study. Medical Journal of Malaysia, Volume 70 Supplement 1.

George, D., & Mallery, P. (2003). Reliability analysis. SPSS for Windows, step by step: a simple guide and reference, 14th edn. Boston: Allyn & Bacon, 222-232.

Gunderson, E. P., Rifas-shiman, S. L., Oken, E., Rich-edwards, J. W., Kleinman, P., Taveras, E. M., & Gillman, M. W. (2008). Association of Fewer Hours of Sleep at 6 Months Postpartum with Substantial Weight Retention at 1 Year Postpartum, 167(2), 178–187. https://doi.org/10.1093/aje/kwm298

Haugen, M., Brantsaeter, A. L., Winkvist, A., Lissner, L., Alexander, J., Oftedal, B., … Meltzer, H. M. (2014). Associations of pre-pregnancy body mass index and gestational weight gain with pregnancy outcome and postpartum weight retention: a prospective observational cohort study. BMC Pregnancy and Childbirth, 14(403), 201. https://doi.org/10.1186/1471-2393-14-201

Herring, S. J., Rich-edwards, J. W., Oken, E., Rifas-shiman, S. L., Kleinman, P., & Gillman, M. W. (2008). Association of Postpartum Depression With Weight Retention 1 Year After Childbirth. Obesity (Silver Spring), 16(6), 1296–1301. https://doi.org/10.1038/oby.2008.71

Hoff, G. L., Cai, J., Okah, F. A., & Dew, P. C. (2009). Pre-Pregnancy Overweight Status between Successive Pregnancies and Pregnancy Outcomes. Journal of Women's Health, 18(9), 1413–1417. https://doi.org/10.1089/jwh.2008.1290

Huang, T.-T., & Dai, F.-T. (2007). Weight Retention Predictors for Taiwanese Women at Six-Month Postpartum. Journal of Nursing Research, 15(1), 11–20.

Institute of Medicine. (2009). Weight gain during pregnancy: reexamining the guidelines. Washington, DC: National Academies Press.

Kac, G., Benicio, M. H., Velásquez-Meléndez, G., & Valente, J. G. (2004). Nine months postpartum weight retention predictors for Brazilian women. Public Health Nutrition, 7(5), 621–628. https://doi.org/10.1079/PHN2003579

Klainin, P., & Arthur, D. G. (2009). Postpartum depression in Asian cultures: a literature review. International Journal of Nursing Studies, 46(10), 1355–73. https://doi.org/10.1016/j.ijnurstu.2009.02.012

Lai, J. Q., Teng, Y., Dong, W. L., Yan, L., & Yin, S. A. (2011). Association of pre-pregnancy body weight, gestational weight gain and postpartum weight retention among women in Beijing. Zhonghua yu fang yi xue za zhi [Chinese journal of preventive medicine], 45(9), 794-797.

Lemeshow, S., Hosmer, D. W., Klar, J., Lwanga, S. K., & World Health Organization. (1990). Adequacy of sample size in health studies.

Lyu, L.-C., Lo, C.-C., Chen, H.-F., Wang, C.-Y., & Liu, D.-M. (2009). A prospective study of dietary intakes and influential factors from pregnancy to postpartum on maternal weight retention in Taipei, Taiwan. The British Journal of Nutrition, 102(12), 1828–37. https://doi.org/10.1017/S0007114509991243

Mirnalini, K., Zalilah, M. S., Safiah, M. Y., Tahir, A., Siti, H. M. D., Siti, R. D., … Normah, H. (2008). Energy and nutrient intakes: Findings from the Malaysian Adult Nutrition Survey (MANS). Malaysian Journal of Nutrition, 14(1), 1–24.

Mohamad Yusuff, A. S., Tang, L., Binns, C. W., & Lee, A. H. (2015). Prevalence and risk factors for postnatal depression in Sabah, Malaysia: A cohort study. Women and Birth, 28(1), 25–29. https://doi.org/10.1016/j.wombi.2014.11.002

Oken, E., Taveras, E. M., Popoola, F. a, Rich-Edwards, J. W., & Gillman, M. W. (2007). Television, walking, and diet: associations with postpartum weight retention. American Journal of Preventive Medicine, 32(4), 305–11. https://doi.org/10.1016/j.amepre.2006.11.012

Pedersen, P., Baker, J. L., Henriksen, T. B., Lissner, L., Heitmann, B. L., Sørensen, T. I. A., & Nohr, E. A. (2011). Influence of psychosocial factors on postpartum weight retention. Obesity, 19(3), 639–646. https://doi.org/10.1038/oby.2010.175

Siega-Riz, A. M., Herring, A. H., Carrier, K., Evenson, K. R., Dole, N., & Deierlein, A. (2010). Sociodemographic, perinatal, behavioral, and psychosocial predictors of weight retention at 3 and 12 months postpartum. Obesity (Silver Spring, Md.), 18(10), 1996–2003. https://doi.org/10.1038/oby.2009.458

Somvanshi, N., P., (2002). Preventing postpartum weight retention. American Family Physician, 66(3), 1–3.

Spiegel, K., Tasali, E., Penev, P., & Van Cauter, E. (2004). Brief communication: sleep curtailment in healthy young men is associated with decreased leptin levels, elevated ghrelin levels, and increased hunger and appetite. Annals of internal medicine, 141(11), 846-850.Standard, Australian. (2007). Glycemic Index of Food. Sydney: Standards *Australia*

Usuda, K., Nishi, D., Okazaki, E., Makino, M., & Sano, Y. (2017). Optimal cut- off score of the Edinburgh Postnatal Depression Scale for major depressive episode during pregnancy in Japan. Psychiatry and clinical neurosciences.

World Health Organization (2010). WHO Global InfoBase: International Comparisons. Retrieved from http://apps.who.int/infobase/Comparisons.aspx

WHO Expert Consultation. (2004). Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet, 363(9403), 157–163. https://doi.org/10.1016/S0140-6736(03)15268-3

World Health Organization (WHO). (2000). The Asia-Pacific perspective: Redefining Obesity and its Treatment. Geneva, Switzerland: World Health Organization. Hong Kong: World Health Organization, International Obesity Task Force, International Association for the Study of Obesity. https://doi.org/0-9577082-1-1

Xiao, R. S., Kroll-Desrosiers, A. R., Goldberg, R. J., Pagoto, S. L., Person, S. D., & Waring, M. E. (2014). The impact of sleep, stress, and depression on postpartum weight retention: A systematic review. Journal of Psychosomatic Research, 77(5), 351–358. https://doi.org/10.1016/j.jpsychores.2014.09.016

Xuto, P., Sinsuksai, N., Piaseu, N., Nityasuddhi, D., & Phupong, V. (2012). A causal model of postpartum weight retention among Thais. Pac Rim Int J Nurs Res Thail, 16(1), 48-63.

Yong, H. Y., Zalilah, M. S., & Jamilah, S. (2017). Pre-pregnancy bmi and gestational weight gain are associated with 6 months postpartum, 4(4), 112–125.

Yong, H. Y., Shariff, Z. M., Rejali, Z., Yusof, B. N. M., Yasmin, F., & Palaniveloo, L. (2018). Seremban Cohort Study (SECOST): a prospective study of determinants and pregnancy outcomes of maternal glycaemia in Malaysia. BMJ Open, 8(1), e018321.