

## **A Causal Model of Postpartum Weight Retention among Thais**

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**Abstract :** The aim of this descriptive, prospective research was to develop a causal model of postpartum weight retention among Thai women in Bangkok. The study hypotheses were developed based on an ecological model of obesity predictors. Simple random sampling was employed to obtain 223 postpartum women, from three settings, who brought their babies to well-baby clinics. Four self-administered questionnaires, two records and two anthropometric measures were used to collect data: a Personal Data Questionnaire; the Center for Epidemiologic Studies Depression Scale; the Postpartum Drive for Thinness Scale; the Inventory of Social Support Behaviors Questionnaire; a dietary record; a physical activity record; and, height and weight. Descriptive statistics were used to describe demographic characteristics of the key variables, while principle analysis, via the maximum likelihood method, was performed using LISREL.

The results revealed 36% of subjects had more than 5 kgs (11 lbs.) of weight retention six months postpartum. The modified model fit the data well, accounting for 33% of the variance in weight retention. The largest coefficient explaining weight retention was gestational weight gain by giving a positive direct effect on weight retention, and the second largest was physical activity by giving a negative direct effect on weight retention. The results suggest nurses should conduct interventions that encourage suitable gestational weight gain and moderate activity so as to prevent postpartum weight retention.

*Pacific Rim Int J Nurs Res 2012 ; 16(1) 48-63*

**Key Words:** Gestational weight gain; Physical activity; Postpartum weight retention; Postpartum women

### **Introduction**

Overweight status and obesity are increasing among people throughout the world, including Thailand. Overweight status refers to having an increased body weight in relation to height, when compared with the standard range,<sup>1</sup> or having a body mass index (BMI) of 25 to 29.9 kg/m<sup>2</sup>. Obesity, on the other hand, has been identified as occurring when an individual's BMI is equal to or greater than 30 kg/m.<sup>2</sup> The 4<sup>th</sup> National Health Examination Survey of Thailand (2008-2009) revealed 40.7%

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of Thai women and 28.4% of Thai men over 15 years of age were overweight.<sup>2</sup> The fact Thai women have more overweight status than men may be due to the fluctuation women experience in their reproductive hormone concentrations throughout their lives.<sup>3</sup>

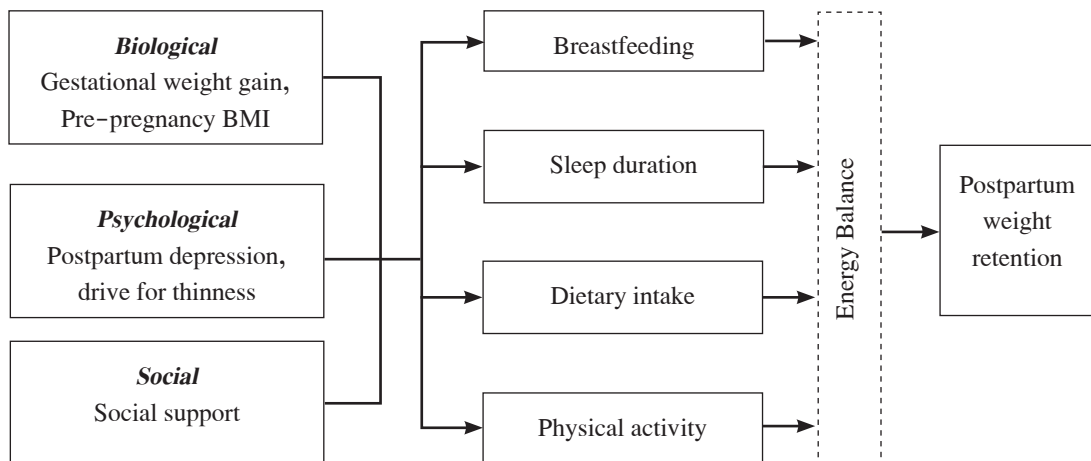
Since women tend to experience an increase in fatty tissue during pregnancy, leading to postpartum weight retention after delivery, pregnancy has been identified as a stimulus for the development of overweight status and obesity.<sup>4</sup> Postpartum weight retention (PPWR) is recognized as the weight gain of women during pregnancy that they retain following childbirth.<sup>5</sup> PPWR significantly decreases the first three months after delivery and then slowly and steadily declines the remainder of the first year postpartum.<sup>6</sup> Failure to lose retained pregnancy weight, within six months postpartum, has been found to be a predictor for mothers to carry excessive weight, 8 to 10 years later.<sup>7, 8</sup>

Failure to lose weight after childbirth can lead to various obesity-related illnesses. For example, the prevalence of risk factors for cardiovascular disease (i.e. elevated cholesterol and hypertension) and cancer

of female reproductive organs have been found to be high among overweight and obese individuals.<sup>9</sup> Furthermore, diabetes has been shown to be linked to increased BMI.<sup>10</sup>

## Conceptual framework of the study

The framework for this study was based on an ecological model of obesity predictors which looks at known biological, psychological and social factors and behaviors that influence the occurrence of obesity<sup>11</sup> (See **Figure 1**). The biological factors included gestational weight gain (total weight gain during pregnancy) and pre-pregnancy BMI (key index for relating body weight to height in pre-pregnancy). The psychological factors encompassed postpartum depression (mother's feelings of depression one week before data collection) and drive for thinness (determination to take action to return to pre-pregnancy weight). The social factors focused on social support (how often help or assistance was received from another during previous month).

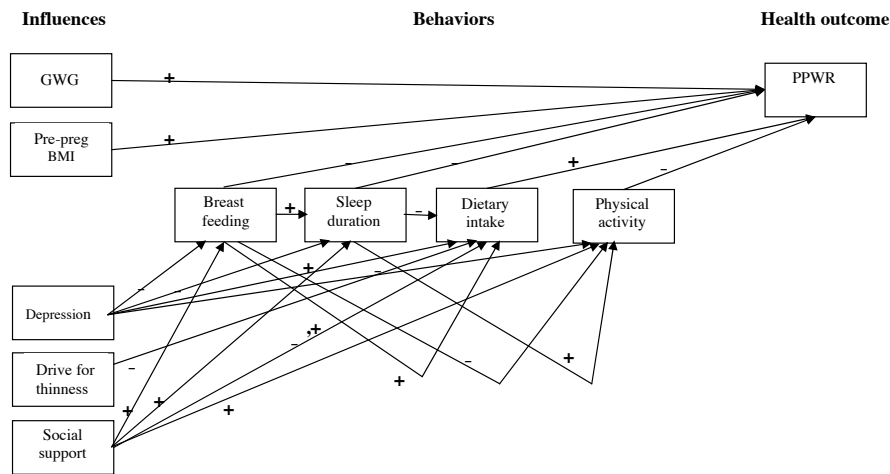


**Figure 1** Conceptual framework for the study

As shown in **Figure 1**, the influencing factors (biological, psychological and social) affect postpartum women's dietary intake, breastfeeding, sleep duration, and physical activity that can lead to postpartum weight retention. Based on the conceptual framework, the influencing factors, individual behaviors and PPWR are illustrated in terms of the hypothesized model shown in **Figure 2**.

## Review of Literature

Postpartum weight retention has been shown to be affected by biological (gestational weight gain and pre-pregnancy BMI), psychological (postpartum depression and drive for thinness) and social (social support) factors, as well as individual behaviors (dietary intake, breast feeding, sleep duration, and



Note: GWG = gestational weight gain; Pre-preg BMI = pre-pregnancy Body Mass Index; PPWR = postpartum weight retention

**Figure 2** Hypothesized model of postpartum weight retention among Thai women

physical activity). Gestational weight gain (GWG) has been noted to have an effect on PPWR due to changes in women's insulin levels, during their first two semesters of pregnancy, which alters the storage and oxidation of fat.<sup>8</sup> Women who gain more weight than recommended have been found to experience significantly higher weight retention than those who maintain their GWG within or below their recommended weight gain.<sup>12</sup> Recommended GWG is based on women's pre-pregnancy BMI.<sup>5</sup> For example, a GWG of 11.5 to 16 kgs. (25 to 35 lbs.) is recommended for those with a pre-pregnancy BMI of 18.5 to 24.9 kg/m<sup>2</sup>. Pre-pregnancy BMI has been found to be negatively associated with PPWR in that underweight women at pre-pregnancy have been

found to have higher weight retention than women who are obese at pre-pregnancy.<sup>13</sup> In addition, those experiencing postpartum depression, noted by their lower serotonin and higher serum cortisol levels,<sup>14</sup> have been found to have a greater than twofold risk of PPWR. The relationship between postpartum depression and PPWR may be because the decreased levels of estrogen and progesterone, that occur during the postpartum period, lead to increased consumption of carbohydrate-rich food and fat accumulation, which, in turn, increases the risk of PPWR.<sup>14</sup> The drive for thinness also has been shown to be negatively associated with postpartum women's consumption of food, whereby they decrease their food intake as their drive for thinness increases.<sup>15</sup>

The amount and type of social support postpartum women receive appears to influence their PPWR via a mediated relationship with breastfeeding, sleep duration, dietary intake and physical activity. Social support received from family and friends has been shown to increase duration of postpartum women's breastfeeding.<sup>16</sup> Breastfeeding has been found to be a way for postpartum women to regulate their PPWR, with an average of 675 kcal/day being expended when exclusively breastfeeding and 460 kcal/day being expended when partially breastfeeding.<sup>17</sup> The availability and frequency of social support also has been shown to impact postpartum women's sleep duration, in that when assistance is available and used to deal with their newborn's nighttime awakenings for feeding and care, they tend to experience decreased sleep disturbance.<sup>18</sup> Short sleep duration is known to result in postpartum women experiencing tiredness, fatigue and a lack of energy to do daily activities, as well as increase the opportunity for food intake.<sup>19</sup> Women having a sleep duration of less than five hours per day six months after childbirth have been found to be 2.3 times more likely to retain at least 5 kgs. (11 lbs.) of weight the first year postpartum.<sup>20</sup>

Postpartum women also have been found to need social support from their husbands and family members in dealing with dietary intake.<sup>21</sup> Furthermore, their husbands' frequency of exercise participation has been noted to be a significantly positive predictor of their frequency of exercise participation.<sup>15</sup>

From a behavioral standpoint, postpartum women need to recognize their weight is an outcome of the balance between their energy intake and energy expenditure, and that they experience weight increase when their energy intake is greater than their energy expenditure.<sup>11</sup> Thus, the impact of dietary changes or increases, secondary to social support, breast feeding, sleep duration, dietary intake and physical activity, appear to be significant with respect to PPWR.

Most studies, addressing PPWR, have been conducted in western cultures with minimal work

being found in Thailand. Thus, based upon prior research, the fact minimal studies on PPWR have been conducted in Thailand, and that obesity is a national health problem in Thailand, this study sought to: a) find the best causal model of postpartum weight retention among postpartum Thai women; and, b) explore the relationships among gestational weight gain, pre-pregnancy BMI, postpartum depression, drive for thinness, social support, breastfeeding, sleep duration, dietary intake, physical activity and PPWR among postpartum Thai women.

## Method

**Design:** A prospective design was used to generate a structural equation model of PPWR so as to determine how the bio-psycho-social factors influence PPWR, via individual behaviors, among postpartum Thai women.

**Ethical Considerations:** Approval to conduct the study was granted by the Institutional Review Board of the primary investigator's (PI) academic institution and the three hospitals used as study sites. Written consent was obtained from subjects, after an explanation of the study's purposes and data collection procedures were provided. Confidentially regarding the participants' data and identities were assured. In addition, assurance was given they could withdraw from the study at anytime without repercussions. As a token of appreciation for participating, each subject received a baby shampoo/powder sample.

**Sample:** Since power values increase with an increase in the number of subjects, degrees of freedom, and decreasing error,<sup>22</sup> to strengthen the structural equation modeling (SEM), a statistical power for it was addressed. The degrees of freedom was calculated by the equation of the number of measured variables, minus the effective number of parameters.<sup>23</sup> Given the number of measured variables was 17, with 71 parameters ( $\delta$  and  $\epsilon = 17$ ,  $\lambda_X$  and  $\lambda_Y = 17$ ,  $\gamma = 11$ ,  $\beta = 9$ ,  $\phi = 12$ ,  $\psi = 5$ ), the

model's degrees of freedom (df) was 82. Thus, with a power of 0.80,  $\alpha = 0.05$ ,  $df = 82$  and a root mean square error of approximation (RMSEA) = 0.02, a minimum of 245 cases was determined to be needed. However, based on the subjects' characteristics, the questionnaire design and the study design potentially leading to an increase in the attrition rate, a dropout rate of 40% was adopted.<sup>24</sup> Therefore, 350 postpartum Thai women, whose 4 month-old child was receiving care at the well-baby clinics of one of the three study site hospitals in Bangkok, were recruited for the study.

The inclusion criteria consisted of being a postpartum Thai woman who: a) gave birth to one healthy 37 to 42 week gestational infant, without any birth deficits, at one of the three selected study site hospitals four months prior to time of data collection; and, b) could speak, read and write Thai. Potential subjects whose pre-pregnancy or delivery weights were not available or were trying to get pregnant during the time of data collection were excluded from the study.

Simple random sampling of all public hospitals in Bangkok was used to select three general teaching hospitals as data collection sites. Well-baby clinic chart review was then conducted at each hospital. Due to the number of potential subjects with a four month follow-up appointment at the well-baby clinics being different, a ratio of selected subjects (3.5:5:4) was set for each hospital for a total of 350 subjects. However, during data collection 127 of the 350 selected subjects did not return their dietary and physical records. Thus, data from 223 of the 350 postpartum women (63.71%) were analyzed.

Subjects ranged in age from 18 to 35 years (mean = 29.74 years) and primarily: were nulliparous ( $n = 130$ ; 58.3%); had a bachelors/diploma ( $n = 97$ ; 43.5%) or secondary level education ( $n = 95$ ; 42.6%); were employees ( $n = 63$ ; 28.25%), service providers ( $n = 98$ ; 44%) or merchants ( $n = 59$ ; 26.46%); and, had a monthly income of 5,000 to 10,000 baht ( $n = 94$ ; 42.2%) [mean = 12,795.78

baht; 30 baht = 1 USD].

**Instrumentation:** Data were obtained via use of four questionnaires, two self-report records, and two anthropometric measures. The four questionnaires consisted of the: *Personal Data Questionnaire (PDQ)*; *Center for Epidemiologic Studies Depression Scale (CES-D)*;<sup>25</sup> *Postpartum Drive for Thinness Scale (PPDT)*; and, *Inventory of Social Support Behaviors Scale (ISSB)*.<sup>26</sup> The two self-report records consisted of a: three-day, 24-hour dietary record (3 DDR)<sup>27</sup> and, 24-hour physical activity record (DAR).<sup>28</sup> The two anthropometric measures included each subject's height and weight. Prior to data collection, permission for use was obtained from the owners of the ISSB. The CES-D and two self-report records were in the public domain.

The *Personal Data Questionnaire* was a three-part, researcher-designed, self-administered questionnaire used to obtain data regarding each subject's: a) personal demographics; b) type of breastfeeding and number of weeks of lactation during the first 16 weeks postpartum; and, c) nightly sleep duration for the first 16 weeks postpartum. Data obtained included: age; education; income; pre-pregnancy weight; delivery weight; employment; number of weeks of lactation; type of breastfeeding (full = only breast milk; or, partial = vitamins, minerals, water and/or cow's milk, plus breast milk); the average number of hours slept at night; and, the number of times awakened at night for the first 16 weeks. Subjects who were breastfeeding were assigned, on a weekly basis, one point per week for having performed full breastfeeding and ½ (0.5) point per week for having provided partial breastfeeding for each of the first 16 weeks postpartum.

The *Center for Epidemiologic Studies Depression Scale (CES-D)*<sup>25</sup> is a 20-item, Likert-like scale, translated into Thai by Kuptniratsaikul and Pekuman,<sup>29</sup> and was used to measure depression in postpartum women. The CES-D measures four aspects of depression, including: depressed affect (7 items,

e.g., “I felt depressed”); positive affect (4 items, e.g., “I felt hopeful about the future”); somatic and retarded activity (7 items, e.g., “I did not feel like eating; my appetite was poor”); and, interpersonal relationships (2 items, e.g., “I felt that people disliked me”). Each item is rated on a scale of 0 to 3 (none or less than 1 day = 0; 1 to 2 days = 1; 3 to 4 days = 2; and, 5 to 7 days = 3). A total score is obtained by summing across all items, with a possible score range of 0 to 60. A score of 16 or above is considered to indicate depression, while a score of 0 to 15 is considered to be “not depressed.”<sup>25</sup> Cronbach’s alpha coefficient of the CES-D, in this study, was 0.86.

The researcher-developed *Postpartum Drive for Thinness Scale (PPDT)* was used to determine the drive for thinness based on review of the literature and personal observations of postpartum women. The drive for thinness was defined as the drive or motivation postpartum women have to return to their pre-pregnancy weight or reduce their postpartum weight retention. The 11-item PPDT measured 3 aspects of drive for thinness, including: goal (3 items, e.g. “I must return to my pre-pregnancy shape”); incentive-motivation (4 items, e.g. “I must be thin enough to wear my old-dresses”); and, anxiety/dissatisfaction (4 items, e.g. “I felt unsatisfied when someone told me that I got bigger after giving birth”). Each item was rated from 1 = strongly disagree to 5 = strongly agree. A total score was obtained by summing across all items, with a possible score range of 11 to 55. A high score indicated a high level of drive to be thin, while a low score was interpreted as a low level of drive to be thin. The PPDT scale was validated by three experts in women’s health, instrument development and concept analysis. The PPDT was determined to have a S-CVI of 1.00 and Cronbach’s alpha coefficient of 0.86.

The *Inventory of Social Support Behaviors (ISSB)*<sup>26</sup> was used to measure social support in this study. Nirattharadorn modified and reduced the original ISSB to 35 items for use in the Thai culture.<sup>30</sup> The modified Thai version of the ISSB, used in this

study, was composed of 35 items measured on a 5-point Likert-like scale (1 = never received to 5 = received everyday). The modified ISSB measures 3 aspects of social support, including: guidance (13 items, e.g. “Gave you some information on how to do something”); emotional support (15 items, e.g. “Told you that you are OK just the way you are”); and, tangible support (7 items, e.g. “Provided you with some transportation”). A total score is determined by summing across all items, with a possible score ranges of 35 to 175, whereby the higher the score, the greater the social support. The Cronbach’s alpha coefficient for the modified ISSB, used in this study, was 0.95.

The 3-day, 24-hour, self-report, dietary intake record (3DDR)<sup>27</sup> was used to determine the total amount of food, drink and supplements consumed over three consecutive, 24-hour periods. Each subject was asked to record her dietary intake via use of a standard measuring cup and spoon to measure the quantity of food, drink and supplements she consumed over two week days and one weekend day. In addition, each subject recorded the cooking methods used and brand names of foods consumed. Each food item, from the three-day food record, was assigned a pre-determined five-digit food code. The food codes were then entered into INMUCAL (Thai nutrient analysis program developed by the Institute of Nutrition, Mahidol University) to analyze the total energy intake of each participant for each of the 3 days. An average of the subjects’ three-day energy intake was entered into the causal model.

The 24-hour physical activity record (24 HPAR) was adapted from the Daily Activity Record<sup>28</sup> to capture each subject’s light, moderate and vigorous activity. The two page 24 HPAR included: a) space for each subject to record each activity (i.e. child care, cleaning, cooking) performed during one 24-hour period, including sports performed within the last seven days, and the amount of time, in ten-minute increments, spent doing each activity; and, b) definitions and metabolic equivalents of task (METs)



values for light, moderate and vigorous activity. Activities requiring 0 to 3 METs were considered to be light physical activity, while activities that required 3 to 6 METs were considered to be moderate physical activity. Activities that required more than 6 METs were considered to be vigorous activity.<sup>31</sup> The energy expenditure (EE) for each recorded activity (RA) was calculated by multiplying the number of hours spent during each activity per day (THA/D) by the MET value for each of the activities ( $EE = THA/D \times MET$ ).<sup>31</sup> The energy expended, performing the activities, was summed to represent the energy expenditure for the 24 hour period assessed (MET per hour/day).

Each subject's height and weight (pre-pregnancy, delivery) was retrieved from her medical record. In addition, each subject's six month postpartum weight was measured and used to assess postpartum weight retention, body mass index (BMI) and gestational weight gain. Pre-pregnancy weight was measured during the first prenatal visit, but no later than 12 weeks gestation. If unavailable, a subject's self-reported pre-pregnancy weight, recorded on the *Personal Data Questionnaire*, was used. No significant differences were found between the pre-pregnancy (PPW) or delivery weight (DW) of those who self-reported (PPW =  $53.32 \pm 9.58$  kgs; DW =  $68.55 \pm 11.61$  kgs) and those weighed by medical personnel (PPW =  $54.04 \pm 10.03$  kgs; DW =  $68.62 \pm 11.51$  kgs). Each subject's postpartum weight retention was calculated as the difference, in kilograms (kg), between her six month postpartum weight and pre-pregnancy weight. Gestational weight gain was calculated as the difference between delivery weight and pre-pregnancy weight. Pre-pregnancy BMI ( $\text{kg}/\text{m}^2$ ) was determined by dividing each subject's pre-pregnancy weight by her height, in square meters ( $\text{m}^2$ ).

**Procedure:** Women visiting each of the three well-baby clinics used as study sites, who appeared to have a four month-old child, were approached by the PI. These women were then assessed to assure they

met the study's inclusion criteria. If a woman met the inclusion criteria, she was escorted to either a private location in the clinic waiting room or to the clinic's conference room. Each woman was then told about the study, instructed on all ethical considerations, and invited to be involved in the study. All women agreeing to take part were asked to sign a consent form. Once a consent form was signed, each woman was given the four questionnaires to complete, which took approximately 25 minutes. Upon completion of the questionnaires, each woman was given the three-day, 24 hours dietary intake record and the one-day, 24 hours physical activity record to take home and complete. How each record was to be completed was thoroughly explained. In addition, each woman was given a self-addressed, pre-stamped envelope for returning the completed forms, the following week, to the PI. Finally, once each subject completed her six month well-baby clinic visit, her weight was measured.

**Data Analysis:** Descriptive statistics were used to describe the characteristics of the key variables. Principle analysis, via the maximum likelihood method, was performed using LISREL. Statistical significance was set at  $\alpha$  (two-tailed).

## Results

**Table 1** presents a detailed description of each of the key variables. As can be noted, on average the subjects: had a gestational weight gain of 14.89 kgs; had a pre-pregnancy BMI of  $21.06 \text{ kg}/\text{m}^2$ ; had a six-month postpartum BMI of  $22.55 \text{ kg}/\text{m}^2$ ; were not depressed; had a moderate drive for thinness; had a moderate amount of social support; lactated an average of 14.85 weeks; either fully or partially breastfed; obtained an average of 6.63 hours sleep/night; awoke an average of twice/night; consumed an average of 1,552 kcal/day; performed a moderate amount of physical activity; and retained an average of 3.71 kgs six months postpartum.

**Table 1** Characteristics of study variables (n = 223)

Characteristics	n	%	$\bar{X} \pm SD$	Min-max
<b>Gestational weight gain (kg)</b>			14.89±4.82	3.6-27.8
<11.5	59	26.46		
11.5-16	91	40.81		
>16	73	32.73		
<b>Pre-pregnancy BMI* (kg/m<sup>2</sup>)</b>			21.06±3.25	14.88-28.69
<18.5	51	22.87		
18.5-24.9	141	63.23		
25-29.9	24	10.76		
≥30	7	3.14		
<b>BMI at six month postpartum (kg/m<sup>2</sup>)</b>			22.55±3.76	15.82-33.97
<18.5	27	12.11		
18.5-24.9	141	63.23		
25-29.9	43	19.28		
≥30	12	5.38		
<b>Postpartum depression</b>			12.08±6.78	0-29
<16	166	74.44		
≥16	57	25.56		
<b>Drive for thinness</b>			38.01±6.50	22-50
≤30	22	9.87		
31-40	123	55.16		
41-50	68	30.49		
≥51	10	4.48		
<b>Social support</b>			125.43±29.19	55-175
≤70	12	5.38		
71-105	36	16.14		
106-140	104	46.64		
≥141	71	31.84		
<b>Weeks of lactation</b>			14.85±5.93	0-20*
≤12	62	27.80		
>12	161	72.20		
<b>Sleep duration (hours)</b>			6.63 ± 1.48	3-10.5
≤5	44	19.73		
6	75	33.63		
7	46	20.63		
≥8	58	26.01		



**Table 1** Characteristics of study variable (n = 223) (continued)

Characteristics	n	%	$\bar{X} \pm SD$	Min-max
<b>Wake up at night (times)</b>			$2.02 \pm 0.42$	1-3
None	24	10.76		
1-2	114	51.12		
>2	85	38.12		
<b>Dietary intake (kcal/day)</b>			$1,552.60 \pm 493.07$	762.82-2,828.60
<1200	62	27.80		
1200-1750	98	43.95		
1750-2250	41	18.38		
>2250	22	9.87		
<b>Physical activity (MET/h/day)</b>			$41.48 \pm 5.84$	25.39-54.29
<30	2	0.90		
30-39	98	43.95		
40-50	94	42.15		
>50	29	13.00		
<b>Physical activity intensity</b>				
Moderate 30 minutes	149	66.82		
Vigorous 30 minutes	12	5.38		
<b>Weight retention at 6 mo. (kg)</b>			$3.71 \pm 4.21$	-5.90-13.40
<0	51	22.87		
0-5	91	40.81		
>5	81	36.32		

Note: \*BMI category was based on IOM 2009 recommendations.<sup>5</sup>

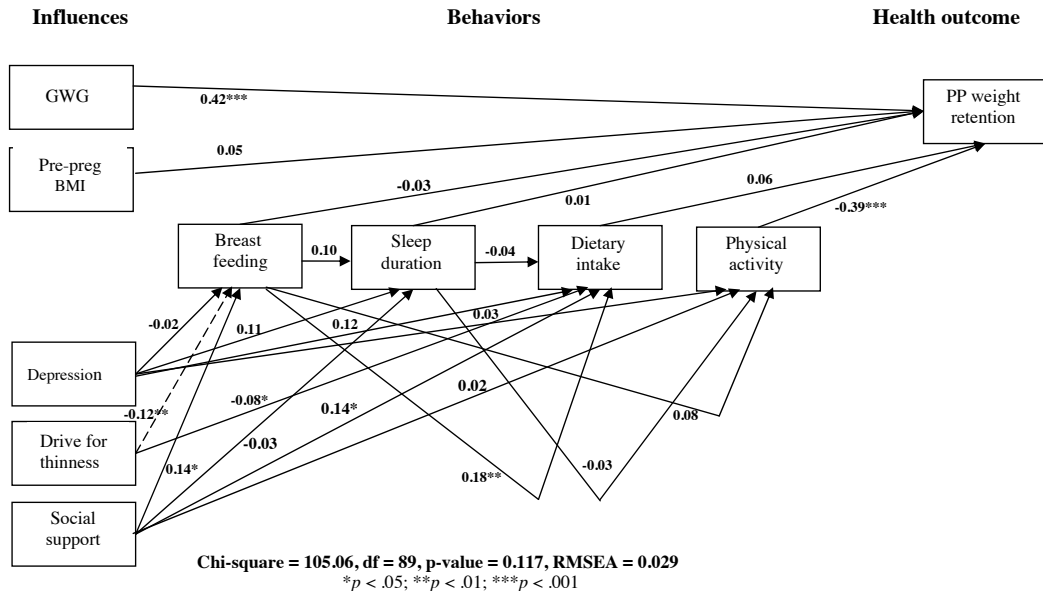
BMI = Body Mass Index; kg = kilogram; kg/m<sup>2</sup> = kilogram per square meter; kcal/day = kcal per day;

MET/h/day = Metabolic Equivalent Task per one hour per day.

\*Some delayed a visit to the well baby clinic due to their baby having a fever. Thus, the number of weeks of lactation was extended to 20 weeks.

As shown in **Figure 2**, the hypothesized model did not fit the data ( $\chi^2=163.23$ ,  $df=96$ ,  $p$  value < 0.001, RMSEA = 0.056, and  $\chi^2/df = 1.70$ ). Consequently, the hypothesized model was modified via use of the modification indices of the program, and theoretical support, by adding a path between drive for

thinness and breastfeeding (see **Figure 3**), which lead to an improved  $p$  value and goodness of fit indices ( $\chi^2= 105.06$ ,  $df = 89$ ,  $p$ -value = 0.117, RMSEA = 0.029, and  $\chi^2/df = 1.18$ ). The modified model explained 33% of variance in the subjects' PPWR.



**Figure 3** Modified model of postpartum weight retention among Thai women

As can be noted in **Table 2**, the largest coefficient explaining weight retention was gestational weight gain which had a positive direct effect, followed by physical activity which had a negative direct effect. Drive for thinness had a negative direct effect on dietary intake, whereas social support and breastfeeding had positive direct effects. In addition, drive for thinness had a negative direct effect on breastfeeding. The subjects' pre-pregnancy BMI, dietary intake, breastfeeding, and average sleep duration were not found to have an effect on their PPWR.

## Discussion

The findings revealed subjects' average weight retention, at six months postpartum, was  $3.71 \pm 4.21$  kgs. Compared to a population of postpartum Taiwanese women, the women in this study had more

weight retention six months after delivery than did the Taiwanese ( $2.42 \pm 3.57$  kgs).<sup>13</sup>

The fact gestational weight gain had a direct effect on postpartum weight retention was not surprising. A systematic review of 14 studies revealed GWG to be a predictor of postpartum weight retention, with GWG retained from 2 days to 11 weeks to more than 15 years postpartum.<sup>32</sup> In addition, based on across group comparisons of pre-pregnancy BMI, GWG has been found to be a predictor of six month PPWR.<sup>13</sup>

The fact a negative direct effect was found between physical activity and PPWR would be expected given the subjects' rare involvement in vigorous physical activity. Epidemiological studies regarding the physical activity of postpartum women have revealed women who have higher levels of physical activity after delivery are more likely to

return to their pre-pregnancy body weight.<sup>33</sup> Their level of physical activity, however, has been found to decrease during the postpartum period because of a sustained decrease in moderate and vigorous activities.<sup>34</sup> Although the study subjects rarely engaged in vigorous activity, they did engage in a limited amount of light activities and a great deal for moderate activities. Their moderate activities included: lifting, standing with, transporting, bathing and clothing their babies; mopping the floor; and, walking up and down stairs. Even though these activities seem small in terms of energy expenditure, the subjects performed them throughout the day. Thus, their moderate level

of energy expenditure, from their daily activities, appeared to have contributed to their PPWR.

The fact pre-pregnancy BMI was not found to have an effect on PPWR is congruent with previous research that has noted pre-pregnancy BMI has not been associated with PPWR.<sup>7</sup> Trans-fat intake rather than total dietary intake in the early postpartum period has been found to be directly associated with substantial weight retention at one-year postpartum.<sup>35</sup> Since this study used a score of total daily energy intake and did not classify food content, especially trans-fats, may explain why dietary intake was found to not have an effect on PPWR.

**Table 2** Summary of total effect, direct effect and indirect effects of causal variables and endogenous variables (n = 223)

Causal Variables	Endogenous variables								
	BF			Dietary intake			Weight retention		
	D	I	T	D	I	T	D	I	T
GWG	-	-	-	-	-	-	.42***	-	.42***
Drive	-.12**	-	-.12**	-.08*	-	-.08*	-	-	-
SOS	-	-	-	.14*	-	.14*	-	-	-
BF	-	-	-	.18**	-	.18**	-	-	-
PA	-	-	-	-	-	-	-.39***	-	-.39***
R <sup>2</sup>		.02			.07			.33	

**Note:** Only path coefficients having statistically significant difference are presented.

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

D = direct effect; I = indirect effect; T = total effect; GWG = gestational weight gain;

Drive = drive for thinness; SOS = social support; BF = breastfeeding; PA = physical activity;

Weight retention = weight retention six months postpartum

Breastfeeding, in this study, also was not found to have an effect on PPWR. The possibility that breastfeeding may assist women in minimizing PPWR has long been a controversial issue. Some prior research, however, has found breastfeeding to be negatively associated with PPWR in postpartum women who exclusively breastfeed for at least six months.<sup>36</sup> The reasons breastfeeding may not have had an effect on PPWR, in this study, may have been because measurement of breastfeeding was done for only four months (16 weeks) and subjects did both total and partial breastfeeding. Thus, the appropriate duration and intensity of breastfeeding may not have been adequate to achieve a benefit on PPWR.

Although prior studies have provided evidence to support an association between short sleep duration and weight gain,<sup>19</sup> the findings of this study did not reveal such an effect. The reasons may have been because: a) many confounding factors, which were not controlled in this study, can generate a spurious relationship between sleep duration and weight gain, such as watching television, using a computer, drinking caffeinated coffee and one's hours of work;<sup>37</sup> and b) a possible measurement error in sleep duration may have existed, which could have reduced the magnitude of the association between sleep duration and weight gain. Nielsen and colleagues<sup>38</sup> found short sleep duration was consistently associated with development of obesity in children and young adults, but not consistently in adults. Thus, findings of this study support the evidence presented in Nielsen's systematic review.

Finding that the drive for thinness had a direct negative effect on dietary intake and breastfeeding is similar to prior findings that have found increased drive for thinness to be related to decreased dietary intake<sup>15</sup> and negatively correlated with breastfeeding.<sup>39</sup> The fact the women in this study, who highly desired thinness, decreased their dietary intake was not surprising, given that when someone strongly desires to be thin he/

she is more likely to decrease his/her dietary intake. In addition, the finding that the women who desired to be thin also breastfed less is supportive of prior research that revealed breastfeeding not to be a choice for mothers who desire to be thin because they believe purging and strenuous exercise are a more effect and rapid way to loose postpartum weight.<sup>39</sup>

Even though this study did not investigate the source of social support, the findings support those of a prior study that revealed social support from friends to be significantly related to healthful dietary change.<sup>40</sup> This may be because postpartum women find their relationship with friends to be less conflictual than with family, especially with respect to one's weight gain or loss. In addition, the findings support those of a previous study regarding a positive correlation between breastfeeding and energy intake.<sup>41</sup> This finding may be due to mothers requiring additional energy intake in order to produce a sufficient quantity of milk.

## Conclusions

The findings of the study have the potential for serving as a guide for health care providers as they work with pregnant Thai women. More specifically, since the findings of the study demonstrated the need for pregnant women to balance dietary intake and physical activity during the gestational period and after delivery, health care providers need to encourage them to actively engage in moderate activity on a daily basis. In addition, because the subjects' drive for thinness was found to be negatively correlated with breastfeeding and dietary intake, postpartum mothers need to be encouraged to exclusively breastfeed at least six months to decrease their PPWR, and to consume sufficient dietary intake to produce an adequate amount of milk. Furthermore, postpartum women need to be encouraged to seek social support to assist them in balancing their dietary intake when they are breastfeeding.

## **Limitations and Recommendations for Future Research**

Although the findings of this study demonstrated the usefulness of the postpartum weight retention model in explaining factors that contribute to weight retention among postpartum Thais, the study had limitations that may have influenced the results. Since the women's pre-pregnancy weight, taken at their initial antenatal visit, was retrieved from each of the subjects' hospital records, there was no way to assure the weights were accurate. Thus, underestimation of their GWG and PPWR may have occurred. In addition, since subjects were asked to rely on their memories of their pre-pregnancy weight, there was no way to assure the weight they reported was accurate.

A 40% subject attrition was experienced during the study which may have been due to subjects' demographics (i.e. predominantly low to the middle-class economic status) and respective burdens, as well as the demands of the study's design. In addition, no measurement of the amount of trans-fats (known to be a risk factor for weight gain) subjects consumed was obtained. Although simple random sampling was used to select the setting, private hospitals were not included in the random selection process. Thus, generalizability of the findings should be used with caution.

Future investigations of postpartum weight retention may best be served via intervention studies regarding control of weight gain during pregnancy and daily physical activity programs both during and after pregnancy. In addition, determination needs to be made regarding the effect trans-fats, fibers and total fats have on PPWR, as well as the effect a daily household routine has on the risk of PPWR and long-term maternal health. However, to decrease potential subject attrition, the tools used to obtain data regarding the subjects' dietary intake and physical activity

should not pose a burden to the postpartum women. Refinement of the drive for thinness scale also should be considered prior to further use.

## **Acknowledgements**

This study was supported by the 60<sup>th</sup> Year Supreme Reign of His Royal Majesty King Bhumibol Adulyadej Scholarship of the Faculty of Graduate Studies, Mahidol University, and a grant from the Thailand Nursing and Midwifery Council.

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## แบบจำลองเชิงเหตุผลเกี่ยวกับภาวะน้ำหนักเกินหลังคลอดของสตรีไทย

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**บทคัดย่อ:** การวิจัยเชิงบรรยายแบบศึกษาไปข้างหน้านี้มีวัตถุประสงค์เพื่อพัฒนาแบบจำลองเชิงเหตุผลเกี่ยวกับภาวะน้ำหนักเกินหลังคลอดของสตรีไทยในกรุงเทพมหานคร โดยกรอบแนวคิดมีพื้นฐานจากแบบจำลองปัจจัยทำนายภาวะอ้วน ใช้การสุ่มอย่างง่ายในการคัดเลือกสถานที่ในการเก็บข้อมูล ได้สตรีหลังคลอดจำนวน 223 คนที่พาบุตรมารับวัคซีน เก็บรวบรวมข้อมูลโดยใช้แบบสอบถาม 4 ฉบับ, แบบบันทึก 2 ฉบับ, และการวัดทางมานุษยวิทยา 2 ลักษณะ ประกอบด้วยแบบสอบถามข้อมูลส่วนบุคคล แบบสอบถามความรู้สึกรู้สึกซึมเศร้า แบบวัดความต้องการที่จะพอมในระยะเวลาหลังคลอด แบบสอบถามการสนับสนุนทางสังคม แบบบันทึกอาหารและกิจกรรมประจำวันและการวัดน้ำหนักและส่วนสูง ทดสอบแบบจำลองด้วยโปรแกรมลิสเรลโดยวิธีความน่าจะเป็นสูงสุด

ผลการวิเคราะห์พบว่า ร้อยละ 36 ของกลุ่มตัวอย่างมีน้ำหนักเกินหลังคลอดมากกว่า 5 กิโลกรัม (11 ปอนด์) ในเดือนที่ 6 หลังคลอด แบบจำลองมีความสอดคล้องกลมกลืนกับข้อมูลเชิงประจักษ์ และสามารถอธิบายความผันแปรของภาวะน้ำหนักเกินหลังคลอดได้ร้อยละ 33 โดยน้ำหนักที่ขึ้นระหว่างตั้งครรภ์มีอิทธิพลโดยตรงทางบวกต่อภาวะน้ำหนักเกินหลังคลอดได้มากที่สุด รองลงมา ได้แก่ กิจกรรมทางกาย มีอิทธิพลโดยตรงทางลบต่อภาวะน้ำหนักเกินหลังคลอดผลการศึกษาข้างชี้ว่าพยาบาลควรพัฒนากลวิธีในการควบคุมน้ำหนักที่ขึ้นระหว่างตั้งครรภ์ให้อยู่ในเกณฑ์ กระตุ้นให้สตรีหลังคลอดมีกิจกรรมทางกายในระดับกลางเพื่อป้องกันภาวะน้ำหนักเกินหลังคลอด

*Pacific Rim Int J Nurs Res 2012 ; 16(1) 48-63*

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