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Polly Ryan
University of Wisconsin - Milwaukee

Marianne Weiss
Marquette University, marianne.weiss@marquette.edu

Nicole Traxel
University of Wisconsin - Milwaukee

Michael J. Brondino
Center for Addiction and Behavioral Health Research

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Polly Ryan
College of Nursing, University of Wisconsin Milwaukee, Centre Scientist Self-management Science Centre, Milwaukee, WI
Marianne Weiss
Wheaton Franciscan St Joseph/Sister Rosalie Klein, Milwaukee, WI
College of Nursing, Marquette University, Milwaukee, WI
Nicole Traxel
Associate Scientist Centre for Addiction and Behavioural Health Research, University of Wisconsin, Milwaukee, WI
Michael Brondino
Centre for Addiction and Behavioural Health Research, University of Wisconsin, Milwaukee, WI

Abstract

Aim. This is a report of a correlational study to test the Integrated Theory of Health Behaviour Change within the context of postpartum weight self-management including the impact of race/ethnicity and weight classification.

Background. Women experiencing childbirth face increasing challenges to manage their weight postpartum. Little is known about women's weight self-management during the complex physiological and psychosocial transition of the postpartum period.

Methods. Data were collected during the birth hospitalization and 4 months postbirth during 2005 and 2006. A quota sample of 250 postpartum women using two strata, race/ethnicity and prepregnant weight classification, were enrolled; 179 women completed the follow-up survey. A survey questionnaire measured concepts from the Integrated Theory of Health Behaviour Change concepts, including knowledge and beliefs (self-efficacy, outcome expectancy and goal congruence), self-regulation skills and abilities, and social facilitation (social support and social influence) and the proximal outcome of weight retention. Factor analysis identified 5 factors consistent with the theoretical concepts that accounted for 47·1% of total survey variance.

Results. Model testing using path analysis explored the relationship among factors. The final model explained 25·7% of the variance in self regulation at 4 months, but did not explain weight retention. The contribution of select concepts to total variance was different for Caucasian and African American women, but not by weight classification.

Conclusions. Findings support use of theoretical concepts and relationships to understand postpartum weight self-management. The different relationships among concepts in Caucasian and African American women should be considered in planning targeted postpartum weight self-management interventions.

What is already known about this topic

- Throughout developed countries, women retain weight following childbirth and it is cumulative across multiple pregnancies.
- Weight retention is predictive of body weight up to 15 years following childbirth.
- Little is known about women's knowledge and beliefs, self-regulation skills and abilities, and social facilitation related to postpartum weight self-management.

What this paper adds

- Illuminates a perspective that weight self-management after childbirth is more than a physiological phenomena. It is a process requiring active engagement and management.
- Use of the Integrated Theory of Health Behaviour Change is helpful in framing weight self-management in the context of health behaviour self-management.
- Supports the impact for race, but not weight classification on weight self-management.

Implications for practice and/or policy

- The postpartum period should be recognized as a unique opportunity for initiation of weight self-management health behaviour.
- Nurses and other healthcare professionals should include weight self-management as a component of regular follow-up care.
- Follow-up care should focus on enhancing self-efficacy, self-regulation skills and abilities, and social facilitation.

Introduction

The increase in obesity in developed countries across the world is associated with increases in diseases including metabolic syndrome, diabetes, hypertension, heart disease and diseases of the bone – to name just a few (Nawaz & Katz 2001, Raven 2003, NIH 2004, Carcieri 2007, Gunderson *et al.* 2009). Women are more likely than men to experience health problems and diminished quality of life related to obesity (Muenning *et al.* 2006). A notable increase in weight has occurred – with women of the same age weighing approximately 22 pounds (10 kg), more now than 10 years ago (Jeffery *et al.* 2000). Results of studies conducted internationally have shown that most women desire to lose pregnancy weight following childbirth, (Krummel 2007), yet many do not achieve this goal (Öhlin & Rossner 1994, Williamson *et al.* 1994, Gunderson *et al.* 2001, Kac *et al.* 2004a, Krummel *et al.* 2004, Keller *et al.* 2008). Nearly 40% of non-obese women retain at least 14 pounds (6·34 kg) above prepregnancy weight 1 year following childbirth (National Research Council and Institute of Medicine 2007). It has been observed that pregnancy weight retention contributes to the gradual increase in obesity throughout a woman's life, with 6·4–8% of women advancing from normal weight prepregnancy to overweight at 1 year postbirth (Öhlin & Rossner 1994, Gunderson *et al.* 2000). Weight retention at 1 year postbirth is predictive of weight 15 years later (Linne *et al.* 2004, Rooney *et al.* 2005). Subsequent pregnancies result in weight retention and add to women's lifetime weight gain trajectory (Beazley & Swinhoe 1979, O'Toole *et al.* 2003).

Women experiencing pregnancy and childbirth in developed countries around the world face increasing challenges to manage their weight postpartum and over time. Little is known about women's weight self-management during the complex physiological and psychosocial transition of the postpartum period (Gore *et al.* 2003, Fowles & Walker 2006, Keller *et al.* 2008).

Background

Postpartum weight retention

Reports of weight retention after childbirth reveal retention levels of 6·6–15·4 pounds (3–7 kg) at 2 weeks postpartum (Walker *et al.* 2005), 6–11 pounds (2·7–5 kg) at 4 months (Gennaro & Fehder 2000), and up to 8 pounds (3·6 kg.) at 1 year (Öhlin & Rossner 1994, Walker *et al.* 2005). Weight retention following pregnancies occurs in women across the globe; for example, women living in China (To & Cheung 1998), Taiwan (Lyu *et al.* 2009), Brazil (Kac

et al. 2003, 2004a,b) and Sweden (Öhlin & Rossner 1994) retain weight following pregnancy. Gore and colleagues summarized the results of 12 studies and concluded that average postpartum weight retention ranged from 1·1 to 6·6 lbs (0·5–3 kg) up to 24 months (Gore *et al.* 2003). In their meta-analysis of studies conducted across a number of countries, Schmitt *et al.* (2007) used body mass index (BMI) as a measure of weight-to-height changes rather than weight. An increase in BMI of 2·42 was observed at 6 weeks postpartum, 1·14 at 6 months and 0·46 at 12 months. Notably, for women without follow-up care, the increase in BMI was up to 80% greater than for women who received postpartum follow-up, suggesting a role for postpartum healthcare professionals in enhancing women's ability to self-manage the loss of gestational weight following childbirth.

Factors associated with weight retention

Weight retention is associated with many factors; among them are prepregnancy weight and race/ethnicity. Postpartum weight retention is a greater problem for overweight women and obese women (Gunderson *et al.* 2001). A lower percentage of normal weight women (19%) retain 9 or more pounds (4·1 kg) of pregnancy weight when compared with the percentage of overweight women (35%) (Abrams 1993). Disparity in weight retention has been described, with African American women retaining more than White women (Parker & Abrams 1993). According to the 1988 National Maternal and Infant Health Survey, 44% of White women and 63% of African American women retain 4 or more pounds (0·113 kg) after pregnancy (Keppel & Taffel 1993). There is compelling evidence from observational studies that pregnancy weight gain in excess of Institute of Medicine guidelines is associated with short, intermediate and long-term weight retention (Viswanathan *et al.* 2008), and that African American women retain more weight than White women (Siega-Riz *et al.* 2004, National Research Council and Institute of Medicine 2007).

Behavioural factors have been tested as predictors of weight retention. Self-efficacy was positively related to weight loss (Krummel 2007). In African American women, higher social support was related to lower BMI (Walker *et al.* 2005). Stage of change, one dimension of the Transtheoretical Model, explained little with respect to postpartum weight, with stage assessment of perceptions differing from actual behaviours (Krummel *et al.* 2004). A new theoretical perspective inclusive of self-efficacy and social support provides a new perspective of weight self-management in the postpartum period.

Postpartum weight self-management

Women desire to lose pregnancy weight (Boyington *et al.* 2007), but little is known about women's thoughts and beliefs about weight loss or the processes used to manage the loss of weight gained during pregnancy. The postpartum period presents a challenge for women and an opportunity for nurses and other healthcare professionals to provide women increasing knowledge and beliefs, skills and abilities, and social facilitation to manage their weight.

Postpartum weight self-management is a term for several scenarios. Postpartum weight self-management includes what women do to lose the weight gained during pregnancy and also what women do to manage other weight-related issues following childbirth. This may include

actions to maintain healthy weight; lose weight retained from prior pregnancies; reduce weight gained in childhood, adolescence, or over the trajectory of weight gain experienced in early adulthood; or to prevent additional weight gain.

The Integrated Theory of Health Behaviour Change

Empirical testing of nursing theories is critical as it provides evidence of the comprehensiveness and essential nature of theoretical concepts, the accuracy of proposed relationships among concepts, and the adequacy of the theory to predict outcomes across specific populations, conditions, developmental stages or venues (Fawcett 2005). This capacity for explanation and prediction is critical to enrichment of the clinical practice of nursing (Im & Meleis 1999). Providing empirical evidence about the adequacy of a theory to predict clinical outcomes is critical for continued knowledge development for nursing practice, and shaping intervention development and testing. The Integrated Theory of Health Behaviour Change (ITHBC) was developed to guide nurses and other healthcare professionals in the development of interventions, focus assessments, identify patient-sensitive outcomes, and provide the logic to design and evaluate the quality of intervention studies (Ryan 2009).

Integrated Theory of Health Behaviour Change is a midrange theory compiled from existing and new concepts to explain health behaviour change (Ryan 2009). This theory purports that knowledge and positive beliefs, use of self-regulation skills and abilities, and social facilitation lead to the self-management of health-related behaviours. The theory suggests that changes in one's self-management behaviours result in improved health outcomes. Changes in self-management behaviours are considered proximal outcomes, whereas improvements in actual health status are considered distal outcomes. The construct of knowledge and beliefs is composed of behaviour-specific knowledge, self-efficacy, outcome expectancy and goal congruence. The construct of self-regulation skills and abilities comprises the processes of goal setting, self-monitoring and reflective thinking, decision-making, planning for and engaging in specific behaviours, self evaluation, and the management of physical, emotional, and cognitive responses associated with health behaviour change. Social facilitation contains the concepts of social influence, social support and active collaboration related to health outcomes among persons, families and healthcare professionals (Ryan & Sawin 2009).

Applying this theory to the specific situation of postpartum weight self-management (McQuiston & Campbell 1997), women will be more likely to engage in behaviours to manage their weight if they are knowledgeable about weight self-management (e.g. understand the relationship between caloric intake, activity and exercise, and weight) and embrace health beliefs consistent with effective weight self-management behaviours (e.g. feel confident that they can manage their weight in normal and challenging situations and believe that engaging in weight self-management behaviours will result in weight management). Women will be more likely to manage their weight if their goals are congruent (e.g. if the weight self-management goals are congruent with time management and reflected in behaviours such as minimal use of prepackaged foods and fast food consumption). Women self-manage their weight by using self-regulation skills and abilities such as setting weight, activity and eating goals; regularly monitoring their weight and making connections between their eating and activity behaviours and their weight; making realistic plans to change a behaviour; evaluating whether or not they

have achieved their goal and adjusting their plans based on outcomes; and by identifying and managing the impact of emotions and their physical state on their behaviour. Women need to learn to use resources that match their goals, to ask for and accept support of family and friends, and to learn how to collaborate actively to meet their needs and achieve their goal of weight self-management.

The study

Aim

The aim of the study was to test the ITHBC in the context of postpartum weight self-management including the impact of race/ethnicity and weight classification.

Design

A correlational design was used to evaluate the relationships among the concepts of the ITHBC theory including knowledge and beliefs (self-efficacy, outcome expectancy and goal congruence), self-regulation skills and abilities, and social facilitation (social support and social influence) and the proximal outcome of weight retention. The interaction effects of theoretical concepts, race and prepregnancy weight classification on postpartum weight retention were investigated. Data from 24 to 48 hours postbirth and 4-month time period were used. This is a secondary analysis of data from a study designed to explore postpartum women's expectations, goals and actions in self-managing pregnancy-related and additional weight loss in the year after childbirth (M. Weiss & P. Ryan, unpublished data).

Sample

A quota sample of 250 postpartum women stratified by race/ethnicity (White, African American and Latina) and prenatal weight classification (normal weight, overweight, obese) (Centers for Disease Control and Prevention 2009) was enrolled over 12 months from 2005 to 2006. A quota sample was used to balance representation of White, African American and Latina women. To test the theory, a minimum of 10 times as many cases as the number of parameters being estimated is recommended; thus, the sample size of 250 participants is adequate for the 13 parameters in the analyses (Kline 1998). Women were eligible for the study if they were at least 18 years of age; had an uncomplicated birth of a live born, full-term infant; and planned to be discharged with the infant. Eligibility criteria also included adequate mastery of the English language for informed consent procedures, written responses to study questionnaires, and verbal responses to questions asked in telephone interviews. Eligibility was contingent on the participant's ability and willingness to give a telephone number for follow-up contacts for data collection purposes. Women underweight at the time of conception were excluded from the study.

Participants were recruited from two urban hospitals belonging to a healthcare system in the Midwestern United States. One hospital was a tertiary perinatal centre with more than 350 deliveries per month and the second was a community hospital in the same city with approximately 100 births per month. Both hospitals serve the same urban community

comprising predominantly White (40%), African American (36%) and Hispanic women (18%) (Wisconsin Department of Health Services 2007).

Data collection measures

Patients were recruited postbirth during their hospitalization. The postbirth hospital data were collected using a written enrolment form and survey – a telephone survey was conducted 4 months postbirth. Additional data were abstracted from medical records.

Enrolment and medical record abstraction form

Participants provided information related to their age, race/ethnicity, prepregnancy weight category, marital status and education. Data obtained from the medical record include height and prepregnancy weight; these data were the primary source of information for determination of weight classification using BMI (CDC 2009).

Postpartum Weight Concerns Survey: Postbirth form

Relatively little is known about the factors affecting women's weight self-management behaviours during the postpartum period and no previously tested instruments were identified to measure women's postpartum weight self-management. Survey questions were developed by the investigators to obtain information related to each of the theoretical concepts of weight self-management knowledge and beliefs (which included knowledge and the concepts of self-efficacy, goal congruence and outcome expectancy), self-regulation skills and ability (goal setting, planning, and weight self-management skills and abilities), and social facilitation (influence and support) (Table 1). This survey was completed prior to hospital discharge. The survey contained 27 questions of which 19 measured the concepts of the ITHBC. Question formats differed depending on the content domain and included multiple choice, true and false, fill in the blank, and 0–10 point linear rating scales formats. Eight questions requested the respondent to select all responses that applied. These items focused on planned weight self-management behaviours, weight self-management behaviours and goal incongruence with weight self-management. Each of these eight items was scored by aggregating the number of choices the participant selected, with the score reflecting the breadth and scope of the behaviours, but not their frequency of use.

Table 1. Conceptual, theoretical and empirical linkages

Theory constructs →	Theory concepts →	Empirical indicators
Integrated Theory of Health Behaviour Change		Study measures: postpartum weight management (PPWM)
	Knowledge condition specific information	Factual information related to PPWM • Usual weight loss • When to expect to return to weight • How to lose pregnancy weight • How to lose more weight • Diet after childbirth, diet programmes • Physical activity after childbirth • Online resources
Health belief	Self-efficacy	Confidence weight loss will occur, ability to watch diet, and to engage in physical activity • How confident are you…that you will lose your pregnancy weight • …you will watch your diet while you lose your pregnancy weight • …will be physically active while you lose your pregnancy weight
	Outcome expectancy	Expectancy that engagement in behaviour will result in weight loss • How much weight do you want to lose after your pregnancy • How much weight do you expect to lose
	Goal congruence	Congruence among multiple personal goals • Finding time while caring for baby or other children • Being too tired, not being motivated • Feeling anxious or nervous, feeling upset, feeling stressed, feeling depressed • Don't enjoy exercise, family members don't exercise • I like to nibble, I have trouble resisting high calorie/high fat foods, Family members eat high calorie/high fat foods
Self-regulation	Goal setting	Set a weight self-management goal • Specific weight goal
	Planning	Planning a specific behavioural approach to weight management • Plan to keep an activity chart • Watch how clothes fit • Do nothing special • Watching and/or changing the foods I eat • Increasing my physical activity • Increasing exercise
	Action	Uses specific behaviours for PPWM • Eat a healthy diet, eat healthier diet than before pregnancy • Eat smaller portions, eat fewer carbohydrates, eat fewer fatty foods, decrease calories • Breast feed • Walk, increase my usual physical activity, join an exercise class or program, exercise at home, exercise with a partner or friend, join a gym or recreation center • Attend weight loss programme, use weight loss book, use an on-line diet programme
Social facilitation	Social influence	Influenced by family, friend, health provider, or media to lose weight • How important is losing pregnancy weight to spouse • Influenced by doctor, nurse, hospital, family or friend
	Social support	Receives instrumental, emotional, or informational support to lose weight • Will spouse support your efforts to lose pregnancy weight • Will he eat same meals • Will he join in physical activity
Proximal outcome	Weight retention	Difference between prepregnancy and weight at 4 months • Mothers (self-reported) prepregnant weight? • What is your weight now (4 months)? (in pounds)

Postpartum Weight Self-Management Survey: 4-month form

This structured survey was completed via telephone interview, 4 months following birth. The survey took 15–20 minutes to complete. Items used in this survey included questions related to weight self-management knowledge and beliefs, self-regulation skills and abilities, social facilitation and weight retention. Questions were comparable to questions asked in the previous survey, but focused on what participants did over the past 4 months to manage their weight.

Evaluation of the validity of survey items

An exploratory factor analysis using principal axis factoring and promax rotation was conducted to clarify the underlying dimensions of the Postpartum Weight Concerns Survey: Postbirth and construct item pools to serve as aggregate measures of the theoretical constructs. Gorsuch (1983) stated that samples larger than 175 are adequate for interpreting factor loadings > 0·30, thus our sample size of 250 was adequate for this analysis. Factors were retained if their eigenvalues were > 1 (Kaiser 1960).

Fourteen of the original 19 items were retained. Two of the dropped items pertained to the actual number of pounds women expected and wanted to lose. These items depend on each woman's weight rather than weight retention and were not good variables for comparisons. Three items were removed because they did not load strongly on any one factor; instead, they loaded approximately equally on more than one factor. These items pertained to women's expectations of how long it will take to lose weight gained during pregnancy (factor loading of 0·212 on the self-regulation factor and 0·308 on the outcome expectancy factor), where women will get information on how to lose pregnancy weight (factor loading of 0·260 on the self-regulation factor and 0·308 on the social influence factor), and total knowledge about postpartum weight loss (factor loading of 0·215 on the self-regulation factor and −0·268 on the social support factor).

The factor analysis was run with the 14 retained items and a five-factor model was found to provide the most interpretable solution for the item set and accounted for 47·1% of the variance. Table 2 displays the 14 items, their factor loadings and the inter-factor correlations. The resulting factors were found to represent five of the concepts of the ITHBC and were labelled: self-regulation, self-efficacy, outcome expectancy, social influence and social support. The inter-factor correlations were generally low, indicating that there was little shared variance between factors. In the original conception of the ITHBC, goal congruence was thought to be a health belief (Ryan 2009); however, results indicated that goal-congruence fits better under the self-regulation dimension. For the purpose of continued analysis, goal congruence questions were aggregated with self-regulation questions and the concept of goal congruence was placed with the larger construct of self regulation.

Table 2. Retained items and their factor loadings and inter-factor correlations: Postpartum Weight Concerns Survey: Postbirth

Items	Self-regulation	Self-efficacy	Outcome expectancy	Social influence	Social support
Total number of specific things woman thought would help lose pregnancy weight	0·892	−0·007	−0·020	−0·020	0·033
Total number of plans to lose pregnancy weight	0·701	0·162	−0·032	−0·088	−0·040
Total number of plans for keeping track of weight	0·502	0·088	0·137	−0·228	0·021
Total number of weight loss barriers	0·458	−0·339	−0·033	0·330	0·015
Confidence that pregnancy weight will be lost	−0·140	0·746	0·014	−0·038	−0·060
Confidence that diet will be watched	0·251	0·737	0·028	0·064	−0·111
Confidence that will be physically active	0·098	0·687	0·009	0·157	0·155
How much weight expect to lose	−0·051	0·098	0·966	0·022	0·099
How much weight want to lose	0·283	−0·165	0·490	0·055	−0·120
Importance of losing pregnancy weight to spouse	−0·146	0·192	0·030	0·744	−0·123
Total number of sources of information received about losing pregnancy weight	−0·099	−0·018	0·026	0·439	0·167
Spouse will eat the same meals	−0·079	−0·144	0·135	0·049	0·498
Spouse will exercise or join in physical activity	0·078	0·132	−0·032	−0·068	0·378
Spouse will support efforts to lose pregnancy weight	0·110	0·118	−0·123	0·127	0·324
Inter-factor correlations					
Self-regulation	1·000				
Self-efficacy	0·151	1·000			
Outcome expectancy	0·313	0·008	1·000		
Social influence	0·510	0·114	0·044	1·000	
Social support	0·044	0·382	−0·131	−0·020	1·000

Items belonging to the same factor are shaded.

Ethical considerations

Approvals were obtained from university and hospital Institutional Review Boards. Trained research assistants reviewed inpatient medical records for eligibility, contacted prospective participants, explained the study answering questions and obtaining a written consent, collected study data before hospital discharge and conducted the 4- month follow-up telephone survey.

Data analysis

Means, standard deviation, frequency counts and percentages were used to describe the sample. Chi-squared and *t*-tests for independent samples were used for comparison of participants completing surveys postbirth and at 4 months. Path analysis was used to test the model for all participants and by race/ethnicity and weight category.

Results

Participants

A total of 250 women were enrolled in the study and completed the postbirth survey prior to hospital discharge (Table 3). Of those enrolled, 179 completed the follow-up survey at 4 months for a retention rate of 71·6%. Sampling goals for equivalent size sample groups were

not achieved resulting in a sample predominantly consisting of White and African American women. Distribution of normal, overweight and obese women approached equal sample group sizes. The majority of the participants were married or living with the father of the baby and educated beyond the high school level. Comparison of postbirth and 4-month sample groups revealed that women who remained in the study at 4 months were significantly different from women in the postbirth sample in that they were more likely to be older [$t(248) = -4{\cdot}477$, $P < 0{\cdot}001$], married [$\chi^2(1) = 27{\cdot}671$, $P < 0{\cdot}001$] and White [$\chi^2(2) = 36{\cdot}358$, $P < 0{\cdot}001$].

Table 3. Sample characteristics

	Postbirth (*N* = 250)	**4-Months (*N* = 177)**
	Mean (SD)	**Mean (SD)**
Age*	27·18 (6·048)	28·34 (6·021)
	n (%)	*n* (%)
Race/ethnicity*		
White	118 (47·2)	104 (58·8)
African American	108 (43·2)	56 (31·6)
Latina	24 (9·6)	17 (9·6)
Weight		
Normal	93 (37·2)	64 (36·2)
Overweight	71 (28·4)	52 (29·4)
Obese	86 (34·4)	61 (34·5)
Marital status*		
Married or single and living with baby father	185 (74·0)	142 (80·2)
Separated or single not living with baby father	63 (25·2)	34 (19·2)
Education		
Less than high school	30 (12·0)	13 (7·3)
High school graduate	65 (26·0)	36 (20·3)
At least 1 year college	62 (24·8)	48 (27·1)
College graduate	92 (36·8)	79 (44·6)

- *$P < 0{\cdot}001$.

Model testing

Composite scores on each of the five factors (self-regulation, self-efficacy, outcome expectancy, social influence and social support) were created for postbirth and 4- month time

intervals by aggregating item scores. These newly formed composites were used in a path analysis to examine the relationships among the composites. Knowledge scores collected postbirth only and weight retention at 4 months were included in the initial model. The change in BMI from prepregnancy to 4 months postpartum was calculated as an indicator of weight retention.

The theoretical model was retained as conceptualized with two exceptions. First, a preliminary check using bivariate correlations indicated that the knowledge construct was uncorrelated with all other factors and it was dropped from subsequent analyses. Second, a model including all variables (five factors – self-regulation, self-efficacy, outcome expectancy, social influence, and social support postbirth and at 4 months) and weight retention was tested and did not fit well [$\chi^2(2, N = 249) = 8{\cdot}005, P = 0{\cdot}018$; CFI = 0·922; RMSEA = 0·110]. The model that best fit included the variables self-efficacy, outcome expectancy, social influence, social support at 1 month and self-regulation at 1 and 4 months (Figure 1). Four-month self-efficacy, outcome expectancy, social influence and social support weight retention were dropped from further testing. This best-fit model was tested in all further analyses. This model was fit using Mplus 4.2 software (Muthén & Muthén, Los Angeles, CA, USA). Parameter estimates and standard errors were obtained using full information maximum likelihood (FIML) due to the missing data in the sample. FIML has been shown to lead to better estimates of model parameters relative to more traditional methods for handling missing data (Joreskog & Sorbom 1993).

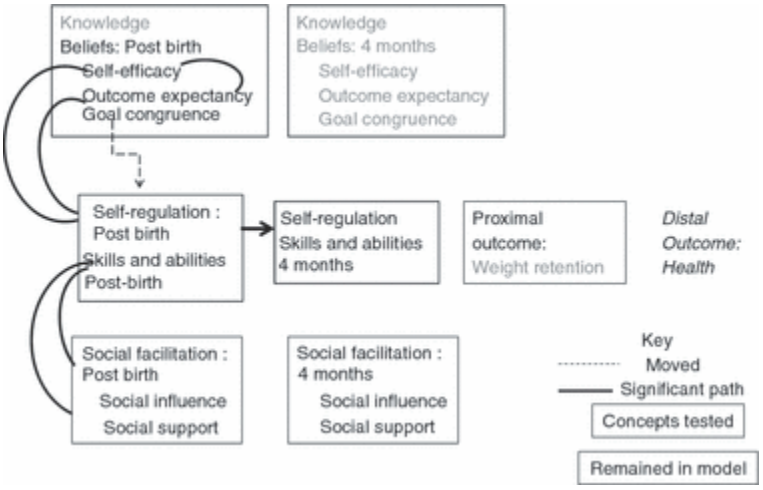

Figure 1 Integrated Theory of Health behaviour Change for postpartum weight management.

The initial model was fit using data from the full sample. The overall fit of the model was adequate and the model explained 25·7% of the variance in postbirth self-regulation and 11·8% of the variance in self-regulation at 4 months. Significant paths were found from postbirth self-regulation to self-regulation at 4 months and from self-efficacy, outcome expectancy and social influence to postbirth self-regulation, and between self-efficacy and outcome expectancy (Figure 2). Model fit statistics and completely standardized path coefficients appear in Table 4.

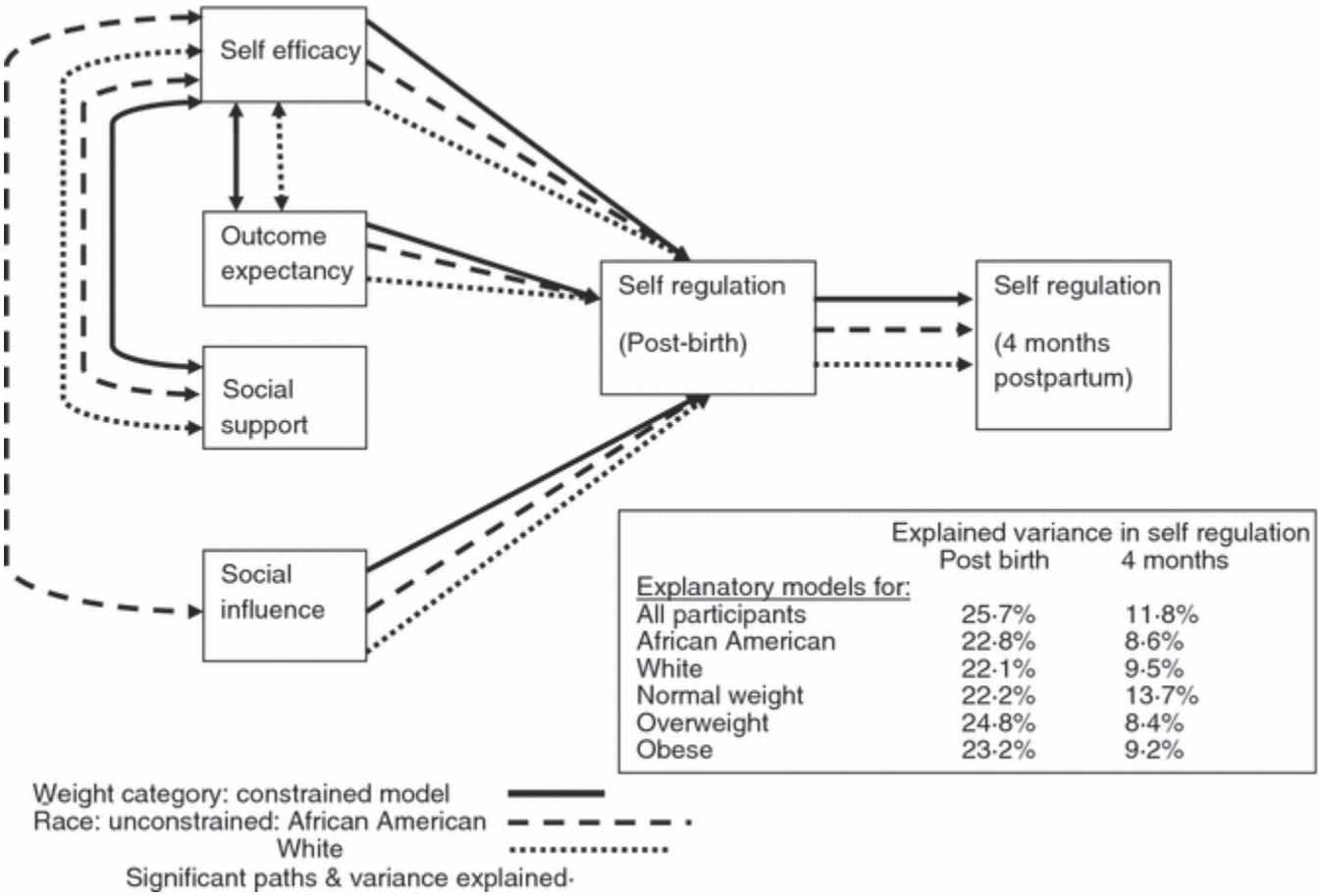

Figure 2 Significant paths and variance explained.

Table 4. Completely standardized path coefficients with standard errors and model fit statistics for all models

Parameters	Overall model	Races constrained	African American	Caucasian	Weight groups constrained
Self-regulation (postbirth)–self-regulation (4 months)	0·271* (0·040)	0·253* (0·042)	0·227* (0·042)	0·255* (0·042)	0·265* (0·043)
Self-efficacy–self-regulation (4 months)	0·039 (0·036)	0·028 (0·038)	0·028 (0·038)	0·029 (0·038)	0·057 (0·038)
Social influence–self-regulation (4 months)	0·136 (0·069)	0·129 (0·071)	0·119 (0·071)	0·124 (0·071)	0·167 (0·066)

Parameters	Overall model	Races constrained	African American	Caucasian	Weight groups constrained
Self-efficacy–self-regulation (postbirth)	0·216* (0·058)	0·194* (0·062)	0·207* (0·062)	0·190* (0·062)	0·228* (0·058)
Outcome expectancy–self-regulation (postbirth l)	0·352* (0·271)	0·312* (0·287)	0·344* (0·289)	0·315* (0·289)	0·221* (0·331)
Social support–self-regulation (postbirth)	0·058 (0·531)	0·075 (0·549)	0·079 (0·550)	0·083 (0·550)	0·076 (0·530)
Social influence–self-regulation (postbirth)	0·218* (0·126)	0·162* (0·134)	0·188* (0·133)	0·174* (0·133)	0·243* (0·123)
Self-efficacy with outcome expectancy	0·139* (0·510)	0·279* (0·458)	−0·049 (0·921)	0·357* (0·559)	0·311* (0·426)
Social influence with social support	−0·051 (0·179)	0·027 (0·173)	0·011 (0·170)	0·015 (0·170)	−0·051 (0·181)
Social influence with self-efficacy	0·106 (1·472)	0·022 (1·317)	0·307* (3·108)	−0·070 (1·440)	0·104 (1·483)
Social influence with outcome expectancy	−0·005 (0·324)	0·021 (0·282)	0·005 (0·288)	0·008 (0·288)	0·027 (0·264)
Social support with self-efficacy	0·209 (0·317)	0·241* (0·306)	0·191* (0·307)	0·258* (0·307)	0·214* (0·313)
Social support with outcome expectancy	0·034 (0·064)	0·021 (0·061)	0·016 (0·061)	0·022 (0·061)	0·147 (0·053)
Goodness-of-fit indices					
Model chi-square	χ^2 = 4·828, d.f. = 2, P = 0·090	χ^2 = 30·838, d.f. = 17, P = 0·021	χ^2 = 19·173, d.f. = 15, P = 0·206		χ^2 = 32·552, d.f. = 32, P = 0·440
CFI	0·965	0·777	0·933		0·992
RMSEA	0·844	0·085	0·050		0·014

- *P < 0·05.

Model testing for race/ethnicity groups and weight categories

To determine if the model differed for women in different race/ethnicity groups and weight categories, multi-group path analyses were run. Specifically, separate initial models were estimated that included equally constrained path coefficients across either the racial/ethnic or weight subgroups and the overall fit assessed (constrained models being determined by theory). If the completely constrained model was found not to give an adequate fit to the data based on the chi-squared goodness-of-fit test, paths were freed one at a time and the chi-square difference test examined to determine which paths varied across groups (freeing paths allows testing not proposed in the original model). A final model was estimated with all paths constrained except for the paths found to vary significantly across groups.

For testing for differences between race/ethnicity subgroups, 118 Caucasian and 107 African American women were included (total of 225 participants). Latina women were not included in this aspect of the analysis due to insufficient numbers. This model did not fit the data well [$\chi^2(17, N = 225) = 30{\cdot}838, P = 0{\cdot}021$; CFI = 0·777; RMSEA = 0·085]. It was found that freeing the path between self-efficacy and outcome expectancy caused a significant improvement in model fit [$\Delta\chi^2(1, N = 225) = 5{\cdot}672, P < 0{\cdot}05$] as did freeing the path between self-efficacy and social influence [$\Delta\chi^2(1, N = 225) = 6{\cdot}395, P < 0{\cdot}05$]. The final model allowed the paths between self-efficacy and outcome expectancy and between self-efficacy and social influence to vary while all other paths were constrained to be equal. Model fit statistics and completely standardized path coefficients for these models appear in Table 4. Of the constrained paths, significant paths were found in the postbirth period for both African American and Caucasian women from postbirth self-regulation to self-regulation at 4 months, and from self-efficacy, outcome expectancy, and social influence to self-regulation and between self-efficacy and social support. Self-efficacy was significantly related to outcome expectancy for the White women, but not for the African American women, and self-efficacy was significantly related to social influence for the African American women but not for the White women. The model explained 22·1% of the variance in postbirth self-regulation and 9·5% of the variance in self-regulation at 4 months for the White women. The model explained 22·8% of the variation in postbirth self-regulation and 8·6% of the variation in self-regulation at 4 months for the African American women (Table 4).

The initial model was also constrained to be equal for women in the three weight category classifications (normal, overweight, and obese). For this analysis, 92 women were included in the normal weight category, 71 in the overweight category and 86 in the obese category. The model fit well [$\chi^2(32, N = 249) = 32{\cdot}552, P = 0{\cdot}440$; CFI = 0·992; RMSEA = 0·014]. Therefore, the standardized path coefficients and model fit statistics for the constrained model appear in Table 4. The significant paths in this model were from postbirth self-regulation to self-regulation at 4 months and paths in the postbirth period from self-efficacy, outcome expectancy, and social influence to self-regulation, between self-efficacy and outcome expectancy, and between self-efficacy and social support. The model accounted for 22·2% of the variance in postbirth self-regulation and 13·7% of the variance in self-regulation at 4 months for the women in the normal weight category. For the women in the overweight category, the model accounted for 24·8% of the variance in postbirth self-regulation and 8·4% of the variance in self-regulation at 4 months. The model accounted for 23·2% of the

variance in postbirth self-regulation and 9·2% of the variance in self-regulation at 4 months for the women in the obese category (Table 4).

Discussion

This study has a number of limitations. As no existing instrument was identified that could measure the study constructs for postpartum weight management, a theoretically based survey was developed. The survey was designed to obtain the range of types of behaviours used rather than frequency of use. The study was designed to obtain an equal number of African American, White, and Latina women. Recruitment of Latina women who spoke and read English proved to be more difficult than anticipated and use of translators and translation of research material into Spanish was beyond the scope of the project. Attrition was 28% at 4 months postpartum with significant differences in select socio-demographic characteristics between the women participating at postbirth and 4 months. The generalizability of the results is limited to participants recruited from two Midwest hospitals who were discharged after essentially normal birth with healthy newborns. The postbirth weight self-management experiences of women in different geographical areas, with high-risk birth, or less positive newborn outcomes may be significantly different. ITHBC postpartum weight self-management concepts were not associated with weight retention as an outcome in this analysis. Further instrument development is needed to extend model testing to discover the relationships between self-management behaviours and weight change outcomes. Engagement in postpartum weight self-management behaviours may also have positive health implications not measured in this study.

Although it has been known for years that pregnancy and childbirth are associated with a change in body size, shape and weight, the importance of the postpartum period as a life event should be recognized as a unique opportunity for initiation of weight self-management health behaviours. This preliminary study illuminates a perspective on postpartum weight that extends the conceptualization of losing weight after childbirth from an expected physiological phenomenon to a process that requires active engagement and management. Use of the ITHBC to frame weight self-management in the context of health behaviour self-management is helpful in understanding women's health behaviours and partnerships with nurses and other health professionals.

Measurement of postpartum knowledge and beliefs, self-regulation skills and abilities, and social facilitation related to postpartum weight self-management using multiple single item questions mirror the clinical realities of patient–provider encounters. The ITHBC provided the foundation for development of the survey and in this study, survey items came together on the constructs outlined by the theory. Theory-based assessment and measurement tools have concurrent utility for both clinical practice and research.

The concepts of the ITHBC were evident in the factors that emerged from the exploratory factor analyses with the exception of weight self-management knowledge, which was not supported. While there is strong evidence that knowledge, in and of itself, does not result in health behaviour change (IOM 2002, 2001, Wofford *et al.* 2007), it is counterintuitive to assume that people can effectively make changes in their health behaviours without factual

information. Information about the benefits of weight self-management is so compelling that it seems logical that this knowledge would influence a person's behaviour; but, this assumption was not supported. Why is it that weight self-management knowledge was not one of the concepts included in the factors influencing behaviour? Perhaps the type of knowledge people need to change health behaviours differs from factual information commonly used to educate people about a condition. Perhaps standardized information needs to become patient-centred, that is congruent with a person's values and goals, pragmatic to their lifestyle and action-oriented so that it is easily translated into their lifestyle.

The study-provided evidence for the model differed between White and African American women, but not for women of different weight classifications. There is support for the impact of a race on health behaviour change. Patient compliance studies conducted in the 1950s and early 1960s focused on socio-demographic factors such as age, education and race as determinants of health behaviour. Repeated evaluations of the impact of socio-demographic characteristics on compliance resulted in negative or equivocal results (Haynes *et al.* 1979). Probably, the impact of socio-demographic characteristics is more complex than originally suspected. This study provides evidence that beliefs and processes differ across race, supporting the need for additional research and offering a potential explanation for effectiveness of patient-centred interventions. It is also likely that there will be differences in the way the model works for other health behaviours, conditions and venues – highlighting the necessity of testing the model in different populations, behaviours and settings.

It was interesting to note that social support was related to self-efficacy, but not to self-regulation. Self-efficacy was related to social influence for African American women, but not White women. And self-efficacy was related to outcomes expectations for White women, but not African American women. While these findings are preliminary, there are potential implications for the development of interventions. For example, interventions designed to enhance self-efficacy need to include, or at least address, the importance of social support, particularly for African American women. Targeting interventions specific to the culture-specific context of women's lives in the postpartum period could increase the impact of the intervention.

The concept of goal congruence is unique to the ITHBC. Initially, goal congruence was conceptualized as a health belief; however, the results of these analyses support goal congruence as a self-regulation concept. The year following the birth of a child is characterized by multiple competing priorities for a woman's time and attention. Some participants actively engage in managing their weight in the face of multiple competing demands. Hence, goal congruence may not be a belief, but rather an ability critical to or gained while learning to self-regulate.

This preliminary work provides support for the continuing need to develop and test interventions to enhance weight self-management during the interconceptional period. It is anticipated that person-centred interventions designed to enhance knowledge and beliefs, self-regulation skills and abilities, and social facilitation will further increase the amount of variance explained by this theory and enhancement of health beliefs, self-regulation, and social encounters will result in changes to the proximal outcome – loss of retained weight.

Conclusions

The postpartum period presents a unique opportunity for women to initiate weight self-management health behaviour, with the potential for impacting the progression towards obesity.

Nurses and other healthcare professionals should include weight self-management assessment and support as components of regular follow-up care. Teaching alone will not enable women to engage successfully in weight self-management; rather, enhancing self-regulation skills and abilities and improving social facilitation is needed.

Weight self-management after childbirth is a complex phenomenon requiring active engagement and management similar in some aspects for White and African American women and different in other aspects. The ITHBC, a new theory, is helpful in framing and understanding weight self-management in the context of health behaviour self-management.

Reversing obesity trends is a global health priority. Continuing research is needed to refine measurement tools and to design and test theoretically based interventions. The ITHBC holds promise for guiding the design of intervention protocols for future research into postpartum weight management and other health behaviours.

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Conflict of interest

No conflict of interest has been declared by the authors.

Author contributions

PR and MW were responsible for the study conception and design. MW performed the data collection. PR, MW and NT performed the data analysis, made critical revisions to the paper for important intellectual content. PR was responsible for the drafting of the manuscript, provided administrative, technical or material support, and supervised the study. MB provided statistical expertise.

References

1 Abrams B. (1993) Prenatal weight gain and postpartum weight retention: a delicate balance. *American Journal of Public Health* 83, 1082–1084.

2 Beazley J.M. & Swinhoe J.R. (1979) Body weight in parous women: is there any alteration between successive pregnancies? *Acta Obstetricia et Gynecologica Scandinavica* 58(1), 45–47.
3 Boyington J., Johnson A. & Carter-Edwards L. (2007) Dissatisfaction with body size among low-income, postpartum black women. *Journal of Obstetric, Gynecologic, and Neonatal Nursing* 36(2), 144–151.
4 Carcieri D. (2007) Obesity in women: an overview of its risks and responses to interventions. *OBG Management* 19(4 Suppl.), S3–S7.
5 Centers for Disease Control and Prevention (2009) About BMI for Adults. Retrieved from http://www.cdc.gov/healthyweight/assessing/bmi/adultbmi/index.html on April 2009.
6 Fawcett J. (2005) Criteria for evaluation of theory. *Nursing Science Quarterly* 18(2), 131–135.
7 Fowles E.R. & Walker L.O. (2006) Correlates of dietary quality and weight retention in postpartum women. *Journal of Community Health Nursing* 23(3), 183–187.
8 Gennaro S. & Fehder W. (2000) Health behaviors in postpartum women. *Family and Community Health* 22(4), 16–26.
9 Gore S.A., Brown D.M. & West D.S. (2003) The role of postpartum weight retention in obesity among women: a review of the evidence. *Annals of Behavioral Medicine* 26, 149–159.
10 Gorsuch R.L. (1983) Factor Analysis, 2nd edn. Lawrence Erlbaum Associates, Hillsdale, NJ.
11 Gunderson E.P., Abrams B. & Selvin S. (2000) The relative importance of gestational gain and maternal characteristics associated with the risk of becoming overweight after pregnancy. *International Journal of Obesity Related Metabolic Disorders* 24(12), 1660–1668.
12 Gunderson E.P., Abrams B. & Selvin S. (2001) Does the pattern of postpartum weight change differ according to pregavid body size? *International Journal of Obesity* 21, 853–862.
13 Gunderson E.P., Jacobs D.R., Chiang V., Lewis C., Tsai A., Quesenberry C.P. & Sidney S. (2009) Childbearing is associated with higher incidence of the metabolic syndrome among women of reproductive age controlling for measurements before pregnancy: the 'CARDIA' study. *American Journal of Obstetrics & Gynecology* 201(177), 1–9.
14 Haynes B., Taylor D.W. & Sackett D.L. (1979) Compliance in Health Care. Johns Hopkins University Press, Baltimore, MD.
15 Im E.-O. & Meleis A.I. (1999) Situation specific theories: philosophical roots, properties, and approaches. *Advances in Nursing Science* 22(2), 11–24.
16 Institute of Medicine (IOM): Committee on Communication for Behavior Change in the 21st Century: Improving the Health of Diverse Populations (2002) Speaking of Health: Assessing Health Communication Strategies for Diverse Populations. National Academy Press, Washington, DC.
17 Institute of Medicine (IOM): Committee on Health and Behavior: Research, Practice, and Policy Board on Neuroscience and Behavioral Health (2001) Health and Behavior: The

Interplay of Biological, Behavioral, and Social Influences. National Academy Press, Washington, DC.
18 Jeffery R.W., Drewnowski A., Epstein L., Stunkard A.J., Wilson G.T., Wing R.R. & Hill D.R. (2000) Long-term maintenance of weight loss: current status. *Health Psychology* 19(1), 5–16.
19 Joreskog K.G. & Sorbom D.L. (1993) PRELIS 2. User's Reference Guide. Scientific Software International, Chicago, IL.
20 Kac G., Benício M.H.D.A., Valentine J.G. & Velásquez-Meléndez G. (2003) Postpartum weight retention among women in Rio de Janeiro: a follow up study. *Cadernos de Saúde Pública, Rio de Janeiro* 19(Suppl.1), S149–S161.
21 Kac G., Benício M.H.D.A., Velásquez-Meléndez K.G. & Valentine J.G. (2004a) Nine months postpartum weight retention predictors for Brazilian women. *The Journal of Nutrition* 7(5), 621–628.
22 Kac G., Benício M.H.D.A., Velásquez-Meléndez G., Valentine J.G. & Struchiner C.J. (2004b) Gestational weight gain and prepregnancy weight influence postpartum weight retention in a cohort of Brazilian women. *American Society for Nutritional Science* 134, 661–666.
23 Kaiser H.F. (1960) The application of electronic computers to factor analysis. *Educational and Psychological Measurement* 20(1), 141–151.
24 Keller C., Records K., Ainsworth B., Permana P. & Coonrod D.V. (2008) Interventions for weight management in postpartum women. *Journal of Obstetric, Gynecologic, and Neonatal Nursing* 37, 71–79.
25 Keppel K.G. & Taffel S.M. (1993) Pregnancy-related weight gain and retention: implications of the 1990 Institute of Medicine Guidelines. *American Journal of Public Health* 83(8), 1100–1103.
26 Kline R.B. (1998) Principles and Practice of Structural Equation Modeling. The Guilford Press, New York.
27 Krummel D.A. (2007) Postpartum weight control: a vicious cycle. *Journal of the American Dietetic Association* 107(1), 37–39.
28 Krummel D.A., Semmens E., Boury J., Gordon P.M. & Larkin K.T. (2004) Stages of change for weight management in postpartum women. *The Journal of the American Dietetic Association* 104, 1102–1108.
29 Linne Y., Dye L., Barkeling B. & Rossner S. (2004) Long-term weight development in women: a 15-year follow-up of the effects of pregnancy. *Obesity Research* 12(7), 1166–1179.
30 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, Twain. *British Journal of Nutrition*. Retrieved from http://www.scopus.com on November 2009.
31 McQuiston C.M. & Campbell J.C. (1997) Theoretical substruction: a guide for theory testing research. *Nursing Science Quarterly* 10(3), 117–123.
32 Muenning P., Lubetkin E., Jia J. & Franks P. (2006) Gender and the burden of disease attributable to obesity. *American Journal of Public Health* 96(9), 1662–1668.

33 National Research Council and Institute of Medicine (2007) Influence of Pregnancy Weight on Maternal and Child Health. Workshop Report. Committee on the Impact of Pregnancy Weight on Maternal and Child Health. Board on Children, Youth, and Families, Division of Behavioral and Social Sciences and Education and Food and Nutrition Board, Institute of Medicine. The National Academies Press, Washington, DC.
34 Nawaz H. & Katz D.L. (2001) Weight management counseling of overweight adults. *American Journal of Preventive Medicine* 21(1), 73–78.
35 NIH; Obesity Research Task Force (2004) Strategic Plan for NIH Obesity Research. US. Department of Health and Human Services, Bethesda, MD.
36 Öhlin A. & Rossner S. (1994) Trends in eating patterns, physical activity and socio-demographic factors in relation to postpartum body weight development. *British Journal of Nutrition* 71, 457–470.
37 O'Toole M.L., Sawicki M.A. & Artal R. (2003) Structured diet and physical activity prevent postpartum weight retention. *Journal of Women's Health* 12(10), 991–998.
38 Parker J.D. & Abrams B. (1993) Differences in postpartum weight retention between black and white mothers. *Obstetrics and Gynecology* 81(5), 768–774.
39 Raven G.M. (2003) Importance of identifying the overweight patient who will benefit the most by losing weight. *Annals of Internal Medicine* 138, 20–423.
40 Rooney B.L., Schauberger C.W. & Mathiason M.A. (2005) Impact of perinatal weight change on long-term obesity and obesity-related illnesses. *Obstetrics & Gynecology* 106(6), 1349–1356.
41 Ryan P. (2009) Integrated Theory of Health Behavior Change: background and intervention development. *Clinical Nurse Specialist, The Journal for Advanced Nursing Practice* 23(3), 161–170.
42 Ryan P. & Sawin K. (2009) The Individual and Family Self-management Theory: background and perspectives on context, process and outcomes. *Nursing Outlook* 57, 217–225.
43 Schmitt N., Nicholson W. & Schmitt J. (2007) The association of pregnancy and the development of obesity – results of a systematic review and meta-analysis on the natural history of postpartum weight retention. *International Journal of Obesity* 31(11), 1642–1651.
44 Siega-Riz A.M., Evenson K.R.. & Dole N. (2004) Pregnancy-related weight gain – a link to obesity? *Nutrition Review* 11, S105–S111.
45 To W.W.K. & Cheung W. (1998) The relationship between weight gain in pregnancy, birth-weight and postpartum weight retention. *Australia & New Zealand Journal of Obstetrics and Gynecology* 38(2), 176–179.
46 Viswanathan M., Siega-Riz A.M., Moos M.-K., Deierlein A., Mumford S., Knaack J., Thieda P., Lux L.J. & Lohr K.N. (2008) Outcomes of Maternal Weight Gain, Evidence Report/Technology. Assessment No. 168. (Prepared by RTI International-University of North Carolina Evidence-based Practice Center under Contract No. 290-02-0016.) AHRQ Publication No. 08-E009. Agency for Healthcare Research and Quality, Rockville, MD.

47 Walker L.O., Sterling B.S. & Timmerman G.M. (2005) Retention of pregnancy-related weight in the early postpartum period: implications for Women's Health Services. *Journal of Obstetric, Gynecological, & Neonatal Nursing* 34, 418–427.
48 Williamson D.F., Madams J., Pamuk E., Flegal K.M., Kendrick J.S. & Serdula M.K. (1994) A prospective study of childbearing and 10-year weight gain in U.S. white women 25 to 45 years of age. *International Journal of Obesity Related Metabolic Disorders* 18(8), 561–569.
49 Wisconsin Department of Health Services (2007) Wisconsin Births and Infant Deaths 2007. Wisconsin Department of Health Services, Madison, WI.
50 Wofford T.S., Greenlund K.J., Croft J.B. & Labarthe D. (2007) Diet and physical activity of U.S. adults with heart disease following preventive advice. *Preventive Medicine* 45(4), 295–301.