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Predictors of Engagement in Postpartum Weight Self-Management Behaviours in The First 12 Weeks After Birth

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Abstract
Aim: To explore factors that influence postpartum weight self-management behaviours. Transitions Theory and the Integrated Theory of Health Behaviour Change guided selection of variables. Transition conditions, level of patient activation and social facilitation were examined for association with postpartum weight self-management behaviours.
Background: Retention of pregnancy weight increases risk of overweight and obesity later in life. Little is known about what women do to self-manage return to pre-pregnant weight and how providers can influence their behaviours.

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Design: Prospective, longitudinal, correlational.
Methods: Data collection occurred from March through October, 2013. One hundred and twenty-four women completed surveys during postpartum hospitalization; telephone interviews were completed by 91 women at 6 weeks and 66 women at 12 weeks. Standard and hierarchical multiple regression methods were used for analyses.
Results: Transition difficulty was negatively associated with patient activation and immediate postbirth patient activation was positively associated with eating behaviours at 6 weeks, eating behaviours at 12 weeks and physical activity at 12 weeks. Social support and social influence were not significant predictors in the regression models.
Conclusion: Patients experiencing a difficult postpartum transition have lower activation levels; those less activated are less probably to engage in weight self-management behaviours in the 12 weeks following their baby's birth. Patient activation level should be considered in tailoring promotion of healthy postpartum weight management.
Why is this research needed?

- Little is known about the process of postpartum weight self-management and what providers can do to influence that process.
- Current postpartum care models do not prioritize promotion of weight self-management among postpartum women.
- Women who do not return to pre-pregnancy weight within the postpartum year are at risk for overweight and obesity later in life.

What are the key findings?

- Women who are experiencing a difficult postpartum transition are likely to be less activated for postpartum weight self-management.
- Women with higher patient activation for postpartum weight self-management are more likely to engage in postpartum weight self-management behaviours.
- Perinatal providers and postpartum nurses are as influential as those in women's social circles over health behaviour decisions.

How should the findings be used to influence policy/practice/research/education?

- Providers and nurses caring for postpartum women should intentionally engage each woman in planning for postpartum weight self-management behaviours by using interventions targeted to her activation level.
- The frequent contacts with women during the childbearing process should be seen as a window of opportunity in which promotion of healthy weight-related behaviours is a priority of care.

Introduction

Nurses and other perinatal providers have an opportunity to prioritize promotion of healthy weight among childbearing women, thus contributing to the goal of improving weight and health status of populations (World Health Organization [WHO] 2013). There is a growing body of evidence that behaviour based interventions

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facilitated by providers are effective in reducing weight among adults (LeBlanc *et al*. 2011). Women have frequent encounters with their healthcare providers during the perinatal period, offering the opportunity to develop a trusting relationship (Ostbye *et al*. 2008, Phelan 2010).

There is a dearth of evidence regarding strategies that nurses and other providers can use to support the weight self-management efforts of women attempting to lose weight gained during pregnancy. In prior research studies, women participated in a structured weight management program designed by a researcher or provider (Currie & Develin 2001, Kinnunen *et al*. 2007, Maturi *et al*. 2011, Colleran & Lovelady 2012, Cahill *et al*. 2013, Wiltheiss *et al*. 2013). None have examined strategies women use on their own or ways providers can promote those strategies and none have studied characteristics that can be assessed to identify which women are likely to lose pregnancy weight on their own and which are more likely to benefit from provider influence. This study examines patient activation as a characteristic that may identify the level of self-management guidance a woman might need.

Background

Healthy weight is a priority for nurses and other healthcare providers worldwide. Prevalence of overweight among adult females ranges from 65-80% and obesity prevalence is between 35-50% (WHO 2011). Women exceeding normal weight parameters are at higher risk for chronic health problems, reproductive health concerns and perinatal risks for mothers and babies (Manson *et al*. 2004, Arendas *et al*. 2008, Ferraro *et al*. 2012).

Dramatic physical and psychosocial changes, including changes in body weight and body composition, are normative as a result of pregnancy and the postpartum recovery (O'Reilly 2004, George 2005). As women navigate the postpartum transition, they are faced with new facilitators and barriers for weight management in their new or expanded motherhood role (Meleis *et al*. 2000, Montgomery *et al*. 2011). There is a rapid decline in weight in the 3 months postbirth, followed by a slower decline of weight in the remaining 9 months of the postpartum year (Schmitt *et al*. 2007). On average, women retain

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6-9 pounds after the postpartum year and 25% of women retain more than 10 pounds after 6 months (Gunderson *et al*. 2008, Shrewsbury *et al*. 2009).

There are lifelong consequences for women who retain pregnancy weight past the postpartum year, including higher risk for overweight or obesity in future pregnancies and well past the childbearing years (Schmitt *et al*. 2007, Amorim Adegboye & Linne 2013). The risks extend to the next generation because the woman's pre-pregnancy weight, gestational weight gain and gestational dietary quality all have effects on her offspring's health and weight status over the lifespan (Aviram *et al*. 2011, Parsons *et al*. 2013, Symonds *et al*. 2013). Researchers and nurse providers must have a framework within which to promote postpartum weight self-management (PPWSM) behaviours, so they can use this window of opportunity to influence lifespan health.

Theoretical framework

Transitions Theory (Meleis *et al*. 2000) and the Integrated Theory of Health Behaviour Change (Ryan 2009) provide salient concepts for examining PPWSM promotion.

Transitions theory

Transitions Theory (Meleis *et al*. 2000) is relevant to the developmental transition of postpartum adaptation (O'Reilly 2004). This study's theoretical model includes several personal factors that represent transition conditions relevant to the process of PPWSM: parity, SES, type of birth, transition difficulty and pre-pregnancy Body Mass Index (BMI). In this study, PPWSM behaviours (healthy dietary behaviours and physical activity) represent the patterns of response construct from Transitions Theory.

Integrated theory of health behaviour change (ITHBC)

The ITHBC (Ryan 2009) purports that health behaviour change is a self-driven, dynamic, iterative process with three model constructs: (a) condition-specific knowledge and beliefs, (b) self-regulation and (c) social facilitation that, together, predict the proximal

outcome (necessary/desired health behaviours) and distal outcomes (improved health status). The ITHBC has been tested for PPWSM previously (Ryan *et al*. 2011).

Condition-specific beliefs

Condition-specific beliefs are the perceptions held about a desired or necessary health behaviour (Ryan 2009). In this construct, the concepts of knowledge and beliefs are linked to three concepts: behaviour-specific self-efficacy, outcome expectancy and goal congruence.

Patient activation (PA) refers to a person's tendency to actively participate in the management of his or her health conditions (Hibbard *et al*. 2004, 2005). The Patient Activation Measure, short form (mPAM-13) is comprised of similar concepts to the ITHBC's condition-specific knowledge and beliefs, with items on the mPAM-13 that assess 'knowledge (e.g. I know what kinds of things I can do to lose my pregnancy weight), self-efficacy (e.g. I am confident I can follow through on weight loss advice I received when I am at home), outcome expectancy (e.g. Taking an active role in my own weight management is the most important factor in determining my health and ability to function) and goal congruence (e.g. I have been able to maintain lifestyle changes for my weight that I have made). The mPAM-13 was the empirical referent for the ITHBC's condition-specific knowledge and beliefs in this study.

Patients with higher levels of PA are more likely to make positive changes in health self-management behaviours, including physical activity, stress management, monitoring dietary fat, maintaining recommended weight, goal-setting, problem-solving, asking healthcare providers about medication side effects, and performing disease-specific management for diabetes and arthritis (Hibbard *et al*. 2007, Skolasky *et al*. 2011, Wolever *et al*. 2011).

Social facilitation. Social influence (SI) and social support (SS) are types of social facilitation (Ryan 2009). SI refers to the idea that the expectations of those surrounding a woman have an influence over her level of engagement in self-management behaviours (Ryan *et al*. 2011). SI has been identified as a component of health behaviour

change in many populations and in relation to several desirable behaviours, including weight loss in overweight and obese young adults (Leahey *et al*. 2011), fruit and vegetable intake and physical activity engagement in adults (Emmons *et al*. 2007, Gabriele *et al*. 2005) and physical activity among midlife women (Lee & Im 2010).

SI can be exerted by multiple sources, including family, friends/peers, spouse, social networks and a sense of 'social norms' (van den Putte *et al*. 1989, Emmons *et al*. 2007, Bahr *et al*. 2009, Ashida *et al*. 2010, Im *et al*. 2010). Few studies have examined the role that providers could play as social influencers to promote adoption of a particular health behaviour.

In the ITHBC, social support (SS) is defined as 'instrumental, emotional or informational support which facilitates engagement in a health behaviour' (Ryan 2009, p. 6). Social support is an important facilitator of health behaviour change, particularly for women (Thrasher *et al*. 2004, Wolfe 2004, Thornton *et al*. 2006, Costanzo & Noble Walker 2008). In Ryan *et al*.'s (2011) study, SS was positively associated with PPWSM indirectly, through self-efficacy.

Integrated theoretical model

The model for this study includes concepts from these theories that are complementary; yet each offers a unique contribution. Transitions theory provides the context where women are changing behaviour and the ITHBC contributes process concepts and the proximal outcome necessary to explain the PPWSM process. The expected relationship between the theoretical concepts and the empirical measures is represented in Figure 1.

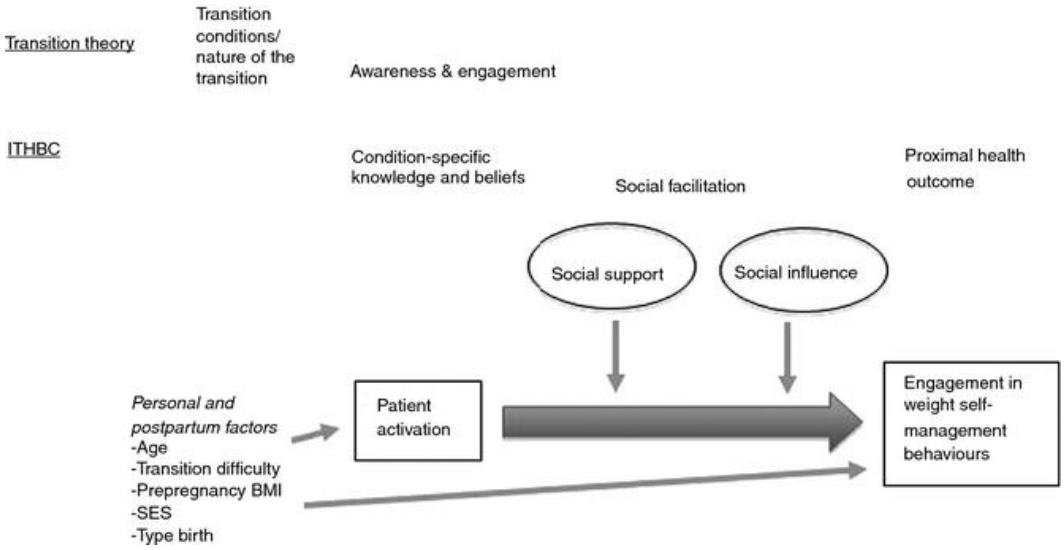

Figure 1. Proposed relationship between study variables.

The study

Aims

The first aim was to explore the processes of postpartum weight self-management by examining associations between transition conditions, patient activation, social support and social influence on engagement in PPWSM behaviours (eating and physical activity). Specific research questions (RQ) to address this aim were: (RQ1): Which transition conditions are associated with patient activation for PPWSM?; (RQ2) Which transition conditions have a direct association with engagement in PPWSM behaviours at 6 and 12 weeks after the birth of a baby?; (RQ3) What is the relationship between patient activation and engagement in PPWSM behaviours 6 and 12 weeks after the birth of a baby?; and (RQ4) Does social facilitation (social support and social influence) moderate the relationship between patient activation and engagement in PPWSM behaviours at 6 and 12 weeks after the birth of a baby?

The second aim was to examine the role providers and other social influencers play in promoting engagement in PPWSM behaviours. RQ5 addressed this aim: Who do women identify as significant sources of social influence on engagement in PPWSM behaviours?

Design

The study used a prospective, longitudinal and correlational design. Participants completed an enrolment survey during the postpartum hospitalization and were contacted by telephone at 6 and 12 weeks postpartum for completion of follow-up surveys. The 6-week contact was selected as the time when women are considered to be physically healed after a birth (Lowdermilk *et al*. 2011). The 12-week contact was selected as a point at which gestational weight loss would not be complete, but regular engagement in weight self-management activities would allow the woman to return to pre-pregnancy weight by 6 months postbirth – a time point associated with weight retention at 1 year and with long-term overweight risk (Linne & Rossner 2003, Rooney *et al*. 2005).

Sample/participants

The sample was recruited from women hospitalized after the birth of their baby at three tertiary perinatal centres, with approximately 3500 births, 3000 births and 1750 births annually. In a convenience sampling approach, all women at the study sites on selected data collection days, typically three times per week, were approached if they met the inclusion criteria: (1) at least 24 hours postdelivery of a live born infant; (2) at least 18 years old; (3) neither mother nor newborn experienced complications expected to prevent discharge together in 5 days postpartum; (4) had telephone access and an address for follow-up and (5) spoke and read English with self-report of sufficient fluency to complete consent and surveys.

Women whose pre-pregnancy BMI was underweight (below 18·5) were excluded to prevent potential adverse outcomes if they interpreted PPWSM questions as suggesting that they lose an unhealthy amount of weight. BMI category was calculated based on pre-pregnancy height and weight from prenatal records (or participant self-report if the prenatal record was not available in the inpatient medical record) using the Centers for Disease Control and Prevention Calculator (CDC 2011a).

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Ad hoc power analyses were performed using G*Power software, version 3·1 (Erdfelder *et al*. 1996), for the planned regression analyses with five predictor variables, effect size = 0·15, 80% power and *P* = 0·05, resulting in a required sample size of 92. Previous research with this population in one of the centres used for this study yielded a 35% loss to follow-up rate (Ohlendorf 2012). An oversampling of 35% resulted in an enrolment target of 124 women.

Data collection

Data collection occurred between March and October, 2013. The principal investigator (JO) reviewed inpatient records to identify eligible patients, described the study to potential participants and obtained informed consent. At this time, an interview was conducted to complete the demographic questionnaire, the modified Transition Difficulty Scale (mTDS), the modified Patient Activation Measure (mPAM-13) and the Social Influence Questionnaire (SIQ). A telephone interview was conducted with each woman at 6 and 12 weeks postpartum and the following instruments were completed: (1) mTDS; (2) mPAM-13; (3) the eating styles questionnaire (ESQ); (4) the Stanford Patient Education Research Center Exercise Behaviours Scale (SEBS). The Postpartum Support Questionnaire (PSQ) was completed by phone during the 6-week phone interview only. Women were provided with a $5 gift card to a local discount store after the 6-week call was completed and a $10 gift card after the 12-week call was completed.

Parity, socioeconomic status (SES), type of birth (vaginal or cesarean), transition difficulty and pre-pregnancy BMI were selected as relevant transition conditions. Parity was recorded as number of children, including the current birth. SES was calculated using the Hollingshead Four-Factor Index of Social Status, which incorporates education and occupation of both parents (Hollingshead 1975). Updated occupation categories were used in the calculation (Davis *et al*. 1991).

Ethical considerations

Prior to data collection, IRB approval was obtained from university and study sites.

Data analysis

For RQ1 (Which transition conditions are associated with patient activation for PPWSM?), the five transition condition measures were then entered as predictor variables and patient activation as the outcome variable. Separate multiple regression models were computed to determine association with patient activation at each of the three study time points.

Hierarchical multiple regression analyses were used to test the sequence of relationships of study predictor variables with eating and physical activity behaviours. Specifically, transition conditions (SES, type of birth, parity, pre-pregnancy BMI, transition difficulty) were entered in step 1 (RQ2). The immediate postbirth patient activation score was entered in step 2 (RQ3). A 2 step process was used to test the moderating influence of SI and SS (RQ4). The total SI and the SS difference score were entered in step 3 and the interaction terms between PA and SI and between PA and SS were entered in step 4. Four separate hierarchical regression models were computed to determine predictors of eating and physical activity behaviours at 6 and 12 weeks.

RQ5 (Who do women identify as significant sources of social influence on engagement in PPWSM behaviours?) was analysed using one-way repeated measures anova. Social influence scores for each potential influencer (significant other, mother, friends, pre-natal provider and hospital nurses) were entered as the explanatory variables.

Validity and reliability

Modified Transition Difficulty Scale

The mTDS (Steffensmeier 1982) is a 31-item 8-point scale (0-7) with an additional five-question subscale added by Gosch Twiss (1989) with a 5-point (1-5) scale. The range of potential scores is 5-249, with higher scores indicating a greater difficulty with transition to motherhood. A Cronbach's alpha coefficient of 0·90 was previously reported (Gosch Twiss 1989). Cronbach's alpha reliability estimate for this study was 0·84 at enrolment, 0·83 at 6 weeks and 0·88 at 12 weeks.

Patient Activation Measure, short form

The PAM-13 (Hibbard *et al*. 2005) was developed to assess patients' tendency to actively participate in the management of their health conditions. The tool's wording was modified with permission to apply to PPWSM. The 13-item, 5-point (1-5) scale is summed and then converted to a scale-level activation score; higher scores indicate higher tendency to actively manage one's health condition. The reliability when tested in a general population sample was α = 0·81 (Hibbard *et al*. 2005). The Cronbach's alpha coefficients for this study were 0·82 at enrolment, 0·86 at 6 weeks and 0·85 at 12 weeks.

Social influence questionnaire

The SIQ assesses beliefs of people in the participant's life regarding the desired behaviour and how influential the participant perceives those people to be over health decisions (Champion 1994). The sum for each person's beliefs that the health behaviour is important, is multiplied by the participants' rating of how influential that person is over their health behaviours. The scale range for the entire scale is 0-875 and each influencer's score can range from 0-125. Higher scores indicate stronger social influence for adopting the health behaviour. For this study, two providers (doctor/midwife and hospital nurses) were included as potential influencers. The other influencers included were: spouse/partner, mother, friends, media influences and online social circles. The internal consistency reliability

when tested on women's mammogram compliance was α = 0·83. Cronbach's alpha for the scale was 0·84 in this sample.

Postpartum support questionnaire

The postpartum support questionnaire (PSQ) is a 34-item questionnaire that measures social support (SS) that a woman reports needing and receiving after the birth of a baby (Logsdon 2002). Higher difference scores indicate a larger gap (SS gap) between the woman's needed support and the support she received since the birth of her baby. Cronbach's alphas of 0·90-0·94 and test-retest reliability of 0·69-0·79 have been previously reported (Logsdon *et al*. 1996). For this study, Cronbach's alpha for the support needed score was 0·94 and for the support received score was 0·92.

Eating Styles Questionnaire

The ESQ (Hargreaves *et al*. 2003) is a 16-question, 5-point (1-5) survey instrument that measures low-fat diet behaviours. Higher scores indicate lower dietary fat intake. Cronbach's alpha was reported at 0·90 in the general population. Validity was supported via correlation with actual fat intake and was −0·65 (Hargreaves *et al*. 2003). Cronbach's alpha for this sample was 0·88 at 6 weeks and 0·89 at 12 weeks.

Stanford patient education research center exercise behaviours scale

This 6-question survey yields a total number of self-reported minutes of physical activity in the week preceding the survey, including stretching, strength exercises, walking, bicycling, swimming, exercise machine use and 'other aerobic activity' (Lorig *et al*. 1996). Test-retest reliability for aerobic exercise was 0·72 in previous research among adults in the general population (Lorig *et al*. 1996).

Results

On enrolment, the diverse patient population at the three recruitment sites was reflected in the enrolled sample of 124 women (38·4% Caucasian, 36·8% African American, 14·4% Latina, 5·6%

Asian and 4·0% other). The sample had a mean age of 29·0 (sd 5·3), was mostly multiparous (*n* = 85, 68·0%), married or living with a partner (*n* = 97, 78·2%) and had at least partial college education (*n* = 97, 78·2%). Participants' pre-pregnancy BMIs were distributed across all 3 categories (39·2% normal weight, 23·2% overweight and 36·8% obese). Table 1 contains a listing of sample demographics at the three time points.

Table 1. Descriptive statistics of study variables and other sample descriptors

	Post-birth	**6 weeks**	**12 weeks**
Number of participants	124	91	66
Transition conditions			
Parity; M (%)			
Primiparous	39 (31·2)	29 (31·5)	21 (31·8)
Number of children	2·52	2·63	2·65
Hollingshead index; M (sd)*	37·3 (16·9)	38·7 (16·8)	40·1 (17·3)
Type of Birth; *n* (%)			
Vaginal	84 (67·2)	64 (70·3)	47 (71·2)
Cesarean	40 (32·0)	27 (29·7)	19 (28·8)
Transition difficulty; M (sd)	124·10 (30·81)	132·64 (31·62)	129·98 (33·06)
Pre-pregnancy BMI; M (sd)	28·67 (7·9)	28·6 (8·2)	28·1 (8·2)
Sample descriptors			
Level of education; *n* (%)			
Partial high school or less	9 (7·2)	6 (6·6)	6 (9·1)
High school graduate	18 (14·5)	12 (13·2)	5 (7·6)
Partial college	50 (40·3)	37 (40·7)	22 (33·3)
College graduate	21 (16·9)	15 (16·5)	12 (18·2)
Graduate degree	26 (21·0)	21 (23·1)	21 (31·8)
Race/ethnicity; *n* (%)			
White	48 (38·4)	38 (41·8)	26 (39·4)
Black	46 (36·8)	31 (34·1)	20 (30·3)
Hispanic	18 (14·4)	14 (15·4)	12 (18·2)
Asian	7 (5·6)	4 (4·4)	5 (7·6)
Native American	3 (2·4)	2 (2·2)	2 (3·0)
Other	2 (1·6)	2 (2·2)	1 (1·5)
Marital status; *n* (%)			
Married/living with partner	97 (77·6)	74 (81·3)	53 (80·3)
Single, not living with partner	24 (19·2)	16 (17·6)	11 (16·7)
Legally separated	3 (2·4)	1 (1·1)	2 (3·0)
Infant feeding method; *n* (%)			

1. *Hollingshead Four-Factor Index of Social Status (1975), using updated occupation categories (Davis *et al*. 1991).

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	Post-birth	6 weeks	12 weeks
Exclusive breastfeeding	77 (63·1)		
Breastfeeding & formula	24 (19·7)		
Formula feeding	20 (16·4)		
Expressed breastmilk	1 (0·8)		

There was a 26% loss to follow-up at 6 weeks (n = 91) and a 47% loss to follow-up at 12 weeks (n = 66). The women who completed the entire study were different from women who were lost to follow-up: lower enrolment patient activation scores [(M = 66·8, sd 14·6 vs. M = 75·4, sd 14·2), $t(122) = 3{\cdot}30$, $P = 0{\cdot}001$, $\eta^2 = 0{\cdot}08$]; were older [(M = 30·4, sd 5·33 vs. M = 27·4, sd 4·8), $t(122) = -3{\cdot}28$, $P = 0{\cdot}001$, $\eta^2 = 0{\cdot}08$]; and higher level of education [(M = 5·5, sd 1·4 vs (M = 5·0, sd 0·9), $t(122) = -2{\cdot}20$, $P = 0{\cdot}03$, $\eta^2 = 0{\cdot}04$]. The two groups did not differ on enrolment TDS score, SS difference score, parity, SES or pre-pregnancy BMI.

Preliminary analyses were conducted to ensure that there were no violations of assumptions of normality, linearity or homoscedasticity. For all regression analyses, the VIF and tolerance were used to screen for violations of multicollinearity; no analysis violated this assumption.

For RQ1, the model predicted 13% of the variance in patient activation, $R^2 = 0{\cdot}13$, $F_{change}(5,117) = 3{\cdot}49$, $P = 0{\cdot}006$. Two transition conditions were significant predictors: pre-pregnancy BMI ($\beta = -0{\cdot}20$, $P = 0{\cdot}03$) and transition difficulty ($\beta = -0{\cdot}29$, $P = 0{\cdot}001$). There was no association of transition conditions to patient activation at 6 or 12 weeks postpartum.

RQ2, RQ3 and RQ4 were examined using hierarchical multiple regression. In Step 1, which tested the association of transition conditions with PPWSM eating and physical activity behaviours (RQ2), the only statistically significant model was for healthy eating at 6 weeks postpartum. The total variance explained by the model was 15·3%, $F(5,84) = 3{\cdot}03$, $P = 0{\cdot}02$ and two transition conditions were statistically significant predictors – SES ($\beta = 0{\cdot}35$, $P = 0{\cdot}002$) and transition difficulty ($\beta = -0{\cdot}23$, $P = 0{\cdot}03$).

Steps 2-4 in the hierarchical regression analyses answered RQ3 and RQ4. In the model for low-fat eating behaviours at 6 weeks, variables entered at step 2 explained 21·0% of the variance, $F(1,84) = 5·99$, $P = 0·02$, with two statistically significant predictors: SES ($\beta = 0·38$, $P < 0·001$) and the immediate postbirth patient activation score ($\beta = 0·26$, $P = 0·02$). (Table 2). None of the models significantly predicted physical activity at 6 weeks (Table 3).

Table 2. Hierarchical regression analysis for variables predicting eating behaviours at 6 weeks ($N = 91$)

Variable	Model 1			Model 2			Model 3			Model 4		
	B	se B	β	B	se B	β	B	se B	β	B	se B	β
SES	0·275	0·08	0·35**	0·30	0·08	0·38**	0·28	0·08	0·36**	0·29	0·08	0·36**
Type of birth	−2·21	2·94	−0·08	−2·20	2·86	0·08	−1·89	2·80	−0·07	−1·91	2·84	−0·07
Parity	−0·33	0·92	−0·04	−0·32	0·89	−0·04	−0·51	0·88	−0·06	−0·43	0·91	−0·05
Prepregnancy BMI	0·05	0·18	0·03	0·14	0·18	0·08	0·14	0·17	0·08	0·14	0·17	0·08
Transition difficulty immediately postbirth	−0·10	0·04	−0·23*	−0·07	0·05	−0·15	−0·11	0·05	−0·24*	−0·10	0·05	−0·24*
Patient activation immediately postbirth				0·23	0·09	0·26*	0·24	0·09	0·27*	0·25	0·10	0·28*
Social influence							0·01	0·01	0·06	0·01	0·01	0·06
Social support gap							−0·08	0·04	−0·24*	−0·09	0·04	−0·25*
Activation × social influence										0·00	0·00	0·02
Activation × social support gap										0·00	0·00	−0·05
R^2	0·15			0·21			0·26			0·27		
R^2 change	0·15			0·06			0·05			0·00		
F for change in R^2	3·03*			5·99*			3·00			0·16		

1. *$P < 0·05$; **$P < 0·01$.

Table 3. Hierarchical regression analysis for variables predicting eating behaviours at 12 weeks ($N = 62$)

Variable	Model 1			Model 2			Model 3			Model 4		
	B	se B	β	B	se B	β	B	se B	β	B	se B	β
SES	0·22	0·09	0·32*	0·26	0·09	0·37*	0·25	0·09	0·35*	0·26	0·09	0·37*
Type of birth	−2·95	3·26	−0·12	−2·93	3·06	−0·12	−2·76	3·08	−0·11	−2·55	3·13	−0·10
Parity	−1·12	1·02	−0·14	−1·12	0·95	−0·14	−1·22	0·97	−0·15	−1·09	1·00	−0·14
Prepregnancy BMI	−0·06	0·20	−0·04	0·05	0·19	0·03	0·05	0·19	0·03	0·05	0·19	0·04
Transition difficulty immediately postbirth	−0·02	0·05	−0·04	0·03	0·05	0·07	0·00	0·05	0·01	0·01	0·06	0·03
Patient activation immediately postbirth				0·29	0·10	0·37*	0·30	0·10	0·38*	0·33	0·11	0·42*
Social influence							0·00	0·01	0·03	0·00	0·01	0·03
Social support gap							−0·05	0·04	−0·15	−0·04	0·04	−0·14

1. *$P < 0·05$.

Variable	Model 1			Model 2			Model 3			Model 4		
	B	se B	β	B	se B	β	B	se B	β	B	se B	β
Activation × social influence										0·00	0·00	0·11
Activation × social support gap										0·00	0·00	0·01
R^2	0·15			0·27			0·29			0·30		
R^2 change	0·15			0·12			0·02			0·01		
F for change in R^2	1·94			8·52*			0·77			0·33		

In predicting low-fat eating behaviours at 12 weeks, one model was statistically significant – the step 2 model, which explained 26·9% of the variance, $F(1,53) = 8{\cdot}52$, $P = 0{\cdot}01$. Two variables were significant independent predictors: SES (β = 0·37, $P = 0{\cdot}01$) and the immediate postbirth patient activation score (β = 0·37, $P = 0{\cdot}01$) (Table 4).

Table 4. Hierarchical regression analysis for variables predicting physical activity minutes at 6 weeks ($N = 91$)

Variable	Model 1			Model 2			Model 3			Model 4		
	B	se B	β	B	se B	β	B	se B	β	B	se B	β
SES	1·14	1·01	0·13	1·41	1·0	0·16	1·54	1·01	0·17	1·45	1·02	0·16
Type of birth	40·04	35·31	0·12	40·20	34·77	0·12	42·01	34·74	0·13	39·49	35·03	0·12
Parity	−1·3	11·01	−0·01	−1·24	10·84	−0·01	1·43	10·97	0·01	2·10	11·19	0·02
Prepregnancy BMI	−1·03	2·13	−0·05	−0·22	2·14	−0·01	−0·51	2·14	−0·03	−0·44	2·15	−0·02
Transition difficulty immediately postbirth	−0·75	0·53	−0·15	−0·44	0·55	−0·09	−0·18	0·60	−0·04	−0·19	0·61	−0·04
Patient activation immediately postbirth				2·16	1·14	0·21	1·91	1·15	0·19	1·80	1·22	0·18
Social influence							0·20	0·14	0·16	0·19	0·14	0·15
Social support gap							0·42	0·47	0·11	0·27	0·49	0·07
Activation × social influence										0·00	0·01	−0·03
Activation × social support gap										−0·03	0·03	−0·13
R^2	0·06			0·10			0·12			0·14		
R^2 change	0·06			0·03			0·03			0·02		
F for change in R^2	1·02			3·64			1·21			0·71		

Step 2 of the hierarchical regression significantly predicted physical activity minutes at 12 weeks, explaining 17·1% of the variance, $F(1,50) = 6{\cdot}67$, $P = 0{\cdot}01$, The immediate postbirth patient activation score was the only significant predictor, β = 0·36, $P = 0{\cdot}01$ (Table 5).

Table 5. Hierarchical regression analysis for variables predicting physical activity minutes at 12 weeks (*N* = 62)

Variable	Model 1			Model 2			Model 3			Model 4		
	B	se B	β	B	se B	β	B	se B	β	B	se B	β
SES	0·23	1·31	0·03	0·69	1·26	0·08	0·81	1·29	0·09	1·05	1·30	0·11
Type of birth	−12·85	46·11	−0·04	−12·57	43·74	−0·04	−13·06	44·48	−0·04	−9·78	44·50	−0·03
Parity	−6·83	14·38	−0·07	−6·75	13·64	−0·07	−5·20	14·05	−0·05	−1·28	14·22	−0·01
Prepregnancy BMI	−2·69	2·78	−0·14	−1·30	2·69	−0·07	−1·39	2·74	−0·07	−1·23	2·73	−0·06
Transition difficulty immediately postbirth	−1·02	0·69	−0·20	−0·50	0·69	−0·10	−0·27	0·77	−0·05	−0·06	0·78	−0·01
Patient activation immediately postbirth				3·69	1·43	0·36*	3·55	1·47	0·34*	4·21	1·55	0·41*
Social influence							0·04	0·18	0·03	0·02	0·18	0·02
Social support gap							0·44	0·61	0·11	0·43	0·63	0·11
Activation × social influence										0·02	0·01	0·19
Activation × social support gap										−0·02	0·04	−0·08
R^2	0·06			0·17			0·18			0·22		
R^2 change	0·06			0·11*			0·01			0·04		
F for change in R^2	0·66			6·67			0·26			1·20		

1. *P < 0·05.

None of the potential moderators – SI, SS gap or the interaction terms between patient activation and SI and SS gap – significantly modified the relationship between patient activation and the PPWSM outcome variables at 6 weeks or 12 weeks. There were no interaction effects when the social influence/PA and social support/PA variables were added to the models in step 4.

For RQ5, spouses had the highest scores for social influence toward promoting postpartum weight self-management (M = 77·4, sd 36·0), followed by pregnancy providers (M = 77·0, sd 30·4), mothers (M = 60·2, sd 33·2), inpatient postpartum nurses (M = 58·3, sd 29·7) and friends (M = 58·0, sd 29·1). One-way repeated measures ANOVA revealed that there were significant differences between influencers, Wilks' λ = 0·55, $F(4,120)$ = 25·05, P < 0·001, multivariate partial η^2 = 0·46. There was no statistically significant difference between the top-rated influencers – spouses/significant others and providers (P = 1·0), nor between the next similarly top-rated influencers – mothers and hospital nurses (P = 1·0), mothers and friends (P = 1·0) and friends and hospital nurses (P = 1·0).

Discussion

The study results point to the importance of transition difficulty and patient activation in healthy eating and physical activity during the postpartum transitional period. Transition difficulty was associated with patient activation immediately postbirth and patient activation was associated with eating and physical activity PPWSM behaviours at 6 and 12 weeks, with one exception – there were no significant predictors of physical activity minutes at 6 weeks. Neither social support, social influence nor their interaction terms moderated the relationship between patient activation and PPWSM behaviours.

The results showing that transition difficulty was positively associated with patient activation suggests that it is important to address each woman's personal transition factors to influence her weight self-management effectively. The patient activation measure offers tools to providers that allow them to assess women's likelihood to self-manage their weight loss. The tool's authors have developed interventions appropriate to promote engagement in health behaviours for women in each activation level (Insignia Health 2012). While these interventions have been shown to be effective in improving health outcomes in other populations, further research examining their use among the postpartum population is necessary.

The women in this study were activated for PPWSM in the immediate postpartum period, but weight self-management is not a standard priority for education among perinatal providers or inpatient hospital nurses (Heslehurst *et al*. 2011). In this sample, patient activation for PPWSM was relatively stable between enrolment through 12 weeks and the sample's mean activation level was high at all three time points. This finding highlights a missed window of opportunity, where provider influence and contacts with providers as part of usual care could be matched to women's activation.

The findings that enrolment transition difficulty was negatively associated with patient activation for weight management among this sample of postpartum women suggests that women experiencing a difficult transition to motherhood may invest their energies in managing the transition and may be less ready to focus on PPWSM behaviours. This resonates with a qualitative study done by Darvill

et al. (2010) who that found that women felt they did not have control over their bodies during the postpartum period and felt overly emotional, fatigued and disoriented. Those who had less support or who were not as prepared for the transition said that they could not do anything more than care for their newborn's and their own physical needs. It may be necessary to help women plan how to address their transition difficulties, via connection to resources or assistance with mobilizing existing resources, before they are able to prioritize PPWSM.

Postpartum women may benefit from engaging in physical activity for reasons beyond its effects on weight management. Evidence suggests that physical activity can have a positive effect on women's mood during the postpartum period (Teychenne & York 2013). Therefore, engagement in physical activity itself may reduce transition difficulty.

The social influence and support of spouses, friends and mothers were not associated with PPWSM behaviours. This is consistent with the findings of Ryan *et al*. (2011) who tested the ITHBC among postpartum women and also found that social facilitation was not directly related to self-regulation in PPWSM. It is impossible to tell from these data whether this lack of association is due to members of women's social circles lacking the requisite knowledge and skills needed to be supportive or due to support people holding beliefs that PPWSM is not valuable or safe. It is possible that women with the most difficulties simply cannot overcome those difficulties, even in the presence of social support to engage in PPWSM because of pressing daily stressors. On the other hand, women with low difficulty and high activation may not need as much support, so the support they receive may not affect their already strong ability to plan and prioritize for PPWSM behaviours. The relationship between these variables warrants further examination to develop interventions that will address the most vulnerable women.

The fact that social influence was neither a direct predictor nor a moderator of PPWSM behaviours even though women identified their providers as influencers provides new evidence for a mismatch between women's expectations of the maternal transition and the kind of professional guidance they actually receive after the birth. Others

have reported that women desire proactive professional guidance for their self-management efforts in a way that empowers the woman to drive the process (Seefat-van Teeffelen *et al*. 2011), but that their providers do not include PPWSM promotion in their care (Ohlendorf *et al*. 2012). These unmet needs for professional guidance lead to stress and feelings of vulnerability (Darvill *et al*. 2010). Given that this is the current state of practice norms, it makes sense that social influence would not change the relationship between the woman's own intrinsic activation and her engagement in PPWSM. Women are essentially on their own in making daily choices that affect weight. Intentional actions by providers to positively influence PPWSM through mutual goal-setting, providing tools for self-management, mobilizing social support or monitoring progress may change the relationship of social influence to PPWSM.

Because the patient activation assessment has previously been used to assess likelihood to self-manage chronic health concerns, it is significant that patient activation emerged as appropriate for use in this population to identify women likely to engage in PPWSM behaviours. Future research should examine the coaching interventions targeted for each activation level (Hibbard *et al*. 2009) to determine if those are effective in this population to promote PPWSM.

Limitations

There were three measurement limitations: (1) pre-pregnancy weight was extracted from the prenatal record, but it is not known if the recorded weight was actually measured or estimated by the woman; (2) the wording of the mPAM-13 and the SI questionnaire was modified for PPWSM; and (3) the outcome variables were both assessed with self-report surveys rather than more reliable measures, such as dietary intake and physical activity logs, or a wearable tracking tool to measure physical activity. In addition, the follow-up phone calls did include several instruments and participants' answers may have been affected by fatigue in answering a large number of questions.

Finally, because there are two outcome behaviours at two time points, it was necessary to run four separate hierarchical regressions

to answer the research questions. The potential for cumulative error should be considered when interpreting the results.

The self-selection bias of a convenience sampling approach was compounded by the loss to follow-up. While loss to follow-up is expected in longitudinal studies and effective retention is known to require thoughtful planning and considerable resources (Spears *et al*. 2013, Wilbur *et al*. 2013, Brannon *et al*. 2014), the loss to follow-up in this study was more than expected based on a previous 8-week study in this same setting (Ohlendorf 2012). The 12-week model should be interpreted cautiously because of limited statistical power and because the group who completed the study had lower enrolment activation scores than the group that did not.

Finally, the data collection did not extend to examine PPWSM factors through the first 6–12 months postpartum. Because those are the time points associated with long-term health outcomes, it would be advantageous to examine the associations evident in the study model at more remote time points.

Conclusion

Both patient activation for PPWSM and transition difficulty were associated with eating and physical activity behaviours among postpartum women. These results provide support for assessment of patient activation in this population as a tool for promotion of PPWSM and for consideration of the unique transitional context of each woman when planning health promotion. Women are activated to manage their weight in the immediate postpartum period and they report that their healthcare providers, family and friends are influential over their health behaviour choices, but there is a gap between those reports and current practice reality.

Future research should examine effective ways to assist women with addressing transition difficulties or with making weight self-management plans that address difficulties, and ways that the influence of providers can be used to harness women's activation toward PPWSM in the early postpartum period.

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- substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data;
- drafting the article or revising it critically for important intellectual content.

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