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Pregnant women's perceptions of weight gain, physical activity, and nutrition using Theory of Planned Behavior constructs

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Abstract

A better understanding of women's perceptions of weight gain and related behaviors during pregnancy is necessary to inform behavioral interventions. We used the Theory of Planned Behavior (TPB) to examine pregnant women's perceptions and intentions toward weight gain, physical activity (PA), and nutrition using a mixed methods study design. Women between 20 and 30 weeks gestation ($n = 189$) were recruited to complete an Internet-based survey. Salient beliefs toward weight gain, PA, and nutrition were captured through open-ended responses and content analyzed into themes. TPB constructs (attitude, subjective norm, perceived behavioral control, intentions) were examined using Pearson correlations and hierarchical linear regression models. Salient beliefs were consistent with the existing literature in non-pregnant populations, with the addition of many pregnancy-specific beliefs. TPB constructs accounted for 23–39 % of the variance in weight gain, PA, and nutrition intentions, and made varying contributions across outcomes. The TPB is a useful framework for examining women's weight-related intentions during pregnancy. Study implications for intervention development are discussed.

Keywords

Theory of Planned Behavior; Pregnancy; Weight; Physical activity; Nutrition

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Conflict of interest Kara M. Whitaker, Sara Wilcox, Jihong Liu, Steven N. Blair and Russell R. Pate declares that they have no conflict of interest.

Compliance with ethical standards

Human and animal rights and Informed Consent All procedures followed were in accordance with ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all patients for being included in the study.

Introduction

Weight gain, physical activity (PA), and dietary intake all directly influence pregnancy outcomes and the long-term health of mother and child. Only one-third of women meet the Institute of Medicine (IOM) weight gain guidelines during pregnancy, with up to 50 % gaining excessive weight (Institute of Medicine, 2007; Olson, 2008; Simas et al., 2011). Pregnancy weight gain above recommendations is associated with many adverse health outcomes, including an increased risk of gestational diabetes, preeclampsia, cesarean delivery, macrosomia, and new or persistent overweight or obesity in the mother (Guelinckx et al., 2008; Hernandez, 2012; Nehring et al., 2011). Evidence also suggests an association between excessive gestational weight gain and overweight and obesity in the offspring (Lau et al., 2014).

PA and diet are two key modifiable behavioral factors that influence pregnancy weight gain. During pregnancy, women are less likely to meet PA guidelines than non-pregnant women (Evenson et al., 2004), and activity levels further decline from the second to third trimester (Evenson and Wen, 2011). The majority of women of childbearing age also do not meet federal nutrition guidelines, with <20 % consuming adequate servings of fruits, vegetables, whole grains and milk, and 97 % exceeding the maximum energy allowance for fats and added sugars (Krebs-Smith et al., 2010). Few studies have assessed dietary intake of pregnant women; however, evidence suggests that the majority do not meet dietary guidelines (Fowles, 2002; Siega-Riz et al., 2002; Watts et al., 2007).

Given the high prevalence of excessive gestational weight gain, physical inactivity, and poor diet quality during pregnancy, there is a clear need for behavioral intervention. However, in order to develop effective interventions, it is first critical to better understand women's perceptions of weight gain and related behaviors during pregnancy. Many different theories have been developed in an attempt to understand and predict behavior, including the Theory of Planned Behavior (TPB) (Ajzen, 1985, 1991). Research provides support for the predictive validity of the TPB for a variety of health behaviors, including PA, dietary behaviors, and to a lesser extent, weight control (Armitage and Conner, 2001; Conner et al., 2002; Godin and Kok, 1996; McConnon et al., 2012; McEachan et al., 2011; Downs and Hausenblas, 2005b). According to the TPB (Ajzen, 1985, 1991), behavioral intention is the primary determinant of behavior. Behavioral intention is in turn directly influenced by three constructs: attitude, subjective norms, and perceived behavioral control. Attitude refers to the overall evaluation of the behavior, subjective norm is the perceived social pressure to engage or not engage in the behavior, and perceived behavioral control is the measure of perceived control over the behavior. This theory hypothesizes that people will intend to engage in a behavior if they view it positively (attitude), believe that important others want them to participate in certain behaviors (subjective norm), and perceive that the behavior is under their control (perceived behavioral control).

The TPB is an appropriate framework to use during pregnancy because it includes factors that may be influenced by aspects of the pregnancy. For example, a woman's attitude about PA may change due to her personal beliefs about the risks or benefits of exercise during pregnancy. Similarly, a woman may excessively increase caloric intake because her family

tells her she needs to eat for two during pregnancy (subjective norm). Likewise, a woman may believe she has no control over her weight gain in pregnancy, therefore impacting her intention to restrict her weight gain within a certain range (perceived behavioral control).

The TPB is commonly used to predict behavioral intention and behavior, but can also be used to explain behavior by assessing the salient beliefs of a population (Ajzen, 1991). Salient beliefs consist of behavioral, normative, and control beliefs. Behavioral beliefs influence attitude, and reflect the perceived advantages and disadvantages of performing the behavior. Normative beliefs affect subjective norms, and are formed by the belief about whether important others approve or disapprove of the behavior. Finally, control beliefs influence perceived behavioral control, and relate to the presence or absence of barriers and enablers to behavioral performance.

To date, the majority of TPB guided research in pregnant women has focused on PA (Downs and Hausenblas, 2003, 2004; Hausenblas et al., 2008; Hausenblas and Downs, 2004). Less is known about pregnant women's perceptions of weight gain or nutrition. Given that weight gain and nutrition are key determinants of health outcomes for the mother and child, it is important to examine the utility of the TPB in predicting weight gain and nutrition intentions. An additional limitation of the literature is the near exclusive examination of the direct TPB constructs, while not considering underlying salient beliefs. To our knowledge, only one study has utilized the TPB to assess pregnant women's salient beliefs of PA (Downs and Hausenblas, 2004), and no studies were identified that examined salient beliefs of weight gain or nutrition in pregnancy.

The first objective of this study is to elicit women's behavioral, normative, and control beliefs toward weight gain, PA, and nutrition in pregnancy. The second objective is to examine whether the TPB explained significant variation in weight gain, PA, and nutrition intentions. Based on existing research findings (McEachan et al., 2011), we hypothesized that attitude would explain the greatest variation in behavioral intention across the three outcomes, followed by perceived behavioral control, and subjective norm.

Methods

Study participants and procedures

Participants were recruited through pregnancy-related Internet chat forums and social media sites from April to August 2014. Inclusion criteria were: 20–30 weeks pregnant, 18–44 years old, pre-pregnancy body mass index (BMI) between 18.5 and 45.0 kg/m², singleton pregnancy, and attended first prenatal visit before 16 weeks gestation. If eligible, women were invited to complete a cross-sectional Internet-based survey to assess perceptions of weight gain, PA, and nutrition. Participants had the option to enter a drawing to win one of eight \$50 Amazon gift cards. The University of South Carolina Institutional Review Board approved all study protocols.

Participants were provided with a short description explaining the current weight gain, PA, and nutrition recommendations during pregnancy. These recommendations were presented early in the survey in order to assess participant perceptions of these specific guidelines.

Weight gain recommendations were based on the 2009 IOM guidelines and were tailored based on the woman's self-reported pre-pregnancy body mass index (BMI). It is recommended that healthy weight women (BMI 18.5–24.9 kg/m²) gain 25–35 pounds in pregnancy, overweight women (BMI 25.0–29.9 kg/m²) gain 15–25 pounds, and obese women (BMI ≥30.0 kg/m²) gain 11–20 pounds (Institute of Medicine, 2009). PA recommendations were based on the 2008 Physical Activity Guidelines for Americans, or 150 min of moderate to vigorous intensity PA per week (U.S. Department of Health and Human Services, 2008). Nutrition recommendations were based on the 2010 Dietary Guidelines for Americans (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2010). Specifically, women were told that a healthy diet includes plenty of fruits and vegetables, low fat dairy products, protein, fiber, and whole wheat breads and pastas instead of refined grains like white bread, rice, and pasta. It also recommended women to watch portion sizes and to avoid eating too much of very sugary or fatty foods.

Measures

Salient beliefs (indirect TPB constructs)—Behavioral, normative, and control beliefs were assessed using open-ended questions, with separate questions for weight gain, PA, and nutrition. Behavioral beliefs were assessed by asking women to list up to five advantages and five disadvantages of meeting recommendations for weight gain, PA, and nutrition during pregnancy. Normative beliefs were examined by asking participants to list up to five people who influence their weight gain, PA, and nutrition. Control beliefs were explored by asking women to list up to five factors that make it difficult or easier for them to meet recommendations for weight gain, PA, and nutrition during pregnancy.

Direct TPB constructs—The primary constructs of the TPB (attitude, subjective norm, perceived behavioral control, intentions) were assessed for each outcome of interest, or weight gain, PA, and nutrition using scales developed in accordance with established guidelines (Ajzen, 1991, 2002; Montano and Kasprzyk, 2002). These scales have demonstrated validity and reliability across a wide range of health behaviors (Armitage and Conner, 2001; Conner et al., 2002; Godin and Kok, 1996; Hales et al., 2010; McConnon et al., 2012; McEachan et al., 2011; Downs and Hausenblas, 2005b).

Attitude: Women's attitude toward weight gain, PA, and nutrition recommendations were assessed using the following seven discrepant word pairs commonly used in the existing literature: (1) bad-good, (2) useless-useful, (3) foolish-wise, (4) harmful-beneficial, (5) unpleasant-pleasant, (6) boring-interesting and (7) unenjoyable-enjoyable (Ajzen, 1991; Downs and Hausenblas, 2003; Hausenblas et al., 2008). The survey was designed to automatically propagate the recommended IOM weight gain range (i.e. 25–35, 15–25, or 11–20 pounds) based on the woman's self-reported pre-pregnancy BMI. Specifically, women read the following statements: 'Gaining between [*recommended weight gain range*] total pounds during my pregnancy will be...'; 'Exercising during my pregnancy for 150 min per week at a moderate intensity level (e.g. brisk walking) will be...'; 'Eating a healthy diet during pregnancy will be...'. Participants were asked to respond to the statements by rating each of the word pairs using a seven-point Likert scale ranging from –3 (e.g. bad, useless,

foolish) to 3 (e.g. good, useful, wise). The direct measure of attitude for weight gain, PA, and nutrition was assessed by summing the scores from the corresponding seven discrepant word pairs (Cronbach's $\alpha = 0.92$ for weight gain, 0.90 for PA and 0.94 for nutrition). Possible scores for each health behavior range from -21 to 21. Higher scores indicate a more positive attitude toward the corresponding health behavior.

Subjective norms: Participants were asked what important others think about weight gain, PA, and nutrition in pregnancy. Women read the following statements, 'Most people who are important to me think I should: gain between [*recommended weight gain range*] total pounds during my pregnancy; exercise regularly during my pregnancy; eat a healthy diet during pregnancy.' Participants were asked to rate each statement using a seven-point Likert scale ranging from -3 (strongly disagree) to 3 (strongly agree). The direct measure of subjective norms was assessed using the score on the single item question with a possible range of -3 to 3 for each behavior. A single item measure of subjective norm is consistent with existing research and is a reliable and valid measure (Ajzen, 2002; Conner et al., 2002; Hausenblas et al., 2008). Higher scores indicate greater perceived pressure to engage in the behavior.

Perceived behavioral control: Participants' perceived behavioral control over meeting the recommendations for weight gain, PA, and nutrition was assessed using three questions for each behavior. First, participants were asked how much control they have over their weight gain, PA, and nutrition during pregnancy using a seven-point Likert scale ranging from -3 (very little control) to 3 (complete control). The ease or difficulty of meeting recommendations was assessed using a seven-point Likert scale ranging from -3 (extremely difficult) to 3 (extremely easy). Finally, women were asked if they could meet the recommendations for each behavior using a seven-point Likert scale ranging from -3 (strongly disagree) to 3 (strongly agree). Summing the scores from the three corresponding survey items assessed the direct measure of perceived behavioral control for each behavior, with a possible range of -9 to 9 (Cronbach's $\alpha = 0.70$ for weight gain, 0.80 for PA and 0.78 for nutrition). Higher scores indicate higher levels of perceived control to engage in the corresponding health behavior.

Intentions: Weight gain intentions were assessed with the statement "I plan on gaining between [*recommended weight gain range*] total pounds during this pregnancy," using a seven-point Likert scale ranging from -3 (strongly disagree) to 3 (strongly agree). PA and nutrition intentions were assessed with the statements "I plan on exercising at a moderate intensity for 150 min per week (e.g. 30 min per day, 5 days per week) during my pregnancy," and "I plan on eating a healthy diet during my pregnancy," using the same Likert scale. Intentions were assessed using the score on the one-item question with a possible range of -3 to 3 for each behavior. Higher scores indicate stronger intentions to meet weight gain, PA, and nutrition recommendations in pregnancy. Intentions were measured first, before women were informed of the current weight gain, physical activity and nutrition guidelines to limit social desirability bias.

Personal history questionnaire

Self-reported height and pre-pregnancy weight were used to calculate pre-pregnancy BMI. Self-reported weight is the most commonly used measure of pre-pregnancy weight and has shown to be both reliable and valid (Shin et al., 2014; Tomeo et al., 1999). Additional measures included race, age, gestational age, highest grade or years of education, income level, employment status, marital status, parity, smoking status, and health conditions.

Qualitative analyses

Salient beliefs toward weight gain, PA, and nutrition were assessed using content analysis of open-ended survey questions. Data were organized by outcome and then categorized by belief type (behavioral, normative, or control beliefs) using NVivo 10. As recommended for TPB content analysis, verbatim statements were placed in the following lists: (1) positive and negative behavioral beliefs about outcomes or attributes of the action, (2) people or groups that influence the action, and (3) factors or situations that make it easier or more difficult to perform the action (Ajzen, 1991). To increase the validity of the analysis, one investigator (KW) and a second rater independently read and coded the response data. Discussion and consensus between the two raters guided the organization of the statements in each list into major themes. Frequencies and percentages of responses were calculated, and the most frequently discussed beliefs were listed.

Statistical analyses

Pearson correlations were used to examine bivariate associations between attitude, subjective norm, perceived behavioral control, and each of the three corresponding outcomes: weight gain, PA, and nutrition intentions. Using recommended TPB analytical procedures, hierarchical regression analyses were used to examine the predictive utility of the TPB on behavioral intentions (Ajzen, 1991). Construct entry order and grouping was based on the theoretical principles of the TPB and previous research (Ajzen, 1991; Downs and Hausenblas, 2003). The first model regressed weight gain intention (dependent variable) on attitude and subjective norm toward weight gain (block 1). The second model regressed weight gain intention on attitude, subjective norm, and perceived behavioral control (block 2). Using this same method, hierarchical regression analyses were repeated for PA and nutrition intentions. For each model, the variance inflation factors were computed as a multicollinearity diagnostic statistic to test the impact of multicollinearity among the covariates included in the model. The variance inflation factors computed weak dependencies (< 1.2) and therefore no modifications were made to the constructs included in the models.

Results

Sample characteristics

Of the 724 women who accessed the web-link, 549 completed the screening form and 197 women were excluded for not meeting one or more of the eligibility criteria. Due to the low representation of minority women, the survey was closed to White women at the midpoint of data collection to achieve a more diverse sample. A total of 352 women were deemed

eligible to participate (64.1 %), and 199 women completed the survey (56.5 %). Participants primarily resided in the United States (90.5 %) and Canada (7.5 %). Those with IP addresses outside the U.S. or Canada (n = 4), or who later reported values inconsistent with eligibility criteria (n = 6) were excluded from analyses, resulting in a final sample of 189 women. Women from Canada were included in analyses as the Canadian guidelines for pregnancy weight gain, physical activity and nutrition are identical or very similar to the U.S. guidelines (Health Canada, 2009; Institute of Medicine, 2009; Tremblay et al., 2011). Characteristics of study participants are shown in Table 1. There were significant differences by race in income, employment, marital status, and parity, with African American women being more likely to report a household income less than \$25,000, being unemployed, single, and having more children as compared to White women (not shown in table).

Salient beliefs (indirect TPB constructs)

The most frequently cited behavioral, normative, and control beliefs toward weight gain, PA, and nutrition can be found in Tables 2, 3 and 4.

Weight gain beliefs

Commonly cited advantages of meeting weight gain recommendations in pregnancy were health benefits to the baby (73 %), easier to lose the weight in the postpartum period (28 %), and health benefits to the mother (15 %). When asked to list the disadvantages of meeting weight gain recommendations, the majority of women discussed disadvantages of general weight gain during pregnancy, while not specifically focusing on the listed weight gain range. Women stated that any weight gain might be challenging to lose (37 %). Other commonly cited disadvantages of pregnancy weight gain included physical discomfort (28 %) and negative psychological impact (18 %). For example, some women reported struggling with their body image or reduced self-esteem as a result of pregnancy weight gain. The most salient normative influences on weight gain were women's husband or partner (73 %), doctor (46 %), parents (35 %), and friends (23 %).

Women discussed barriers and enablers of meeting weight gain recommendations (control beliefs) from three different perspectives. Some listed factors that would make it difficult or easier to avoid excessive pregnancy weight gain (43 %); others discussed factors that would make it difficult or easier to meet minimal weight gain recommendations (36 %) and some cited barriers and enablers of gaining within the recommended ranges without focusing on either end of the weight gain spectrum (21 %).

Women listed cravings (14 %), lack of exercise (13 %) and eating unhealthy foods (9 %) as barriers to limiting their pregnancy weight gain. Factors that would help them limit weight gain included healthy eating habits (30 %) and regular exercise (16 %). Women who discussed barriers to gaining enough weight in pregnancy cited nausea (23 %), difficulty eating enough because of feeling full faster (10 %), psychological barriers such as body image issues (9 %), and having an active lifestyle (7 %). For this group of women, factors that would help them gain enough weight included indulging in foods (24 %), experiencing an increase in appetite (12 %), and limiting exercise (9 %). Some women discussed lack of

control over their weight gain as a barrier (9 %), and social support was listed as a factor that would help women gain appropriate weight (10 %).

Physical activity beliefs

Commonly cited advantages of PA included having an easier labor and delivery (46 %), management of weight gain (38 %), and health benefits to the mother (31 %). Disadvantages of PA were that it increased fatigue (34 %), required time (19 %), and caused additional aches and pains (18 %). Salient normative influences on PA were similar to weight gain (i.e. husband, doctor, parents, friends), with the addition of participants' children (10 %). Control beliefs hindering PA include lack of time for exercise (59 %), pregnancy-related fatigue (49 %) and pain (20 %). Women discussed how social support (32 %), additional time (21 %), and increased access to fitness facilities or equipment (15 %) would facilitate their participation in PA.

Nutrition beliefs

Advantages of meeting nutrition recommendations included health benefits for the baby (70 %), management of weight gain (52 %), and health benefits for the mother (37 %). Being unable to indulge in cravings was the most commonly cited disadvantage of healthy eating during pregnancy (30 %). Other disadvantages were that it requires more time and effort to prepare healthy meals or snacks (19 %), and the higher cost of healthy foods (16 %). Participants listed the same people influencing healthy eating as PA (normative influences). Barriers to healthy eating include cravings for unhealthy food (43 %), lack of time to prepare food (35 %) and the higher cost of healthy food (20 %). Women also discussed factors that would help them consume a healthy diet during pregnancy, such as planning meals or snacks ahead of time (23 %), having adequate social support (19 %) and regular access to healthy foods (14 %).

Direct TPB constructs

Bivariate correlations—Correlations between TPB constructs can be found in Table 5. All correlations were significant and positive with the exception of attitude and perceived behavioral control for weight gain. Subjective norm had the strongest correlation with intentions to meet weight gain recommendations ($r = 0.45$). Perceived behavioral control had the strongest correlation with intentions to meet PA ($r = 0.62$) and nutrition recommendations ($r = 0.49$). Effect sizes for TPB constructs were moderate (i.e. $r = 0.3$) to large (i.e. $r = 0.5$) (Cohen, 1992) across behaviors with the exception of attitude-intention ($r = 0.24$) and perceived behavioral control-intention ($r = 0.16$) for weight gain.

Linear regression—Table 6 displays results from hierarchical linear regression models. Attitude and subjective norm explained 22 % of the variance in weight gain intention (block 1). Subjective norm was associated with weight gain intention ($\beta = 0.51, p < 0.01$) while attitude was not ($\beta = 0.02, p = 0.07$). The addition of perceived behavioral control to the model (block 2) only explained an additional 1 % of the variance in the model, and was not significant ($\beta = 0.05, p = 0.18$).

In the model examining PA intention, significant associations were observed for both attitude ($\beta = 0.05, p < 0.01$) and subjective norm ($\beta = 0.33, p < 0.01$), explaining 15 % of the variation in PA intention (block 1). The addition of perceived behavioral control explained an additional 24 % of the variance in the model ($\beta = 0.26, p < 0.01$), with attitude and subjective norm failing to make unique contributions to the final model ($\beta = 0.02, p = 0.14$ and $\beta = 0.14, p = 0.11$, respectively).

Finally, in the nutrition models, both attitude ($\beta = 0.03, p = 0.01$) and subjective norm ($\beta = 0.30, p < 0.01$) were significantly associated with nutrition intentions, explaining 16 % of the variance in the model (block 1). The addition of perceived behavioral control (block 2) explained an additional 13 % of the model ($\beta = 0.16, p < 0.01$), with attitude and subjective norm maintaining unique contributions to the model ($\beta = 0.02, p = 0.03$ and $\beta = 0.16, p = 0.03$, respectively).

Discussion

Women described salient beliefs that were largely consistent with the existing literature in non-pregnant population, with the addition of many pregnancy-specific beliefs. TPB constructs made varying contributions in the prediction of women's intentions to meet recommendations. Overall it appears that the TPB is a useful framework for examining and predicting women's weight gain, PA, and nutrition intentions during pregnancy.

Salient beliefs

Many of the cited behavioral, normative, and control beliefs toward both PA and nutrition (healthy eating) were consistent with the existing literature in non-pregnant populations (Downs and Hausenblas, 2005a; Eikenberry and Smith, 2004) and pregnant populations (Downs and Hausenblas, 2004). For example, commonly cited advantages of PA and healthy eating are weight control and improvements in health; salient normative referents consistently include family, friends, and healthcare professionals; and commonly perceived barriers include lack of time or lack of social support. Our study uniquely contributes to the literature by using the TPB to examine salient beliefs toward nutrition and weight gain in a pregnant population.

Consistently cited advantages of meeting recommendations for all three behaviors were health benefits for the baby and health benefits for the mom. The percentage of women who discussed health benefits to the baby was greater for weight (73 %) and nutrition (70 %) as compared to PA (22 %). Evidence suggests that PA has many positive health benefits to the fetus that extend into childhood and possibly adulthood via fetal programming (Barker et al., 1989). PA during pregnancy increases placental functional capacity, circulation, and gas exchange, all of which increase nutrient delivery to the fetus (Clapp et al., 2000). Women who are active during pregnancy are at decreased risk of large-for-gestational age infants (Mudd et al., 2013) and these beneficial effects on the child's weight status persist into early childhood (Mattran et al., 2011). Future interventions should seek to increase awareness of the benefits of maternal PA for the fetus.

When assessing salient normative referents, women's husband or partner exerted the largest influence across behaviors, followed by doctors, parents, friends and other children. Women also stated that social support would help them meet recommendations across outcomes. Considering these beliefs together, it may be especially important for interventions targeting weight gain and related behaviors during pregnancy to involve close family members (e.g. husband) or friends. This intervention strategy is further supported by the work of Thornton et al. (2006), who found social support to be an important determinant of women's beliefs toward weight, diet, and PA in a sample of lower income pregnant and postpartum Latina women.

Interestingly, more women cited their doctor as an influencing source of information as compared to the existing pregnancy literature. One study found that only 3 % of women discussed their healthcare provider as influencing exercise behaviors during pregnancy (Downs and Hausenblas, 2004), compared to 37 % in our study. A high percentage of women also cited their doctor as influencing their weight gain (46 %) and nutrition (37 %) in our study. The American College of Obstetricians and Gynecologists (ACOG, 2013) recommends that healthcare providers discuss weight gain, PA, and nutrition with women during prenatal visits. Given that providers are advised to counsel women on these topics and women consistently cite their doctor as an influencing source of information, future research is needed to see if providers are aware of the ACOG counseling guidelines and whether they think they are able to effectively counsel women on these topics.

Women discussed barriers and enablers of meeting weight gain recommendations from multiple perspectives. Women who were concerned with excessive weight gain commonly discussed the importance of healthy lifestyle practices such as regular exercise and healthy eating, while also acknowledging many barriers to these behaviors. For women at risk for excessive weight gain, it may be especially important to focus on strategies to overcome barriers to healthy lifestyle practices in pregnancy. Conversely, women who were focused on gaining enough weight in pregnancy listed unhealthy lifestyle practices, such as reducing exercise and indulging in cravings or unhealthy foods in order to gain adequate weight. Nausea and inability to consume adequate calories were common concerns. For women at risk of inadequate weight gain, it may be helpful to provide strategies to promote weight gain in a healthful manner. For example, women should be encouraged to eat smaller and more frequent meals and provided with meal ideas that are both nutritious and calorically dense.

Some women also stated they lacked control over their weight gain. Pregnancy weight gain is caused by many factors, some of which are not modifiable. However, PA and dietary intake are both modifiable determinants of pregnancy weight gain. Future interventions should seek to empower women by teaching them how to apply behavioral strategies to better control their weight gain in pregnancy through appropriate PA and dietary intake.

TPB direct constructs

The overall efficacy of the TPB constructs in predicting behavioral intention was consistent with the existing literature. A meta-analysis describing the efficacy of the TPB across a variety of health behaviors in general populations found that attitude, subjective norm, and

perceived behavioral control explained 44 % of the variance in behavioral intention (McEachan et al., 2011). This result is comparable to our findings examining exercise intentions (39 %); however the predictive value of the TPB to explain intention was lower for nutrition (29 %) and weight gain (23 %).

Our hypothesis that attitude would have the strongest relationship with behavioral intention across outcomes was not supported. The relationship between attitude and intention was small for weight gain and nutrition and moderate for PA (Cohen, 1992). In final regression models, attitude was not significantly associated with weight gain or PA intentions. These findings are surprising, as attitude has typically shown to have the strongest association with intentions in non-pregnant (Armitage and Conner, 2001; McEachan et al., 2011) and pregnant populations (Bassett-Gunter et al., 2013; Downs and Hausenblas, 2003; Hausenblas et al., 2008; Hausenblas and Downs, 2004) across a variety of behaviors. This implies that women's beliefs or feelings toward weight gain or physical activity in pregnancy have less of an effect on their intention to meet weight gain and PA recommendations as compared to the other TPB constructs. Targeting attitude alone may therefore not be an effective intervention approach for weight management or PA promotion during pregnancy. However, it is important to note that attitude was significantly associated with the other constructs in the model, which may have reduced associations and significance in simultaneous regression models.

The strength of the association between subjective norm and intention was greater than hypothesized. Subjective norm was moderately correlated with intentions across all three behaviors, and was significantly associated with weight gain and nutrition, but not PA in final models. Subjective norm is typically the weakest predictor of both intention and behavior in non-pregnant populations (Armitage and Conner, 2001; McEachan et al., 2011). However, studies examining the utility of subjective norm in pregnant populations have shown more mixed findings (Bassett-Gunter et al., 2013; Downs and Hausenblas, 2003, 2004; Hausenblas et al., 2008). Hausenblas and Downs (2004) have published three studies examining exercise intentions and behaviors in pregnant women; subjective norm was a significant predictor of exercise intention in one of the three studies. Bassett-Gunter et al. (2013) found subjective norm to significantly predict healthy eating intentions and behaviors among parents expecting their first child. Taken together, it is possible that subjective norm is a stronger predictor of behavioral intention due to our specific population under study. Pregnancy is a teachable moment where women are more receptive to change for the sake of the baby and may be more responsive to the influence of others.

The relationship between perceived behavioral control and intention was smaller than hypothesized for weight gain and larger than hypothesized for PA and nutrition. This construct independently explained a larger proportion of the variance in PA and nutrition intentions (24 and 13 %, respectively) as compared to the existing literature, where on average, perceived behavioral control accounts for 6 % or less of the variance in intentions in non-pregnant (Armitage and Conner, 2001; McEachan et al., 2011) and pregnant populations (Downs and Hausenblas, 2003; Hausenblas et al., 2008; Hausenblas and Downs, 2004). This illustrates that the perceived ease or difficulty of meeting PA or nutrition recommendations plays an important role in women's intentions to meet these

recommendations. It may be helpful for interventions to target perceived behavioral control by teaching women strategies to overcome commonly cited barriers to PA and healthy eating (e.g. lack of time and pregnancy-related fatigue). Perceived behavioral control does not appear to be a strong predictor of weight gain intentions, possibly due to the perception that pregnancy weight gain is not under one's control.

Strengths of this study include examination of multiple behaviors, exploration of salient beliefs, and theoretical grounding. While this study contributes novel findings to the literature, multiple limitations must be noted. Participants were presented with the guidelines for weight gain, PA, and nutrition early in the survey, without first assessing prior knowledge of these guidelines. This may have introduced bias to subsequent participant responses; however, it was necessary to provide information on the current recommendations in order to assess participant perceptions of these specific guidelines. We did not evaluate current health behaviors, which may influence perceptions and intentions to engage in future health behaviors. Due to the cross-sectional nature of the study, we also did not assess if intentions translated into women's behaviors. Future studies should collect baseline data on health behaviors and then prospectively follow women over time to examine the utility of the TPB constructs for predicting weight gain, PA, and dietary behaviors in pregnant women. Additionally, respondents were primarily white with high levels of education and income, which may limit the generalizability of study findings and restrict the range of responses, thus limiting the variance we were able to explain in behavioral intentions. Finally, self-selection bias may be present as participants were volunteers who may have been more interested in weight-related behaviors during pregnancy.

Overall, findings indicate that interventions targeting multiple behaviors require specific attention to each of the behaviors to optimize their efficacy. Interventions targeting nutrition behaviors in pregnancy may be more effective if they seek to improve women's attitudes toward healthy eating, increase perceived pressure to eat a healthy diet during pregnancy, and increase perceived sense of control by teaching women ways to overcome barriers to healthy eating. To increase intentions to engage in PA it may be most effective to target perceived behavioral control. Finally, weight gain interventions may experience greater success if targeting the construct of subjective norm, possibly through involvement of family, health care providers, and friends.

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Table 1

Participant characteristics (N = 189)

Characteristic	n	Mean (SD) or % (n)	Range
Age	186	30.3 (4.2)	21.2–42.6
Gestational Age	189	25.6 (3.2)	20.0–30.0
Race	188		
White		82.4 (155)	
African American		10.6 (20)	
Other		7.0 (13)	
Education	189		
High school graduate		5.8 (11)	
Some college or technical school		22.2 (42)	
College graduate		72.0 (136)	
Employment	189		
Employed for wages full time		56.1 (106)	
Employed for wages part time		10.6 (20)	
Self-employed		10.0 (19)	
Student		3.2 (6)	
Homemaker		18.5 (35)	
Out of work		1.6 (3)	
Household annual income	189		
<\$25,000		11.1 (21)	
\$25,000–\$49,999		15.9 (30)	
\$50,000–\$74,999		18.0 (34)	
\$75,000 or more		55.0 (104)	
Marital status	188		
Single		4.8 (9)	
Married/member of unmarried couple		94.2 (177)	
Divorced		1.1 (2)	
Parity	189		
0		51.9 (98)	
1		31.8 (60)	
2+		16.4 (31)	
Smoking during pregnancy	189	1.1 (2)	
Prepregnancy BMI	188	25.7 (5.5)	18.6–42.3
Prepregnancy BMI category	188		
Healthy weight		59.3 (112)	
Overweight		19.1 (36)	
Obese		21.2 (40)	
Diagnosed pregnancy conditions	189		
Preeclampsia		1 (2)	
Gestational diabetes mellitus		1.6 (3)	

Characteristic	n	Mean (SD) or % (n)	Range
Other pregnancy complications		5.3 (10)	
Diagnosed chronic health conditions	189		
Hypertension		10.1 (19)	
Type 1 diabetes		3.1 (6)	
Cancer		2.1 (4)	
Other health conditions		5.8 (11)	

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Table 2

Salient behavioral, normative, and control beliefs for meeting weight gain recommendations during pregnancy (N = 189)

Beliefs	N	%	Participant quote
Behavioral beliefs—advantages			
Health benefits for baby	138	73.0	Baby will be healthier
Easier to lose weight postpartum	53	28.0	It won't be as hard to get the weight off
Health benefits for mother	28	14.8	Better for my overall health
Prevents health complications	20	10.6	Less risk of diabetes and other complications
Behavioral beliefs—disadvantages			
Hard to lose weight postpartum	69	36.5	It may be hard to get back to pre-pregnancy weight
Discomfort	52	27.5	The extra weight gain in so short a time makes my body uncomfortable
Negative psychological impact	34	18.0	Some women get depression from weight gain
Unappealing physical changes	24	12.7	It may be gained in places I don't want (ex. arms/thighs as opposed to stomach/breasts)
Normative beliefs			
Husband or partner	138	73.0	My husband
Doctor	87	46.0	My doctor is really the only one I can see influencing me
Parents	66	34.9	My mother because she is of course concerned the baby is getting everything he needs
Friends	44	23.3	Close friends
Control beliefs—barriers to avoid excessive weight gain			
Cravings	27	14.3	I indulge in cravings too often
Lack of exercise	25	13.2	Difficult to maintain exercise
Eating unhealthy foods	17	9.0	I will probably gain more because I have a sweet tooth
Control beliefs—enablers to avoid excessive weight gain			
Healthy eating habits	57	30.2	Sticking to a balanced diet with adequate vitamins, protein, and minerals makes it easier
Regular exercise	30	15.9	Daily physical activity
Control beliefs—barriers to adequate weight gain			
Nausea	43	22.8	Nausea and heartburn making it difficult to eat
Hard to eat enough	19	10.1	Pregnancy causes you to feel full faster so it's hard to consume a lot of calories at one time
Psychological barriers	18	9.5	Body image issues
Control beliefs—enablers to adequate weight gain			
Indulging in foods	47	24.9	Not focused on dieting
Increased hunger	22	11.6	Sometimes an increase in appetite
Limiting exercise	16	8.5	I quit exercising regularly

Table 3

Salient behavioral, normative, and control beliefs for meeting physical activity recommendations during pregnancy (N = 189)

Beliefs	N	%	Participant quote
Behavioral beliefs—advantages			
Easier labor and delivery	86	45.5	Maintain strength and flexibility, which may make for an easier labor, delivery, and recover
Manages weight gain	72	38.1	It helps to maintain healthy weight gain
Health benefits for mother	58	30.7	Healthier mom
Improves fitness	49	25.9	Stay fit during pregnancy
Psychological benefits	47	24.9	Mood lifted by working out
Health benefits for baby	42	22.2	Has been shown to be beneficial to the baby's growth and intelligence
Faster postpartum recovery	37	19.6	A body in shape before birth is easier to get in shape after birth
Increases energy	23	12.2	Keeps energy levels up
Behavioral beliefs—disadvantages			
Causes fatigue	64	33.9	I can't do as much without becoming very fatigued
Requires time	35	18.5	Time commitment
Causes aches or pains	33	17.5	Increase in back pain and increase in Braxton hicks during and after exercise
Potential for injury	15	7.9	Feeling nervous about doing something unsafe
Normative beliefs			
Husband or partner	140	74.1	My husband is great at encouraging me to exercise more, regardless of me being pregnant
Doctor	67	35.4	As long as my doctor is supportive of the amount I am working out, I will continue
Parents	48	25.4	My mom and I walk together
Friends	30	15.9	Trusted friends
Children	19	10.1	My toddler—he won't let me sit down
Control beliefs—barriers			
Lack of time	112	59.3	Time constraints
Fatigue	92	48.7	Being extremely tired
Pain	37	19.6	Back and hip pain
Bad weather	31	16.4	The winter was cold so it was hard to get outside to walk or exercise
Aches/pains	21	11.1	Discomfort and aches related to pregnancy
Nausea	20	10.6	First trimester fatigue and nausea make it difficult
Control beliefs—enablers			
Social support	60	31.7	Companionship during exercise outings
More time	39	20.6	If I had more time
Access	29	15.3	Access to a fitness facility
Good weather	20	10.6	Nice weather to encourage me to get outside
Planning ahead	19	10.1	Planning ahead—setting alarm, setting out clothes, etc.
Enjoyment	16	8.5	I enjoy exercising and want to be fit

Table 4

Salient behavioral, normative, and control beliefs for meeting dietary recommendations during pregnancy (N = 189)

Nutrition	N	%	Participant quote
Behavioral beliefs—advantages			
Health benefits for baby	133	70.4	Good start for baby
Manages weight gain	98	51.9	Helps keep weight gain in the optimal range
Health benefits for mother	70	37.0	I feel healthier and have more energy
More energy	30	15.9	Giving me more energy throughout the day
Prevents health complications	27	14.3	Less chance of certain diseases for mom and baby
Feel better	21	11.1	Feel better when you eat better
Psychological advantages	11	5.8	Eating fresh and healthy makes me feel good about myself and what I am providing to baby
Behavioral beliefs—disadvantages			
Unable to indulge in cravings	56	29.6	Not being able to enjoy cravings
Requires more time and effort	36	19.0	Can be time consuming (trips to store and meal preparation)
Higher cost	30	15.9	It can be a lot more expensive to eat fresh produce and locally sourced foods
Enjoyment of unhealthy foods	14	7.4	Sometimes junk food just sounds better than veggies
Normative beliefs			
Husband	152	80.4	If my husband doesn't eat well, it makes it more difficult for me
Doctor	68	36.0	Midwives and Ob/Gyn involved in my care
Parents	45	23.8	My parents
Friends	30	15.9	My friends
Other children or baby	26	13.8	My toddler (I don't want him eating junk so I won't eat junk in front of him)
Control beliefs—barriers			
Cravings	81	42.9	Cravings for unhealthy foods
Lack of time	66	34.9	Sometimes my schedule is hectic and I grab food that is convenient
Cost	37	19.6	Price of healthy foods
Lack of energy	22	11.6	Too tired to prep food and cook
Negative influence of others	19	10.1	Influence of others who think that because you are pregnant it's okay to eat unhealthy foods
Nausea	17	9.0	Morning sickness made it hard to eat most foods during the first trimester
Control beliefs—enablers			
Planning ahead	43	22.8	Keeping pantry stocked with healthy snacks
Support from others	35	18.5	Having someone else help out and cook healthy meals
Access	27	14.3	More access to healthy food options
Thinking about benefits to baby	20	10.6	Focusing on how eating healthy is the best thing to do for the baby
More money or cheaper cost	20	10.6	More affordable fresh foods
Enjoyment	20	10.6	I enjoy eating healthy foods

Table 5

Pearson correlations (r), means (M), and standard deviations (SD), and ranges among the Theory of Planned Behavior constructs

Variable	r (p value)				n	M	SD	Range
	2	3	4	4				
Weight gain								
1. Intention	0.235 (0.001)	0.453 (<0.001)	0.164 (0.024)	0.164 (<0.001)	189	0.720	1.941	-3.0 to 3.0
2. Attitude		0.266 (<0.001)	0.099 (0.181)	0.099 (<0.001)	186	6.355	10.015	-21.0 to 21.0
3. Subjective norm			0.169 (0.020)	0.169 (<0.001)	189	0.804	1.597	-3.0 to 3.0
4. PBC					188	1.500	3.669	-9.0 to 9.0
Physical activity								
1. Intention	0.317 (<0.001)	0.331 (<0.001)	0.616 (<0.001)	0.616 (<0.001)	189	0.503	1.830	-3.0 to 3.0
2. Attitude		0.284 (<0.001)	0.358 (<0.001)	0.358 (<0.001)	185	11.97	8.530	-21.0 to 21.0
3. Subjective norm			0.334 (<0.001)	0.334 (<0.001)	189	1.339	1.334	-3.0 to 3.0
4. PBC					189	2.937	3.892	-9.0 to 9.0
Nutrition								
1. Intention	0.298 (<0.001)	0.376 (<0.001)	0.489 (<0.001)	0.489 (<0.001)	189	1.841	1.075	-3.0 to 3.0
2. Attitude		0.363 (<0.001)	0.243 (<0.001)	0.243 (<0.001)	186	14.618	7.860	-21.0 to 21.0
3. Subjective norm			0.377 (<0.001)	0.377 (<0.001)	189	2.048	1.007	-3.0 to 3.0
4. PBC					189	4.762	2.709	-6.0 to 9.0
PBC Perceived behavioral control								

Table 6

Hierarchical regression analyses for the Theory of Planned Behavior constructs and weight gain, physical activity, and nutrition intentions

Variables	β	R ²	Model F	F	Model p value	Variable t	Variable p value
Weight gain (n = 186)							
Block 1		0.22	26.06		<0.001		
Attitude	0.024					1.81	0.072
Subjective norm	0.512					6.26	<0.001
Block 2		0.23	18.05	8.01	<0.001		
Attitude	0.023					1.73	0.085
Subjective norm	0.496					6.01	<0.001
PBC	0.047					1.35	0.180
Physical Activity (n = 185)							
Block 1		0.15	16.34		<0.001		
Attitude	0.053					3.51	<0.001
Subjective norm	0.331					3.33	0.001
Block 2		0.39	39.05	22.71	<0.001		
Attitude	0.020					1.48	0.140
Subjective Norm	0.139					1.59	0.113
PBC	0.259					8.47	<0.001
Nutrition (n = 186)							
Block 1		0.16	17.8		<0.001		
Attitude	0.025					2.63	0.009
Subjective norm	0.302					4.03	<0.001
Block 2		0.29	25.32	7.52	<0.001		
Attitude	0.019					2.13	0.034
Subjective norm	0.164					2.25	0.025
PBC	0.158					5.83	<0.001

Bold values are statistically significant ($p < 0.05$)