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To cite this article: Hye Kyung Kim, Jeff Niederdeppe, Jamie Guillory, Meredith Graham, Christine Olson & Geri Gay (2015) Determinants of Pregnant Women's Online Self-Regulatory Activities for Appropriate Gestational Weight Gain, Health Communication, 30:9, 922-932, DOI: [10.1080/10410236.2014.905900](https://doi.org/10.1080/10410236.2014.905900)

To link to this article: <http://dx.doi.org/10.1080/10410236.2014.905900>



Published online: 10 Sep 2014.



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Determinants of Pregnant Women's Online Self-Regulatory Activities for Appropriate Gestational Weight Gain

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This study examined psychosocial and sociodemographic factors associated with pregnant women's use of Web-based tools to set and monitor personal goals for healthy diet and physical activity. These tools were made available to women participating in a randomized trial testing a Web-based intervention to promote appropriate gestational weight gain. We used data from a baseline survey of pregnant women assigned to the intervention group and log data on women's use of various intervention features ($N = 873$). Women who believed that appropriate gestational weight gain would lead to healthy outcomes for their child were more likely to engage in online goal-setting and self-monitoring. Less positive outcome expectancy beliefs about the relationship between their own weight and baby's health partially explains why some at risk subpopulations (e.g., African-American women) were less likely to utilize online self-regulatory tools. This study specifies key psychosocial and motivational factors that guide the construction and monitoring of goals among pregnant women. These findings offer guidance for the design of interventions to promote self-regulatory techniques by identifying groups for whom those features are most likely to be useful, as well as psychological determinants of their use.

Maternal obesity is an increasing health concern in the United States (Centers for Disease Control and Prevention [CDC], 2007). Research suggests that many women enter pregnancy already overweight or obese and gain excessive body weight during pregnancy (CDC, 2007). Excessive gains in body weight during pregnancy increase the likelihood of maternal complications, including the risk of cesarean section (a surgical procedure to deliver a baby when complications with gestation or delivery prevent a normal vaginal birth; Rhodes, Schoendorf, & Parker, 2003), gestational hypertension (blood pressure higher than 140/90), and gestational diabetes (high blood sugar levels that develop during pregnancy; Castro & Avina, 2002). Excessive gestational weight gain has also been associated with an increased risk of fetal macrosomia (a newborn with an excessive birth weight) and offspring obesity in infancy, childhood, and adulthood (Schack-Nielsen, Michaelsen, Gamborg, Mortensen, & Sørensen, 2010; Watkins, Rasmussen, Honein, Botto, & Moore, 2003). Furthermore, women who gain excessive weight during pregnancy are less likely to return to their original weight after giving birth, increasing their risk of other health and social consequences of adult obesity (Nehring, Schmoll, Beyerlein, Hauner, & von Kries, 2011).

Meta-analytic studies document the efficacy of dietary and lifestyle interventions for minimizing excessive gestational weight gain during pregnancy (Gardner, Wardle, Poston, & Croker, 2011; Thangaratinam et al., 2012). Accordingly, national guidelines for prenatal care recommend that health professionals prescribe regular physical activity and a nutritionally balanced diet to pregnant women to reduce excessive weight gain (Institute of Medicine, 2009). Further meta-analytic evidence, although not specific to gestational weight gain, suggests that diet and physical activity interventions are more effective when self-regulatory techniques are used (Michie, Abraham, Whittington, McAteer, & Gupta, 2009).

Self-regulation is a multifaceted construct that involves a number of cognitive processes, including goal-setting, self-monitoring, and evaluating one's performance (Bandura, 1991). *Goal-setting* is a strategy that mobilizes one's efforts toward attainment of personal standards or goals by asking a person to anticipate what it would take to reach those goals (Bandura, 1991). *Self-monitoring* refers to the systematic observation and recording of ongoing goal-directed activities (Krukowski, Harvey-Berino, Bursac, Ashikaga, & West, 2013). Within the general population, self-regulatory activities consistently predict weight loss outcomes in both in-person (Burke et al., 2008) and online behavioral intervention programs (Burke et al., 2011; Gold, Burke, Pintauro, Buzzell, & Harvey-Berino, 2007).

Although self-regulatory techniques have been used in several gestational weight gain interventions, none of them have utilized Web-based tools to set and monitor

weight-related goals. Health promotion interventions that utilize the Internet as a communicative medium have several advantages over in-person approaches, such as the capacity to reach a broad population (because they can be accessed at a low cost) and to increase ease and convenience of access to intervention features (because Web-based systems can record and display information in real time). In particular, Web-based interventions that offer self-regulatory features have the potential to promote healthy weight gain among pregnant women by providing individualized feedback and advice on physical activity and dietary intake during pregnancy because people often lack personal awareness of their own performance levels for complex self-regulatory behaviors (Kelders, Van Gemert-Pijnen, Werkman, Nijland, & Seydel, 2011).

It is largely unknown, however, for whom and why online self-regulatory features are most likely to be utilized among pregnant women. To enhance the effectiveness of online interventions designed to promote healthy gestational weight gain, it is important to first identify user characteristics and psychosocial factors that promote engagement. Researchers have addressed the possibility that Web-based interventions are least utilized among those who could benefit the most (Kelders et al., 2011; Verheijden, Jans, Hildebrandt, & Hopman-Rock, 2007). Within the general population, those who had room for improvement on physical activity and diet were less likely to utilize a Web-based intervention program (Kelders et al., 2011). Also, users of online interventions were generally knowledgeable about healthy behavior and had healthier life styles than nonusers (Kelders et al., 2011; Verheijden et al., 2007). This evidence suggests that at-risk populations for excessive gestational weight gain may also be less inclined to use online self-regulatory features on an intervention website.

Due to a variety of environmental, social, economic, and structural challenges, Hispanic women, African American women, and women of lower socioeconomic status are at elevated risk for excessive gestational weight gain (Schieve, Cogswell, & Scanlon, 1998; Setse, Grogan, & Cooper, 2008). Higher prepregnancy body mass index (BMI) has also been associated with heightened risk for excessive gestational weight gain and pregnancy complications (Okah, Hoff, & Cai, 2007; Shin & Song, 2012). Having other children in the home also reduces exercise participation among pregnant women because increased time demands of child care make parenthood a major barrier to physical activity (Gaston & Cramp, 2011; Godin, Vezina, & Leclerc, 1989). Because these at-risk pregnant women are most likely to benefit from online interventions, it is important to identify strategic approaches to encourage their use of online self-regulatory tools.

Researchers and practitioners worry that socially disadvantaged populations, including those with low income, limited years of formal education, or from minority racial or

ethnic groups, may have limited access to computers or the Internet (known as the digital divide; Zickuhr, 2013) or lack health literacy (Rudd, Kirsch, & Yamamoto, 2004) necessary to effectively utilize online intervention features (Bodie & Dutta, 2008). Beyond these social patterns, however, little is known about the beliefs and motivational factors that guide online self-regulatory activities among pregnant women who are at elevated risk for excessive weight gain. To our knowledge, only two studies have examined psychosocial factors associated with pregnant women's health behavior change (Kendall, Olson, & Frongillo, 2001; Wright et al., 2013). These studies utilized relatively homogeneous subpopulations (i.e., rural pregnant or urban low-income postpartum women), limiting the generalizability of their findings and precluding any comparisons between sociodemographic groups characterized by different levels of risk for excessive gestational weight gain. To our knowledge, no study has examined self-regulatory behavioral outcomes among pregnant women beyond weight gain outcomes.

To address these gaps in the literature, guided by the Social Cognitive Theory of Self-Regulation (Bandura, 1991), this study examines psychosocial and motivational factors that guide construction and monitoring of goals relevant to appropriate weight gain during pregnancy. Goal pursuit is initiated with the formation of a goal intention, which summarizes how people are willing to and plan to perform the goal-relevant behavior (Ajzen, 1991). The likelihood of self-regulation depends on the extent to which individuals are motivated to exert self-control, which is achieved by creating incentives or anticipated positive outcomes to one's own actions (Bandura, 1991). Because the valuation of behaviors is an important element in making self-regulatory decisions (Bandura, 1991), we expect that outcome expectancy beliefs (i.e., the belief that appropriate gestational weight gain would lead to healthier weight outcomes for the mother after delivery or for her child after birth) are likely to motivate pregnant women to engage in online self-regulatory activities related to diet and physical activity.

Self-efficacy, which refers to beliefs about one's own capabilities to exercise control over her/his behaviors, is another factor thought to play a central role in the exercise of self-regulatory agency (Bandura, 1989). Perceived self-efficacy is theorized to increase the performance of a health behavior directly (e.g., increasing physical activity itself) and indirectly through its effects on personal goal-setting and monitoring (Bandura, 1991). The more capable pregnant women evaluate themselves to be, the more likely they are to set (appropriate) goals for themselves and to firmly commit to them. Collectively, these psychosocial factors should help us better understand why some pregnant women choose not to use online self-regulatory tools, and thereby identify strategic ways to promote their engagement in a Web-based intervention.

STUDY OBJECTIVES

We intend to offer guidance for the design of interventions that involve online self-regulatory tools to promote healthy gestational weight gain. This study thus examined psychosocial and sociodemographic factors associated with pregnant women's use of Web-based tools made available in an intervention program to set and monitor personal goals for healthy diet and physical activity. We gauged a variety of psychosocial and sociodemographic factors found to predict gestational weight gain in previous studies or emphasized in relevant theories of behavior change and prediction (Ajzen, 1991; Bandura, 1991). Specifically, we examined the likelihood of online self-regulatory activities in association with a variety of sociodemographic factors linked to higher gestational weight gain (e.g., prepregnancy weight status, race, ethnicity, income status, parent status) (Objective 1). We also examined the extent to which psychosocial factors central to Social Cognitive Theory (Bandura, 1991), including outcome expectancy beliefs, self-efficacy beliefs, and intentions/motivation to engage in healthy dietary and physical activity behaviors, predict whether or not women used these goal-setting and self-monitoring tools (Objective 2). We further investigated whether these psychosocial factors explain group disparities in the utilization of online self-regulatory tools found from Objective 1 (Objective 3).

METHOD

Study Design

This article presents results from the analysis of data from a group of pregnant women enrolled in a Web-based intervention to promote appropriate gestational weight gain. Pregnant women living in a large and racially diverse metropolitan area within the northeastern United States between the ages of 18 and 35 years were invited to participate in a study to promote healthy pregnancy. All pregnant women who planned to deliver in one of four participating hospitals were eligible for the study. Additional eligibility criteria included: consented at or before 20 weeks gestation, available for a 24-month intervention, planned to carry their pregnancy to term and keep their baby, read and understood English, and had a valid e-mail address. Exclusion criteria included: BMI < 18.5 kg/m² or ≥ 35.0 kg/m², multiple gestation (e.g., twins), having had eating disorders or gastric bypass surgery in the past, having had three or more consecutive miscarriages, or the presence of prepregnancy medical conditions that could influence weight loss or gain. Informed consent was obtained at screening.

Eligible participants ($N = 1,664$) were randomized to one of three conditions: condition 1, a healthy weight intervention during pregnancy and postpartum ($n = 554$); condition

2, a healthy weight intervention during pregnancy only ($n = 556$); and condition 3, a non-weight-based control ($n = 554$). This article analyzes data from the pregnancy period of the study observation period, meaning that conditions 1 and 2 were functionally equivalent for the time period studied here. Participants in all three conditions had access to a variety of pregnancy-related information and features, including informational and interactive features that women could use to gather information and advice about pregnancy, maintain calendars for their appointments with prenatal care provider, and share experiences with other pregnant women who had access to the intervention website through a blog feature. The intervention conditions (1 and 2) provided participants with access to additional website features for setting and monitoring goals to support healthy weight gain during pregnancy.

Only those in the intervention groups (condition 1 and 2; $N = 1,110$) had access to online goal-setting and self-monitoring tools and were thus the focus of the analysis described here. We excluded those (a) who did not complete at least some portion of the baseline survey ($n = 178$; response rate 84%) and (b) who dropped out from the intervention program before delivery and those who miscarried, lost, or delivered a baby before 28 weeks gestation ($n = 59$), resulting in an analytic sample of $N = 873$ (see Table 1 for demographic characteristics). Effects of randomized treatment will be presented in future papers. All intervention materials, study procedures, and research instruments were approved by the institutional review boards of the principal

investigators' home institutions, as well as the four hospitals that agreed to participate in the study.

Prenatal Phase Online Intervention Program

Intervention features were designed to encourage pregnant women to achieve several behavioral targets for appropriate gestational weight gain at the prenatal stage. Specifically, the intervention encouraged three primary behavioral targets: women entering their weight regularly into the website's "weight gain tracker" feature (coinciding with their obstetrician [OB] visits), and taking appropriate action in the areas of diet or physical activity. Goal-setting and self-monitoring features were offered separately for healthy dietary and physical activity behaviors. We focus on use of tools related to diet and physical activity because these features involved both goal-setting and self-monitoring, both of which are essential components of self-regulation (Bandura, 1991).

For physical activity features, participants first reviewed information on physical activity during pregnancy and reported whether they had been physically active at prepregnancy and whether or not they can be physically active during pregnancy. Based on these assessments, the intervention website offered participants feedback, named appropriate goal areas (e.g., the type of activities that a participant should consider, like regular walking or taking the stairs), outlined barriers that could be encountered in the pursuit of those goals, and described strategies to overcome those barriers. Women were then prompted to set personal goals by specifying types of activities that they hoped to participate in, and a timeline for accomplishing these goals. Participants were also given opportunities to review and monitor goals that they had set. Women could come back to the website to monitor progress on (or simply remind themselves of) their physical activity goals.

Equivalent procedures were applied to the features relevant to healthy diet. Participants were advised to engage in different healthy eating behaviors (e.g., to eat enough vegetables, to eat appropriate portion sizes, not to eat high-fat foods) based on their responses to questions assessing common dietary problem areas. Then a participant indicated which issue area she would like to focus on at the time and the frequency and timeline to pursue the goal. The ability to review and monitor diet goals over time was the same as for physical activity features.

Measures

Goal-setting and self-monitoring behavior. Each participant's online activities were continuously and automatically monitored throughout the prenatal intervention period, which is from the program enrollment date to delivery date. Each goal-setting or self-monitoring entry was time stamped; entries that occurred after delivery were excluded

TABLE 1
Participant Demographics ($n = 873$)

	Proportion (n)
Prepregnant body mass index (BMI)	
Normal	.55 (479)
Overweight	.29 (257)
Class I obese ($30 \leq \text{BMI} < 35$)	.16 (137)
Race	
White or Caucasian	.67 (586)
Black or African American	.19 (169)
Other	.14 (118)
Hispanic or Latino	
Yes	.11 (98)
No	.89 (775)
Low income	
Yes	.39 (338)
No	.61 (535)
Highest level of education completed	
High school diploma or less	.25 (209)
Some college or technical school	.27 (223)
College degree or higher	.48 (404)
Number of children (under age 18 years)	
None	.41 (340)
One	.34 (280)
Two or more	.25 (205)

Note. Low income was defined as those who receiving or eligible to receive PCAP in the past 12 months.

from the analysis. We created a dichotomous variable to indicate whether or not a participant (a) set at least one goal, and (b) self-monitored that goal (or those goals) at least once. Women who set at least one dietary goal were assigned a code of 1, while women who never set a dietary goal were coded as 0. Women who monitored this goal at least once were assigned a code of 1 while women who never monitored a goal, as well as those who never set a goal to begin with were coded as 0. We applied the same coding procedure to physical activity goal-setting and self-monitoring.

Beliefs about weight control. Two types of beliefs relevant to weight control were assessed: outcome expectancy and self-efficacy. Positive outcome expectancies associated with appropriate weight gain during pregnancy were assessed in reference to both the baby's healthy weight and the participant's own healthy weight. On a 7-point scale (1 = *unlikely true for me*, 7 = *likely true for me*), participants indicated the extent to which they felt that each of three statements was true for them and her pregnancy. Responses to the following two statements were averaged to create a scale of positive outcome expectancy in reference to the baby's healthy weight: "Gaining the recommended amount of weight during pregnancy will help [me to have a baby with a healthy birth weight; my baby to have a healthy weight as he/she grows up to be a child]" ($r = .65$, $M = 6.04$, $SD = 1.28$). One item assessed outcome expectancy in reference to the participant's own healthy weight: "Gaining the recommended amount of weight during pregnancy will help me to be a healthy weight after my baby is born" ($M = 6.07$, $SD = 1.57$). To gauge weight control self-efficacy, we asked participants the following question: "How sure are you that you will be able to control the amount of weight you gain during this pregnancy?" ($M = 3.18$, $SD = 1.02$; 1 = *very unsure*, 5 = *very sure*).

Motivation and intention. We examined two direct measures of motivational orientation toward behavioral goals. For physical activity, intention was measured as a summary of the extent to which a participant planned to perform the goal-relevant behavior. Participants reported on "How likely is it that you will engage in 30 minutes of moderate-intensity physical activity on 5 or more days per week for the rest of this pregnancy?" (1 = *very unlikely*; 7 = *very likely*, $M = 4.77$, $SD = 1.96$). For healthy diet, we instead assessed "motivation to change" because people tend to define healthy diet differently (e.g., some consider the amount of food they take in, while others base this upon what they eat). For a healthy weight gain, both the quantity of diet and the quality of dietary intake need to be considered. Thus, motivation to change was a more feasible construct to assess a participant's orientation toward the behavioral goal. On a 7-point scale ranging from 0 (*not at all*) to 6 (*very much*), participants reported the extent to which they want to make changes in their eating habits during the current pregnancy ($M = 3.73$, $SD = 1.79$).

Demographic information and BMI. In the baseline survey, participants reported their race, ethnicity, number of children (to gauge parent status), and highest education completed (Table 1). Based on self-reported income level at the recruitment, those who were receiving or eligible to receive Prenatal Care Assistant Program (PCAP; expanded Medicaid for during pregnancy which is for those at less than 185% of poverty line) were categorized as "low income." BMI was calculated based on participant's prepregnancy body weight and height reported at the recruitment. Overweight ($25.0 \leq \text{BMI} < 30$) and class I obese ($30 \leq \text{BMI} < 35$) were combined into a single group to increase statistical power for comparisons with normal-weight women.

Analytic Approach

We began the analysis by describing rates of online goal-setting and self-monitoring between the two behaviors. To predict the likelihood of a participant engaging in online goal-setting and self-monitoring, we ran a series of logistic regressions for each recommended behavior, controlling for number of days from program enrollment to delivery (to account for differential availability of the intervention website). In the analyses relevant to physical activity, we excluded 33 participants who reported that they could not be physically active in the baseline survey. To address objective 1, prepregnancy BMI and sociodemographic factors associated with higher risk of excessive gestational weight gain in previous research (i.e., African American, Hispanic, low income, less educated women, parent status) were entered in the logistic regression models. To examine the extent to which psychosocial factors promote the likelihood of online self-regulatory activities (objective 2), beliefs about weight control and motivation/intention were added to the logistic regression models, controlling for BMI and sociodemographic factors. To address objective 3, we conducted multiple mediation analyses with the PROCESS macro (SPSS) to explore psychosocial mechanisms for observed group disparities in the utilization of online self-regulatory tools.

We also performed parallel regression analyses with counted behavioral outcomes (i.e., number of times each participant engaged in online goal-setting and monitoring of these goals) using negative binomial distribution, and found consistent patterns with the dichotomized outcome. For the sake of simplicity, we only report results with the dichotomized outcome, which also enabled us to test multiple mediation using the PROCESS macro.¹

¹PROCESS macro uses an ordinary least squares or logistic regression-based path analytical framework for estimating direct and indirect effects in multiple mediator models. Thus, the mediation analysis could not be performed with the counted behavioral outcome that follows negative binomial distribution.

RESULTS

Descriptive Patterns of Online Goal-Setting and Self-Monitoring

Comparable percentages of women engaged in goal-setting for the two recommended behaviors: 36.5% for healthy diet and 36.8% for physical activity. Twenty-six percent of women engaged in both physical activity and diet goal-setting, while 10.5% engaged in physical activity goal-setting only and 10.1% engaged in healthy diet goal-setting only. Self-monitoring of physical activity (29%) was slightly lower than that of healthy diet (35.6%). Twenty-two percent of participants self-monitored both behavioral goals (7.3% monitored only physical activity and 13.8% did only healthy diet). Among those who set physical activity goals ($n = 309$, $M = 1.72$, $SD = 1.46$) and healthy diet goals ($n = 319$, $M = 1.73$, $SD = 1.38$), 32% did so more than once (for both behaviors $Mdn = 1$, Range = 1–11). Among those who self-monitored physical activity goals ($n = 244$), 77% did so more than once ($M = 7.30$, $SD = 10.55$, $Mdn = 4$, Range = 1–87). Among those who self-monitored healthy diet goals ($n = 311$), 57% did so more than once ($M = 3.96$, $SD = 4.48$, $Mdn = 2$, Range = 1–29).

Online Goal-Setting and Self-Monitoring by BMI and Sociodemographic Groups

As shown in Table 2, overweight and obese women were significantly more likely to utilize healthy diet self-monitoring tools than normal weight-women. The odds of an overweight/obese woman engaging in healthy diet

self-monitoring were 1.35 times greater than the odds for a normal weight woman, Wald’s $\chi^2 = 4.03$, $p < .05$. The pattern was similar for diet goal-setting (odds ratio [OR] = 1.25, $p = .13$) and both physical activity goal-setting ($OR = 1.23$, $p = .17$) and self-monitoring ($OR = 1.28$, $p = .13$), but these differences were not statistically significant.

African American women were significantly less likely than non-African American women to engage in online physical activity self-monitoring. The odds of African-American women engaging in physical activity self-monitoring were .40 times lower than the odds for non-African American women (Wald’s $\chi^2 = 12.18$, $p < .001$). Although not statistically significant, the same basic pattern was found for physical activity goal-setting ($OR = .72$, $p = .15$) and diet goal-setting ($OR = .67$, $p = .07$) and self-monitoring ($OR = .70$, $p = .11$).

Pregnant women of Hispanic origin were less likely than non-Hispanic women to set physical activity goals (Wald’s $\chi^2 = 4.20$, $p = .04$) and self-monitor them (Wald’s $\chi^2 = 5.27$, $p = .02$). The odds of Hispanic women engaging in physical activity goal-setting were .57 times (for self-monitoring, .50 times) lower than the odds for non-Hispanic women. However, we found no differences in the odds of setting or monitoring dietary goals by ethnicity.

The likelihood of online goal-setting and self-monitoring did not statistically differ by income status for both recommended behaviors. Education level was a significant predictor of the likelihood of setting and monitoring of dietary goals. The odds of a woman with a college or higher degree engaging in healthy diet goal-setting was .57 times (for self-monitoring, .61 times) lower than the odds for a woman who only completed high school or lower degree, respectively

TABLE 2
Logistic Regression Results Predicting Online Goal-Setting and Self-Monitoring

	Physical Activity OR (β SE)				Healthy Diet OR (β SE)			
	Goal-Setting		Self-Monitoring		Goal-Setting		Self-Monitoring	
Intervention period	1.00 (.01)	1.00 (.01)	1.00 (.01)	1.00 (.01)	1.00 (.01)	1.00 (.01)	1.00 (.01)	1.00 (.01)
BMI group (0 = normal, 1 = overweight and obese)	1.23 (.15)	1.23 (.16)	1.28 (.16)	1.32 (.17)	1.25 (.15)	1.25 (.16)	1.34 (.15)*	1.37 (.16)*
African American (0 = no, 1 = yes)	.72 (.23)	.79 (.23)	.40 (.26)***	.44 (.27)**	.67 (.22)	.62 (.23)*	.70 (.22)	.65 (.23)
Hispanic (0 = no, 1 = yes)	.57 (.28)*	.59 (.28)	.50 (.30)*	.52 (.31)*	1.11 (.24)	1.12 (.25)	1.05 (.25)	1.05 (.25)
Low Income (0 = no, 1 = yes)	1.21 (.20)	1.16 (.20)	1.41 (.21)	1.31 (.21)	.76 (.19)	.82 (.20)	.79 (.19)	.85 (.20)
Education level (high school or less)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Some college or technical school	1.21 (.22)	1.16 (.22)	.93 (.23)	.89 (.24)	.94 (.21)	1.02 (.22)	.97 (.21)	1.06 (.22)
College degree or higher	1.05 (.23)	.95 (.23)	.91 (.24)	.83 (.25)	.57 (.22)*	.61 (.23)*	.61 (.22)*	.66 (.23)
Parent status (0 = no, 1 = yes)	.56 (.15)***	.60 (.16)**	.62 (.16)**	.68 (.16)*	.87 (.15)	.93 (.16)	.83 (.15)	.88 (.16)
Outcome expectancy: baby’s health		1.14 (.07)		1.18 (.08)*		1.17 (.07)*		1.17 (.07)*
Outcome expectancy: own health		.99 (.06)		.99 (.06)		.94 (.06)		.93 (.06)
Weight control self-efficacy		.86 (.08)		.94 (.09)		.97 (.08)		.98 (.08)
Intention to be physically active		1.13 (.04)**		1.13 (.05)**		—		—
Motivation to change diet						1.08 (.04)		1.06 (.04)

Note. OR = odds ratio (e^β , where β refers to individual regression coefficient). Parent status (yes = those who have at least one child before current pregnancy).

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

Wald's $\chi^2 = 6.44, p = .01, \chi^2 = 4.96, p = .03$. No differences were found in the likelihood of setting physical activity goals or monitoring these goals by education level.

Women with at least one child were less likely to set physical activity goals (Wald's $\chi^2 = 14.31, p < .001$) and self-monitor these goals (Wald's $\chi^2 = 8.65, p = .003$) than women planning to give birth to their first child. The odds of a woman with children engaging in physical activity goal-setting were .56 times (for self-monitoring, .62 times) lower than the odds of a woman without a child. No differences were observed for behaviors relevant to healthy diet.

Psychosocial Factors That Promote the Odds of Online Goal-Setting and Self-Monitoring

As presented in adjacent columns in Table 2, the expectation that appropriate gestational weight gain would help women to have a healthy-weight child was a consistent predictor of a woman's increased likelihood of using online goal-setting and self-monitoring tools for all four behaviors: (a) physical activity goal-setting ($OR = 1.14, Wald's \chi^2 = 3.14, p = .07$), (b) physical activity monitoring ($OR = 1.18, Wald's \chi^2 = 4.39, p = .04$), (c) healthy diet goal-setting ($OR = 1.17, Wald's \chi^2 = 5.00, p = .03$), and (d) healthy diet monitoring ($OR = 1.17, Wald's \chi^2 = 4.86, p = .03$). However, outcome expectancy beliefs relevant to women's own healthy weight after pregnancy were not associated with either of these online activities for either behavior.

Intention to engage in physical activity was a strong predictor of setting physical activity goals ($OR = 1.13, Wald's \chi^2 = 8.88, p = .003$) and monitoring these goals ($OR = 1.13, Wald's \chi^2 = 7.70, p = .006$). For each unit increase in intention, the odds of physical activity goal-setting and monitoring increased by a factor of 1.13. Motivation to change diet was marginally associated with the odds of diet

goal-setting ($OR = 1.08, Wald's \chi^2 = 2.84, p = .09$), but not monitoring these goals ($OR = 1.06, p = .17$). Contrary to our a priori expectations, the more confident pregnant women were about their weight control, the less likely they were to utilize the online physical activity goal-setting tool ($OR = .86, Wald's \chi^2 = 3.25, p = .07$). Self-efficacy was not associated with the likelihood of utilizing other tools (monitoring for physical activity, goal-setting, or monitoring for dietary behavior).

Mediation Analyses Examining Whether Psychosocial Factors Explain Group Disparities

Having confirmed that the likelihood of online self-regulatory activities differs by BMI and some sociodemographic groups, we performed mediation analyses to identify psychosocial mechanisms for these differences (objective 3). Online self-regulatory activities that showed group differences ($p < .05$) were subject to mediation analyses. Using methods developed by Preacher and Hayes (2008), path coefficients and bootstrap bias corrected confidence intervals (CI; 5,000 samples) were estimated in multiple mediator models. In each model, psychosocial factors that were significant predictors of each self-regulatory behavior were entered as potential mediators. Sociodemographic factors associated with each behavior were entered as covariates. We used multiple mediation models to determine whether an overall effect exists if multiple psychosocial factors are entered into the model (i.e., total indirect effect) and to what extent specific psychosocial factor mediates, conditional on the presence of other mediators. Table 3 presents these results.

Physical activity. African American and Hispanic women and women with children were less likely to engage

TABLE 3
Mediation of the Effect of BMI and Sociodemographic Factors on Online Goal-Setting and Self-Monitoring

IV → DV	Path Through Outcome Expectancy			Path Through Intention			
	IV → OE B (SE)	OE → DV B (SE)	Indirect Effect	IV → INT B (SE)	INT → DV B (SE)	Indirect Effect	Total Indirect Effect
<i>Physical activity</i>							
African American → SM	-.34 (.12)**	.12 (.07)+	-.04 (-.13, .001)	-.26 (.18)	.12 (.04)**	-.03 (-.10, .009)	-.07 (-.17, -.008)
Hispanic → SM	.01 (.15)	.12 (.07)+	.001 (-.05, .05)	-.11 (.23)	.12 (.04)**	-.01 (-.09, .04)	-.01 (-.10, .06)
Hispanic → GS				-.09 (.23)	.11 (.04)**	-.01 (-.08, .04)	-.01 (-.08, .04)
Parent Status → SM	-.37 (.09)***	.12 (.07)+	-.05 (-.12, .001)	-.25 (.14)+	.12 (.04)**	-.03 (-.08, -.001)	-.08 (-.16, -.02)
Parent Status → GS				-.27 (.14)+	.11 (.04)**	-.03 (-.08, -.001)	-.03 (-.08, -.001)
<i>Healthy Diet</i>							
BMI → SM	-.28 (.10)**	.14 (.07)+	-.04 (-.11, -.002)				-.04 (-.11, -.002)
Education level → SM	.32 (.10)**	.14 (.07)+	.05 (.003, .13)				.05 (.003, .13)
Education level → GS	.34 (.10)**	.12 (.07)+	.04 (-.002, .12)				.04 (-.002, .12)

Note. Point estimate of indirect effects (bias corrected 95% confidence interval) with 5,000 bootstrap samples. SM = self-monitoring, GS = goal-setting. OE = outcome expectancy about baby's health, INT = intention to be physically active.

+ $p < .10$. ** $p < .01$. *** $p < .001$.

in online self-regulatory activities related to physical activity. Outcome expectancy about baby's healthy weight and intentions to be physically active were examined as potential mediators to explain these differences (for goal-setting, only intention was included). Controlling for ethnicity and parent status, African American women reported significantly lower outcome expectancy beliefs than non-African Americans ($b = -.34$, $t = -2.80$, $p = .005$). Intention to be physically active did not differ by racial status ($p = .16$). The total indirect effect was significant (95% CI = $-.17$ to $-.008$), although only outcome expectancy beliefs emerged as a significant mediator (95% CI = $-.13$ to $-.001$) between African American race and the likelihood of self-monitoring, but not intention to be physically active (95% CI = $-.10$ to $.01$).

Controlling for race and parent status, outcome expectancy about baby's health and physical activity intention did not differ by Hispanic ethnicity (respectively, $p = .95$, $p = .62$). The bias-corrected 95% CI for the indirect effects of both outcome expectancy and intention on self-monitoring contained zero (respectively, CI = $-.05$ to $.05$, CI = $-.09$ to $.04$), indicating no mediation. Intention was not a significant mediator either for setting physical activity goals.

Accounting for race and ethnicity, women with at least one child had lower intentions to be physically active ($b = -.25$, $t = -1.75$, $p = .08$) and lower outcome expectancy beliefs about baby's health ($b = -.37$, $t = -4.04$, $p < .001$) than women planning to give birth to their first child. The total indirect effect through two mediators was significant on self-monitoring (CI = $-.16$ to $-.02$). Only intention emerged as a significant mediator (CI = $-.08$ to $-.001$), but not outcome expectancy (CI = $-.12$ to $.001$). For goal-setting, the bias-corrected 95% CI for the indirect effect of intention did not contain zero (CI = $-.08$ to $-.001$), indicating significant mediation.

Healthy diet. The odds of healthy diet self-regulatory activities differed by prepregnancy BMI status and education level. Outcome expectancy about baby's healthy weight was examined as a potential mediator of the effect of BMI status (or education level) on behavioral outcomes related to healthy diet. Controlling for the education level, overweight and obese women had significantly lower outcome expectancy belief compared to normal weight women ($b = -.28$, $t = -2.77$, $p = .006$) and the bias-corrected 95% CI for the indirect effect of outcome expectancy on self-monitoring did not contain zero (CI = $-.11$ to $-.002$; i.e., a significant mediation).

Compared to high school or lower degree holders, women with college or higher degree perceived significantly higher outcome expectancy beliefs ($b = .32$, $t = 3.07$, $p = .002$). The bias-corrected 95% CI for the indirect effect of outcome expectancy on diet self-monitoring did not contain zero (CI = $.003$ to $.13$, i.e., a significant mediation), but it did for diet goal-setting (CI = $-.002$ to $.12$, i.e., no

mediation). These mediation results suggest that outcome expectancy about baby's healthy weight likely to play a role in the construction of dietary self-monitoring behaviors. However, its indirect effect was in the opposite direction of the total effect that we observed by BMI status or education level. Although some psychosocial factors differed by BMI status or education level, we were unable to identify mechanisms that explain higher utilization of diet self-monitoring tools among overweight/obese women (or lower utilization among those with higher education level). For instance, overweight and obese women were more motivated to change their diet habit during pregnancy than were normal-weight women ($M = 4.02$, $M = 3.48$), $t(830) = -4.38$, $p < .001$. However, this factor was not associated with their diet self-monitoring, thus ruling out its possible role as a mediator.

DISCUSSION

This article investigated sociodemographic and psychosocial factors that predict the use of online goal-setting and self-monitoring features designed to promote appropriate weight gain among pregnant women. Although online self-regulatory activities are likely to enhance weight control outcomes, only about 37% of pregnant women in the intervention group utilized these features on the program website. This suggests considerable room for change in pregnant women's utilization of online self-regulatory tools for appropriate gestational weight gain. To reduce adverse maternal and child health outcomes associated with excessive gestational weight gain, it is an important task for health professionals to promote self-regulatory activities relevant to healthy diet and physical activity among pregnant women. We offer useful information to encourage the use of online self-regulatory tools among those women who are at elevated risk of excessive gestational weight gain by specifying psychosocial and motivational factors that guide their setting and monitoring of diet and physical activity goals.

Within the general population, some research suggests that demographic factors such as race and socioeconomic status do not predict effective use of online weight self-management tools (Krukowski et al., 2013; Sevick et al., 2010). In this study sample, the likelihood of goal-setting and monitoring did not differ by pregnant women's income status. Yet we found some variations in online self-regulatory activities by pregnant women's race, ethnicity, and education level. In particular, African American women, who are at elevated risk for excessive gestational weight gain, were less likely than non-African Americans to utilize online goal-setting and monitoring features relevant to physical activity. This is consistent with the notion that those who could benefit most are least likely to utilize online applications (Kelders et al., 2011; Verheijden et al., 2007). Our finding further suggests that this disparity can be partially explained by African American women's lower positive outcome expectancy that

appropriate weight gain would lead to their baby's healthy weight.

It has been suggested that the valuation of behaviors is an influential factor when making self-regulatory decisions (Bandura, 1989, 1991). Parental responsibility has been emphasized in addressing childhood obesity, as parents have some control over their child's nutrient intake and possibilities for physical activity (Holm, 2008). Similarly, positive outcome expectancy beliefs related to the baby's healthy weight constantly predicted online self-regulatory activities and thus appear to be an important element for the valuation of weight control activities among pregnant women. On the other hand, expectancy about one's own weight after pregnancy appears to be less influential for pregnant women in making diet and physical activity related self-regulatory decisions. Collectively, enhancing positive outcome expectancies for the impact of the mother's weight on baby's health (rather than the mother's own health) appears more likely to lead to better utilization of online weight management tools among pregnant women.

Women with at least one child were less likely to utilize physical activity goal-setting and monitoring features than their previously childless counterparts, consistent with the literature that documents parenthood as a major barrier to physical activity among young mothers and pregnant women (Gaston & Cramp, 2011; Godin et al., 1989). In addition to lower outcome expectancies about baby's healthy weight, those who already have children reported lower intentions to be physically active. This intention was in turn predictive of online goal-setting and self-monitoring, in line with the assertion that intention formation precedes implementation action plans and goal striving (Bagozzi & Dholakia, 1999; Bandura & Simon, 1977). Specific to the behavioral goals relevant to physical activity, the indirect effect through intention was stronger than the effect through outcome expectancy beliefs about baby's healthy weight. Thus, intention formation would be an important step toward promoting physical activities among pregnant women, especially for those already with children. It remains unclear how best to promote these intentions, since pregnant women with children have already experienced a previous pregnancy and presumably draw on this experience in shaping their intentions for future behavior. This remains a key question for future research.

Pregnancy is thought to be a "teachable moment" with heightened motivation and ability to change health behaviors (Linde, Rothman, Baldwin, & Jeffery, 2006). Higher prepregnancy BMI, overweight and obese, appeared to be an important motivator for pregnant women to engage in healthier dietary behavior through online self-monitoring activities, despite their lower positive outcome expectancy compared to normal weight women. Overweight and obese women reported higher motivation to modify dietary behavior during pregnancy, suggesting that they recognize the need to restrict the amount of gestational weight gain in

line with Institute of Medicine (IOM) guidelines. However, motivation to make changes in one's own eating habits was only marginally associated with diet goal-setting, and not associated with the monitoring of these goals. Although we can only speculate, this may be due to overweight and obese women's frustration with their attempts to monitor and control their diet prior to their pregnancy. Alternatively, it may be due to the nonalignment between the motivation measure used here (*change* in diet) and the targeted goal-relevant behavior (healthy diet). Only baby-oriented outcome expectancy appeared to be a significant mediator, but this was in the opposite direction of the total effect. More research is required to better understand psychosocial factors that promote or suppress self-regulatory activities among obese and overweight women who are at a higher risk for adverse maternal and child health outcomes.

Perceived self-efficacy is thought to enhance the likelihood of performing health-promoting behaviors, possibly mediated through self-regulatory activities such as goal-setting and self-monitoring (Bandura, 1991). Contrary to this assertion, self-efficacy was not associated with healthy diet self-regulatory activities. Furthermore, we found some indication ($p = .07$) that the more people evaluated themselves to be capable of weight control, the less likely they were to utilize physical activity goal-setting features on the intervention website. This is not unprecedented in research on Internet-based weight loss programs. For instance, one study reported that individuals with higher baseline self-efficacy scores were less likely to be engaged in and to adhere to the Internet-based intervention program (Glasgow et al., 2007). It is noteworthy that the measure of self-efficacy in the current study was not specific to physical activity; it covered pregnant women's general sense of weight control. Pregnant women may perceive online self-regulatory tools as a supplement to their own means of weight control, and when they are sufficiently confident about their weight control, they may not see the utility of this supplementary feature.

Despite the notion of disparities in the utilization of technology by years of formal education, women with college or higher degree were less likely to utilize healthy diet self-regulatory tools made available in the intervention website. Consistent with our finding, Nijland, van Gemert-Pijnen, Boer, Steehouder, and Seydel (2009) also found that individuals who were less educated were more motivated to utilize e-consultation than those who are highly educated. Research suggests that mobile application users are more educated than nonusers (Purcell, 2010). Mobile health applications, in particular, are utilized more frequently by those who attended college than those with less formal education (Fox, 2010). In light of these broader patterns of use, it is possible that women with college degrees have already used alternative tools for weight management (including mobile health applications) that offer detailed goal-setting and monitoring tools, making them less inclined to use similar features

in our intervention website. Future research should further address the relationships between perceived self-efficacy, prevalence of alternative tools, and the likelihood of online self-regulatory activities.

Study Strengths and Limitations

We recruited a demographically diverse group of pregnant women with varying socioeconomic status, prepregnancy BMI, race, and ethnicity. The diversity in demographics enabled us to investigate group disparities in the utilization of online self-regulatory tools. Literature is sparse regarding psychosocial reasons why some sociodemographic groups are at a higher risk of excessive gestational weight gain. We sought to fill this gap by examining associations between theory-guided constructs and behavioral outcomes relevant to weight management. Although research suggests that consistent online self-monitoring enhances long-term weight loss outcomes within the general population (Krukowski et al., 2013), further study is warranted to confirm this relationship among pregnant women.

Hispanic women were less likely to utilize physical activity features on the intervention website, and outcome expectancy about baby's health was not a significant mediator that explained this group disparity. Some research documents cultural norms in the Hispanic community of being sedentary due to the negative belief that physical activity is unsafe during pregnancy (Mudd, Nechuta, Pivarnik, Paneth, & the Michigan Alliance for the National Children's Study, 2009; Thornton et al., 2006). Less utilization of online tools related to physical activity found here may also be attributed to this cultural difference. There may be other important cultural differences to consider as well—for instance, different perceptions of healthy baby weight or the desire to control one's prenatal or postpartum weight. Future research should address these cultural factors, as they may differentially guide the construction and monitoring of physical activity goals among pregnant women.

All pregnant women who planned to deliver in one of four participating hospitals in the study region were eligible for the study. There is also the potential for selection bias because we only included those who completed some portion of the baseline survey in our analytic sample. Thus, findings from this study should be cautiously applied to the population of pregnant women with different demographic characteristics. This study monitored online self-regulatory activities that were available only on the intervention website. Thus, it is unknown whether participants were using other weight management tools aside from our intervention program.

Conclusions

The study findings offer guidance for the design of interventions to promote self-regulatory techniques by identifying

groups for whom those features are most likely to be useful and addressing possible reasons why some demographic groups did not use these tools. Messages targeting the belief that that appropriate weight gain is likely to lead to their baby's healthy weight could provide a unique opportunity to promote the utilization of online weight management tools among pregnant women.

FUNDING

This research was supported by the National Heart, Lung, and Blood Institute and Eunice Kennedy Shriver National Institute of Child Health and Human Development (NIH Grant No. HL096760). Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the funding institutions. Dr. Kim was a PhD Candidate at Cornell University during the data collection period of the study.

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