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Perceived Weight Gain as a Correlate of Physical Activity and Energy Intake Among White, Black, and Hispanic Reproductive-Aged Women

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Abstract

Objective: To estimate the effects of perception of weight gain on women's physical activity and eating behaviors over time.
Methods: A total of 608 women self-reported their experience regarding perceived weight gain and physical activity at baseline and every 6 months thereafter for 36 months. Data about dietary habits were obtained every 12 months. Longitudinal relationships of perceived weight gain with physical activity and total energy intake were assessed using mixed model regression analysis after adjusting for age, race/ethnicity, obesity, and lifestyle variables. Effect of body esteem scores on physical activity and energy intake was also examined.
Results: At baseline, of 608 reproductive-aged women, 129 (21.2%) reported perceived weight gain, whereas 479 (78.8%) did not. Perceived weight gain was not associated with changes in physical activity over the period of 36 months (−8.04 min/week, 95% confidence interval [CI] −20.80-4.72 min/week, $p = 0.22$). A separate mixed model based on annual follow-up data over 36 months showed that those who perceived weight gain were more likely to have higher energy intake over time (112 Kcal/day higher, 95% CI 23-200 Kcal/day, $p = 0.01$). Body esteem was not associated with changes in physical activity over time (−0.13 min, 95% CI −0.44-0.18 min, $p = 0.41$) or energy intake over time (<1 Kcal/day, 95% CI −2-2 Kcal/day, $p = 0.82$).
Conclusions: Neither perceived weight gain nor body esteem was associated with increased physical activity or decreased total energy intake. Rather, increased energy intake was observed among women who perceived weight gain. Future research should look at additional potential cues to action for behavior changes related to physical activity or energy intake.

Introduction

The prevalence of obesity and overweight is increasing rapidly in the United States.[1] Recent public health campaigns have focused on raising people's awareness of the health implications of obesity and suggest steps that individuals may take to decrease their risk of obesity, such as increasing physical activity and changing nutritional habits.[2,3] Population-level data indicate, however, that most people have not changed their lifestyles.[4,5] It is possible that individuals may need additional motivators to initiate weight gain prevention and weight loss. The Health Belief Model offers some potential explanation for the mechanisms underlying behavior change. The model is based on six components: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy. Public health campaigns on obesity have addressed that most Americans are susceptible to weight gain, and weight gain can cause obesity-related health problems. In addition, people seem to have knowledge about the benefits and barriers to maintaining a healthy weight,[6,7] but perhaps individuals may need a personal motivator to spur them into action. The Health Belief Model calls for a cue to action to trigger actions to address a specific health concern, such as obesity. We hypothesized that perception of weight gain may serve as a cue to action for increasing physical activity and decreasing dietary energy intake.

One group that is at particularly high risk for weight gain is reproductive-aged women.[8–10] Whereas most previous studies have used perception of weight status (e.g., underweight,

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normal, overweight, obese) as a correlate of physical activity[7,11] and dietary intake, we focused on perceived weight gain over the last 3 months to explore whether perceived weight gain is a useful estimator of behavior change. Specifically, the purpose of this study was to examine the association of perceived weight gain with changes in physical activity behavior and dietary energy intake in reproductive-aged women participating in a 3-year study on contraceptive use and bone mineral density (BMD). We also explored if these associations differ according to age, race/ethnicity, body mass index (BMI), parity, contraceptive method, and body esteem.

Materials and Methods

As part of a larger study, 805 non-Hispanic black, non-Hispanic white, and Hispanic women between 16 and 33 years of age were recruited between October 9, 2001, and September 14, 2004. The methods for the larger study are reported in detail elsewhere.[12] Briefly, recruitment was conducted to achieve a sample that was balanced by age group (16–24 years and 25–33 years), race (black, white, Hispanic), and contraceptive method: nonhormonal (NH), oral contraceptives (OCs), and depot medroxyprogesterone acetate injections (DMPA). Of the 805 women who signed a consent form for the larger study, 197 women were excluded from these analyses because the baseline symptom checklist was not completed ($n = 95$), some failed additional screening tests ($n = 92$), or the Data and Safety Monitoring Board (DSMB) removed them from the study because of a T-score ≤ -2.5 ($n = 5$). Women who were excluded from analysis ($n = 197$) did not differ from women included in the analyses ($n = 608$) on age, marital status, parity, education, or income (all $p > 0.05$). Written informed consent was obtained from all participants; parental consent was obtained for participants <18 years of age. All procedures were approved by the Institutional Review Board at the University of Texas Medical Branch at Galveston.

The Exercise Module of the Behavioral Risk Factor Surveillance System (BRFSS) questionnaire was used to assess the frequency and duration of physical activity.[13] This measure lists 56 common activities and asks participants to identify up to 2 activities performed during the past month and report the number of minutes per week they engaged in these activities. The Compendium of Physical Activities and the Scoring System for the Physical Activity Questions of the BRFSS were used to classify the physical activities as mild, moderate, or vigorous.[13,14] Physical activity was expressed as the number of minutes per week spent in all types of physical activities. Participants reported their physical activities every 6 months from baseline to 36 months (i.e., baseline, 6 months, 12 months, 18 months, 24 months, 30 months, 36 months).

Participants also completed a symptom checklist including questions on perceived weight gain every 6 months from baseline to 36 months. Women responded Yes to indicate they had gained weight in the past 3 months or No if not. To obtain estimates on daily energy intake along with amount of protein, fat, and carbohydrate consumed, a registered dietitian conducted a 24-hour dietary recall interview with each participant annually (i.e., baseline, 12 months, 24 months, 36 months). Nutrient calculations were performed using the Nutrition Data System for Research (NDS-R) software, version 4.05 (Nutrition Coordinating Center, University of Minnesota, Minneapolis).[15]

Information on body esteem was obtained every 6 months using the multidimensional Body Esteem Scale (BES).[16] The BES measures body esteem in women according to three gender-specific subscales: sexual attractiveness (13 items), weight concern (10 items), and physical condition (9 items). The possible range of total body esteem scores is 32–160; higher scores indicate higher body esteem. Although one of the subscales is labeled Weight concern, a higher score reflects greater satisfaction, not concern or negativity, as the label would suggest. The BES has been shown to be reliable and valid [17] and has been used previously with adult women.[18,19] Baseline measures of BES showed high internal reliability for the overall scale, Cronbach's $\alpha = 0.95$, as well as the subscales: sexual attractiveness ($\alpha = 0.90$), weight concern ($\alpha = 0.92$), and physical condition ($\alpha = 0.90$).

Student's t tests for continuous variables and chi-square test for categorical variables were used for descriptive analyses. Longitudinal analyses were conducted to determine changes in duration of physical activity along with their predictors over time. To accommodate the repeated measurements (e.g., perceived weight gain, physical activity, energy intake, body esteem), the data were modeled using Stata's mixed effects regression procedure (xtmixed module) (Stata Corp., College Station, TX). This random intercept model allowed us to obtain regression coefficients for various predictors while adjusting for the estimated errors for the repeated measurements. This class of model also allows inclusion of time-dependent covariates and accommodates subjects with incomplete data due to variation in number and spacing in observations over the period of follow-up, which frequently occurs in longitudinal studies.

The primary outcomes of interest were (1) duration of physical activity and (2) energy intake. To examine the overall effect of perceived weight gain, contraceptive method, race, and duration of follow-up, our models included perceived weight gain (yes/no), contraceptive method (OC/DMPA/NH), race/ethnicity, and duration of follow-up (time) as main effects after adjusting for other covariates. Interaction terms (perceived weight gain×method, perceived weight gain×race/ethnicity) were then included in the model. The interaction term between perceived weight gain and contraceptive method was included to estimate the changes in physical activity over time in different contraceptive users. Other variables, such as age, income, education, marital status, parity, baseline BMI, lifestyle variables (e.g., smoking, alcohol use), total scores of each BES subscale (sexual attractiveness, weight concern, and physical condition), were also included in the model if $p \leq 0.20$ was found in the bivariate analysis with the outcomes of interest or main exposure variable. Similar mixed models were also constructed to examine the effect of perceived weight gain on daily energy intake (based on 12-month follow-up data). All analyses were performed using SPSS 16.0 (SPSS, Chicago, IL) or STATA 10.

Results

Demographics

At baseline, the total sample included 178 blacks, 205 whites, and 225 Hispanics with a mean age of 24.8 (±5.0) years. Of the 608 subjects, 218 chose OCP, 219 chose DMPA,

and 171 chose NH. In all, 179 reported perceived weight gain at baseline, and 429 did not (Table 1). At baseline, these two groups were similar with regard to age, contraceptive method chosen, marital status, education, income, parity, age at menarche, physical activity, prior use of DMPA and OC, total energy intake, and intake of protein, fat, and carbohydrate (Table 1). Overall, women who reported perceived weight gain were more likely to have higher body weight and BMI and lower scores for body esteem.

Racial differences in baseline characteristics

As shown in Table 1, black and Hispanic women were more likely to report perceived weight gain than white women. Black women (mean [M] = 119.47) had significantly higher overall body esteem than Hispanic women (M = 109.76) and white women (M = 105.52) (both $p < 0.001$). White and Hispanic women did not significantly differ in body esteem ($p = 0.156$). When looking at the subscales of body esteem, the same pattern emerged for sexual attractiveness and physical condition. When examining weight concern, however, all three groups were significantly different from each other, with whites having the lowest score (M = 31.61), followed by Hispanics (M = 33.64), and blacks (M = 36.59) (all $p < 0.05$).

Perceived weight gain and physical activity

Irrespective of the perceived weight gain reported, duration of mean physical activity declined significantly over time (Table 2). Mixed model regression analysis, after adjusting for age, race/ethnicity, lifestyle variables, and other covariates, showed that perceived weight gain was not associated with changes in physical activity over the period of 36 months (−8.04 min/week, 95% confidence interval [CI] −20.80-4.72 min/week, $p = 0.217$) (Table 3). In addition, duration of physical activity of DMPA users declined significantly more than that of NH users. To further examine this association, we used an interaction term between contraceptive method and perceived weight gain status in the mixed model regression

Table 1. Baseline Characteristics of Study Population According to Perceived Weight Gain Status ($N = 608$)

	Perceived weight gain		
Characteristic	*Yes* (n = *179*)	*No* (n = *429*)	p
	Number of study subjects (%)[a]		
Age, years			0.626
16–24	90 (50.3)	225 (52.5)	
25–33	89 (49.7)	204 (47.5)	
Race/ethnicity			0.020
Black	62 (34.6)	116 (27.0)	
White	46 (25.7)	159 (37.1)	
Hispanic	71 (39.7)	154 (35.9)	
Contraceptive method			0.148
NH	54 (30.2)	117 (27.3)	
DMPA	54 (30.2)	165 (38.5)	
OC	71 (39.7)	147 (34.3)	
Currently married	54 (30.2)	112 (26.1)	0.306
High school graduate	141 (78.8)	327 (76.2)	0.497
Income (annual household)			0.784
Unknown	4 (2.2)	10 (2.3)	
<$15,000	52 (29.1)	111 (25.9)	
$15,000–$29,999	41 (22.9)	113 (26.3)	
≥$30,000	82 (45.8)	195 (45.5)	
Initial obesity (BMI ≥30)	82 (45.8)	107 (24.9)	<0.001
Ever been pregnant	121 (67.6)	283 (66.0)	0.698
	Mean ± SD		
Weight (kg)	77.2 ± 18.6	69.9 ± 18.1	<0.001
BMI	29.7 ± 6.6	26.7 ± 6.6	<0.001
Age at menarche	12.1 ± 1.6	12.4 ± 1.4	0.061
Parity	1.2 ± 1.3	1.2 ± 1.2	0.792
Physical activity (min/week)	95 ± 103	103 ± 104	0.388
Energy intake (Kcal/day)	1812 ± 820	1720 ± 819	0.210
Fat intake (g/day)	73 ± 41	70 ± 44	0.393
Protein intake (g/day)	64 ± 34	64 ± 37	0.953
Carbohydrate intake (g/day)	227 ± 108	210 ± 103	0.059
Total body esteem score	106 ± 23	113 ± 23	<0.001
Sexual attractiveness score	44 ± 9	47 ± 9	<0.01
Weight concern score	32 ± 8	35 ± 8	<0.001
Physical condition score	30 ± 7	32 ± 7	<0.001

[a]Data are *n* (%) or mean ± standard deviation. Student *t* tests were used for continuous variables, and chi-square tests were used for categorical variables.

BMI, body mass index; DMPA, depot medroxyprogesterone acetate; NH, nonhormonal; OC, oral contraceptive.

Table 2. Changes in Perceived Weight Gain, Physical Activity, and Total Calorie Intake over Study Period

	Perceived weight gain[a] (n = *179*)			*Did not perceive weight gain*[a] (n = *429*)		
Follow-up visit	*Number of women (% of total)*	*Mean duration of physical activity (min/week)*[b]	*Mean energy intake (Kcal/day)*[c]	*Number of women (% of total)*	*Mean duration of physical activity (min/week)*[b]	*Mean energy intake (Kcal/day)*[c]
Baseline	179 (29)	95	1812	429 (71)	103	1720
6 months	161 (34)	114		307 (66)	119	
12 months	138 (37)	94	1867	233 (63)	89	1653
18 months	97 (32)	84		206 (68)	89	
24 months	79 (31)	71	1729	175 (69)	85	1603
30 months	66 (35)	69		125 (65)	71	
36 months	50 (32)	39	1784	108 (68)	62	1603

[a]Perceived weight gain status was based on weight gain perceived during the 3 months before follow-up visit.
[b]Mean physical activity duration decreased significantly over the period.
[c]Mean calorie intake was measured every 12 months.

analysis to identify if any particular contraceptive method with perceived weight gain would make participants prone to changes in physical activity. No significant relationship was identified from this analysis. Those who ever delivered a child were more likely to have lower physical activity than those who did not. Age, race/ethnicity, BMI, lifestyle variables, BES scores and subscales (sexual attractiveness score, weight concern score, and physical condition score) were not significantly associated with physical activity.

Perceived weight gain and energy intake

Energy intake was measured every 12 months from baseline to 36 months (Table 2). Separate mixed model analysis, based on annual follow-up data over 36 months and adjusting for covariates, showed that those who reported perceived weight gain were more likely to have higher energy intake over time (112 Kcal/day higher, 95% CI, 23-200 Kcal/day, $p = 0.013$) (Table 3). Racial differences were observed in this relationship; black women with perceived weight gain were more likely to have higher energy intake than their white counterparts (282 Kcal higher, $p = 0.005$). A similar phenomenon was observed in Hispanic women, although statistical significance at $p < 0.05$ was not achieved (91 Kcal, $p = 0.261$). Age, contraceptive method, lifestyle variables, and BES scores and its subscales (sexual attractiveness score, weight concern score, and physical condition score) were not significant predictors of energy intake. No interactions were observed

Table 3. Association of Perceived Weight Gain with Physical Activity and Total Energy Intake over 36 Months Based on Mixed Model Regression Analysis

	Physical activity (min/week)[a]			*Total energy intake (Kcal/per day)*[a]		
Characteristic	*Coefficient*	*95% confidence interval*	p	*Coefficient*	*95% confidence interval*	p
Perceived weight gain (1, yes; 0, no)[b]	−8.04	−20.80-4.72	0.217	111.57	23.33-199.81	0.013
Total body esteem score[c]	−0.13	−0.44-0.18	0.410	−0.24	−2.29-1.81	0.817
Race[d]						
Black	−12.57	−34.17-9.04	0.254	125.07	−15.73-265.86	0.082
Hispanic	−5.57	−24.27-13.14	0.560	57.27	−64.01-178.56	0.355
Contraceptive method[e]						
DMPA	−19.89	−38.91-−0.88	0.040	−0.20	−124.24-123.83	0.997
OC	8.00	−10.71-26.71	0.402	−95.86	−217.35-25.62	0.122
Body mass index (kg/m^2)	−0.57	−1.77-0.63	0.351	−8.15	−16.02-−0.29	0.042
Ever been pregnant (1, yes; 0, no)[b]	−20.18	−38.10-−2.26	0.027	6.07	−110.64-122.78	0.919
Physical activity (min/week)				−0.17	−0.54-0.20	0.372
Total energy intake (100 Kcal/day)	−0.36	−1.15-0.42	0.364			

Dependent variable: Physical activity (min/week); total caloric intake (Kcal/day).
[a]Models were adjusted for age (16–24 and 25–33 years), income (US$ <15,000 15,000–29,999, ≥30,000), current smoker (1, yes, 0, no), alcohol use (at least 2–4 times/month), and duration of follow-up (months).
[b]Reference category: 0.
[c]Based on 32 items; higher scores indicate higher body esteem. Three body esteem subscales (sexual attractiveness 13 items, weight concern 10 items, and physical attractiveness 9 items) were also included in the model separately because they were highly co-linear, but statistical significance was not observed.
[d]Reference category: White.
[e]Reference category: Nonhormonal contraception.

between perceived weight gain and contraceptive methods with regard to changes in energy intake.

Discussion

In this longitudinal study, we used the Health Belief Model as a theoretical framework to examine if perceived weight gain functions as a cue to action for behavior change in reproductive-aged women. Our study findings make a novel contribution to the literature by examining women's perception of weight gain as a possible cue to action, whereas most previous studies have focused on weight status or BMI[6,8] as a variable of interest.[2,7,11,20] Contrary to our expectations, we found that women with perceived weight gain did not have increased duration of physical activity or reduced amount of energy intake and were more likely to have greater energy intake than women who did not perceive weight gain. This is troubling, as it suggests that knowledge about weight gain does not increase women's healthy habits.

Perceived weight gain was not associated with increased physical activity over time. Although our study used a different variable of interest (i.e., perceived weight gain) than previous studies, a few comparisons can be drawn. Similar to other studies,[6] we found that physical activity declined over time for women irrespective of weight gain status. One potential explanation for the decline in physical activity is parity. Parity was associated with less physical activity in our participants. This supports current literature that shows women with children are less physically active because of lack of free time, lack of access to exercise facilities, or lack of child care.[21] Future studies may benefit from including direct measures on community design as a potential barrier to physical activity. Past research has shown an association among obesity, physical activity, and community design.[22–24]

A second study finding is that perceived weight gain was not associated with decreased energy intake. Rather, perceived weight gain was associated with increases in energy intake over time, which is consistent with previous reports.[25–27] We did observe a statistically significant association between BMI and decreased energy intake over time, but the decrease was only 8 Kcal/day. This may not be clinically meaningful, as an intake of 8 Kcal is equivalent to chewing a piece of sugared chewing gum or eating one large strawberry. However, in contrast to our study finding, past studies have shown increases of energy intake as small as 10–15 Kcal/day caused weight gain in women.[28,29] To better understand the relationship between perceived weight gain and energy intake, future studies may benefit from measuring energy intake more frequently and from directly assessing behavioral factors that function as perceived barriers to healthy eating, such as cost of nutritious healthful foods, lack of time to prepare healthy foods,[20] or fast food consumption.[30]

Although not a primary aim of this study, body esteem was examined as a potential moderator of perceived weight gain and behavior change. At baseline, we found that black women were more likely to perceive weight gain than white women, yet black women also reported higher baseline body esteem than white women. This finding lends support to the idea that black women may have different perceptions of body image than white women.[31,32] Even though the black women in our study perceived weight gain, their body esteem was relatively high, which suggests that perceived weight gain may not function as a cue to action for black women. Future studies should explore how the relationship of body image and behavior change varies by race/ethnicity. Interventions may be more successful if some attention is given to race/ethnicity, especially as black women are at high risk for obesity. An intervention targeting black women might fare better if it focuses on improving health as opposed to losing weight to be thin because black women do not have the same perception of attractive body size as white women.[31,32]

Our findings that total BES scores and scores derived from its subscales were not associated with any changes in physical activity and energy intake have several implications. In bivariate analyses, although perceived weight gain was associated with lower body esteem at baseline, BES and its subscales were not predictive of behavior change over time. It is possible that social comparison[33] was a more salient factor than individual body esteem. Social comparison refers to the cognitive process that people undergo in self-evaluation by comparing themselves to their peer group. For example, if a participant looks around her network and sees that her peers are gaining weight, weight gain appears to be normative, and she will not perceive a need to change her behavior. This potential explanation is supported by the fact that 67% of Texans are classified as overweight or obese.[34] With such a high rate of overweight and obesity of their peers, we speculate that our participants might not have been motivated to change their behavior to lose weight, as everyone around them was also overweight or obese. Although we were unable to empirically test this in our study, other researchers have found support for the social comparison argument for body esteem.[31,32,35] Future studies may benefit from including social comparison measures as a moderator between weight gain perception and behavior change in adult women.

This study had several strengths. First, we followed women over an extended period of time (36 months) and performed assessments every 6 months for physical activity, weight gain, and body esteem and every 12 months for energy intake. This enabled us to monitor physical activity and energy intake regularly and conduct longitudinal analyses. A second strength is the inclusion of Hispanic women, who have not been included in most studies. A third strength is that our balanced and relatively large samples allowed for comparisons among the three ethnic groups.

Several study limitations should be noted. First, we were not able to include women >300 pounds because of the weight limitations of the dual-energy x-ray absorptiometry equipment. Second, we obtained data on amount of exercise and energy intake by self-report retrospectively, which is subject to recall bias. Third, because our study was conducted as a secondary data analysis, the study questionnaire did not include direct measures of barriers to physical activity and healthy eating. Together, these limitations could impact the overall generalizability of our findings, and selection bias cannot be ruled out.

In conclusion, it is evident that knowledge alone does not predict behavior change. Although women may perceive weight gain and suffer lowered body esteem, this does not spur them into changing their behavior by eating less and exercising more. A myriad of factors may influence the relationship between perception of weight gain and subsequent behavior change. Although our study sought to estimate the effect of perceived weight gain on behavior change while controlling for some of these confounding factors, more research is needed to

uncover the complex mechanisms underlying behavior change. Based on our findings, we suggest that future interventions targeting behavior change may be more successful if they use a comprehensive, multilevel approach (i.e., individual, community, societal) that examines both individual factors, such as race/ethnicity, body esteem, social comparison, and personal barriers, and community factors, such as access to low-cost nutritious foods, access to public transportation, and access to safe exercising. Interventions using a comprehensive, multilevel approach are the next logical step in combating the growing epidemic of obesity in the United States.

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Disclosure Statement

The authors have no conflicts of interest to report.

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