HHS Public Access

Author manuscript

Clin Obes. Author manuscript; available in PMC 2018 October 01.

Published in final edited form as:

Clin Obes. 2017 October ; 7(5): 316–322. doi:10.1111/cob.12198.

Social Status and Energy Intake: A Randomized Controlled Experiment

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Abstract

Objective—While the inverse association between socioeconomic status (SES) and obesity in high GDP countries is well established using observational data, the extent to which the association is due to a true causal effect of SES, and if so, the mechanisms of this effect remain incompletely known. To assess the influence of social status on obesity via energy intake, we randomized individuals to a higher or lower social status and observed subsequent energy intake.

Methods—College students between the ages of 18 and 25 were randomized to social status, operationalized as being a leader or follower in a partner activity as purportedly determined by a (bogus) test of leadership ability. Investigators were blinded to treatment assignment. Immediately after being told their leadership assignment, paired participants were provided with platters of food. Energy intake was objectively measured in kilocalories (kcals) consumed and paired t-tests were used to test for significant differences in intake between leaders and followers.

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Disclosure Statement: The authors declare that they have no conflict of interest pertinent to this study.

Conflict of interest statement

Dr. Pavela reports grants from National Institute of Diabetes and Digestive and Kidney Diseases of the National Institutes of Health during the conduct of the study; Dr. Lewis reports grants from National Institute of Diabetes and Digestive and Kidney Diseases of the National Institutes of Health during the conduct of the study; Dr. Cardel has nothing to disclose; Dr. Dawson reports grants from National Heart, Lung, and Blood Institute during the conduct of the study; Dr. Allison reports grants from NIH/NIDDK during the conduct of the study. He also serves on the Scientific Advisory Board for IKEA.

Results—Sixty participants were included in the final analysis (males=28, females=32). Overall, no difference in energy intake was observed between leaders and followers, consuming an average of 575.3 kcals and 579.8 kcals, respectively (diff=4.5 kcals, p=0.94).

Conclusion—The null hypothesis of no effect of social status, operationalized as assignment to a leadership position in a small-group activity, on energy intake was not rejected.

Keywords

Socioeconomic Status; Obesity; Social Status; Energy Intake

Introduction

The inverse association between socioeconomic status (SES) and obesity in high gross domestic product (GDP) countries is well established (1, 2, 3, 4). Proposed explanations for the relationship between SES and obesity include the role of education in the development of the skills and knowledge necessary to maintain a healthy weight (5), and increased access to health promoting resources available to individuals with greater material resources (6) or residing in higher income areas (7). The association may also be due, in part, to the selection of higher weight individuals to lower SES (8). Importantly, the possibility that selection and spuriousness explain the observed relationship between SES and obesity cannot be excluded because previous research is based almost entirely on observational data (with important exceptions, discussed below). For example, all 289 studies included in Cohen, Rai, and Rehkopf's's (3) systematic review of the relationship between education and obesity were observational studies. The present research addresses this limitation by randomizing individuals to a higher or lower social status and observing the effect of social status on energy intake. While there are limitations to this approach, including the generalizability of findings and its conceptual concordance with traditional indicators of SES, it has the benefits of a randomized controlled experiment.

In brief, we randomly assign participants to a higher status "leader" or a lower status "follower" position in a two-person activity. We hypothesize that assignment to the follower position will result in increased energy intake. This hypothesis is based on the theory that increased energy intake may be a response to a sense of powerlessness and increased uncertainty about the future availability of food. Indeed, individuals with a lower SES report greater powerlessness, are more likely to perceive constraints on their ability to act (9), and report a lower sense of control (10). Low SES is also an important predictor of food insecurity (11), itself associated with obesity (i.e., the "food insecurity paradox") (12, 13). It may be that individuals with a reduced sense of control over future energy acquisition, and the physiological and psychological responses to such uncertainty that promote energy intake explain, in part, the association between SES and obesity in high GDP countries. We are not the first to make this conjecture. Kaiser, Smith, and Allison (14) observed that "animals (including humans) respond to perceived threats to their energetic security by switching to life strategies to build and preserve energy stores to the extent that they…buffer against true food scarcity that may occur later…"(14:2). For additional discussion and theoretical development of the connections between energetic security and energy intake, see Nettle, Andrews, and Bateson (15) and Dhurandhar (16).

While most research on social status, food insecurity, and obesity in humans is observational, we are aware of three studies that experimentally manipulated power and financial resources. Cardel, Johnson, and Beck, et al., (17) conducted a pilot randomized crossover study in which nine Hispanic adults between the ages of 19 and 25 were randomized to a high or low social status position. Compared to participants in the high social status condition, low status participants consumed 130 more calories, though this group difference was not statistically significant at an alpha of 0.05 (p=0.07). Bratanova, Loughnan, and Klein et al., (18) found that participants asked to read about and personally identify with financial scarcity in their society consumed more calories than participants asked to read and write about material abundance in their society. Finally, Cheon and Hong (19) found that low subjective social status was associated with increased appetite. While each of these studies uniquely contributes to the literature on social status and obesity, we believe our study makes two important contributions. First, Cardel et al. (2016) was designed as a pilot study. Second, we believe our experimental manipulation of social status more closely approximates the theoretical construct of interest: one's position in an *objective* social hierarchy. Indeed, Cheon et al. explicitly designed their manipulation of social status such that it did "not involve an actual experience of subordination or status loss (thus having low risk of producing profound ego threats or stress." (19) While our manipulation did entail actual status loss, we were similarly concerned with the stress associated with ego threat, hence we immediately debriefed participants as to the random assignment of status as described below.

Materials and Methods

This study's protocol was approved by the Institutional Review Board of the University of Alabama at Birmingham (UAB, protocol number X131210007) and registered at ClinicalTrials.gov (NCT02048774). This was a single-blind (researchers were blind to treatment assignment) randomized study. Participants were blind to the main purpose of the study to minimize reactivity effects. Participants were recruited from the University of Alabama at Birmingham and surrounding area and interested persons were screened over the telephone. Inclusion criteria included being between the ages of 18–25 and currently enrolled as a college student. Individuals with severe food allergies that restricted them from eating foods commonly served at major restaurants and pregnant individuals were excluded. A randomization sequence was generated prior to the study by a statistician using computer software and allocation was concealed by placing treatment assignments into envelopes. The flow of subjects through the study is described in the CONSORT diagram (Figure 1). Participants who completed the study prior to January 12, 2015 were compensated $15 for participation; afterwards participants were compensated $20. The incentive was increased to enhance study enrollment. Our original sample size target was n=80, calculated using a desired power ($1-\beta=0.80$), a Type 1 error rate of $\alpha=0.05$, and an estimated effect size (expressed as a standardized mean difference) of $d=0.30$ based on the findings of Cornil and Chandon (20). Due to enrollment and scheduling difficulties, only sixty-two participants were enrolled. Two participants (assigned to be partners for the study) were excluded from the analysis because one of the participants was determined to be ineligible for the study following completion of the study. Recalculating the original power analysis but using a

sample size of 60 yields and estimated power of (1-β=0.63) to detect an effect size of d=0.30.

Procedure

Upon arrival at the study site, participants were told that the purpose of the study was to determine the effect of leadership position on behaviors of undergraduate students without mention of observing food intake. To help control for the effects of gender on sense of power in dyadic relationships, and because the SES-obesity association is more consistently observed for women than men, participants completed the study in sex-matched pairs. After providing informed consent, participants were given twenty minutes to complete a 56-item multiple choice test purportedly on leadership and leadership styles. After completing the questionnaire, research staff collected the tests and scantron sheet and told participants that their tests would be graded and that they would be assigned to a leader or follower position based on their scores. Approximately five minutes after collecting the tests, study staff returned to the room with an envelope containing their “results”, which were in fact randomly assigned to participants. These “results” were the basis for assigning participants to either a leader or follower position within the pair. All pairs had one leader and one follower.

Participants were given a brief opportunity to read their results and then led to an adjacent room where an ad libitum buffet lunch was made available containing more food than any two people could reasonably consume. Food options included a plate of Oreo cookies, six 1-ounce bags of chips, two or more 4 oz. applesauce snacks, 12 sandwich pieces, bottled drinks (including water, diet, and sugar-sweetened beverages), and condiments (0.44 oz. packets of mayonnaise and 0.18 oz. packets of mustard). To disguise the true purpose of the study and reduce the risk that participants might discuss the true purpose of the study with future participants participants were tasked with a 2-minute tower-building activity with their partner using only the materials provided (dry spaghetti and play-dough) following lunch. Following the tower-building activity, participants completed an exit-questionnaire that included Anderson’s 8-item Sense of Power Scale (21). Finally, participants were debriefed about the randomization to a leader or follower position and given the opportunity to have their data excluded from future analyses (none opted to do so). While we did not debrief participants about the measurements of energy intake, it is still possible that participants had been told by previous participants that leadership assignment was random. We therefore asked participants in the exit-questionnaire if they had spoken about the study with anybody else. Two participants (males) reported they had done so. Excluding these participants from analyses in sensitivity tests did not alter our conclusions.

Outcome measures

The primary outcome of interest is the amount of energy consumed by participants, measured in kilocalories. The secondary outcome of interest is the amount of energy selected by participants, also in kilocalories. The energy content of each food item was known, either through FDA-mandated nutrition labelling or bomb calorimetry. Research staff blind to treatment assignment tracked food selected as well as food consumed, which

was measured by taking the difference between the energy content of food selected and food remaining on the plate to the nearest gram.

Statistical Analyses

Because participants completed the experiment in matched pairs, paired t-tests were used to test for statistically significant differences in energy consumed and selected by participants. All analyses were conducted using SAS 9.4 (SAS Institute, CARY, NC, USA). A visual inspection of differences in calories consumed between leaders and followers indicated an approximately normal distribution with a slight right skew; results of a Shapiro-Wilk test failed to reject the null hypothesis that the sample came from a normal distribution. Four participants had missing data on the scale measuring sense of power and their observations were not included in the test of differences in power between leaders and followers.

Results

Table 1 presents the mean and standard deviation of baseline characteristics of study participants as well as for the primary and secondary outcomes of interest. Table 2 presents the results of paired t-tests for differences in calories consumed and plated by leader status for the overall sample as well as stratified by sex. Overall, leaders consumed on average 575.3 calories and followers consumed 579.8 calories. Among males, leaders consumed an average of 667.9 calories and followers consumed an average of 702.5 calories. Among females, leaders consumed an average of 492.4 calories and followers consumed an average of 481.0 calories. No significant differences in calories consumed or calories plated were found between leaders and followers, either in the overall sample of pairs or in analyses stratified by sex-pairing.

Differences in perceived power

Following assignment to being a leader or follower and completion of the tower-building activity, participants completed a questionnaire that included Anderson's 8-item Sense of Power Scale (21). Among others questions, participants were asked if they could get their partner to do what they wanted and whether their ideas and opinions were often ignored. All items were rated on a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree). Mean score on the scale was 5.8, with a Cronbach's alpha of 0.76 and a SD of 0.7. Sense of personal power did not significantly differ between leaders and followers (Mean(leaders)=5.7, Mean(followers)=5.9), diff.=−0.2, p=0.1996).

Discussion

Substantial epidemiological evidence points to an inverse association between SES and obesity in countries with a high GDP. Much of this research, however, is observational and cross-sectional in nature. We sought to test whether random assignment to social status affected energy intake, one plausible mechanism for the observed association between SES and weight in observational studies. Operationalizing social status as assignment to a leader or follower in a partner-activity, we randomly assigned participants to a higher or lower social status and observed subsequent energy intake. While we hypothesized that those

assigned to a lower social status position would consume more energy, we did not find statistically significant differences in energy consumed between leaders and followers.

There are several possibilities why we failed to observe a statistically significant effect of social status on energy intake in our study—the first being that social status does not have a causal effect on acute energy intake among the population of US college-age students. A second possibility is that social status does have such an effect, but our operationalization of social status as being assigned to a “leader” or a “follower” does not appropriately reflect the experiences of occupying a higher or lower social status. Indeed, it’s particularly difficult to develop a valid operationalization of social status that permits the ethical randomization of participants to different levels of social status. Thus far, four studies have used (at least) four different operationalizations of social status with the intent to measure its effects on energy intake: 1) varying the financial resources available to participants in a Monopoly game (17); 2) writing about shared experiences of scarcity or abundance (18); 3) thinking and writing about how one is different from individuals lower on the MacArthur Scale of Subjective Social Status (19); and 4) assignment to a leader or follower in a partner activity. While the diversity of operationalizations of social status in this area of research, as with others, is understandable given the complexity of the concept, it would ultimately be beneficial to adopt a standard operationalization shared by researchers interested in the effect of social status on energy-intake and other behavioral or physiological outcomes. The development of a standard experimental manipulation of social status may also wish to consider the age of participants, as the salient indicators of one’s position in the social hierarchy likely differs across age groups.

Relatedly, not only is it difficult to know to what degree experimental operationalizations of social status fully capture the lived experiences of individuals, but each was intended to measure a different aspect of social status (subjective or perceived social status (Cardel et al. 2016, Cheon et al. 2017), absolute poverty and wealth (Bratanova et al., 2016), and objective social status (the present paper). In the present study, we hypothesized that assignment to a leader or follower would affect participants’ sense of power; however, post-hoc analyses indicated no difference in sense of power between treatments. Thus, our finding of no effect on food intake may be due to a failure to create differences in feeling of power between participants, and future operationalizations of social status must carefully consider if and how they intend to measure hypothesized social-psychological mediators of objective social positions. Previous studies have also had difficulty in manipulating the subjective states of participants hypothesized to mediate the link between social status and energy intake. Cheon et al’s, (19) manipulation of subjective status did not have any measurable effect on negative affect or self-concept and, in conjunction with our results, evidence does not support the hypothesis that power, negative affect, or self-concept mediate the association between social status and energy intake. We conclude, as they do, that subjective social status may influence energy intake through other mechanisms, if it affects intake at all. Bratanova et al.’s manipulation did induce differences in anxiety between groups, and this avenue may be worth further research.

An additional limitation of our study is not providing a standardized meal to participants prior to the experimental meal. Participants likely arrived at the study site with varying

degrees of hunger though randomization ultimately ensures that any differences in hunger between the treatment groups is due to chance. Differences in hunger between participants may introduce additional variability into our measures of energy intake (e.g., a participant who just ate breakfast consumes zero calories while for another the experimental meal is the first meal of the day). Similarly, we did not measure or control for time since onset of menstruation. The midluteal and midfollicular phases of the menstrual cycle are associated with increased energy intake, potentially introducing additional variability into our measurements of energy intake in females (22).

Finally, throughout this manuscript, we have focused on one explanation for the relationship between social status and energy intake—broadly, the effect of social status on an individual's perceptions of power and the physiological and psychological reactions to perceived resource availability. While this explanation relies on social-psychological and ecological reasoning, there are reasons to suspect social status may influence energy intake through additional mechanisms. Drawing directly from sociology, food consumption is used as a tool of impression management. Across cultures, food plays an important role in expressing one's identity, including social status, race, and gender (23). Even in politics, one's food choices can implicate a politician as belonging to an undesirable social class. After hiring a French chef in the White House, Martin Van Buren's 1840 presidential re-election campaign struggled to combat criticisms that he enjoyed effete French cuisine. Buren's political opponents contrasted his aristocratic attachment to French cooking with the favored food of his opponent: raw beef and salt (24). Assignment to a leadership position may therefore result in eating behaviors better explained by impression management rather than an altered sense of power and control.

More recently, Furst, Connors, Bisogni, Sobal and Falk (25) identified "ideals" as a pervasive influence on food choice, defining ideals as the "expectations, standard, hopes, and beliefs that provided points of reference and comparison by which people judged and evaluated food choices" (19):252–253). These ideals included beliefs about whether one had to eat "poor food" or could afford to eat other foods. In another qualitative study of food choice and identities, several participants reported being a "peasant eater" or, like Buren's common-man diet of beef and salt, consciously rejecting an affluent diet for a working-class one (26). Given the body of work on taste and class (27), we do not wish to suggest that the association between SES and obesity is solely due to psychological or evolutionary responses to scarcity (especially given our null findings)—only to suggest that social status and its effect on perceived scarcity is one of a myriad of factors that may influence energy intake. We also note an affinity between our interest in perceptions of future food availability and energy-intake and research on resource scarcity and cognitive performance (28, 29). However, while explanations for the effect of poverty on cognitive performance focus on the cognitive resources consumed by the experience of having scarce resources, our explanations focus on the acute physiological and psychological responses to perceived resource scarcity and the impact on eating behaviors.

Conclusion

We did not find a statistically significant effect of assignment to being a leader or follower on acute energy intake. Social status per se, as operationalized in our study, may not affect energy-intake in the population; however, because we did not induce differences in feelings of power of sense of control in participants, we cannot rule out that a sense of powerlessness due to lower social status affects energy intake. There are two major strengths of this study: First, the ability to reduce confounding through randomization is a contribution to the SES and obesity literature. Second, the outcome of this study was objectively measured and observed food intake. Most existing epidemiologic studies rely on problematic self-reported energy intake.

Acknowledgments

Funding: This research was supported by the National Institute of Diabetes and Digestive and Kidney Diseases of the National Institutes of Health under Award Numbers T32DK062710 and P30DK056336. The opinions expressed are those of the authors and not necessarily those of the NIH or any other organization.

The authors wish to thank study participants, Madeline Jeansonne-Gibson for her recruitment efforts, and Emily Dhurandhar for her guidance on study planning.

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What is already known?

1. There is a negative association between socioeconomic status and obesity in high GDP countries.
2. This association may be due, in part, to selection of higher weight individuals into lower socioeconomic status.

What does this study add?

1. The random assignment of individuals to social status, operationalized as a leader or follower in a partner activity, did not affect energy intake.
2. Testing whether socioeconomic status is causally related to obesity through the effect of perceived social status on energy intake requires further experimental testing with procedures more demonstrably affecting perceived social status.

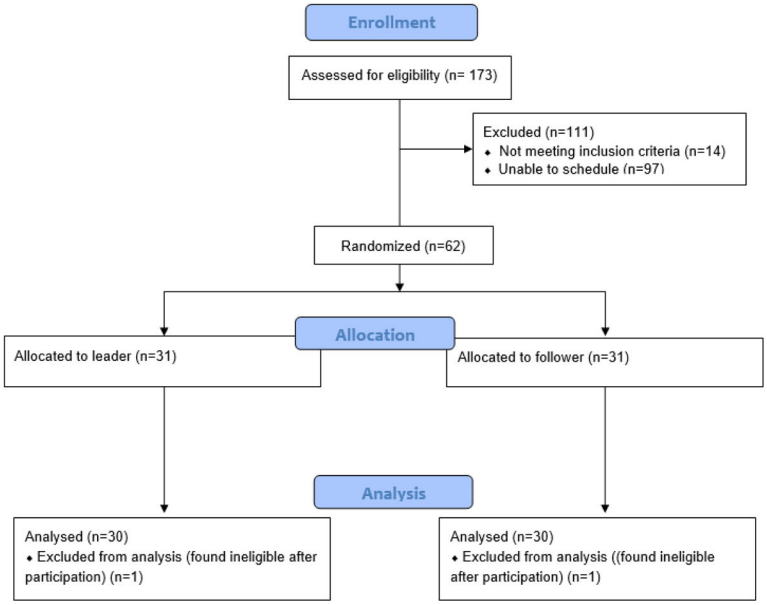

Figure 1.
CONSORT DIAGRAM

Table 1

Descriptive Statistics of Baseline Characteristics and Outcomes

Variable	Mean	SD	Min	Max
Age (years)	21.0	1.9	18	25
Sex (n/%)				
Female	33(55%)	-	-	-
Male	27(45%)	-	-	-
*Race (*n/%*)*				
White	15 (25%)	-	-	-
Black	35 (58%)	-	-	-
Asian	2 (3%)	-	-	-
Not reported	8 (13%)	-	-	-
Energy Related				
Calories Consumed	577.6	333.8	0	1445.3
Calories Selected	624.2	340.0	0	1489.5

Table 2

Estimated Mean Difference in Calories Consumed by Leadership Status

Variable	Leader(L)	Follower (F)	F-L (Δ)	SE Δ	p
All Pairs					
Consumed	575.3	579.8	4.5	63.9	0.94
Plated	620.4	628.0	7.6	68.1	0.91
Male Pairs					
Consumed	667.9	702.5	34.6	135.7	0.80
Plated	687.6	747.3	59.7	145.8	0.69
Female Pairs					
Consumed	492.4	481.0	−11.4	47.9	0.81
Plated	562.5	533.2	−29.3	45.8	0.53