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Personal history of dieting and family history of obesity are unrelated: Implications for understanding weight gain proneness

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ABSTRACT

Identifying predictors of future weight gain is important in obesity prevention efforts. Both family history of obesity and personal dieting history have been established as predictors of future weight gain; however, it is unknown if they are independent or overlapping predictors. The purpose of this study was to examine the degree of overlap between these two predictors using cross-sectional data. Baseline data from four studies were examined separately and in combination for a total of 561 female participants, and analyses were conducted to examine parent anthropometric variables by dieting status within and across studies. All participants were female university students between the ages of 17 and 30. For each study, as well as for the entire sample combined, parent anthropometric variables were examined by dieting status using factorial ANOVAs. No meaningful pattern was found when examining parent anthropometric variables by dieting status, which suggests that the two risk factors are largely independent. This suggests that the processes associated with the development of future weight gain by each variable are different; therefore, future research should use a longitudinal study to test the hypothesis that using both variables to predict future weight gain would account for more variance than using either variable alone.

1. Introduction

Body mass is highly heritable (Allison et al., 1996; Stunkard, Harris, Pederson, & McClearn, 1990), and family history of obesity has been used as a means of identifying individuals susceptible to future weight gain (Agras, Hammer, McNicholas, & Kraemer, 2004; Whitaker, Wright, Pepe, Seidel, & Dietz, 1997). However, genetically based weight gain proneness also interacts with developmental and environmental influences on weight gain (Ichihara & Yamada, 2008; McPherson, 2007). Furthermore, although an individual with two obese parents is much more likely to gain weight in the future than an individual with two normal weight parents, not all offspring of obese parents will themselves become obese. Therefore, in order to target prevention efforts towards individuals at elevated risk of developing obesity, it is important to study additional predictors of future weight gain.

In addition to family weight history, personal history of dieting also predicts future weight gain. Normal weight individuals who have previously dieted to lose weight are much more susceptible to future weight gain compared to those without a dieting history. In a recent review paper of studies examining the prediction of weight gain by self-reported dieting history, 15 of 20 analyses found that individuals with a history of dieting subsequently gained more weight than those without a history of dieting. This rate of successful prediction of future weight gain was substantially higher than that found for three commonly used measures of restrained eating (Lowe, Doshi, Katterman, & Feig, 2013). The reason for the relationship between dieting history and future weight gain is debatable, with some investigators suggesting that dieting itself makes dieters more susceptible to weight gain (Neumark-Sztainer, Wall, Haines, Story, & Eisenberg, 2007) and others (Houben, Nederkoorn, & Jansen, 2012; Lowe & Levine, 2005), suggesting that dieting is a marker or proxy of an already-existing susceptibility toward weight gain.

Lowe et al. (2013) provide one explanation as to why dieting may be a proxy of an already-existing susceptibility toward weight gain. Individuals who are experiencing weight gain are more likely to go on diets than those who are not gaining weight; however, evidence indicates that weight lost on a diet is usually regained (Lowe et al., 2013). Accordingly, individuals who are prone toward weight gain are not only likely to go on weight loss diets but are likely to do so repeatedly. For example, in a sample of obese middle-aged women, participants reported that they had been on an average of 4.7 diets, with a mean lifetime total of 45.9 kg lost on diets (Bartlett, Wadden, & Vogt, 1996). There is little reason to believe that a *history* of dieting contributes to the excess weight gain *beyond* the weight dieters regain when returning toward their pre-dieting weight. It is true that dieting that produces a meaningful weight loss is likely to enhance metabolic efficiency and

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increase appetite, but the research evidence suggests that these reactions contribute to weight regain but not to weight gain beyond that which would have occurred anyway in the absence of a weight loss diet (Lowe, 2015). From this perspective, a history of dieting is an accurate marker of susceptibility toward weight gain from multiple (genetic, environmental, etc.) causes but not from past dieting itself. Similarly, cycles of weight loss and regain appear to alter body composition (but not total BMI) among individuals who start out in the normal weight range but have little effect in those with higher BMIs (Dulloo, Jacquet, & Montani, 2012).

As both a personal history of dieting and a family weight history of obesity predict future weight gain, it is possible that these two predictors significantly overlap and are largely redundant. On the other hand, if there were little or no relation between these two indicators, then the dieting history measure would represent a second, potentially valuable addition to family history of obesity in assessing individuals' susceptibility to gain weight in the future. Although it is essential to conduct longitudinal research on this topic to determine whether these predictors of future weight gain are inter-related, studies examining prospective weight gain require substantial resources and require long-term follow-up periods. Therefore the current study, which involved existing cross-sectional data, was undertaken to determine the nature of the relationship between these two risk factors. If the overlap between the two variables is minimal, then personal dieting history may be an important additional measure of weight gain proneness, in addition to family weight history. Additionally, this would provide justification for a large prospective study with the goal of examining these joint predictors prospectively.

In three recent weight gain prevention studies in female college students, we assessed both personal dieting history and participants' reports of family weight history. Female college students were chosen for these prevention studies because they are known to be at increased risk for weight gain (Butler, Black, Blue, & Gretebeck, 2004; Gropper, Simmons, Connell, & Ulrich, 2012). Additionally, in order to examine these variables in an unselected sample, a study that did not involve weight gain prevention was also included. The baseline data from these studies provided the opportunity to assess the relationship between a personal history of dieting and probability of having an obese parent, with mothers and fathers analyzed separately. Parent weight status in all studies was classified according to participant report of parent height, weight, and body size. Participant reports of their parents' body mass has been used as a proxy for direct measurement of parents because of the infeasibility of doing so (Crerand et al., 2006; Lindroos et al., 1998; Price & Lee, 2001; Riet et al., 2010). The primary aim of this study was therefore discovery-oriented rather than to test an a priori hypothesis. We examine the degree of relationship between personal history of dieting and family weight history across all four studies in order to investigate whether these two variables are likely independent or overlapping predictors of future weight gain.

2. Methods

2.1. Data sources

A convenience sample was drawn from four studies of college-aged females. Three studies were intervention studies, and all data were collected at the baseline visit. Participants in Study 1 were 70 students, age 18–25 years, who had a BMI between 20 and 25 kg/m^2 and enrolled in research on weight gain prevention. Participants in Study 2 were 58 students, age 18–30 years, with a BMI between 25 and 30 kg/m^2. Participants were told the study would teach them ways to prevent weight gain. Participants in Study 3 were 294 students, age 17–19 years, with a BMI of 20 kg/m^2 of higher. The program was advertised as offering a group-based program to avoid weight gain. Participants in these three studies also had to show one or more indication of struggling with their weight or concerns about their weight (e.g., score higher than college student norms on restrained eating or body dissatisfaction or have a history of dieting). Participants in Study 4, a non-intervention study, were 139 students, age 18–25 years, who were recruited to complete a survey that was described as examining health habits of college students. Data from these four studies were combined for analysis, for a total of 561 participants. The appropriate ethics committees at Drexel University approved all four studies and all participants gave informed consent prior to inclusion in the studies.

2.2. Participants

The means and standard deviations of participants' current weight, current BMI, maximum weight, and dieting status were examined by study. Participants who did not provide dieting status information were excluded from the analyses ($n = 8$). Mean current weights for each study were 59.50 kg (Study 1), 71.64 kg (Study 2), 64.58 kg (Study 3), and 61.46 kg (Study 4). Mean BMIs for each study were 21.89 kg/m^2 (Study 1), 26.63 kg/m^2 (Study 2), 23.65 kg/m^2 (Study 3), and 22.89 kg/m^2 (Study 4). The percentage of current dieters ranged from 7.6% to 28.1% across studies, the percentage of historical dieters ranged from 34.5% to 47.4%, and the percentage of never dieters ranged from 24.6% to 52.5% (Table 1).

2.3. Measures

2.3.1. Dieting and Weight History Questionnaire (DWHQ)

The DWHQ is a series of seven questions and assesses the diet and weight history of the participant (Witt, Katterman, & Lowe, 2013). Questions include asking about whether currently on a diet to lose weight and, if not, whether they had dieted in the past. Participants placed into one of three categories: current dieters, who report currently being on a diet to lose weight; historical dieters, who not currently on a diet but had dieted to lose weight in the past; and never dieters. These dieting categories have shown utility in predicting different levels of eating regulation (Konttinen, Haukkala, Sarlio-Lahteenkorva, Silventoinen, & Jousilahti, 2009; Lowe & Thomas, 2009) and future weight gain (Lowe et al., 2006). Previous studies have examined current dieters compared to current and historical dieters combined (Lowe, 1993), as well as the three dieting categories separately (Witt et al., 2013). As it is not known if the current versus historical dieting distinction is associated with different predispositions to weight gain, analyses were also repeated combining the current dieters and historical dieters into the same group.

The DWHQ also asks for self-reported current weight and height. Participants' current BMIs were calculated from their responses. While past studies have found an underestimation of self-reported weight compared to actual weight, the discrepancy is small: an average of 1.40 kg for females and 1.85 kg for males (Spencer, Appleby, Davey, & Key, 2001). In addition, self-reported weight and actual weight are highly correlated and are considered to have sufficient validity when examining large samples of participants (Spencer et al., 2001).

2.3.2. Family weight history

Participants were administered questions about family weight history, which asked them to estimate the height and weight of their mother and father. Mother BMI and father BMI were then calculated using the standard BMI formula. In addition, for all studies except Study 2, participants were presented with nine female silhouettes and nine male silhouettes ranging from underweight to obese (Reed & Price, 1998). Participants were asked to indicate which silhouette most closely represented their biological mother's and father's body shape (on the female and male figures, respectively).

Previous studies have shown that estimations of height and weight are highly correlated with actual heights and weights. When participants estimated the height and weight of first-degree relatives, the

Table 1
Participant characteristics by data source.

	Study 1	Study 2	Study 3	Study 4	F	η^2_p
Current weight, kg, M(SD)	59.50_a (6.80)	71.64_b (10.18)	64.58_c (9.21)	61.46_a (12.32)	19.60**	0.096
Current BMI, kg/m^2, M(SD)	21.89_a (2.10)	26.63_b (2.19)	23.65_c (2.88)	22.89_{ac} (4.09)	28.17**	0.132
Max weight, kg, M(SD)	61.70_a (7.69)	75.12_b (11.64)	67.33_c (9.63)	65.29_{ac} (14.08)	17.12**	0.085
Current dieters (N)	5	16	77	18		
Current dieters (%)	7.6%	28.1%	26.5%	12.9%		
Historical dieters (N)	30	27	123	48		
Historical dieters (%)	45.5%	47.4%	42.3%	34.5%		
Never dieters (N)	31	14	91	73		
Never dieters (%)	47.0%	24.6%	31.3%	52.5%		

** $p < .01$. Means with differing subscripts within rows are significantly different at the $p < .05$ based on Fisher's HSD post hoc paired comparisons.

estimates were highly correlated ($r > .94$) with actual measured height and weight (Paradis, Perusse, Godin, & Vohl, 2008; Reed & Price, 1998). Similarly, Cardinal, Kaciroti, and Lumeng (2006) found that when participants were shown videotapes of women and asked to pick a figure size rating to match the women models, the figure size ratings were highly correlated with actual BMI, suggesting that figure size ratings are a useful proxy for BMI. Additionally, the figure rating scale has been shown to have acceptable reliability and validity in college populations (Thompson & Altabe, 1991).

Previous research has shown that participant report of parent anthropometric variables has clinical validity. For example, extremely obese female patients seeking bariatric surgery reported having significantly heavier parents compared to less obese patients (Crerand et al., 2006). In another study, participants with a family history of type 2 diabetes (which is strongly associated with obesity) were more likely to report a parental history of obesity (Riet et al., 2010) than those without type 2 diabetes. Another study showed that parental obesity, as assessed by offspring report, moderated the relationship between leptin concentrations and weight change over time (Lindroos et al., 1998). Therefore, past findings suggest that participant report of parental weight history is a valid method of assessing parental BMI status. Additionally, the use of two measures of participant report of family weight history in this study (estimated height and weight as well as figure rating) increases the validity of estimated parental BMI.

2.3.3. Comparison pictures

To determine if participants with differing diet histories had biases in reporting height, weight, and figure silhouette, each participant in Study 4 was presented with multiple images of the same female model that had been manipulated to represent different body sizes, ranging from underweight to obese. These pictures were presented in a randomized order, and participants were instructed to choose the female silhouette that most closely represented the body shape of the model in that picture (Stunkard, Sorensen, & Schulsinger, 1983). In addition, participants were asked to estimate the height and weight of the model in each of the five pictures. Estimated figure size, estimated weight, and estimated BMI were then compared across dieting groups in order to examine whether the dieting status of these participants was related to over- or under-estimates of the height, weight, and figure size of the models, as a way to test potential biases in their estimates of parental height, weight and figure size. For each picture, estimated BMI was calculated from the estimated height and weight.

2.4. Data analysis

All analyses were conducted using IBM SPSS Statistics (version 19, 2010, IBM Corp.). One-way ANOVAs were conducted to examine participant characteristics and parent anthropometric variables by study and dieting status. For variables that were significant, one-way ANCOVAs were conducted to examine the variables by dieting status, controlling for participant BMI, to determine if significant relationships remained significant. This was done to see if differences in BMI between dieting groups accounted for significant effects that were found. Post hoc analyses were conducted using Tukey HSD tests. Analyses were conducted combining data from all four studies. Additionally, to examine whether the relationship differed across studies, analyses were repeated within each study individually. The significance level for all analyses was set at $p < .05$.

3. Results

3.1. Parent anthropometric variables by participant dieting status

Data from all studies were combined, and parent anthropometric variables were examined by participant dieting status. Current, historical, and never dieters did not significantly differ in mother or father weight, BMI, or figure size (Table 2). In addition, no variables were statistically significant when current dieters and historical dieters were combined into one group.

3.2. Parent anthropometric variables by participant dieting status by study

For Study 1, parent anthropometric variables were examined by participant dieting status. Only father figure rating was significantly different between the three dieting groups, $F(2, 53) = 3.23$, $p = .048$, $\eta^2_p = 0.113$. Post hoc comparisons using the Tukey HSD test indicated that current dieters had a significantly lower father figure rating than never dieters, $p = .04$. When current dieters and historical dieters were combined for analysis and compared to never dieters, there were no significant differences between groups in mother or father BMI or figure size.

For Study 2, parent weight, BMI, and figure size were compared by participant dieting status. Both father weight ($F(2, 51) = 5.24$, $p = .009$, $\eta^2_p = 0.176$) and father BMI ($F(2, 47) = 3.90$, $p = .03$, $\eta^2_p = 0.148$) were significantly different between the three dieting groups. Post hoc comparisons using the Tukey HSD test showed that for father weight, current dieters reported higher father weights than historical dieters, $p = .02$, and never dieters also reported higher father weights than historical dieters, $p = .04$. Post hoc comparisons using the Tukey HSD test showed that for father BMI, current dieters reported higher father BMI than historical dieters, $p = .04$. Participants were not asked to give a parent figure rating for this study. When current dieters and historical dieters were combined for analysis and compared to never dieters, there were no significant differences between groups in mother or father BMI or figure size.

For Study 3, parent anthropometric variables were examined by participant dieting status. No variables (mother weight, mother BMI, mother figure rating, father weight, father BMI, father figure rating) were significant when analyzed by dieting status. In addition, no variables were significant when current dieters and historical dieters were combined for analysis.

For Study 4, parent anthropometric variables were examined by participant dieting status. Mother BMI was significantly different between the three dieting groups, $F(2, 128) = 3.36$, $p = .04$, $\eta^2_p =$

Table 2
All studies combined: parent anthropometric variables by participant dieting status.

	Current dieters, M (SD)	Historical dieters, M (SD)	Never dieters, M (SD)	F	η_p^2
Mother weight (kg)	70.32 (15.93)	68.69 (15.26)	68.40 (14.13)	.482	.002
Mother BMI (kg/m^2)	26.45 (5.95)	26.05 (5.19)	25.33 (4.74)	1.373	.007
Mother figure rating	4.73 (1.50)	4.78 (1.48)	4.61 (1.48)	.666	.003
Father weight (kg)	90.12 (19.36)	84.89 (15.42)	87.83 (17.71)	2.377	.014
Father BMI (kg/m^2)	28.07 (5.19)	27.43 (4.85)	27.72 (5.38)	.360	.002
Father figure rating	5.13 (1.55)	5.06 (1.58)	5.21 (1.53)	.372	.002

0.051. However, no post hoc comparisons using the Tukey HSD test were significant. When current dieters and historical dieters were combined for analysis, both mother BMI ($F(1, 128) = 6.19$, $p = .01$, $\eta_p^2 = 0.046$) and mother figure rating were significant ($F(1, 136) = 4.89$, $p = .03$, $\eta_p^2 = 0.035$), with combined dieters reporting higher mother BMI and figure ratings than never dieters. Additionally, for each of the five control pictures, ANOVAs were conducted to compare figure ratings, estimated figure weights, and estimated figure BMIs for each picture by dieting status. No significant differences were found between current dieters, historical dieters, or never dieters in ratings of figure size, weight, or BMI for any of the five pictures.

4. Discussion

As past research has shown that both a personal history of dieting and a family history of obesity represent risk factors for weight gain, this study investigated the degree to which these risk factors overlapped. If dieting history was strongly related to family history of obesity, then these two risk factors may be largely redundant and assessing personal history of dieting would add little benefit in predicting future weight gain. However, there was very little evidence that dieting history was related to family weight history, as assessed by the estimated BMIs and body weights of participants' biological parents.

In the analyses of the four data sets, although some significant differences between dieting groups emerged on parental weight status, no meaningful pattern emerged for these findings. For example, in Study 1, current dieters picked a *smaller* father figure rating than non-dieters; for Study 2, current dieters reported higher father weights than historical dieters but non-dieters did also. No differences between dieting groups in parental weight status were detected in Study 3, and in Study 4, the combined group of current and historical dieters viewed their mothers (but not their fathers) as having higher BMIs and therefore reported higher (larger) figure ratings for their mothers than non-dieters did. When data across all studies were combined to maximize power to detect differences, no differences between the dieting groups were found. Thus, the overall pattern of results suggests that there was little if any systematic relationship between the dieting status of participants and the weight status of their biological parents. In addition, because of the number of comparisons tested, fewer would be significant if a correction for multiple comparisons were applied.

Because it was possible that dieting status could bias participants' ratings of their parents weight or shape, we also determined whether current dieters, historical dieters, and non-dieters differed in their weight ratings of five standard silhouettes but found no differences between them. Therefore, dieting status did not influence ratings of height, weight, and body size of another person. Based on these findings, it is possible to conclude that the lack of systematic differences between dieting groups in their ratings of their parents was not likely due to biases in their perception of their parents' weight status.

The results of this study suggest that there is little relationship between parental weight history and dieting status of their young adult offspring. However, this is not the same as demonstrating that both factors will in fact predict weight gain in a particular study or that combining these variables will account for more variance in subsequent weight gain than a single variable would. Therefore, future prospective research will be needed to determine if combining these potential predictors of weight gain adds to such prediction relative to examining just one of these variables. Because conducting this type of study would be resource-intensive and require a long-term follow-up period as well as a large number of participants, it was important to first assess whether dieting status and family history of obesity are in fact independent predictors of future weight gain. The findings of the present study lend support for these future prospective studies.

5. Conclusions

As no pattern was found when examining parent anthropometric variables by dieting status, it is likely that the two risk factors of future weight gain are largely independent. Therefore, the processes associated with the prediction of future weight gain by each variable appear to be different. This study had several limitations, including the fact that participants provided self-report of family history of obesity, all participants were college-aged females, and the study was cross-sectional. However, the fact that our results were based on four different samples recruited over several years, as well as samples recruited for differing purposes, increases confidence in the validity of the findings. Future longitudinal studies should test the hypothesis that using both variables to predict future weight gain would account for more variance than using either variable alone. In addition, further research should examine the variables' applicability to different age groups and to men, as well as control for the recency of dieting.

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Contributors

We confirm that the manuscript has been read and approved by all authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us.

Michael Lowe contributed to the design all four studies, wrote the first draft of the Introduction and Discussion, and provided guidance on and edited the entire manuscript. Lisa Shank and Renee Mikorski helped to design and implement Study 4, conducted all analyses, wrote the first draft of the Methods and Results, and edited the manuscript. Meghan Butryn contributed to the design and implementation of all four studies, and provided guidance on and edited the entire manuscript.

Conflict of interest

All authors declare that they have no conflicts of interest.

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