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Do participants with children age 18 and under have suboptimal weight loss?

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Abstract

Objectives—Parenthood is a time marked by behaviors that may promote risk for weight gain, including decreased physical activity and increased unhealthy eating. Little is known about parents in the context of behavioral weight loss, such as whether they differ in weight losses, and related barriers, or behaviors.

Method—We compared parents of children aged 18 and younger ($n = 105$) to other participants who did not have children, or whose children were in adulthood ($n = 215$) in a behavioral weight loss program to evaluate six-month weight losses, and weight loss barriers and behaviors.

Results—Parents of minor children lost less weight than other participants, and parental status interacted with gender such that men without minor children lost the most weight. Although parents of minor children identified greater stress, depression, time-related barriers to physical activity, and had less adherence to calorie goals, they did not differ from other participants in session attendance, emotional overeating, disinhibited eating, or physical activity.

Discussion—Parents of minor children appear to have greater weight loss barriers, greater difficulty adhering to calorie goals, and less weight loss. Additional research is needed to identify ways to better serve parents in behavioral weight loss programs.

Keywords

parents; obesity; weight loss; barriers; behavior; gender

1. Introduction

Approximately half of individuals who undergo behavioral weight loss interventions do not experience the expected magnitude of weight loss during the first six months of treatment (Group, 2002; Jakicic, Tate, Lang, & et al., 2012; Lundgren, Malcom, Binks, & O'Neil,

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2009). This is problematic because suboptimal weight losses are linked to less reduction of cardiovascular risk factors (J. D. Brown, Buscemi, Milsom, Malcolm, & O'Neil, 2016). One important, yet understudied, potential challenge to weight loss is parental status, specifically for those with one or more minor children. This is a challenge in need of further study, given that there is evidence that the transition to parenthood is associated with decreased physical activity (PA), increased unhealthy eating, and a steepened weight gain trajectory over time known as the “child effect” (Aschemann-Witzel, 2013; Bellows-Riecken & Rhodes, 2008; Hull et al., 2010; Laroche, Hofer, & Davis, 2007; Laroche et al., 2013; Umberson, Liu, Mirowsky, & Reczek, 2011). Longitudinal data suggest that the effect of parenting minor children on weight continues beyond the transition to parenthood (Laroche et al., 2013; Umberson et al., 2011). Additionally, those with poorer health shortly after becoming a parent experiencing faster declines in health over time (Hsu & Wickrama, 2017). Overall, findings suggest that the “child effect” on parents’ weight and health behaviors is sustained over the child rearing years.

There are several reasons why parenting minor children may pose a barrier to weight loss. First, the greater stress and negative emotions that parents face (Nelson, Kushlev, & Lyubomirsky, 2014) may pose challenges for adherence to healthy eating and physical activity goals. Personal/family stress was one of the top obstacles to weight management identified by individuals who previously completed a weight loss program (DePue, Clark, Ruggiero, Medeiros, & Pera, 1995). Although DePue and colleagues do not specify whether this category specifically pertains to parenting stressors, their respondents were on average 43 years old, 75% female, and 76% married, a demographic that likely includes at least some parents. Additionally, stress and negative affect are positively associated with, and may trigger, emotional eating (Jansen et al., 2008; Macht & Simons, 2000; Richardson, Arsenault, Cates, & Muth, 2015). More specifically, motherhood-related stress has been cited as a contributing factor to unhealthy eating patterns (Chang, Nitzke, Guilford, Adair, & Hazard, 2008). Second, parents with minor children may have reduced time to devote to planning and executing key weight loss behaviors (Chang et al., 2008) that are closely related to outcomes (Elfhag & Rössner, 2005). Time has been cited as a barrier to PA (Mailey, Huberty, Dinkel, & McAuley, 2014), as well as healthy eating and food preparation among parents (Horning, Fulkerson, Friend, & Story, 2016; Jabs et al., 2007; Nuss, Clarke, Klohe-Lehman, & Freeland-Graves, 2006). Reduced free time may also impact attendance at intervention meetings, which is a major component in acquiring the necessary skills for successful weight loss. Parents with minor children may also be more likely to have high calorie foods and beverages in the home, increasing the challenge of adherence to calorie goals.

It is also possible that the effect of parental status may differ by gender. Some have suggested the “child effect”, pertaining to steepened weight gain trajectories for parents, is actually only present for mothers (Laroche et al., 2013). While there are some physiological effects of becoming a parent that are unique to women (e.g., pregnancy-related weight gain and potential weight retention), there are other barriers that may contribute to the “child effect” for women well beyond the postpartum period. Women often dedicate more time and resources to childcare and family needs than men (Kotila, Schoppe-Sullivan, & Kamp Dush, 2013; Nomaguchi & Milkie, 2003; Yavorsky, Kamp Dush, & Schoppe-Sullivan, 2015), and

some preliminary research supports the idea that barriers to weight control behaviors may be especially pronounced for mothers. Multiple role expectations, including provision of child care, a sense of commitment to others, along with time burdens, fatigue, and limited family support, have been cited as an influence on PA levels among women (Belza & Warms, 2004; P. R. Brown, Brown, Miller, & Hansen, 2001; O'Dougherty et al., 2008; Ransdell, Vener, & Sell, 2004), and as factors influencing attrition from a weight loss program (Jordan et al., 2008). Perceived barriers to activity are higher, and PA levels are lower, among mothers of young children compared to similarly aged women who do not have children (W. J. Brown, Mishra, Lee, & Bauman, 2000; Verhoef & Love, 1994). It is possible therefore that the potential reduction in time to devote to weight loss behaviors, competing caretaking demands, and associated stress may be greatest for women who have minor children. Subsequently, this may negatively impact their weight loss success the most.

To date, no published research has investigated the individual effect of parental status, or the combined impact of parental status and gender on weight loss, during a behavioral weight loss (BWL) intervention. Since BWL programs produce suboptimal effects for a substantial portion of participants, and the weight trajectory of parents compared to others suggests a need for effective weight loss interventions, it is important to identify whether parents differ from other participants in weight loss. Studies that have evaluated BWL among parents have often done so in single gender designs involving just mothers [e.g., (Hartman, Hosper, & Stronks, 2011; Herring, Cruice, Bennett, Davey, & Foster, 2014; Jordan et al., 2008)], or less commonly, just fathers [e.g., (Morgan et al., 2014)], which removes the possibility of evaluating gender effects within these paradigms. Greater understanding of the effects of parental status, and their interaction with gender, has important clinical implications for optimizing outcomes in BWL.

The primary aim of this study was to determine whether parental status predicted weight loss during behavioral intervention. This study also tested whether gender moderated the relationship between parental status and weight loss. Specifically, we expected that women with minor children would have the smallest weight losses, while men without minor children would have the greatest weight losses. To better understand the impact of parental status on our primary outcome of interest (i.e. weight loss), we planned to explore potential factors that may contribute to reduced weight loss among parents of minor children. Specifically, we planned to determine whether participants with versus without minor children differed in specific weight loss barriers (i.e., stress, negative affect, or perceived time available for weight control efforts), weight loss behaviors (i.e., session attendance, calorie goal adherence and PA), and problematic eating behaviors (i.e., emotional overeating, disinhibited eating).

2. Materials and Methods

2.1. Participants and procedures

The sample ($N = 320$) was 78% female with a mean age of 52.77 ($SD = 10.32$). At the start of the study, BMI averaged 35.12 kg/m² ($SD = 4.76$). The sample self-identified as approximately 70.4% white, 24.8% black or African American, 1.6% Asian, 2.8% more than one race, and <1% American Indian/Native Alaskan. The majority of participants (96%)

were not Hispanic or Latino. We operationalized minor children as youth 18 years old to capture the parenting responsibilities that occur through the end of a child's high school years. Please note, for readability and simplicity, this paper refers to participants with children 18 years old at baseline as "parents of minor children" and uses the term "other participants" to refer to participants who did not have children, or whose children were >18 years old at baseline.

We elected to collapse non-parents and parents of older-aged children into a single comparison group for several reasons: 1) parenting stressors may change once children are able to assume greater responsibility (e.g., less acute caregiving needs/supervision) and as such the stressors parents of children over 18 may more closely resemble general family stressors that non-parents also face, 2) after children reach the age of majority they may leave home to pursue independent endeavors (e.g., college, full-time employment) which may also change the extent to which they influence their parents' weight control behaviors, 3) there was no theoretical reason to expect that those who never had children in the home would differ from those who had adult children who likely were no longer in the home, in the context of current weight control behaviors. In sum, we believed that parents of children over 18 were likely to be more similar to non-parents in that they presumably had greater control over their time and ability to practice weight control behaviors. For these reasons, we elected to include all participants without children 18 in the "other participant" group.¹

Approximately one-third of the sample indicated that they had at least one child 18 years old. More specifically, 33% of female participants ($n = 83$) and 31% of male participant ($n = 22$) had one or more minor child at the time of study enrollment. Most (80%) parents of minor children were currently married. The remainder were divorced or separated (12%), never married (7%), or widowed (1%). Half (51.5%) reported having one child 18 years old, while 36.6% reported having 2, 6.9% reported having 3, and 5.0% reported having 4. The children ranged in age from <1 year old to 18 years old; the average age was 12.9 years old ($SD = 4.2$). Most (97.4%) parents of minor children reported that they lived with their children at baseline. Two participants who were parents of minor children reported that they did not reside with their children, who were aged 17 and 18, respectively; we elected to retain these cases in analyses given that our aims focused on parental status rather than living arrangements².

This study was approved by the Institutional Review Board of Drexel University. Informed consent was obtained from all individual participants included in the study. Participants were eligible for enrollment if their BMI was 27 – 45 kg/m², they were 18 – 70 years old, there were no medical contraindications to participating according to their physician, and they were physically able to participate in exercise. Exclusion criteria included previous bariatric

¹Please note, analytically, there were no differences in key study variables between participants with adult children, and participants without children. Specifically, comparisons were as follows: BMI ($t(214) = .129, p = .90$), time for PA ($t(206) = .34, p = .73$), time for weight control ($U(215) = 5484, p = .53$), negative affect ($t(214) = -.57, p = .57$), stress ($U(153) = 2445.5, p = .10$), session attendance ($t(214) = -.22, p = .83$), calorie goal adherence ($t(210) = .27, p = .79$), PA ($t(208) = -.36, p = .72$), emotional overeating ($t(170) = -.34, p = .74$), disinhibited eating ($t(177) = 1.36, p = .18$).

²Please note, analyses were re-run excluding cases in which parents of minors did not reside with their children. These cases appear to have had a minimal impact on the overall findings. The p-values of the analyses excluding these cases did not differ in significance from those reported in text.

surgery, use of weight-affecting medication, substantial (i.e., >5%) weight loss within the past 6 months, or diagnosis of a major medical or psychiatric condition that would interfere with participation in the treatment. Women who were currently nursing, pregnant, or planning to become pregnant during the study period were also excluded. Out of the total individuals screened <1% were excluded for meeting one or more of the criteria pertaining to pregnancy and nursing; only 4 women were excluded specifically for nursing.

All participants took part in group-based BWL intervention. Sessions were led by clinicians who held Ph.Ds. in clinical psychology, with session content based on established protocols that were expected to produce a 10% weight loss [i.e., Diabetes Prevention Program and Look AHEAD protocols (The Diabetes Prevention Program Research Group, 2002; The Look AHEAD Research Group, 2006)]. Sixteen sessions in total (9 weekly and 7 biweekly sessions) were held during the 6 month (6M) weight loss phase. Additional sessions were held after 6M focusing on specialized weight loss maintenance skills; however, the treatment and data collected during the first 6M were of primary interest since the focus of the current study was to investigate the role of parental status during weight loss.

Participants weighing < 250 lbs. had calorie goals within 1200–1500 kcals, and participants weighing ≥ 250 lbs. had calorie goals within the 1500–1800 kcal range. Participants were encouraged to keep track of calorie intake on a daily basis and reported their weekly calorie goals and averages at each session. In order to allow participants to focus on the adoption of daily calorie recording, adherence to calorie goals was not emphasized for the first session. Throughout the program, participants were not given specific guidance on achieving specific macro or micronutrient targets, but were encouraged to eat a balanced diet that would promote satiety. Portion size estimation, nutrition label reading, and other topics that would support adherence to calorie goals were discussed in sessions.

Session content and individualized feedback were aimed to help participants adjust their eating habits to adhere to personal calorie goals in balanced, realistic and sustainable ways to achieve 1–2 lbs. of weight loss per week. Examples of topics covered during the 6M weight loss phase included guidance on keeping track of intake, meal planning, low calorie eating skills (e.g., food substitutions, calorie balance), PA planning and lifestyle activity, problem solving, stress management, restaurant eating, social cues for eating and exercise, handling hunger, and managing lifestyle modification during special occasions. All participants were prescribed a standard PA progression that included a gradual increase in the number of days and minutes of moderate-to-vigorous PA (MVPA), beginning with 15 minutes per day for 3 days and stabilizing with 50 minutes per day for 5 days. Participants were permitted to divide the total daily minutes of MVPA over several bouts, and instructed that each exercise bout should last for at least 10 minutes due to the cardiovascular benefits. They were also educated about different levels of exertion, including physical indicators of MVPA (e.g., changes in breathing, heart pumping, sweating).

2.2. Measures

2.2.1. Participant Characteristics—Participants completed the Weight and Lifestyle Inventory at their baseline assessment (WALI) (Wadden & Foster, 2006). Participant characteristics such as age, gender, race, and parental status were assessed.

2.2.2. Weight Control Barriers—Negative affect, stress, and time-related barriers were assessed. Negative affect was operationalized as depressive symptoms, and measured by the Beck Depression Inventory II, which has high reliability (test-retest $r = .93$; internal consistency $\alpha = .91$) and validity (e.g., concurrent validity $r = .77$) (Beck, Steer, & Brown, 1996). Stress was measured by an item on the WALI which asked participants to forecast how much anticipated stress they would have over the next 6M using a Likert-type 1–5 scale (1 = *much less stressful than usual*; 5 = *much more stressful than usual*). Also on the WALI, participants were asked to estimate their ability to commit at least 30 minutes per day to weight control with one of the following ordinal scale choices (1) “*I definitely will not be able to devote 30 minutes daily to weight control*,” (2) “*I’m not sure if I can find 30 minutes daily for weight control*,” (3) “*I can definitely find 30 minutes for weight control*,” or (4) “*I can devote more than 30 minutes daily to weight control*.” Participants also completed the time subscale of the Barriers to Being Active questionnaire (US Department of Health and Human Services, 1999). This subscale measures the extent to which lack of time poses a barrier to engaging in PA. Responses to subscale items range from 0 (*Very unlikely*) to 3 (*Very likely*) and refer to the likelihood of interference from time-related barriers (e.g., “*My day is so busy now, I just don’t think I can make the time to include physical activity in my regular schedule*”). Responses are summed to create a total score, with scores of ≥ 5 indicating a clinically meaningful barrier. In this sample, internal consistency was .78.

All weight control barrier assessments were completed at baseline. We also repeated the Barriers to Being Active questionnaire at 6M since participants’ identification of barriers might be affected by programmatic goals to increase in exercise in line with program’s PA prescription.

2.2.3. Weight-control and Non-homeostatic Eating Behaviors—Attendance was measured by study staff noting participants as present or absent at each of 16 group sessions. The total number of sessions attended was summed. Participants’ self-reported calorie goals and weekly calorie averages were collected at each session. Because there were 9 weekly and 7 biweekly sessions, there were 23 weeks of calorie data in total. Calories were self-reported from participants’ weekly logs. Paper and pencil log booklets and CalorieKing reference books were provided to all participants for calorie tracking; however, participants were free to use an electronic method (e.g., spreadsheet, Smartphone app) if they preferred to facilitate completion of their weekly log. Participants weekly calorie goals and averages were compared; an overall adherence score was computed for each participant by summing the number of weeks in which their averages were less than or equal to their weekly calorie goals. To aid in interpretation, summed scores were converted to a 0–100 percentage score, with higher scores indicating more weeks of adherence. Emotional overeating was measured by the Emotional Overeating Questionnaire (EOQ) (Masheb & Grilo, 2006) which assesses overeating frequency in response to six emotions (anxiety, sadness, loneliness, tiredness,

anger, and happiness). Higher scores reflect more frequent overeating. Good test-retest reliability (intraclass correlation coefficients range from .62–.73) and internal consistency ($\alpha = .85$) have been demonstrated in previous research (Masheb & Grilo, 2006); in our sample Cronbach's $\alpha = .81$. Participants also completed the disinhibited eating subscale of the Three Factor Eating Questionnaire (TFEQ) (Stunkard & Messick, 1985), which is scored by averaging responses across 16 items. Higher scores indicate greater disinhibited eating. Internal consistency in the current study was .72. Actigraph GT3X+ tri-axial accelerometers objectively measured PA using established cut-points (Troiano et al., 2008). This method is well validated (Bouten, Westerterp, Verduin, & Janssen, 1994; Ward, Evenson, Vaughn, Rodgers, & Troiano, 2005). At their 6M assessment, participants were asked to wear the accelerometers for one week for all waking hours; however, analytic criteria included participants with 10 hours of wear with at least 4 days of valid data. Data were extracted using ActiLife software. Moderate-to-vigorous PA (MVPA) in bouts of at least 10 minutes was the PA measurement of interest, since this was consistent with the study's PA prescription, and has the most relevance for cardiovascular benefit (Haskell et al., 2007).

2.2.4. Weight—Participants were weighed in the clinic on a Tanita model WB-3000 digital scale at baseline and 6M. Weight loss at 6M was calculated as the percentage lost based on baseline weight.

2.3. Analytic Plan

We conducted secondary analyses of data originally collected as part of a larger clinical trial. Participants with at least one 18 year-old child were coded as positive minor child status for the purposes of our analyses, while those without children, or with children >18 years-old, were coded as null. Percent weight loss was expressed as a negative value (e.g., -10% reflected a 10% weight loss, where as 5% represented a 5% weight gain). We used last observation carried forward to address missing weight data at 6M. Data were analyzed using SPSS version 23 (IBM Corp., 2014). To evaluate the main effects and interaction of minor child parental status and gender on weight loss, we performed a moderation analysis using the PROCESS macro (Hayes, 2013). The PROCESS macro, which has many functions, including the automation of some the multi-step analytic options in SPSS, used ordinary least squares regression to estimate two way interactions in our moderation model. We screened for potential relevant demographic covariates with Pearson r correlations. We identified significant correlations between age and weight loss ($r = -.17, p = .002$) such that older participants lost more weight, and between age and parental status ($r = -.37, p < .001$), and as such controlled for age. Even though using percent weight loss as our outcome variable provided some protection from higher starting weights biasing the interpretation of 6M outcomes, we also controlled for baseline BMI since there was a trend for men to have higher baseline BMIs than women ($t = 1.84, p = .067$). We used t-tests to evaluate whether differences existed in mean score for interval scale measures and other quantitative variables, and when necessary non-parametric equivalents (i.e., Mann-Whitney U tests) for ordinal scale measures. In cases where dependent variables were found to be positively skewed (i.e., MVPA, depression, and emotional overeating) a constant was added and a log transformation was applied prior to analyses. In cases where dependent variables were negatively skewed (i.e., attendance), a reverse score transformation followed by a log

transformation was applied prior to analyses. Non-transformed means and standard deviations are reported for ease of interpretation.

3. Results

3.1. Evaluation of Parental Status, Gender, and Their Interaction

The overall model evaluating the relation of minor child parental status to 6M weight loss, controlling for age, was significant $F(5, 315) = 4.14, p = .001, R^2 = .06, f^2 = .06$. There were significant main effects for minor child parental status [$b = 3.14, t(315) = 2.20, p = .03$], such that parents of minor children exhibited less weight loss than other participants, and gender [$b = 3.24, t(315) = 3.60, p < .001$], such that women exhibited less weight loss than men. There was a significant interaction between minor child parental status and gender [$b = -4.04, t(315) = -2.53, p = .01$], such that parental status was associated with more weight loss for women, and less weight loss for men. Model estimates for weight losses for each of the four categories are as follows: fathers of minor children ($n = 22$): -8.61% , mothers of minor children ($n = 83$): -9.41% , other men ($n = 49$): -11.74% , other women ($n = 166$): -8.50% . The moderation is depicted in Figure 1. Additionally, for parents, there was a negative relation between the age of the youngest minor child and percent weight loss, such that those with younger children had less weight loss than those with older children ($b = -.27, t(97) = -2.67, p = .009$); however, this was not significant after controlling for parental age ($p = .50$).

3.2. Potential Differences in Barriers to Weight Loss

The results from the tests that evaluated whether differences existed between those with and without at least one 18 year-old child in hypothesized barriers of stress, depression, and time are reported in Table 1. There were no differences in self-reported ability to devote at least 30 minutes per day to weight control [parents of minor children $Mdn = 3.49$], other participants $Mdn = 3.47$], ($U = 11224, p = .999$).

3.3. Potential Differences in Weight Loss Behaviors and Non-homeostatic Eating Behaviors

Because we found that parents of minor children had greater self-identified barriers to weight loss, we conducted additional analyses to evaluate whether differences in identified eating and weight loss behaviors also were present. Please refer to the lower half of Table 1. There were no differences in attendance, or minutes spent in bouts (i.e., 10 min. at a time) MVPA. Parents of minor children had lower calorie goal adherence than other participants. Although we expected that parents might have more difficulty regulating their eating behavior, given that we found they had greater stress and depression, there were no differences in emotional overeating or disinhibited eating.

4. Discussion

This is the first study to investigate the effect of parental status on adults enrolled in a BWL program. Parents of minor children are particularly in need of effective weight loss treatments, as the transition to parenthood is a vulnerable time for weight gain (Umberson et al., 2011), and parental weight status may have an intergenerational impact (Whitaker,

Jarvis, Beeken, Boniface, & Wardle, 2010). Since our analyses indicated a main effect for parental status on weight loss, our data suggest that parents may be a group for whom BWL programs produce suboptimal outcomes.

Our initial hypothesis was supported, as participants with one or more children age 18 or younger (parents of minor children) lost less weight than participants without children, or those with children greater than 18 years old (other participants), after controlling for age. Specifically, the difference in mean percent weight loss overall for parents of minor children and other participants was approximately 3%, which suggests a potentially clinically significant effect for parental status. We also found that men lost more weight than women, and that gender was a significant moderator of the impact of parental status on weight loss, which partially supported our second hypothesis. Surprisingly, our prediction that mothers of minor children would have the least weight loss was not supported, as other women had the least weight loss. Notably, men in the “other participants” group had the greatest weight loss.

We examined whether parents of minor children differed from other participants on certain barriers, weight loss behaviors, and other eating behaviors to better understand differences in weight loss. As expected, overall, parents reported greater expected stress, higher depression scores, and greater time related barriers to PA, though no differences were found between parents of minor children and other participants in their predicted ability to commit 30 minutes to weight control each day. In terms of problematic eating behaviors and weight loss behaviors that may suffer for parents, there were no differences between parents of minor children and other participants in attendance, emotional overeating, disinhibited eating, or MVPA; however, parents of minor children had lower adherence to weekly calorie goals. Therefore, it appears parents have greater challenges to weight loss, which may be evidenced through their relative difficulty in meeting their calorie goals.

In regard to the findings and effects that we found in our analyses, the barriers and behaviors in which parents of minor children and other participants differed were small to medium effects, suggesting noticeable differences in the ways in which parents of minor children experience BWL compared to other participants. Of note, there was a discrepancy between the findings for time-related barriers to PA and achieved MVPA. Given that neither group met the goal of 250 minutes of MVPA at 6M, it is possible that parents of minor children may accurately perceive greater time-related barriers to PA, and perhaps other participants faced other unassessed barriers (e.g., pain, fatigue), that led to similar levels of MVPA across participants. Additionally, although parents of minor children reported more stress and depression, it did not appear that greater negative affect corresponded to experience greater problematic eating behaviors. This suggests that the lower calorie goal adherence found among parents of minor children was not likely due to emotional or disinhibited eating, and may be driven by other factors.

It is possible that there may be important factors to understanding the relation of parental status to weight loss that were not evaluated in this study. We were not able to determine the extent to which parental status impacted food choices or other factors that may have contributed greater difficulty in meeting calorie goals. It is possible that the availability of

high calorie foods and beverages in the homes of parents with minor children may have led to lower calorie goal adherence. Further, perceived or actual family resistance to creating a low-calorie home food environment may limit the success of weight control efforts.

In terms of factors that were included in the current study, our data agree with the literature suggesting that limits on time appear to be a prominent obstacle to weight loss for parents, generally (Chang et al., 2008); however, the impact of this obstacle may differ across various weight loss behaviors. In our study, attendance to group meetings was not lower for parents, but there were differences in time-related barriers to PA between parents of minor children and other participants. While parents of minor children may be effective in dedicating time once per week for group meetings, they may find it more difficult to set aside time for more frequent weight loss behaviors that can occur at home. Further, it is possible that meal planning and self-monitoring may be superseded or interrupted by family needs since these can be scheduled more flexibly than BWL groups. It is possible that tailoring of weight loss interventions to accommodate the needs of parents of minor children might help to mitigate the impact of the barriers noted in the current study. For instance, incorporating greater emphasis on stress reduction and time management might help to address the specific challenges that parents face. Additionally, incorporating family into treatment might be another mechanism to satisfy both family and weight control needs, and might be an effective format for addressing family food preference challenges in the home food environment.

Another interesting finding of our study is that the effect of parental status appears to differ by gender, with a notable gap in weight loss for fathers of minor children compared to others. Specifically, fathers of minor children had approximately 3% less weight loss than other men, while women without minor children lost ~1% less than mothers of minors. It is possible that men with minor children are a group that needs additional support in BWL. Interestingly, previous research has found that more fathers than mothers report parenthood-related barriers to PA, including family responsibilities and limited social support (Mailey et al., 2014), and that there is a stronger negative association between work and family roles and time for exercise for fathers than for mothers (Nomaguchi & Bianchi, 2004). It is possible that these challenges may extend to other weight loss behaviors; however, additional research is needed to better understand this finding.

4.1. Limitations and future directions

There are several strengths and limitations to this study. First, we assessed weight loss barriers in a BWL sample, which provides an advantage over focus group-based research that measured barriers among individuals who may not be formally attempting to lose weight. We were able to evaluate the impact of parental status on weight loss, PA, and eating behaviors whereas previous research has typically focused on either eating or PA in isolation. In terms of limitations, we cannot establish causation of weight outcomes in this study. While we evaluated weight losses at 6M, the long-term effects of parental status on weight control are still unknown. Because measures of negative affect and stress-related barriers were not re-administered after baseline, we were not able to evaluate the extent to which 6M levels of these variables may have cross-sectionally related to weight loss for

parents. We also recognize that individual differences in living situations exist. Unfortunately, we did not collect information on whether children lived with one or more parents/caregivers, or whether they lived full or part-time in the household. It is possible that the specific challenges of single parenting, and shared parenting across households, may present important weight control challenges. Because we were unable to assess these factors, it is possible that grouping parents based on their children's ages may not fully capture the stressors or influences of raising children. Additionally, we were not able to compare home food environments across - participants, which might help further explain our results. Although we were able to evaluate differences in calorie goal adherence, self-reports of calorie intake can be flawed. Finally, although we were able to include a total of 71 men in our analyses, women were overrepresented in our sample. Unfortunately, this reflects a larger problem in BWL research (Pagoto et al., 2012); research on fathers' responses to BWL interventions is especially scarce. Future research that includes sufficient enrollment of parents of both genders to address these limitations is warranted.

4.2. Conclusions

In conclusion, this investigation is the first to explore the important effects of parental status and gender on weight loss. Parents appear to be a group for whom BWL programs may underperform, as they experience greater barriers in time, stress, and negative emotion. The current data suggest that parents have greater difficulty adhering to calorie goals; future research is indicated to better understand the mechanisms through which weight control barriers and difficulties with calorie goal adherence impact weight loss. While factors such as gender and parental status are not modifiable, identification of their impact on weight control may help with greater personalization and tailoring of interventions to mitigate barriers. In turn, this may help to increase the percentage of individuals who experience successful weight loss outcomes from first line treatments.

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References

- Aschermann-Witzel J. Danish Mothers' Perception of the Healthiness of Their Dietary Behaviors During Transition to Parenthood. *Journal of Family Issues*. 2013; 34(10):1335–1355. DOI: 10.1177/0192513X12463688
- Beck, AT., Steer, RA., Brown, GK. Beck Depression Inventory Manual. 2. San Antonio: Psychological Corporation; 1996.
- Bellows-Riecken KH, Rhodes RE. A birth of inactivity? A review of physical activity and parenthood. *Preventive Medicine*. 2008; 46(2):99–110. doi:<http://dx.doi.org/10.1016/j.ypmed.2007.08.003>. [PubMed: 17919713]
- Belza B, Warms C. Physical activity and exercise in women's health. *Nursing Clinics of North America*. 2004; 39(1):181–193. doi:<http://dx.doi.org/10.1016/j.cnur.2003.11.011>. [PubMed: 15062735]
- Bouten CV, Westerterp KR, Verduin M, Janssen JD. Assessment of energy expenditure for physical activity using a triaxial accelerometer. *Med Sci Sports Exerc*. 1994; 26(12):1516–1523. [PubMed: 7869887]

- Brown JD, Buscemi J, Milsom V, Malcolm R, O'Neil PM. Effects on cardiovascular risk factors of weight losses limited to 5–10 %. *Translational Behavioral Medicine*. 2016; 6(3):339–346. DOI: 10.1007/s13142-015-0353-9 [PubMed: 27528523]
- Brown PR, Brown WJ, Miller YD, Hansen V. Perceived Constraints and Social Support for Active Leisure Among Mothers With Young Children. *Leisure Sciences*. 2001; 23(3):131–144.
- Brown WJ, Mishra G, Lee C, Bauman A. Leisure time physical activity in Australian women: relationship with well being and symptoms. *Res Q Exerc Sport*. 2000; 71(3):206–216. DOI: 10.1080/02701367.2000.10608901 [PubMed: 10999258]
- Chang MW, Nitzke S, Guilford E, Adair CH, Hazard DL. Motivators and barriers to healthful eating and physical activity among low-income overweight and obese mothers. *J Am Diet Assoc*. 2008; 108(6):1023–1028. DOI: 10.1016/j.jada.2008.03.004 [PubMed: 18502238]
- DePue JD, Clark MM, Ruggiero L, Medeiros ML, Pera V. Maintenance of Weight Loss: A Needs Assessment. *Obesity Research*. 1995; 3(3):241–248. DOI: 10.1002/j.1550-8528.1995.tb00144.x [PubMed: 7627772]
- Elfhag K, Rössner S. Who succeeds in maintaining weight loss? A conceptual review of factors associated with weight loss maintenance and weight regain. *Obesity reviews*. 2005; 6(1):67–85. DOI: 10.1111/j.1467-789X.2005.00170.x [PubMed: 15655039]
- Group DPPR. Reduction in the Incidence of Type 2 Diabetes with Lifestyle Intervention or Metformin. *New England Journal of Medicine*. 2002; 346(6):393–403. doi: DOI: 10.1056/NEJMoa012512 [PubMed: 11832527]
- Hartman MA, Hosper K, Stronks K. Targeting physical activity and nutrition interventions towards mothers with young children: a review on components that contribute to attendance and effectiveness. *Public Health Nutr*. 2011; 14(8):1364–1381. DOI: 10.1017/s1368980010001941 [PubMed: 20633316]
- Haskell WL, Lee I-M, Pate RR, Powell KE, Blair SN, Franklin BA, Bauman A. Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation*. 2007; 116(9):1081–1093. [PubMed: 17671237]
- Hayes, AF. *Introduction to Mediation, Moderation, and Conditional Process Analysis*. New York, NY: The Guilford Press; 2013.
- Herring SJ, Cruice JF, Bennett GG, Davey A, Foster GD. Using technology to promote postpartum weight loss in urban, low-income mothers: a pilot randomized controlled trial. *J Nutr Educ Behav*. 2014; 46(6):610–615. DOI: 10.1016/j.jneb.2014.06.002 [PubMed: 25069621]
- Horning ML, Fulkerson JA, Friend SE, Story M. Reasons Parents Buy Prepackaged, Processed Meals: It Is More Complicated Than "I Don't Have Time". *Journal of Nutrition Education and Behavior*. 2016; 49(1):60–66.e61. DOI: 10.1016/j.jneb.2016.08.012 [PubMed: 27743860]
- Hsu H-C, Wickrama KAS. Maternal life stress and health during the first 3 years postpartum. *Women Health*. 2017; :1–18. DOI: 10.1080/03630242.2017.1316344
- Hull EE, Rofey DL, Robertson RJ, Nagle EF, Otto AD, Aaron DJ. Influence of Marriage and Parenthood on Physical Activity: A 2-Year Prospective Analysis. *Journal of physical activity & health*. 2010; 7(5):577–583. [PubMed: 20864752]
- IBM Corp. *IBM SPSS Statistics for Windows, Version 23.0*. Armonk, NY: IBM Corp; 2014.
- Jabs J, Devine CM, Bisogni CA, Farrell TJ, Jastran M, Wethington E. Trying to find the quickest way: employed mothers' constructions of time for food. *J Nutr Educ Behav*. 2007; 39(1):18–25. DOI: 10.1016/j.jneb.2006.08.011 [PubMed: 17276323]
- Jakicic JM, Tate DF, Lang W, et al. Effect of a stepped-care intervention approach on weight loss in adults: A randomized clinical trial. *JAMA*. 2012; 307(24):2617–2626. DOI: 10.1001/jama.2012.6866 [PubMed: 22735431]
- Jansen A, Vanreyten A, van Balveren T, Roefs A, Nederkoorn C, Havermans R. Negative affect and cue-induced overeating in non-eating disordered obesity. *Appetite*. 2008; 51(3):556–562. DOI: 10.1016/j.appet.2008.04.009 [PubMed: 18495294]
- Jordan KC, Freeland-Graves JH, Klohe-Lehman DM, Cai G, Voruganti VS, Proffitt JM, Bohman TM. A nutrition and physical activity intervention promotes weight loss and enhances diet attitudes in low-income mothers of young children. *Nutrition research (New York, N.Y.)*. 2008; 28(1):13–20. DOI: 10.1016/j.nutres.2007.11.005

- Kotila LE, Schoppe-Sullivan SJ, Kamp Dush CM. Time in Parenting Activities in Dual-Earner Families at the Transition to Parenthood. *Family Relations*. 2013; 62(5):795–807. DOI: 10.1111/fare.12037 [PubMed: 26405367]
- Laroche HH, Hofer TP, Davis MM. Adult fat intake associated with the presence of children in households: findings from NHANES III. *J Am Board Fam Med*. 2007; 20(1):9–15. DOI: 10.3122/jabfm.2007.01.060085 [PubMed: 17204729]
- Laroche HH, Wallace RB, Snetselaar L, Hillis SL, Cai X, Steffen LM. Weight gain among men and women who have a child enter their home. *J Acad Nutr Diet*. 2013; 113(11):1504–1510. DOI: 10.1016/j.jand.2013.05.022 [PubMed: 23876450]
- Lundgren JD, Malcom R, Binks M, O'Neil PM. Remission of metabolic syndrome following a 15-week low-calorie lifestyle change program for weight loss. *International Journal of Obesity*. 2009; 33(1):144–150. DOI: 10.1038/ijo.2008.225 [PubMed: 19015662]
- Macht M, Simons G. Emotions and eating in everyday life. *Appetite*. 2000; 35(1):65–71. DOI: 10.1006/appe.2000.0325 [PubMed: 10896762]
- Mailey EL, Huberty J, Dinkel D, McAuley E. Physical activity barriers and facilitators among working mothers and fathers. *BMC Public Health*. 2014; 14:657. [PubMed: 24974148]
- Masheb RM, Grilo CM. Emotional overeating and its associations with eating disorder psychopathology among overweight patients with Binge eating disorder. *International Journal of Eating Disorders*. 2006; 39(2):141–146. DOI: 10.1002/eat.20221 [PubMed: 16231349]
- Morgan PJ, Collins CE, Plotnikoff RC, Callister R, Burrows T, Fletcher R, Lubans DR. The 'Healthy Dads, Healthy Kids' community randomized controlled trial: a community-based healthy lifestyle program for fathers and their children. *Prev Med*. 2014; 61:90–99. DOI: 10.1016/j.ypmed.2013.12.019 [PubMed: 24380796]
- Nelson SK, Kushlev K, Lyubomirsky S. The pains and pleasures of parenting: When, why, and how is parenthood associated with more or less well-being? *Psychological Bulletin*. 2014; 140(3):846–895. DOI: 10.1037/a0035444 [PubMed: 24491021]
- Nomaguchi KM, Bianchi SM. Exercise Time: Gender Differences in the Effects of Marriage, Parenthood, and Employment. *Journal of Marriage and Family*. 2004; 66(2):413–430. DOI: 10.1111/j.1741-3737.2004.00029.x
- Nomaguchi KM, Milkie MA. Costs and Rewards of Children: The Effects of Becoming a Parent on Adults' Lives. *Journal of Marriage and Family*. 2003; 65(2):356–374. DOI: 10.1111/j.1741-3737.2003.00356.x
- Nuss H, Clarke K, Klohe-Lehman D, Freeland-Graves J. Influence of Nutrition Attitudes and Motivators for Eating on Postpartum Weight Status in Low-Income New Mothers. *J Am Diet Assoc*. 2006; 106(11):1774–1782. doi:<http://dx.doi.org/10.1016/j.jada.2006.08.016>. [PubMed: 17081828]
- O'Dougherty M, Dallman A, Turcotte L, Patterson J, Napolitano MA, Schmitz KH. Barriers and motivators for strength training among women of color and Caucasian women. *Women Health*. 2008; 47(2):41–62. DOI: 10.1080/03630240802092241 [PubMed: 18681100]
- Pagoto SL, Schneider KL, Oleski JL, Luciani JM, Bodenlos JS, Whited MC. Male Inclusion in Randomized Controlled Trials of Lifestyle Weight Loss Interventions. *Obesity*. 2012; 20(6):1234–1239. DOI: 10.1038/oby.2011.140 [PubMed: 21633403]
- Ransdell LB, Vener JM, Sell K. International perspectives: the influence of gender on lifetime physical activity participation. *The journal of the Royal Society for the Promotion of Health*. 2004; 124(1):12–14. doi: DOI: 10.1177/146642400312400105 [PubMed: 14971185]
- Richardson AS, Arsenault JE, Cates SC, Muth MK. Perceived stress, unhealthy eating behaviors, and severe obesity in low-income women. *Nutrition Journal*. 2015; 14:122.doi: 10.1186/s12937-015-0110-4 [PubMed: 26630944]
- Stunkard AJ, Messick S. The three-factor eating questionnaire to measure dietary restraint, disinhibition and hunger. *Journal of Psychosomatic Research*. 1985; 29(1):71–83. [PubMed: 3981480]
- The Diabetes Prevention Program Research Group. The Diabetes Prevention Program (DPP): description of lifestyle intervention. *Diabetes Care*. 2002; 25(12):2165–2171. [PubMed: 12453955]

- The Look AHEAD Research Group. The Look AHEAD Study: A Description of the Lifestyle Intervention and the Evidence Supporting It. *Obesity* (Silver Spring, Md.). 2006; 14(5):737–752. DOI: 10.1038/oby.2006.84
- Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc.* 2008; 40(1):181–188. DOI: 10.1249/mss.0b013e31815a51b3 [PubMed: 18091006]
- Umberson D, Liu H, Mirowsky J, Reczek C. Parenthood and trajectories of change in body weight over the life course. *Soc Sci Med.* 2011; 73(9):1323–1331. DOI: 10.1016/j.socscimed.2011.08.014 [PubMed: 21925781]
- US Department of Health and Human Services. Barriers to Being Physically Active Quiz. 1999. http://www.cdc.gov/nccdphp/dnpa/physical/life/barriers_quiz.pdf
- Verhoef MJ, Love EJ. Women and exercise participation: The mixed blessings of motherhood. *Health Care for Women International.* 1994; 15(4):297–306. DOI: 10.1080/07399339409516122 [PubMed: 8056646]
- Wadden TA, Foster GD. The Weight and Lifestyle Inventory (WALI). *Obesity.* 2006; 14(Suppl 2):99S–118S. [PubMed: 16648601]
- Ward DS, Evenson KR, Vaughn A, Rodgers AB, Troiano RP. Accelerometer use in physical activity: best practices and research recommendations. *Med Sci Sports Exerc.* 2005; 37(11 Suppl):S582–588. [PubMed: 16294121]
- Whitaker KL, Jarvis MJ, Beeken RJ, Boniface D, Wardle J. Comparing maternal and paternal intergenerational transmission of obesity risk in a large population-based sample. *Am J Clin Nutr.* 2010; 91(6):1560–1567. DOI: 10.3945/ajcn.2009.28838 [PubMed: 20375189]
- Yavorsky JE, Kamp Dush CM, Schoppe-Sullivan SJ. The Production of Inequality: The Gender Division of Labor Across the Transition to Parenthood. *Journal of Marriage and Family.* 2015; 77(3):662–679. DOI: 10.1111/jomf.12189 [PubMed: 26430282]

Highlights

- Parents of minor children lost less weight after 6 months in a behavioral weight loss program than other participants.
- Parental status interacted with gender such that men without minor children lost the most weight.
- Parents of minor children identified greater barriers to weight loss than other participants.
- Parents of minor children did not differ from other participants in selected weight loss behaviors.

Figure 1. Interaction of minor child parental status and gender on six month percent weight loss

Note: Parental status groups were defined as having at least one child ≥ 18 years-old (“Parents of Minors” or not (“Other Participants”).

Table 1

Comparison of means and standard deviations for quantitatively measured weight control barriers, weight control behaviors, and non-homeostatic eating behaviors by minor child parental status.

	Parents of Minors (n = 105)		Other Participants (n = 215)		<i>t</i>	<i>p</i>	<i>d</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
<i>Barriers</i>							
Expected stress (baseline)	3.13	.79	2.87	.95	-2.54	.012	.30
Depression (baseline)	8.40	7.43	6.50	6.07	-2.33	.020	.28
Time-related barriers to PA (baseline)	3.63	2.61	2.73	2.36	-3.06	.002	.36
Time-related barriers to PA (6M)	3.60	2.63	2.62	2.39	-3.03	.003	.39
<i>Weight Control Behaviors</i>							
Attendance (6M)	12.69	3.06	12.79	2.78	.23	.82	.03
Minutes of MVPA in 10 minute bouts (6M)	134.79	105.93	135.72	128.19	-.44	.66	.01
Calorie goal adherence (%)	33.86	26.01	42.96	27.83	2.79	.006	.34
<i>Non-homeostatic Eating Behaviors</i>							
Emotional overeating (6M)	.57	.58	.55	.59	-.21	.83	.03
Disinhibited eating (6M)	7.93	3.25	7.56	3.32	-.88	.38	.11

Note. Participants in the "Parents of Minors" group had at least one 18 year old child. Participants in the "Other Participants" group either did not have children, or had children > 18 years old. PA = Physical activity; MVPA = Moderate-to-vigorous physical activity.