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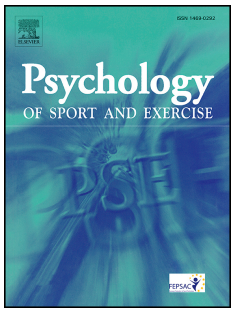
Mensinger, Janell L.; Meadows, Angela

DOI:
10.1016/j.psychsport.2017.01.010

Document Version
Peer reviewed version

Citation for published version (Harvard):
Mensinger, JL & Meadows, A 2017, 'Internalized weight stigma mediates and moderates physical activity outcomes during a healthy living program for women with high body mass index', *Psychology of Sport and Exercise*, vol. 30, pp. 64-72. https://doi.org/10.1016/j.psychsport.2017.01.010

Accepted Manuscript



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PII: S1469-0292(17)30073-0

DOI: 10.1016/j.psychsport.2017.01.010

Reference: PSYSPO 1184

To appear in: *Psychology of Sport & Exercise*

Received Date: 24 July 2016

Revised Date: 29 January 2017

Accepted Date: 29 January 2017

Please cite this article as: Mensinger, J.L., Meadows, A., Internalized weight stigma mediates and moderates physical activity outcomes during a healthy living program for women with high body mass index, *Psychology of Sport & Exercise* (2017), doi: 10.1016/j.psychsport.2017.01.010.

Internalized weight stigma mediates and moderates physical activity outcomes during a healthy living program for women with high body mass index

Janell L. Mensinger[a,b]

Angela Meadows[c]

Corresponding author affiliation at time of research:
[a]Reading Health System
Sixth Avenue and Spruce Street
West Reading, PA 19611, USA

Corresponding author address (present):
[b]Drexel University,
College of Nursing and Health Professions
1601 Cherry Street
3 Parkway Building, 9th floor, MS 9503,
Philadelphia, PA 19102, USA
janell.l.mensinger@drexel.edu

[c]University of Birmingham,
School of Psychology,
Birmingham, B15 2TT, UK
axm583@bham.ac.uk

Acknowledgments: This manuscript was based on data also used in two previously published reports:

Mensinger, J.L., Calogero, R.M., Stranges, S., & Tylka, T.L. (2016). A weight-neutral versus a weight-loss approach to health and well-being in women with high BMI: A randomized controlled trial. *Appetite, 105,* 364-374. doi:10.1016/j.appet.2016.06.006

Mensinger, J.L., Calogero R.M., & Tylka, T.L. (2016). Internalized weight stigma moderates eating behavior outcomes in women with high BMI participating in a healthy living program. *Appetite, 102,* 32-43. doi:10.1016/j.appet.2016.01.033

Funding: This work was supported by a grant from the Edna G. Kynett Memorial Foundation awarded to the first author.

Conflict of Interest Statement: The authors declare no conflicts of interest regarding this work.

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Abstract

Objectives: To investigate the influence of internalized weight stigma (IWS) on physical activity (PA) outcomes among women with body mass index (BMI) over 30 kg/m^2. *Design and Method*: Data were drawn from an RCT that included 80 primarily inactive women (94% non-Hispanic/Latina white; mean age=39.6, SD=4.1, range=30.0 to 45.0; mean BMI=38.0 kg/m^2, SD=3.9, range=30.2 to 44.8 kg/m^2. Participants completed a 6-month weight-neutral, health-at-every-size or weight-loss-focused group-based healthy living program. PA enjoyment and engagement in moderate-intensity PA (MI-PA) (at least 30 minutes most days of the week) were assessed at baseline and immediately post-intervention. We used intention-to-treat linear mixed-effects modeling to test IWS as a moderator of changes in MI-PA engagement. We also tested a model whereby the positive effects of participating in the program on engagement in MI-PA would be serially mediated by a reduction in IWS and a concomitant increase in MI-PA enjoyment. *Results:* The weight-neutral and weight-loss-focused data were combined for all analyses. The moderation hypothesis was supported with a significant interaction between IWS and time. Participants had significant gains overall in MI-PA engagement from baseline to post-intervention; however, those with high IWS had an attenuated response. The serial mediation model was also supported. The positive effect of the program on engagement in MI-PA occurred through decreased IWS and increased MI-PA enjoyment. *Conclusions:* Self-directed stigma and holding negative attitudes about one's weight interferes with positive changes in PA outcomes. Healthy living programs may be less effective for those most vulnerable unless we aim to reduce IWS.

Keywords: weight bias internalization, exercise enjoyment, weight self-stigma, obesity, serial mediation, exercise motivation

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Lack of engagement in physical activity (PA) remains one of the top five contributors to premature mortality (Kohl et al., 2012), and a growing number of public health promotion efforts have focused on establishing effective strategies for increasing PA across the lifespan (see Horodyska et al., 2015 for a review). However, US national data suggest that only one in five American adults meet the recommended PA guidelines, and one quarter do not engage in any leisure-time PA (Centers for Disease Control and Prevention, 2014). Further, some studies show higher-weight individuals are less likely to meet PA guidelines than their counterparts with a BMI less than 25 (Spees et al., 2012). In a recent study of youth, regardless of true body mass index (BMI), perceiving oneself as "overweight" was associated with less vigorous-intensity PA, and lower likelihood of playing sports compared to peers who perceive their weight as "about right" (Patte, Laxer, Qian & Leatherdale, 2016). Given the widespread benefits of PA for both physical and mental well-being, understanding the factors contributing to PA engagement in higher-weight individuals could lead to improvements in health promotion interventions targeted at this population.

In recent years, increasing attention has been paid to the impact of weight stigma on health and behavioral outcomes (e.g., Hilbert et al., 2015; Latner, Barile, Durso, & O'Brien, 2014). Experiences of weight stigma can involve perceptions of negative judgment, poorer treatment, rejection, or outright discrimination based on weight, shape, or body size (Tylka et al., 2104). This form of prejudice is now one of the most frequently reported forms of stigma in both adults (Puhl, Andreyeva, & Brownell, 2008) and children (Bucchianeri, Gower, McMorris, & Eisenberg, 2016), and it affects almost all domains of daily life (Puhl & King, 2013). Most types

of weight stigma are disproportionately targeted at women (Judge & Cable, 2011), and frequency and severity increase exponentially at higher BMIs (see Spahlholz, Baer, König, Riedel-Heller, & Luck-Sikorski, 2015 for a review). When higher-weight individuals personalize the negative societal evaluation of larger bodies and, in turn, apply it to themselves, the consequent self-devaluation is known as internalized weight stigma or weight self-stigma (Durso & Latner, 2008; Tylka et al., 2014). People with high levels of internalized weight stigma not only fear negative evaluation from others, they *endorse* weight-related stereotypes—such as "higher weight individuals have less will-power and are less deserving of a fulfilling social life." Weight self-stigma results in feeling less competent, less valued, more self-conscious, depressed, and anxious (Hilbert, Braehler, Haeuser, & Zenger, 2014; Schvey et al., 2016).

Both the experience of weight stigma and self-directed weight stigma are constructs associated with poorer health and well-being (Hilbert et al., 2014; Latner et al., 2014). In fact, the relationship between higher BMI and poorer physical health-related quality of life is only present for those with high self-directed weight stigma (Latner et al., 2014). Further, evidence suggests that perceived discrimination and stigma concerns explain the relationship between BMI and self-reported health (Hunger & Major, 2015). Additionally, research has reliably shown that self-directed weight stigma is associated with increased disordered eating behavior (Durso & Latner, 2008; Durso, Latner, & Hayashi, 2012; Mensinger, Calogero, & Tylka, 2016). In studies that measured self-directed and the experience of weight stigma together, self-directed weight stigma consistently mediates the relationship between being stigmatized by others and health outcomes (Durso et al., 2012; Pearl, Puhl & Dovidio, 2015). Combining these findings with similar evidence from experimental research (Pearl & Puhl, 2016) suggests that self-directed stigma may be a more potent driver of distress and health outcomes than is experiencing weight stigma.

Weight stigma is also associated with lower engagement in PA (Carels et al., 2009; Wott & Carels, 2010). Specifically, in a study of higher-weight adults seeking behavioral weight-loss treatment, endorsement of greater weight bias was associated with lower energy expenditure, while attributing more positive traits to higher-weight people was associated with longer bouts of exercise (Carels et al., 2009). In addition, data from a cross-sectional study of college-aged females found a positive relationship between weight stigma experiences and motivation for exercise avoidance (Vartanian & Shaprow, 2008). Later evidence noted that this effect was moderated by the participants' own anti-fat attitudes and internalization of the thin ideal (Vartanian & Novak, 2011). Finally, in related research supporting a stereotype threat model, Seacat and Mickelson (2009) showed that behavioral intentions for exercise were significantly lower in a sample of women with a high BMI who were experimentally primed to feel stigmatized for their weight compared to a control condition.

A number of possible explanations exist for the inverse relationship between weight stigma and PA attitudes and behaviors. Systemic or institutional stigma results in physical barriers to PA that affect higher-weight individuals, from facilities or equipment unsuitable for larger bodies (Schvey et al., 2016), to difficulties in finding suitable apparel in bigger sizes (Christel, O'Donnell, & Bradley, 2016; Packer, 1989). Perhaps more importantly though, is the interpersonal aspect of weight stigma. Heavier individuals report fear of being judged, ridiculed, or even abused when they are exercising (Packer, 1989; Schvey et al., 2016), and such fears are not unfounded. Studies examining the prevalence of different types of stigma experienced by higher-weight individuals report that being stared at, mocked, or verbally harassed by strangers is not uncommon in this population, and approximately one in ten individuals with a high BMI report having been physically attacked because of their weight (Puhl & Brownell, 2006). Within

formal fitness environments, larger bodies may be explicitly or implicitly devalued or shamed (Prichard & Tiggemann, 2008; Schvey et al., 2016), and high levels of anti-fat attitudes and endorsement of negative weight-related stereotypes have been reported in exercise science students (Chambliss, Finley, & Blair, 2004), fitness professionals (Robertson & Vohora, 2008), as well as frequent exercisers themselves (Flint & Reale, 2016).

To our knowledge, only one published study has specifically examined the association between internalized weight stigma and PA behavior (Pearl et al., 2015). It was an online cross-sectional study of 177 US women whose self-report BMI placed them in the 'overweight' or 'obese' category. There was a negative association between self-efficacy, motivation to exercise, and internalized weight stigma, even after controlling for BMI. Although weight stigma experiences were associated with increased PA behavior, there was also an indirect effect whereby experiencing weight stigma predicted greater self-directed stigma, which was associated with reduced PA behavior. Thus, while experiencing weight stigma might encourage women to engage in behaviors that will counteract stereotypes, these experiences also contribute to the self-stigma that predicts multiple maladaptive attitudes and behaviors (as reviewed above) including lower engagement in PA.

Little is known about the mechanisms via which the effects of internalized weight stigma on PA behavior are transmitted and how this might fit into larger theoretical models of PA. Despite the domination of cognitive frameworks (e.g., Ajzen, 1991; Bandura, 2001), some researchers have posited the importance of the affective judgments surrounding PA behavior (e.g., French et al., 2005; for a review see Rhodes, Fiala & Conner, 2009). Affective judgments involve studying the extent to which pleasure anticipated or derived from PA influences motivation and engagement. This approach draws from theories of "hedonism" where humans

are believed to behave in ways that will maximize the experience of pleasure and avoid pain (Kahneman, Diener, & Schwarz, 1999). Given that cognitive models have only been able to account for about a quarter of the variation in PA behavior, some researchers have suggested synthesizing these approaches with hedonic theories of motivation (Ekkekakis & Dafermos, 2012). Several studies have supported approaches that combine cognitive and affective models. For example, Kiviniemi et al. (2007) established that affective associations with PA behavior mediated all components of the theory of planned behavior (i.e., attitudes, social norms, and perceived benefits, barriers, and behavioral control) in predicting engagement in PA. Similarly, Lewis et al. (2016) found PA enjoyment at baseline predicted future engagement in PA after participating in a 6-month trial for increasing PA in 448 low-active adults. Their mediation analysis supported a model in which the effect of self-efficacy on future PA was mediated by enjoyment, suggesting greater competency yields more enjoyment.

Also in support of a hedonic framework, two health promotion intervention studies demonstrated enjoyment of PA played an important role in future behavior (Jekauc, 2015; Williams et al., 2008). More specifically, Jekauc (2015) instructed trainers in an experimental group to promote positive emotions, such as pleasure and fun. Compared to a 'treatment as usual' exercise control group, the experimental group experienced greater positive affect during exercise, and group differences in affective states mediated adherence to the exercise program (Jekauc, 2015). In a sample of 37 sedentary primarily female (78.4%) adults drawn from a parent trial that intended to promote 30 minutes of moderate-intensity PA most days of the week, Williams et al. (2008) found the experience of higher positive affect after a single exercise stimulus at baseline predicted greater PA 6 and 12 months later.

By synthesizing components from social-cognitive and affective theories for

understanding behavior change, the purpose of this study was to advance the literature on how internalized weight stigma impacts PA behaviors. We proposed weight self-stigma as a moderator *and* mediator of a treatment effect in a recent trial comparing a weight-neutral, health-at-every-size program (i.e., lifestyle change while emphasizing size acceptance) to a behavioral weight loss (BWL) program for women with high BMI (Mensinger, Calogero, Tylka & Stranges, 2016). Specifically, we first hypothesized that women with high levels of internalized weight stigma would show less improvement in PA than their counterparts with lower internalized weight stigma after taking part in a healthy living program (a moderator effect). Second, we hypothesized a model whereby the positive effects of participating in the program on engagement in PA would be serially mediated by a reduction in internalized weight stigma (a social-cognitive process) and a concomitant increase in PA enjoyment (an affective process).

Method

The present study utilized data derived from a randomized controlled trial comparing the health benefits of manualized weight-neutral, health-at-every-size (HAES) program (Omichinski, 2007) versus a manualized behavioral weight-loss (BWL) program (Brownell, 2000) for women with a BMI between 30 and 45 kg/m^2 (Mensinger et al., 2016b). We recruited from a semi-rural community in Berks County Pennsylvania using local flyers, Clipper magazine advertisements, and the website of the sponsoring community hospital. Low-active or sedentary women (i.e., those who scored in or below the "light intensity activity" category on the Stanford Brief Activity Survey; Taylor-Piliae et al., 2006) who identified as "struggling with their weight" and were free from any serious health conditions were invited to take part in a 6-month facilitator-guided group-based healthy living program that met weekly for 90 minutes. Both programs focused on overall health promotion through sustainable lifestyle change, and they contained

similar PA components (e.g., coordination of walking groups, a brief facilitator-led PA during the weekly sessions). However, the BWL program focused on the goal of weight reduction and monitoring behavior change through PA logs, while the HAES program focused on engaging in PA for the purpose of self-care, health and well-being, regardless of changes in weight. After a phone screen to determine preliminary eligibility in the trial (e.g., health status, age between 30 and 45 years, low activity level, etc.), study participants came to the hospital's Clinical Research Center to complete a series of health assessments, including height and weight measured without shoes on a Detecto balance beam scale and wall-mounted stadiometer. The Institutional Review Board of the Reading Health System (Pennsylvania, USA) approved and monitored the study protocol. Additional details regarding the procedures and primary outcomes for the trial are reported in Mensinger et al. (2016b).

Participants

We enrolled and randomized eighty participants into the study groups. They were primarily non-Hispanic/Latina white women (94%) with a mean age of 39.6 years (SD = 4.1; range 30.0−45.0) and a mean BMI of 38.0 kg/m^2 (SD = 3.9; range 30.2−44.8 kg/m^2). Most participants (80%) were married or in a domestic partnership, 74% of the sample had children, and 65% had at least some college education. The mean household income was $70,873 USD annually (SD = $35,653 USD; range $12,000−180,000 USD). At the end of the 6-month program, 72 study participants returned for a follow-up health assessment.

Measures

Data collection occurred during early morning appointments at baseline and again at the end of the 6-month program. The following measures relevant to this study were included in a larger packet of surveys.

Internalized weight stigma. We used the Weight Bias Internalization Scale (WBIS; Durso & Latner, 2008) to measure the degree to which participants have internalized society's negative attitudes towards higher weight. It contains 11 items rated on a 7-point Likert scale ranging from *strongly disagree* (scored as 1) to *strongly agree* (scored as 7). The WBIS asks participants about current feelings regarding their weight (e.g., "I am less attractive than most other people because of my weight."). Item responses are averaged, with higher scores indicating higher internalized weight stigma. In community-based samples of mostly women (83%) who were classified as 'overweight' or 'obese' by BMI, scores on the WBIS have demonstrated excellent internal consistency reliability (Cronbach's alpha = .90), and convergent as well as incremental validity (Durso & Latner, 2008). In a treatment-seeking sample (pre-bariatric surgery) of predominantly female (71%) adults with a BMI $\geq$ 35 kg/m^2, Hubner et al. (2016) found strong internal consistency (Cronbach's alpha of .84) and established convergent and predictive validity for the scale. In our sample, the Cronbach's alpha was also .84.

Physical activity. We measured engagement in moderate-intensity PA and enjoyment of moderate-intensity PA using two items from the health behaviors subscale of the Red Lotus Quality of Life questionnaire, which was designed to capture change in salutogenic-focused programs (i.e., programs that center on the promotion of health from a wellness as opposed to a disease perspective) (Gregg & O'Hara, 2007; McKinnon, 2008). For engagement in moderate-intensity PA, participants were asked about current behavior by responding to the question, "I participate in moderate-intensity physical activities (activities that make me breathe a bit harder or puff and pant), for about 30 minutes on average, most days of the week" on a 5-point rating scale ranging from 1 (*never true*) to 5 (*always true*). Higher scores indicate more frequent engagement in moderate-intensity PA. This item was found to positively correlate in our

sample's prescreening scores on the Stanford Brief Activity Survey (Taylor-Piliae et al., 2006) (spearman rho = .42; $p < .001$), suggesting preliminary validity for its use as a brief tool for measuring engagement in moderate-intensity PA. For current enjoyment of moderate-intensity PA, participants were asked to respond to the question, "I enjoy participating in moderate-intensity physical activities (activities that make me breathe a bit harder or puff and pant)" on a 5-point rating scale ranging from 1 (*never true*) to 5 (*always true*). Higher scores indicate a greater enjoyment of moderate-intensity PA behaviors.

Data Analysis

Statistical tests were performed in SPSS (Version 24.0, Armonk, NY: IBM Corp.). Scatterplots, normal P-P plots and histograms of the regression standardized residuals indicated that assumptions of linearity and normality were adequately met. We also found no influential outliers applying Cook's distance (Fung, Zhu, Wei & He, 2002).

We tested the moderating role of internalized weight stigma on changes in moderate-intensity PA engagement over the course of the program using linear mixed-modeling with intention-to-treat analysis for repeated measures designs. Although there were missing data (see *n's* for each variable shown in Table 1), sensitivity analyses indicated they met the MAR (missing at random) assumption. Since we used restricted maximum likelihood estimation (REML) to derive the parameters of the model, data from every participant with information on the outcome variable contributed to the final determination of regression weights making these models particularly robust despite missingness (Gallop & Tasca, 2009). The model included an interaction effect between internalized weight stigma and time, a main effect for time (baseline to 6 months), a main effect for internalized weight stigma, and a covariate term for BMI. We plotted the interaction effect and inferentially tested the simple slopes by showing change in

moderate-intensity PA engagement from baseline to the end of the intervention at values of 1 SD above and below the mean on the WBIS (Aiken & West, 1991). We derived an effect size for the interaction by calculating a partial correlation coefficient (ρ_w) from the regression parameter estimate using the procedure outlined by Lipsitz et al. (2001) for repeated measures data. As an effect size, a partial correlation is interpreted much like a zero-order correlation coefficient, which ranges from –1 to 1 and is considered larger as the value approaches either of these endpoints (Lipsitz, Leong, Ibrahim, & Lipshultz, 2001).

Using a path-analytic framework with the MEMORE macro as an add-on in SPSS (Montoya & Hayes, 2016), we tested if the programs' positive effects on engagement in moderate-intensity PA occurred serially through decreases in internalized weight stigma and increases in enjoyment of moderate-intensity PA. To fit the model, the macro calculated regression parameters using simple deviation scores (i.e., change scores) between baseline and 6-months for each of the mediators (internalized weight stigma and moderate-intensity PA enjoyment) and for the outcome variable (moderate-intensity PA engagement). We used the percentile bootstrapping method with 5000 bootstrapped samples to derive standard errors and 95% confidence intervals of the indirect, direct, and total effects. This method advances earlier-generation causal steps approaches by providing a single inferential test instead of relying on piecemeal hypothesis testing to determine the presence of mediation (e.g., Judd, Kenny & McClelland, 2001). Path-analytic frameworks for mediation have become a superior approach also because they allow for more complex models with multiple parallel and/or serial processes that can be tested conditionally as functions of another variable (Hayes, 2015). We calculated effect sizes for the serial mediation model with partially standardized indirect effects[1] (Preacher & Kelley, 2011). These are interpreted as the predicted change in the outcome, expressed in

standard deviations units, resulting from the indirect effect of the program through the mediator(s).

Results

Changes in the PA outcomes (enjoyment and engagement) and internalized weight stigma did not differ according to the program assigned, and tests for moderation showed no difference between programs in how internalized weight stigma impacted outcomes; therefore, the groups were combined into a single sample for the current study. Descriptive statistics for each variable at baseline and 6-months are shown in Table 1.

Moderation Model

The linear mixed-effects model testing the first hypothesis indicated a statistically significant interaction effect between internalized weight stigma and time for predicting change in moderate-intensity PA engagement, b = -0.35, SE = 0.16, 95% CI [-0.67, -0.04], $t(89)$ = -2.23, p = .029, ρ_w = -.25, suggesting that the impact of a healthy living program on effecting change in moderate-intensity PA depended on the degree of the participants' weight self-stigma. The main effect for internalized weight stigma on moderate-intensity PA engagement did not reach statistical significance, b = -0.22, SE = .11, 95% CI [-0.44, 0.01], $t(132)$ = -1.89, p = .061. The main effect for time on moderate-intensity PA engagement was significant, b = 0.80, SE = .14, 95% CI [0.51, 1.08], $t(71)$ = 5.54, p < .001. The effect of BMI on moderate-intensity PA engagement was not statistically significant, b = 0.01, SE = .023, 95% CI [-0.04, 0.05], $t(80)$ = 0.31, p = .76. Figure 1 reveals the graphed predictive model showing that women high on internalized weight stigma (1 SD above the mean) demonstrated little change in moderate-intensity PA engagement from baseline to the 6-months, slope = 0.44, $t(72)$ = 1.93, p = .058. Women with low internalized weight stigma scores (1 SD below the mean), on the other hand,

demonstrated significant improvement in moderate-intensity PA engagement from baseline to 6-months, slope = 1.15, $t(72) = 5.84$, $p < .001$.

Serial Mediation Model

Figure 2 shows the serial mediation model and corresponding regression coefficients for each pathway proceeding from participation in the healthy living program to engagement in moderate-intensity PA (represented as simple deviation scores between pre and post program assessments). In a serial mediation context, the total effect of program participation on the outcome variable (represented by *c*) can be broken down into several indirect effects (represented by a_1b_1, a_2b_2, $a_1a_3b_2$) and a direct effect (represented by *c'*), which is the remaining portion not explained by the mediator variables in the model[2]. The indirect effect of the program on engagement in moderate-intensity PA through internalized weight stigma was statistically significant, a_1b_1 = -0.39, SE = 0.13, 95% CI [-0.66, -0.15], Ind_{ps} (partially standardized indirect effect) = -.32. The indirect effect of the program on engagement in moderate-intensity PA through enjoyment of moderate-intensity PA was not statistically significant, a_2b_2 = -0.06, SE = 0.08, 95% CI [-0.25, 0.07,], Ind_{ps}= -.05. The serial indirect effect of the program on moderate-intensity PA engagement through decreases in internalized weight stigma and increases in enjoyment of moderate-intensity PA was statistically significant, $a_1a_3b_2$ = -0.15, SE = 0.06, 95% CI [-0.28, -0.05], Ind_{ps} = -.12. The direct effect of the program on engagement in moderate-intensity PA did not reach significance, *c'* = -0.33, SE = .19, 95% CI [-0.72, 0.06], $t(58) = -1.69$, $p = .096$. Finally, the total effect of the program on engagement in moderate-intensity PA (i.e., the sum of the direct and indirect effects) was significant, *c* = -0.94, SE = .16, 95% CI [-1.26, -0.61], $t(62) = -5.80$, $p < .001$. The combined indirect effects account for almost two thirds (65%) of the total effect of the program on engagement in moderate-intensity PA[3]. Although the

MEMORE macro for SPSS does not currently accommodate the use of covariates in the model (Montoya & Hayes, 2016), we ran individual linear mixed models using the causal steps approach to mediation for within-subjects designs (Judd et al., 2001) to determine if BMI changes altered the findings. There were no differences in the findings even after controlling for BMI as a time-varying covariate. BMI also did not interact with time, moderate-intensity PA enjoyment, or internalized weight stigma in any of the causal steps models tested.

Discussion

This study draws on social-cognitive and hedonic motivation theories to understanding PA among higher-weight women. First, we sought to determine how internalized weight stigma impacted engagement in moderate-intensity PA for women with high BMI after participating in a 6-month group-based healthy living program. As hypothesized, the positive effect of the healthy living program on engagement in moderate-intensity PA behavior occurred mainly in participants with low internalized weight stigma. This result is consistent with our previous findings pertaining to eating outcomes (Mensinger et al., 2016a), suggesting that the presence of weight self-stigma is detrimental for actualizing some of the benefits of lifestyle modification programs focused on healthy living.

This research is novel, and it is the first to examine the moderating and mediating effect of weight self-stigma on PA outcomes in an experimental trial. A previous weight-loss intervention study found that participants who endorsed high explicit and implicit weight biased attitudes and stereotypes tended to expend less energy in PA (Carels et al., 2009). However, the authors cautioned that their findings might not apply equally to self-directed stigma and recommended future research examine the influence weight *self*-stigma on program outcomes. Therefore, the present study builds on this evidence by showing that women with high levels of

internalized weight stigma experience smaller increases in PA than those with lower internalized stigma after taking part in programs designed to promote health for higher-weight women.

We also sought to determine if reductions in weight self-stigma occurring during a healthy living program accounted for greater engagement in moderate-intensity PA through the impact it had on enjoyment of moderate-intensity PA. This serial mechanism was supported by the data and provides new evidence for processes underlying PA behavior change for women with high BMI. Thus, our study uniquely contributes to the theoretical literature in PA with a sequential process-oriented mediator model of behavior change representing a framework informed by understudied constructs (weight self-stigma and enjoyment) that synthesize components from the social-cognitive model (Bandura, 2001) and a hedonic motivation framework for PA (Ekkekakis & Dafermos, 2012).

Baranowski et al. (1998) noted nearly two decades ago that few PA intervention studies effectively incorporated and tested mediation mechanisms to understand processes behind behavior change, even in light of advances in theory-driven research. Despite their recommendations to test causal chains underlying program outcomes, reviews published since then show limited progress in mechanistic frameworks (e.g., Rhodes & Pfaeffli, 2010). Furthermore, a robust medium effect size (r = 0.42) derived from a meta-analysis of 82 correlational studies supported the association between affective judgements (i.e., pleasure and enjoyment of PA) and increased PA engagement, yet a paucity of experimental research exists on programs designed to effect PA behavior through increasing enjoyment (Rhodes et al., 2009). In addition, many of the intervention studies reviewed in Rhodes et al. (2009) were ineffective in producing change in PA enjoyment and called for more research on the antecedents of enjoyment. Our study addresses these gaps specifically with evidence that a social-cognitive

process—self-directed weight stigma, one that is relatively new to research in the psychology of PA, represents an important construct underlying increased enjoyment.

From a practical standpoint, targeting weight-self stigma to improve PA enjoyment and ultimately engagement in PA is congruent with the conclusions of a new study by Schvey et al. (2016), which surveyed 389 gym members with a BMI over 25 kg/m^2 about gym-related weight stigma and their health and well-being. Internalized weight stigma was highly correlated with maladaptive coping (r = 0.59), which included items about avoiding PA and feeling less confident in oneself (Schvey et al., 2016). This relationship parallels the association between self-stigma and low self-efficacy also seen in many studies of individuals with mental illness (e.g., Watson, Corrigan, Larson & Sells, 2007). Low self-efficacy defines one of the core problems in the theory known as the "why try" effect surrounding goal attainment in those with identities that are devalued by society (Corrigan, Larson, & Rüsch, 2009). With internalized weight stigma, endorsement of negative judgments result in the body shame and self-blame that ultimately lead to poorer self-care behaviors, as posited by Tylka et al. (2014). Preliminary evidence for a connection between these constructs in the PA literature can be found in Pearl et al.'s (2015) study showing a negative correlation between self-directed weight stigma and exercise self-efficacy. Thus, this research underscores the need for healthcare providers, public health messages, and programs to remove blame for body size, celebrate body diversity, and build self-efficacy by reinforcing the capacity for everyone to benefit from the positive and joyful aspects of PA, independent of weight change and body sculpting.

Self-empowerment, which is conceptualized as the polar opposite to the low self-efficacy generated by internalized stigma (Corrigan et al., 2009) predicts positive coping and health outcomes (Vauth, Kleim, Wirtz & Corrigan, 2007). Research by Corrigan and Watson (2002)

suggests that high group identity among individuals coping with mental illness fosters healthy empowerment and righteous indignation towards unjust negative labeling and stereotypes. Similarly, a strong ethnic group identity resulting in empowerment demonstrated by Molix and Bettencourt (2010) may account for the higher self-esteem found among African American compared to Caucasian youth reported in several large-scale studies (e.g., Twenge & Crocker, 2002). By drawing parallels to models created for other stigmatized groups, we can implement strategies such as cognitive restructuring or reframing self-stigmatizing views to enhance self-confidence, strengthening social ties and community to reduce avoidant coping, and encouraging advocacy to push for legal and policy change (e.g., Heijnders & Van Der Meij, 2006).

Although the current research contributes to a better understanding of engagement in PA for women with a high BMI, the study has a number of limitations. Despite having the capacity to examine change from baseline to the end of the 6-month program, the sequencing of the effects within the serial mediation model cannot be fully known without additional measurement points. Thus, we are unable to establish causality between the mediators and the outcome. We conducted tests to check for bidirectional effects between PA enjoyment and PA engagement, and although results showed engagement also predicted enjoyment, the data were a better fit to the model presented, particularly considering the theoretical framework. Future studies should test this model in a more time-lagged fashion so temporal relationships can be established.

In addition, our mediation model could not account for potential confounding variables, such as BMI. However, it is important to note that BMI did not covary with any of the outcomes tested. Moreover, when we utilized the causal steps approach to test alternative mediation models, we ascertained that controlling for BMI did not change the results. Nevertheless, we are unable to attain more precise estimates of the indirect effects without considering omitted

variables, and future replications of the models supported here should aim to do so. Further, the tools used to measure the PA outcomes were simple one-item self-report measures as opposed to objective assessments of energy expenditure. Reporting bias and measurement error must be considered in interpreting the results. The next generation of studies would advance our findings by determining if the models hold when using digitized activity counters to measure PA.

Finally, although the program was targeted for low-active women with a high BMI (≥30 kg/m^2) who identified as "struggling with their weight," the study should be replicated in larger more diverse samples that include men, people of varying weight ranges, and different racial/ethnic and socio-economic backgrounds. Increasingly, men are being exposed to the same body-related pressures experienced by women (Dryer, Farr, Hiramatsu, & Quinton, 2016), and self-directed weight stigma has been demonstrated among people across the weight spectrum (Pearl & Puhl, 2014). Moreover, the benefits of PA are not limited to those with elevated BMI (Barry et al., 2014). It could be argued that health promotion efforts targeted at heavier individuals, or positioning PA simply as a means to achieve weight loss, does a disservice to people of all sizes. Despite the negative relationship between BMI and PA levels (Spees et al., 2012), it is best to avoid thinking about lower engagement in PA as a problem that is unique to higher-weight people. High levels of sedentary behavior are reported across the weight spectrum and are associated with significant personal and societal costs (Bouchard et al., 2015).

The lack of program differences and subsequent decision to combine our sample also deserves mention. Similar improvements in the PA outcomes were not surprising given that both programs equally focused on aiding participants with changing lifestyle, albeit using different frameworks (HAES vs. BWL). On the other hand, one might expect a HAES-oriented approach that emphasized size acceptance, reducing body shame, and lifestyle change regardless of

weight-loss, to achieve greater reductions in weight self-stigma. However, as reported in Mensinger et al. (2016a), both programs resulted in lower internalized weight stigma. There could be several reasons for this. One relates to potential contamination between the programs. Participants were recruited from within a relatively tightknit community where a number of study members were employees of the hospital sponsoring the trial. Information regarding the programs may have been passed between co-workers who were randomized to different groups.

Our findings however are consistent with the patterns shown in a trial comparing two weight-loss programs where only one of the programs specifically targeted concepts like weight self-stigma and body dissatisfaction, yet significant pre-post improvements in self-directed weight stigma were seen in both programs, with no between-group differences (Carels et al., 2014). In a prior study, Carels et al. (2010) compared two weight loss programs, neither of which addressed negative stereotypes toward higher weight people or body acceptance, and they too found significant pre-post reductions in internalized weight stigma. One possibility is that decreases in self-directed weight stigma seen in weight-loss programs may be occurring via different mechanisms than in our HAES program, where participants did not lose weight (Mensinger et al., 2016b). As people lose weight, they may feel less shame about their bodies, and so internalized stigma goes down. If they regain lost weight, self-directed stigma may increase. In a HAES program, the self-directed stigma might decrease due to greater self-acceptance and compassion for oneself regardless of size. In fact, support for a similar mechanism was shown in a correlational study by Hilbert et al. (2015) where self-compassion mediated the relationship between internalized weight stigma and health-related quality of life. Future studies should test the mediating factors accounting for the positive shifts in self-directed stigma occurring in the variety of interventions promoting PA reviewed above.

Alternatively, perhaps the positive changes in self-directed stigma are driven simply by the group component. All of the programs met weekly for an extended period (three to six months). It could be the social atmosphere and camaraderie of being in a program with people who are similar that aids participants in coalescing to reject the harmful negative attitudes and social stereotypes about people with higher BMI. Thus, a stronger group identity may have formed for the study participants, regardless of the content. As shown in the mental health literature, identification with a group is related to lower self-stigma and higher self-efficacy (Watson et al., 2007). Bringing people together based on a common struggle—in this case weight (as they self-identified this way for our study), may be critical for developing the collective empowerment discussed in those with mental illness who have managed to resist internalizing negative social labels (Corrigan & Watson, 2002). In this vein, to further understand the psychology of PA behavior, future research should also examine if increased social support and group identification accounts for changes in weight self-stigma after being part of a group-based health promotion program.

Given that this study is the first to examine the moderating and mediating role of internalized weight stigma on PA behaviors change after taking part in a health promotion program, the field is ripe for growth. The conceptual framework explored should be expanded and replications are needed. In the name of patient-centered care and reducing the body shame and self-blame that weight self-stigma fosters, we recommend that comprehensive programs for health improvement have a weight-inclusive PA component that collaboratively meets participants in their body movement comfort zone (Tylka et al., 2014). This might include starting with modest changes like encouraging activities ranging from simple stretching exercises to playing ball with a pet, dancing to favorite songs, or taking a lunchtime walk—whatever aids

that individual in connecting with their body's natural capacity to move. Future intervention studies should ascertain if doing so increases self-efficacy for PA by assuring people that they *can* succeed, benefit from, and enjoy an active lifestyle, regardless of size. In conclusion, to ensure health promotion efforts involving PA are effective in those with high weight self-stigma, it is critical to further explore factors shown to reduce it. Supportive, non-shaming environments that highlight the pleasure and joy of being physically active are important first steps to improving wider systemic support for individuals across the weight spectrum to participate in health promoting and life-enhancing behaviors.

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691

692 Footnotes

693 [1]Given that it is not possible to calculate a standard deviation when the predictor variable
694 is an intervention, fully standardized indirect effects cannot be derived for the multiple
695 components of the serial mediation model presented here. However, a partially standardized
696 indirect effect is calculated by dividing the coefficient for the indirect effect by the standard
697 deviation of the change scores on the outcome (personal communication with A. Montoya, July
698 21, 2016).

699 [2]Each indirect effect has an associated percentile-derived bootstrapped standard error plus
700 a 95% confidence interval; however, the MEMORE macro calculates *t*-statistics and *p*-values for
701 total and direct effects only.

702 [3]To show the presence of a potential bi-directional effect between moderate-intensity PA
703 engagement and PA enjoyment, we tested a model with enjoyment as the dependent variable and
704 engagement as the second mediator in the serial pathway. The total effect of the program on PA
705 enjoyment was, $c = 0.44$, SE = .11, 95% CI [0.21, 0.67], $t(62) = 3.87$, $p < .001$. The indirect
706 effect of the program on PA enjoyment through decreasing internalized weight stigma was not
707 statistically significant $a_1b_1 = 0.17$, SE = 0.10, 95% CI [-0.3, 0.38]. The indirect effect of the
708 program on PA enjoyment through PA engagement was marginally significant $a_2b_2 = 0.12$, SE =
709 0.08, 95% CI [0.00, 0.32]. The serial indirect effect of the program on PA enjoyment through
710 decreases in internalized weight stigma and increases in PA engagement was statistically
711 significant, $a_1a_3b_2 = 0.15$, SE = 0.05, 95% CI [0.05, 0.26]. The direct effect of the program on PA
712 enjoyment was non-significant, $c' = 0.01$, SE = .15, 95% CI [-0.30, 0.31].

Table 1.

Descriptive statistics of primary variables

Variable	N	Mean (SD)
Internalized Weight Stigma (WBIS mean)		
Baseline	67[a]	4.28 (1.04)
6-months	72	3.41 (1.11)[b]
Enjoyment of moderate-intensity PA		
Baseline	80	3.5 (0.75)
6-months	72	3.94 (0.73)[b]
Engagement in moderate-intensity PA		
Baseline	80	2.25 (0.99)
6-months	72	3.15 (0.94)[b]

Note. Total listwise N = 63 (number of participants with data on all variables used for serial mediation model); PA - physical activity

[a] The WBIS was missing from several baseline survey packets resulting in a reduced sample size for this variable.
[b] Significant pre-post changes ($p < .001$) per intention-to-treat linear mixed model analysis

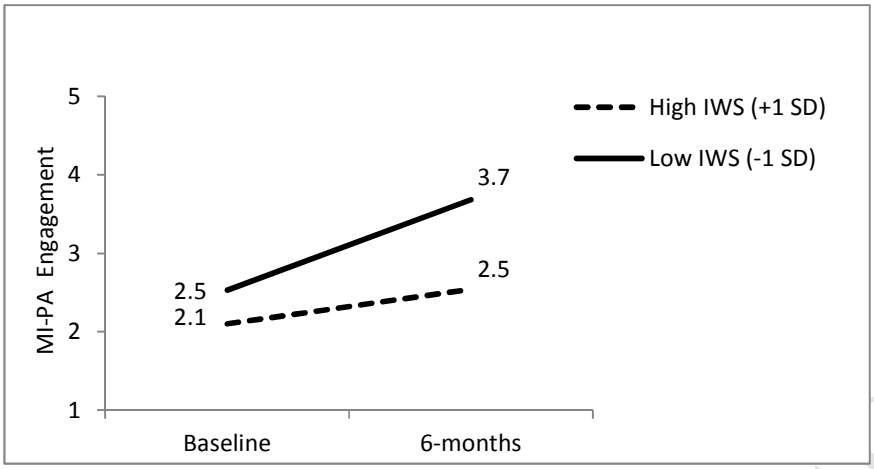

Figure 1. Internalized weight stigma (IWS) as a moderator of the healthy living program's effect on moderate-intensity physical activity (MI-PA) engagement among higher-weight women.

Note. High IWS = 1 SD above the mean. Low IWS = 1 SD below the mean.

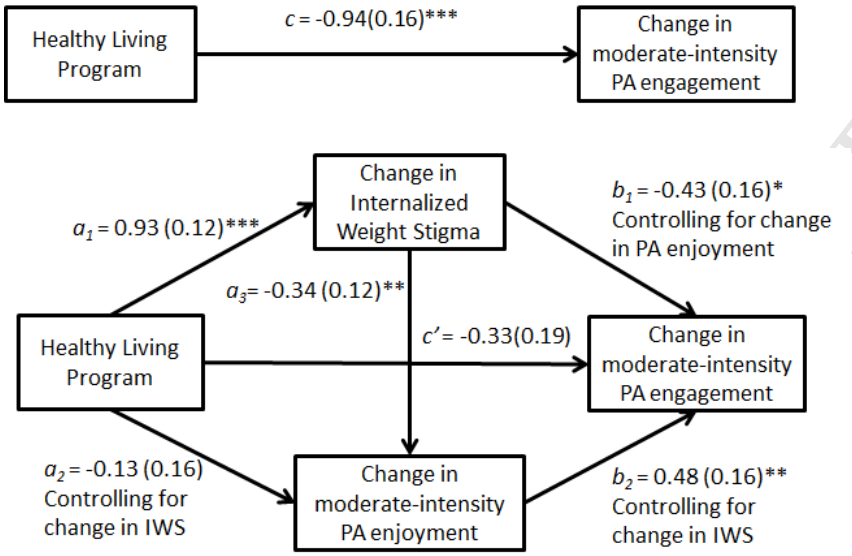

Figure 2. Serial mediation model for the effect of a healthy living program (HLP) on change in moderate-intensity physical activity (MI-PA) engagement among higher-weight women through sequential changes in internalized weight stigma (IWS) and MI-PA enjoyment.

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

Note – Variables represent simple deviations between baseline and 6-month assessments.

c = Total effect of HLP on MI-PA engagement, the total effect is the sum of all the direct and indirect effects, $c = c' + (a_1b_1) + (a_2b_2) = (a_1a_3b_2)$
c'= Direct effect HLP on MI-PA engagement
a_1b_1 = Indirect effect of HLP on MI-PA engagement through IWS
a_2b_2 = Indirect effect of HLP on MI-PA engagement through MI-PA enjoyment
$a_1a_3b_2$ = Serial indirect effect of HLP on MI-PA engagement through IWS and MI-PA enjoyment

Highlights: INTERNALIZED WEIGHT STIGMA AND PHYSICAL ACTIVITY

- Women with high BMI participated in a 6-month health living program.
- We explored the effect of internalized weight stigma (IWS) on physical activity (PA).
- IWS moderated the effect of the program on change in PA behavior.
- IWS and PA enjoyment serially mediated the effect of the program on PA behavior.