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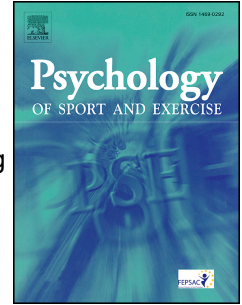
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6 living program for women with high body mass index

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## Abstract

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

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

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32 living program for women with high body mass index

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

47 In recent years, increasing attention has been paid to the impact of weight stigma on  
48 health and behavioral outcomes (e.g., Hilbert et al., 2015; Latner, Barile, Durso, & O’Brien,  
49 2014). Experiences of weight stigma can involve perceptions of negative judgment, poorer  
50 treatment, rejection, or outright discrimination based on weight, shape, or body size (Tylka et al.,  
51 2104). This form of prejudice is now one of the most frequently reported forms of stigma in both  
52 adults (Puhl, Andreyeva, & Brownell, 2008) and children (Bucchianeri, Gower, McMorris, &  
53 Eisenberg, 2016), and it affects almost all domains of daily life (Puhl & King, 2013). Most types

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

64 Both the experience of weight stigma and self-directed weight stigma are constructs  
65 associated with poorer health and well-being (Hilbert et al., 2014; Latner et al., 2014). In fact, the  
66 relationship between higher BMI and poorer physical health-related quality of life is only present  
67 for those with high self-directed weight stigma (Latner et al., 2014). Further, evidence suggests  
68 that perceived discrimination and stigma concerns explain the relationship between BMI and  
69 self-reported health (Hunger & Major, 2015). Additionally, research has reliably shown that self-  
70 directed weight stigma is associated with increased disordered eating behavior (Durso & Latner,  
71 2008; Durso, Latner, & Hayashi, 2012; Mensinger, Calogero, & Tylka, 2016). In studies that  
72 measured self-directed and the experience of weight stigma together, self-directed weight stigma  
73 consistently mediates the relationship between being stigmatized by others and health outcomes  
74 (Durso et al., 2012; Pearl, Puhl & Dovidio, 2015). Combining these findings with similar  
75 evidence from experimental research (Pearl & Puhl, 2016) suggests that self-directed stigma may  
76 be a more potent driver of distress and health outcomes than is experiencing weight stigma.

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

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



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

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

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

123 are believed to behave in ways that will maximize the experience of pleasure and avoid pain  
124 (Kahneman, Diener, & Schwarz, 1999). Given that cognitive models have only been able to  
125 account for about a quarter of the variation in PA behavior, some researchers have suggested  
126 synthesizing these approaches with hedonic theories of motivation (Ekkekakis & Dafermos,  
127 2012). Several studies have supported approaches that combine cognitive and affective models.  
128 For example, Kiviniemi et al. (2007) established that affective associations with PA behavior  
129 mediated all components of the theory of planned behavior (i.e., attitudes, social norms, and  
130 perceived benefits, barriers, and behavioral control) in predicting engagement in PA. Similarly,  
131 Lewis et al. (2016) found PA enjoyment at baseline predicted future engagement in PA after  
132 participating in a 6-month trial for increasing PA in 448 low-active adults. Their mediation  
133 analysis supported a model in which the effect of self-efficacy on future PA was mediated by  
134 enjoyment, suggesting greater competency yields more enjoyment.

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

145 By synthesizing components from social-cognitive and affective theories for

146 understanding behavior change, the purpose of this study was to advance the literature on how  
147 internalized weight stigma impacts PA behaviors. We proposed weight self-stigma as a  
148 moderator *and* mediator of a treatment effect in a recent trial comparing a weight-neutral, health-  
149 at-every-size program (i.e., lifestyle change while emphasizing size acceptance) to a behavioral  
150 weight loss (BWL) program for women with high BMI (Mensinger, Calogero, Tylka & Stranges,  
151 2016). Specifically, we first hypothesized that women with high levels of internalized weight  
152 stigma would show less improvement in PA than their counterparts with lower internalized  
153 weight stigma after taking part in a healthy living program (a moderator effect). Second, we  
154 hypothesized a model whereby the positive effects of participating in the program on  
155 engagement in PA would be serially mediated by a reduction in internalized weight stigma (a  
156 social-cognitive process) and a concomitant increase in PA enjoyment (an affective process).

### 157 **Method**

158 The present study utilized data derived from a randomized controlled trial comparing the  
159 health benefits of manualized weight-neutral, health-at-every-size (HAES) program (Omichinski,  
160 2007) versus a manualized behavioral weight-loss (BWL) program (Brownell, 2000) for women  
161 with a BMI between 30 and 45 kg/m<sup>2</sup> (Mensinger et al., 2016b). We recruited from a semi-rural  
162 community in Berks County Pennsylvania using local flyers, Clipper magazine advertisements,  
163 and the website of the sponsoring community hospital. Low-active or sedentary women (i.e.,  
164 those who scored in or below the “light intensity activity” category on the Stanford Brief  
165 Activity Survey; Taylor-Piliae et al., 2006) who identified as “struggling with their weight” and  
166 were free from any serious health conditions were invited to take part in a 6-month facilitator-  
167 guided group-based healthy living program that met weekly for 90 minutes. Both programs  
168 focused on overall health promotion through sustainable lifestyle change, and they contained

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

### 180 **Participants**

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

### 188 **Measures**

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

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

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

215 sample's prescreening scores on the Stanford Brief Activity Survey (Taylor-Piliae et al., 2006)  
216 (spearman rho = .42;  $p < .001$ ), suggesting preliminary validity for its use as a brief tool for  
217 measuring engagement in moderate-intensity PA. For current enjoyment of moderate-intensity  
218 PA, participants were asked to respond to the question, "I enjoy participating in moderate-  
219 intensity physical activities (activities that make me breathe a bit harder or puff and pant)" on a  
220 5-point rating scale ranging from 1 (*never true*) to 5 (*always true*). Higher scores indicate a  
221 greater enjoyment of moderate-intensity PA behaviors.

## 222 **Data Analysis**

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

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

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

245         Using a path-analytic framework with the MEMORE macro as an add-on in SPSS  
246 (Montoya & Hayes, 2016), we tested if the programs' positive effects on engagement in  
247 moderate-intensity PA occurred serially through decreases in internalized weight stigma and  
248 increases in enjoyment of moderate-intensity PA. To fit the model, the macro calculated  
249 regression parameters using simple deviation scores (i.e., change scores) between baseline and 6-  
250 months for each of the mediators (internalized weight stigma and moderate-intensity PA  
251 enjoyment) and for the outcome variable (moderate-intensity PA engagement). We used the  
252 percentile bootstrapping method with 5000 bootstrapped samples to derive standard errors and  
253 95% confidence intervals of the indirect, direct, and total effects. This method advances earlier-  
254 generation causal steps approaches by providing a single inferential test instead of relying on  
255 piecemeal hypothesis testing to determine the presence of mediation (e.g., Judd, Kenny &  
256 McClelland, 2001). Path-analytic frameworks for mediation have become a superior approach  
257 also because they allow for more complex models with multiple parallel and/or serial processes  
258 that can be tested conditionally as functions of another variable (Hayes, 2015). We calculated  
259 effect sizes for the serial mediation model with partially standardized indirect effects<sup>1</sup> (Preacher  
260 & Kelley, 2011). These are interpreted as the predicted change in the outcome, expressed in

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

### 263 **Results**

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

#### 269 **Moderation Model**

270 The linear mixed-effects model testing the first hypothesis indicated a statistically  
271 significant interaction effect between internalized weight stigma and time for predicting change  
272 in moderate-intensity PA engagement,  $b = -0.35$ ,  $SE = 0.16$ , 95% CI [-0.67, -0.04],  $t(89) = -2.23$ ,  
273  $p = .029$ ,  $\rho_w = -.25$ , suggesting that the impact of a healthy living program on effecting change  
274 in moderate-intensity PA depended on the degree of the participants' weight self-stigma. The  
275 main effect for internalized weight stigma on moderate-intensity PA engagement did not reach  
276 statistical significance,  $b = -0.22$ ,  $SE = .11$ , 95% CI [-0.44, 0.01],  $t(132) = -1.89$ ,  $p = .061$ . The  
277 main effect for time on moderate-intensity PA engagement was significant,  $b = 0.80$ ,  $SE = .14$ ,  
278 95% CI [0.51, 1.08],  $t(71) = 5.54$ ,  $p < .001$ . The effect of BMI on moderate-intensity PA  
279 engagement was not statistically significant,  $b = 0.01$ ,  $SE = .023$ , 95% CI [-0.04, 0.05],  $t(80) =$   
280  $0.31$ ,  $p = .76$ . Figure 1 reveals the graphed predictive model showing that women high on  
281 internalized weight stigma (1 SD above the mean) demonstrated little change in moderate-  
282 intensity PA engagement from baseline to the 6-months, slope = 0.44,  $t(72) = 1.93$ ,  $p = .058$ .  
283 Women with low internalized weight stigma scores (1 SD below the mean), on the other hand,



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

### 286 **Serial Mediation Model**

287 Figure 2 shows the serial mediation model and corresponding regression coefficients for  
288 each pathway proceeding from participation in the healthy living program to engagement in  
289 moderate-intensity PA (represented as simple deviation scores between pre and post program  
290 assessments). In a serial mediation context, the total effect of program participation on the  
291 outcome variable (represented by  $c$ ) can be broken down into several indirect effects  
292 (represented by  $a_1b_1$ ,  $a_2b_2$ ,  $a_1a_3b_2$ ) and a direct effect (represented by  $c'$ ), which is the remaining  
293 portion not explained by the mediator variables in the model<sup>2</sup>. The indirect effect of the program  
294 on engagement in moderate-intensity PA through internalized weight stigma was statistically  
295 significant,  $a_1b_1 = -0.39$ , SE = 0.13, 95% CI [-0.66, -0.15],  $Ind_{ps}$  (partially standardized indirect  
296 effect) = -.32. The indirect effect of the program on engagement in moderate-intensity PA  
297 through enjoyment of moderate-intensity PA was not statistically significant,  $a_2b_2 = -0.06$ , SE =  
298 0.08, 95% CI [-0.25, 0.07,],  $Ind_{ps} = -.05$ . The serial indirect effect of the program on moderate-  
299 intensity PA engagement through decreases in internalized weight stigma and increases in  
300 enjoyment of moderate-intensity PA was statistically significant,  $a_1a_3b_2 = -0.15$ , SE = 0.06, 95%  
301 CI [-0.28, -0.05],  $Ind_{ps} = -.12$ . The direct effect of the program on engagement in moderate-  
302 intensity PA did not reach significance,  $c' = -0.33$ , SE = .19, 95% CI [-0.72, 0.06],  $t(58) = -1.69$ ,  
303  $p = .096$ . Finally, the total effect of the program on engagement in moderate-intensity PA (i.e.,  
304 the sum of the direct and indirect effects) was significant,  $c = -0.94$ , SE = .16, 95% CI [-1.26,  
305 -0.61],  $t(62) = -5.80$ ,  $p < .001$ . The combined indirect effects account for almost two thirds  
306 (65%) of the total effect of the program on engagement in moderate-intensity PA<sup>3</sup>. Although the

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

### 313 Discussion

314 This study draws on social-cognitive and hedonic motivation theories to understanding  
315 PA among higher-weight women. First, we sought to determine how internalized weight stigma  
316 impacted engagement in moderate-intensity PA for women with high BMI after participating in a  
317 6-month group-based healthy living program. As hypothesized, the positive effect of the healthy  
318 living program on engagement in moderate-intensity PA behavior occurred mainly in  
319 participants with low internalized weight stigma. This result is consistent with our previous  
320 findings pertaining to eating outcomes (Mensinger et al., 2016a), suggesting that the presence of  
321 weight self-stigma is detrimental for actualizing some of the benefits of lifestyle modification  
322 programs focused on healthy living.

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

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

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

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

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

355 From a practical standpoint, targeting weight-self stigma to improve PA enjoyment and  
356 ultimately engagement in PA is congruent with the conclusions of a new study by Schvey et al.  
357 (2016), which surveyed 389 gym members with a BMI over 25 kg/m<sup>2</sup> about gym-related weight  
358 stigma and their health and well-being. Internalized weight stigma was highly correlated with  
359 maladaptive coping ( $r = 0.59$ ), which included items about avoiding PA and feeling less  
360 confident in oneself (Schvey et al., 2016). This relationship parallels the association between  
361 self-stigma and low self-efficacy also seen in many studies of individuals with mental illness  
362 (e.g., Watson, Corrigan, Larson & Sells, 2007). Low self-efficacy defines one of the core  
363 problems in the theory known as the “why try” effect surrounding goal attainment in those with  
364 identities that are devalued by society (Corrigan, Larson, & Rüsck, 2009). With internalized  
365 weight stigma, endorsement of negative judgments result in the body shame and self-blame that  
366 ultimately lead to poorer self-care behaviors, as posited by Tylka et al. (2014). Preliminary  
367 evidence for a connection between these constructs in the PA literature can be found in Pearl et  
368 al.’s (2015) study showing a negative correlation between self-directed weight stigma and  
369 exercise self-efficacy. Thus, this research underscores the need for healthcare providers, public  
370 health messages, and programs to remove blame for body size, celebrate body diversity, and  
371 build self-efficacy by reinforcing the capacity for everyone to benefit from the positive and  
372 joyful aspects of PA, independent of weight change and body sculpting.

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

376 suggests that high group identity among individuals coping with mental illness fosters healthy  
377 empowerment and righteous indignation towards unjust negative labeling and stereotypes.  
378 Similarly, a strong ethnic group identity resulting in empowerment demonstrated by Molix and  
379 Bettencourt (2010) may account for the higher self-esteem found among African American  
380 compared to Caucasian youth reported in several large-scale studies (e.g., Twenge & Crocker,  
381 2002). By drawing parallels to models created for other stigmatized groups, we can implement  
382 strategies such as cognitive restructuring or reframing self-stigmatizing views to enhance self-  
383 confidence, strengthening social ties and community to reduce avoidant coping, and encouraging  
384 advocacy to push for legal and policy change (e.g., Heijnders & Van Der Meij, 2006).

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

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

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

404 Finally, although the program was targeted for low-active women with a high BMI ( $\geq 30$   
405  $\text{kg/m}^2$ ) who identified as “struggling with their weight,” the study should be replicated in larger  
406 more diverse samples that include men, people of varying weight ranges, and different  
407 racial/ethnic and socio-economic backgrounds. Increasingly, men are being exposed to the same  
408 body-related pressures experienced by women (Dryer, Farr, Hiramatsu, & Quinton, 2016), and  
409 self-directed weight stigma has been demonstrated among people across the weight spectrum  
410 (Pearl & Puhl, 2014). Moreover, the benefits of PA are not limited to those with elevated BMI  
411 (Barry et al., 2014). It could be argued that health promotion efforts targeted at heavier  
412 individuals, or positioning PA simply as a means to achieve weight loss, does a disservice to  
413 people of all sizes. Despite the negative relationship between BMI and PA levels (Spees et al.,  
414 2012), it is best to avoid thinking about lower engagement in PA as a problem that is unique to  
415 higher-weight people. High levels of sedentary behavior are reported across the weight spectrum  
416 and are associated with significant personal and societal costs (Bouchard et al., 2015).

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

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

428 Our findings however are consistent with the patterns shown in a trial comparing two  
429 weight-loss programs where only one of the programs specifically targeted concepts like weight  
430 self-stigma and body dissatisfaction, yet significant pre-post improvements in self-directed  
431 weight stigma were seen in both programs, with no between-group differences (Carels et al.,  
432 2014). In a prior study, Carels et al. (2010) compared two weight loss programs, neither of which  
433 addressed negative stereotypes toward higher weight people or body acceptance, and they too  
434 found significant pre-post reductions in internalized weight stigma. One possibility is that  
435 decreases in self-directed weight stigma seen in weight-loss programs may be occurring via  
436 different mechanisms than in our HAES program, where participants did not lose weight  
437 (Mensinger et al., 2016b). As people lose weight, they may feel less shame about their bodies,  
438 and so internalized stigma goes down. If they regain lost weight, self-directed stigma may  
439 increase. In a HAES program, the self-directed stigma might decrease due to greater self-  
440 acceptance and compassion for oneself regardless of size. In fact, support for a similar  
441 mechanism was shown in a correlational study by Hilbert et al. (2015) where self-compassion  
442 mediated the relationship between internalized weight stigma and health-related quality of life.  
443 Future studies should test the mediating factors accounting for the positive shifts in self-directed  
444 stigma occurring in the variety of interventions promoting PA reviewed above.

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

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



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

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691

692 Footnotes

693 <sup>1</sup>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 <sup>2</sup>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 <sup>3</sup>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.

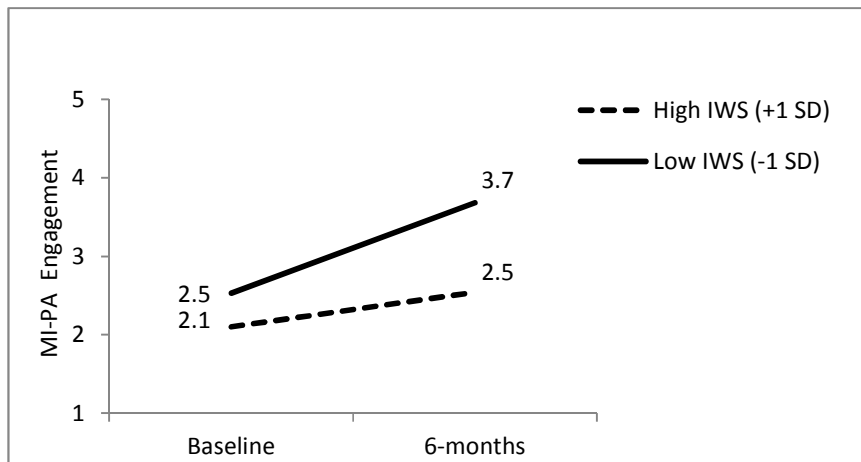
*Descriptive statistics of primary variables*

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

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

<sup>a</sup> The WBIS was missing from several baseline survey packets resulting in a reduced sample size for this variable.

<sup>b</sup> 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.

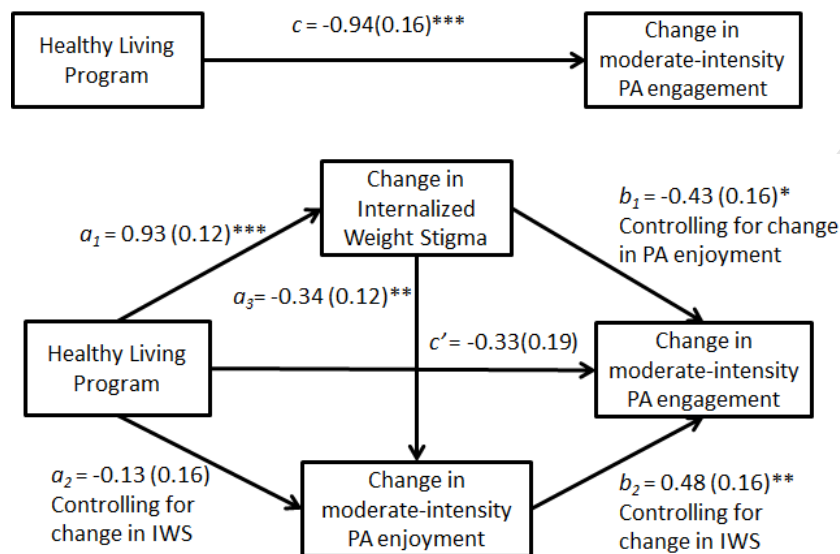


Figure 2. Serial mediation model for the effect of a healthy living program (HLP) on change in moderate-intensity physical activity (MI-PA) engagement among higher-weight women through sequential changes in internalized weight stigma (IWS) and MI-PA enjoyment.

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

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.