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DOI:

[10.1016/j.psychsport.2017.01.010](https://doi.org/10.1016/j.psychsport.2017.01.010)

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Document Version

Peer reviewed version

Citation for published version (Harvard):

Mensingher, 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>

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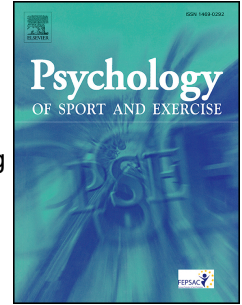
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Accepted Manuscript

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PII: S1469-0292(17)30073-0

DOI: [10.1016/j.psychsport.2017.01.010](https://doi.org/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.

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

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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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5 Internalized weight stigma mediates and moderates physical activity outcomes during a healthy

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/m². *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/m²,
13 SD=3.9, range=30.2 to 44.8 kg/m². 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/m² (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/m² (SD = 3.9; range 30.2–44.8 kg/m²). 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 ≥ 35 kg/m², 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 (ρ_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 effects¹ (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 model². 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 PA³. 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/m² 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 (≥ 30
405 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.

476 References

- 477 Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*.
478 Newbury Park, CA: Sage.
- 479 Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision*
480 *Processes*, 50, 179-211. doi:10.1016/0749-5978(91)90020-T
- 481 Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of*
482 *Psychology*, 52, 1-26. doi:10.1146/annurev.psych.52.1.1
- 483 Barry, V. W., Baruth, M., Beets, M. W., Durstine, J. L., Liu, J., & Blair, S. N. (2014). Fitness vs.
484 fatness on all-cause mortality: A meta-analysis. *Progress in Cardiovascular Diseases*, 56,
485 382–390. doi:10.1016/j.pcad.2013.09.002
- 486 Baranowski, T., Anderson, C., & Carmack, C. (1998). Mediating variable framework in physical
487 activity interventions: How are we doing? How might we do better? *American Journal of*
488 *Preventive Medicine*, 15, 266-297. doi:10.1016/S0749-3797(98)00080-4
- 489 Bouchard, C., Blair, S. N., Katzmarzyk, P. T., Lee, I. M., Shiroma, E. J., Lobelo, F., ... Loprinzi,
490 P. D. (2015). Less sitting, more physical activity, or higher fitness? *Mayo Clinic*
491 *Proceedings*, 90, 1533–1540. doi:10.1016/j.mayocp.2015.08.005
- 492 Brownell, K. D. (2000). *The LEARN program for weight management* (10th ed.). Dallas, TX:
493 American Health Publishing Company.
- 494 Bucchianeri, M. M., Gower, A. L., McMorris, B. J., & Eisenberg, M. E. (2016). Youth
495 experiences with multiple types of prejudice-based harassment. *Journal of Adolescence*, 51,
496 68–75. doi:10.1016/j.adolescence.2016.05.012
- 497 Carels, R. A., Burmeister, J. M., Koball, A. M., Oehlhof, M. W., Hinman, N., LeRoy, M., . . .
498 Gumble, A. (2014). A randomized trial comparing two approaches to weight loss:
499 Differences in weight loss maintenance. *Journal of Health Psychology*, 19, 296-311.

500 doi:10.1177/1359105312470156

501 Carels, R. A., Wott, C. B., Young, K. M., Gumble, A., Koball, A., & Oehlhof, M. W. (2010).

502 Implicit, explicit, and internalized weight bias and psychosocial maladjustment among

503 treatment-seeking adults. *Eating Behaviors*, *11*, 180-185. doi:10.1016/j.eatbeh.2010.03.002

504 Carels, R. A., Young, K. M., Wott, C. B., Harper, J., Gumble, A., Oehlof, M. W., & Clayton, A.

505 M. (2009). Weight bias and weight loss treatment outcomes in treatment-seeking adults.

506 *Annals of Behavioral Medicine*, *37*, 350–355. doi:10.1007/s12160-009-9109-4

507 Centers for Disease Control and Prevention. (2014). *State Indicator Report on Physical Activity*,

508 2014. US Department of Health and Human Services. Atlanta, GA. Retrieved from

509 http://www.cdc.gov/physicalactivity/downloads/pa_state_indicator_report_2014.pdf

510 Chambliss, H. O., Finley, C. E., & Blair, S. N. (2004). Attitudes toward obese individuals among

511 exercise science students. *Medicine and Science in Sports and Exercise*, *36*, 468–474.

512 doi:10.1249/01.MSS.0000117115.94062.E4

513 Christel, D. A., O'Donnell, N. H., & Bradley, L. A. (2016). Coping by crossdressing: An

514 exploration of exercise clothing for obese heterosexual women. *Fashion and Textiles*, *3*, 1-

515 19. doi:10.1186/s40691-016-0063-z

516 Corrigan, P. W., Larson, J. E., & Rüsch, N. (2009). Self-stigma and the “why try” effect: Impact

517 on life goals and evidence-based practices. *World Psychiatry*, *8*, 75-81.

518 doi:10.1002/j.2051-5545.2009.tb00218.x

519 Corrigan, P. W., & Watson, A. C. (2002). The paradox of self-stigma and mental illness. *Clinical*

520 *Psychology: Science and Practice*, *9*, 35-53. doi:10.1093/clipsy.9.1.35

521 Dryer, R., Farr, M., Hiramatsu, I., & Quinton, S. (2016). The role of sociocultural influences on

522 symptoms of muscle dysmorphia and eating disorders in men, and the mediating effects of

523 perfectionism. *Behavioral Medicine*, *42*, 174–182. doi:10.1080/08964289.2015.1122570

- 524 Durso, L. E., & Latner, J. D. (2008). Understanding self-directed stigma: Development of the
525 weight bias internalization scale. *Obesity, 16 (Suppl 2)*, S80–86. doi:10.1038/oby.2008.448
- 526 Durso, L. E., Latner, J. D., & Hayashi, K. (2012). Perceived discrimination is associated with
527 binge eating in a community sample of non-overweight, overweight, and obese adults.
528 *Obesity Facts, 5*, 869-880. doi:10.1159/000345931
- 529 Ekkekakis, P., & Dafermos, M. (2012). Exercise is a many-splendored thing, but for some it does
530 not feel so splendid: Staging a resurgence of hedonistic ideas in the quest to understand
531 exercise behavior. In E. O. Acevedo (Ed.), *The Oxford handbook of exercise psychology*.
532 New York, NY: Oxford University Press.
- 533 Flint, S. W., & Reale, S. (2016). Weight stigma in frequent exercisers: Overt, demeaning and
534 condescending. *Journal of Health Psychology*. Advance online publication.
535 doi:10.1177/1359105316656232
- 536 French, D. P., Sutton, S., Hennings, S. J., Mitchell, J., Wareham, N. J., Griffin, S., ... &
537 Kinmonth, A. L. (2005). The importance of affective beliefs and attitudes in the Theory of
538 Planned Behavior: Predicting intention to increase physical activity. *Journal of Applied*
539 *Social Psychology, 35*, 1824–1848. doi: 10.1111/j.1559-1816.2005.tb02197.x
- 540 Fung, W., Zhu, Z., Wei, B., & He, X. (2002). Influence diagnostics and outlier tests for
541 semiparametric mixed models. *Journal of the Royal Statistical Society. Series B, 64*, 565-
542 579. Retrieved from <http://www.jstor.org/stable/3088789>
- 543 Gallop, R., & Tasca, G. A. (2009). Multilevel modeling of longitudinal data for psychotherapy
544 researchers: II. The complexities. *Psychotherapy Research, 19*, 438-452.
545 doi:10.1080/10503300902849475
- 546 Gregg, J., & O'Hara, L. (2007). The Red Lotus Health Promotion Model: A new model for
547 holistic, ecological, salutogenic health promotion practice. *Health Promotion Journal of*

- 548 *Australia*, 18, 12–19. doi:10.1071/HE07012
- 549 Hayes, A. F. (2015). An index and test of linear moderated mediation. *Multivariate Behavioral*
550 *Research*, 50, 1-22. doi:10.1080/00273171.2014.962683
- 551 Heijnders, M., & Van Der Meij, S. (2006). The fight against stigma: An overview of stigma-
552 reduction strategies and interventions. *Psychology, Health & Medicine*, 11, 353-363.
553 doi: 10.1080/13548500600595327
- 554 Hilbert, A., Braehler, E., Haeuser, W., & Zenger, M. (2014). Weight bias internalization, core
555 self-evaluation, and health in overweight and obese persons. *Obesity*, 22, 79–85.
556 doi:10.1002/oby.20561
- 557 Hilbert, A., Braehler, E., Schmidt, R., Lowe, B., Hauser, W., & Zenger, M. (2015). Self-
558 compassion as a resource in the self-stigma process of overweight and obese individuals.
559 *Obesity Facts*, 8, 293–301. doi:10.1159/000438681
- 560 Horodyska, K., Luszczynska, A., Hayes, C. B., O'Shea, M. P., Langoien, L. J., Roos, G., . . .
561 Brug, J. (2015). Implementation conditions for diet and physical activity interventions and
562 policies: An umbrella review. *BMC Public Health*, 15, 1250. doi:10.1186/s12889-015-
563 2585-5
- 564 Hubner, C., Schmidt, R., Selle, J., Kohler, H., Muller, A., de Zwaan, M., & Hilbert, A. (2016).
565 Comparing self-report measures of internalized weight stigma: The weight self-stigma
566 questionnaire versus the weight bias internalization scale. *PloS One*, 11, e0165566.
567 doi:10.1371/journal.pone.0165566
- 568 Hunger, J. M., & Major, B. (2015). Weight stigma mediates the association between BMI and
569 self-reported health. *Health Psychology*, 34, 172-175. doi:10.1037/hea0000106.supp
- 570 Jekauc, D. (2015). Enjoyment during exercise mediates the effects of an intervention on exercise
571 adherence. *Psychology*, 6, 48–54. doi:10.4236/psych.2015.61005

- 572 Judd, C. M., Kenny, D. A., & McClelland, G. H. (2001). Estimating and testing mediation and
573 moderation in within-subject designs. *Psychological Methods*, *6*, 115–134.
574 doi:10.1037//1082-989X.6.2.115
- 575 Judge, T. A., & Cable, D. M. (2011). When it comes to pay, do the thin win? The effect of
576 weight on pay for men and women. *Journal of Applied Psychology*, *96*, 95–112.
577 doi:10.1037/a0020860
- 578 Kahneman, D., Diener, E., & Schwarz, N. (Eds.). (1999). *Well-being: Foundations of hedonic*
579 *psychology*. New York, NY: Russell Sage Foundation.
- 580 Kiviniemi, M. T., Voss-Humke, A. M., & Seifert, A. L. (2007). How do I feel about the
581 behavior? The interplay of affective associations with behaviors and cognitive beliefs as
582 influences on physical activity behavior. *Health Psychology*, *26*, 152-158.
583 doi:10.1037/0278-6133.26.2.152
- 584 Kohl, H. W., Craig, C. L., Lambert, E. V., Inoue, S., Alkandari, J. R., Leetongin, G., &
585 Kahlmeier, S. (2012). The pandemic of physical inactivity: Global action for public health.
586 *Lancet*, *380*, 294–305. doi:10.1016/S0140-6736(12)60898-8
- 587 Latner, J. D., Barile, J. P., Durso, L. E., & O'Brien, K. S. (2014). Weight and health-related
588 quality of life: The moderating role of weight discrimination and internalized weight
589 bias. *Eating behaviors*, *15*, 586-590. doi:10.1016/j.eatbeh.201408.014
- 590 Lewis, B. A., Williams, D. M., Frayeh, A., & Marcus, B. H. (2016). Self-efficacy versus
591 perceived enjoyment as predictors of physical activity behaviour. *Psychology & Health*,
592 *31*, 456–469. doi: 10.1080/08870446.2015.1111372
- 593 Lipsitz, S. R., Leong, T., Ibrahim, J., & Lipshultz, S. (2001). A partial correlation coefficient and
594 coefficient of determination for multivariate normal repeated measures data. *The*
595 *Statistician*, *50*, 87-95. Retrieved from <http://www.jstor.org/stable/2681160>

- 596 McKinnon, J. (2008). *Assessing the holistic health and well being of the Cootharaba community*
597 (Unpublished master's thesis). University of the Sunshine Coast, Sippy Downs, Australia.
- 598 Mensinger, J. L., Calogero, R. M., & Tylka, T. L. (2016a). Internalized weight stigma moderates
599 eating behavior outcomes in women with high BMI participating in a healthy living
600 program. *Appetite, 102*, 32–43. doi:10.1016/j.appet.2016.01.033
- 601 Mensinger, J. L., Calogero, R. M., Stranges, S., & Tylka, T. L. (2016b). A weight-neutral versus
602 weight-loss approach for health promotion in women with high BMI: A randomized-
603 controlled trial. *Appetite, 105*, 364–374. doi:10.1016/j.appet.2016.06.006
- 604 Molix, L., & Bettencourt, B. (2010). Predicting well-being among ethnic minorities:
605 Psychological empowerment and group identity. *Journal of Applied Social Psychology, 40*,
606 513-533. doi: 10.1111/j.1559-1816.2010.00585.x
- 607 Montoya, A. K., & Hayes, A. F. (2016). Two-condition within-participant statistical mediation
608 analysis: A path-analytic framework. *Psychological Methods*. Advance online publication.
609 doi:10.1037/met0000086
- 610 Omichinski, L. (2007). *The HUGS program group leaders guide: Health-focused, centered on*
611 *Understanding lifestyle behaviors, Group supported, Self-esteem building*. Portage la
612 Prairie, MB R1N 3A3 Canada: HUGS International Inc.
- 613 Packer, J. (1989). The role of stigmatization in fat people's avoidance of physical exercise.
614 *Women & Therapy, 8*, 49–63. doi:10.1300/J015V08N03_07
- 615 Patte, K. A., Laxer, R., Qian, W., & Leatherdale, S. T. (2016). An analysis of weight perception
616 and physical activity and dietary behaviours among youth in the COMPASS study. *SSM -*
617 *Population Health, 2*, 841-849. doi:10.1016/j.ssmph.2016.10.016
- 618 Pearl, R. L., & Puhl, R. M. (2014). Measuring internalized weight attitudes across body weight
619 categories: Validation of the Modified Weight Bias Internalization Scale. *Body Image, 11*,

- 620 89–92. doi:10.1016/j.bodyim.2013.09.005
- 621 Pearl, R. L., & Puhl, R. M. (2016). The distinct effects of internalizing weight bias: An
622 experimental study. *Body Image, 17*, 38–42. doi:10.1016/j.bodyim.2016.02.002
- 623 Pearl, R. L., Puhl, R. M., & Dovidio, J. F. (2015). Differential effects of weight bias experiences
624 and internalization on exercise among women with overweight and obesity. *Journal of*
625 *Health Psychology, 20*, 1626–1632. doi:10.1177/1359105313520338
- 626 Preacher, K. J., & Kelley, K. (2011). Effect size measures for mediation models: Quantitative
627 strategies for communicating indirect effects. *Psychological Methods, 16*, 93–115.
628 doi:10.1037/a0022658.supp
- 629 Prichard, I., & Tiggemann, M. (2008). Relations among exercise type, self-objectification, and
630 body image in the fitness centre environment: The role of reasons for exercise. *Psychology*
631 *of Sport and Exercise, 9*, 855–866. doi:10.1016/j.psychsport.2007.10.005
- 632 Puhl, R. M., Andreyeva, T., & Brownell, K. D. (2008). Perceptions of weight discrimination:
633 Prevalence and comparison to race and gender discrimination in America. *International*
634 *Journal of Obesity, 32*, 992–1000. doi:10.1038/ijo.2008.22
- 635 Puhl, R. M., & Brownell, K. D. (2006). Confronting and coping with weight stigma: An
636 investigation of overweight and obese adults. *Obesity, 14*, 1802–1815.
637 doi:10.1038/oby.2006.208
- 638 Puhl, R. M., & King, K. M. (2013). Weight discrimination and bullying. *Best Practice &*
639 *Research. Clinical Endocrinology & Metabolism, 27*, 117–127.
640 doi:10.1016/j.beem.2012.12.002
- 641 Rhodes, R. E., Fiala, B., & Conner, M. (2009). Affective judgments and physical activity: A
642 review and meta-analysis. *Annals of Behavioral Medicine, 38*, 180–204.
643 doi:10.1007/s12160-009-9147-y

- 644 Rhodes, R. E., & Pfaeffli, L. A. (2010). Mediators of physical activity behaviour change among
645 adult non-clinical populations: A review update. *International Journal of Behavioral*
646 *Nutrition and Physical Activity*, 7, 37. doi: 10.1186/1479-5868-7-37
- 647 Robertson, N., & Vohora, R. (2008). Fitness vs. fatness: Implicit bias towards obesity among
648 fitness professionals and regular exercisers. *Psychology of Sport and Exercise*, 9, 547–557.
649 doi:10.1016/j.psychsport.2007.06.002
- 650 Schvey, N. A., Sbrocco, T., Bakalar, J. L., Ress, R., Barmine, M., Gorlick, J., . . . Tanofsky-
651 Kraff, M. (2016). The experience of weight stigma among gym members with overweight
652 and obesity. *Stigma and Health*. Advance online publication. doi:10.1037/sah0000062
- 653 Seacat, J. D., & Mickelson, K. D. (2009). Stereotype threat and the exercise/dietary health
654 intentions of overweight women. *Journal of Health Psychology*, 14, 556–567.
655 doi:10.1177/1359105309103575
- 656 Spahlholz, J., Baer, N., König, H. H., Riedel-Heller, S. G., & Luck-Sikorski, C. (2015). Obesity
657 and discrimination: A systematic review and meta-analysis of observational studies. *Obesity*
658 *Reviews*, 17, 43–55. doi:10.1111/obr.12343
- 659 Spees, C. K., Scott, J. M., & Taylor, C. A. (2012). Differences in amounts and types of physical
660 activity by obesity status in US adults. *American Journal of Health Behavior*, 36, 56-65.
661 doi:10.5993/AJHB.36.1.6
- 662 Taylor-Piliae, R. E., Norton, L. C., Haskell, W. L., Mahbouda, M. H., Fair, J. M., Iribarren, C.,
663 . . . Fortmann, S. P. (2006). Validation of a new brief physical activity survey among men
664 and women aged 60–69 years. *American Journal of Epidemiology*, 164, 598–606. doi:
665 10.1093/aje/kwj248
- 666 Tylka, T. L., Annunziato, R. A., Burgad, D., Danielsdottir, S., Shuman, E., Davis, C., &
667 Calogero, R. M. (2014). The weight-inclusive versus weight-normative approach to health:

- 668 Evaluating the evidence for prioritizing well-being over weight loss. *Journal of Obesity*,
669 983495. doi:10.1155/2014/983495
- 670 Twenge, J. M., & Crocker, J. (2002). Race and self-esteem: Meta-analyses comparing whites,
671 blacks, Hispanics, Asians, and American Indians and comment on Gray-Little and Hafdahl
672 (2000). *Psychological Bulletin*, 128, 371-408. doi:10.1037/0033-2909.128.3.371
- 673 Vartanian, L. R., & Novak, S. A. (2011). Internalized societal attitudes moderate the impact of
674 weight stigma on avoidance of exercise. *Obesity*, 19, 757–762. doi:10.1038/oby.2010.234
- 675 Vartanian, L. R., & Shaprow, J. G. (2008). Effects of weight stigma on exercise motivation and
676 behavior: A preliminary investigation among college-aged females. *Journal of Health
677 Psychology*, 13, 131–138. doi:10.1177/1359105307084318
- 678 Vauth, R., Kleim, B., Wirtz, M., & Corrigan, P. (2007). Self-efficacy and empowerment as
679 outcomes of self-stigmatizing and coping schizophrenia. *Psychiatry Research*, 150, 71-80.
680 doi:10.1016/j.psychres.2006.07.005
- 681 Watson, A. C., Corrigan, P., Larson, J. E., & Sells, M. (2007). Self-Stigma in people with mental
682 illness. *Schizophrenia Bulletin*, 33, 1312-1318. doi:10.1093/schbul/sbl076
- 683 Williams, D. M., Dunsiger, S., Ciccolo, J. T., Lewis, B. A., Albrecht, A. E., & Marcus, B. H.
684 (2008). Acute affective response to a moderate-intensity exercise stimulus predicts physical
685 activity participation 6 and 12 months later. *Psychology of Sport and Exercise*, 9, 231-245.
686 doi:10.1016/j.psychsport.2007.04.002
- 687 Wott, C. B., & Carels, R. A. (2010). Overt weight stigma, psychological distress and weight loss
688 treatment outcomes. *Journal of Health Psychology*, 15, 608–614.
689 doi:10.1177/1359105309355339

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692 Footnotes

693 ¹Given 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 ²Each 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 ³To 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 ^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

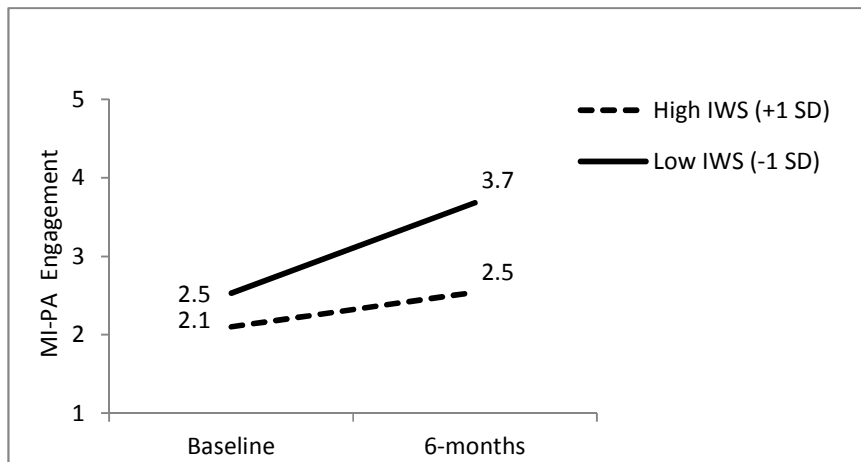


Figure 1. Internalized weight stigma (IWS) as a moderator of the healthy living program's effect on moderate-intensity physical activity (MI-PA) engagement among higher-weight women.

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

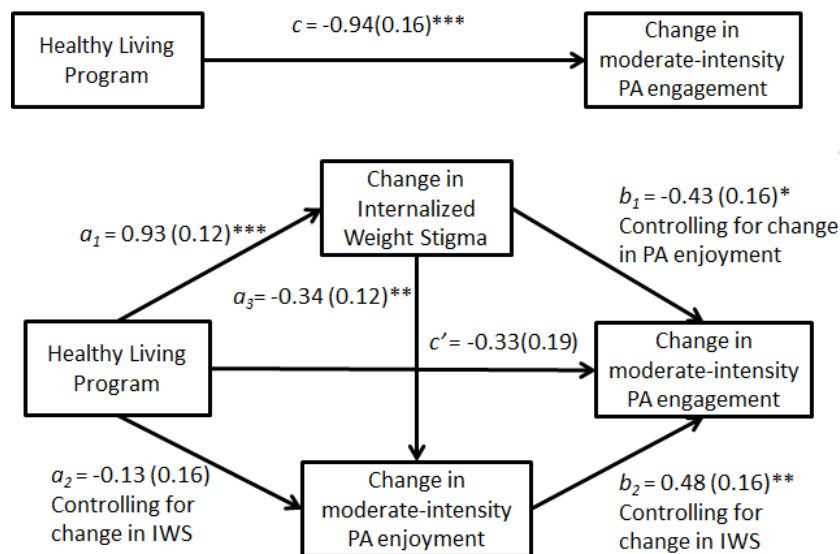


Figure 2. Serial mediation model for the effect of a healthy living program (HLP) on change in moderate-intensity physical activity (MI-PA) engagement among higher-weight women through sequential changes in internalized weight stigma (IWS) and MI-PA enjoyment.

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

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.