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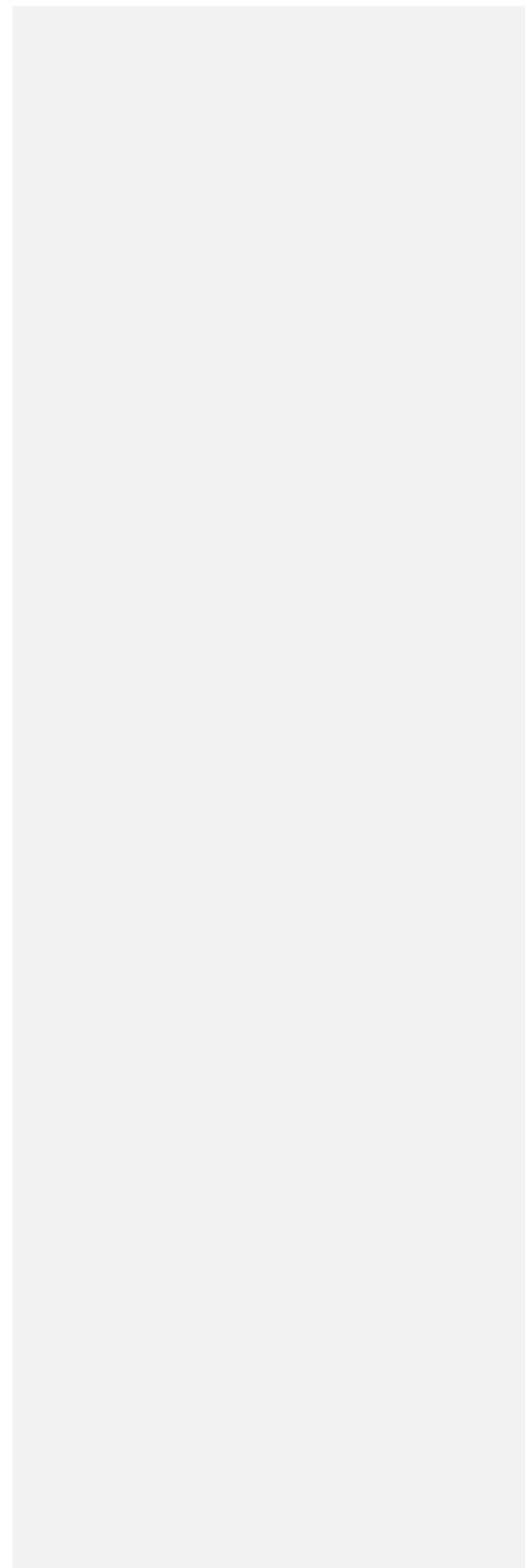
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TITLE PAGE

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Physical activity and body image among men and boys: A meta-analysis

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Abstract

Three meta-analytic reviews have concluded that physical activity is positively related to body image. Historically, research regarding physical activity and body image has been disproportionately focused on female samples. For example, the most recent meta-analysis (2009) extracted 56 effect sizes for women and only 12 for men. The current paper provides an update to the literature regarding the relationship between physical activity and body image among men and boys across 84 individual effect sizes. The analysis also provides insight regarding moderator variables including participant age, and physical activity type and intensity. Overall, physical activity was positively related to body image among men and boys with various moderator variables warranting further investigation. Pragmatic implications are discussed as well as the limitations within existing research and need for additional research to further understand moderator and mediator variables.

Keywords: body image, physical activity, exercise, males, meta-analysis, quantitative synthesis,

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Introduction

30 Body image is a multidimensional construct referring to the “psychological experience of
31 embodiment, especially but not exclusively one’s physical appearance” (Cash, 2004, p. 1). Body
32 image reflects how individuals think, feel, see and act toward their bodies (Thompson, Heinberg,
33 Altabe, & Tantleff-Dunn, 1999). Multiple dimensions of body image have significant
34 implications for one’s physical and mental health (for a detailed review, see Martin Ginis,
35 McEwan & Bassett, 2013). For example, body dissatisfaction is related to lower self-esteem
36 (Miller, & Downey, 1999), as well as higher levels of depression and anxiety (Stice &
37 Whitemton, 2002), eating disorders (Polivy & Herman, 2002) and muscle dysmorphia (Pope,
38 Gruber, Choi, Olivardia, & Phillips, 1997). It has been suggested that body image concerns and
39 body image dissatisfaction have increased over recent decades (for a review, see Cash, 2004)
40 with research suggesting that rates of body dissatisfaction could be as high as 72% among
41 women and 61% among men in North America (Kruger et al., 2008). Although there is great
42 variability around the rates of body dissatisfaction reported based on sample characteristics, the
43 operationalization of body dissatisfaction and study design (Fiske et al., 2014), there is clear
44 evidence that body dissatisfaction is a prevalent issue with important implications.

45 Early research focused on body image as an issue relevant primarily to women and girls
46 (hereafter ‘women’) (Thompson, Penner, & Altabe, 1990), with a mistaken belief that men and
47 boys (hereafter ‘men’) were largely immune to the experience of body dissatisfaction (Cash &
48 Brown, 1989). Subsequent research has demonstrated that body dissatisfaction is indeed present
49 among men (McCabe & Ricciardelli, 2004). Several rationales have been offered to explain
50 earlier findings which suggested that men were generally satisfied with their bodies (e.g., Rozin

51 & Fallon, 1988). For example, researchers have often operationalized body dissatisfaction in
52 relation to a desire to be thinner (for a review see McCreary & Sasse, 2000), which is far too
53 simplistic to capture body image ideals for men. That is, the (westernized) ideal of an ultra-thin
54 physique is pervasive in women leading to a linear relationship between BMI and body
55 dissatisfaction (Kostanski, Fisher, & Gullone, 2004). However, the relationship between BMI
56 and body dissatisfaction is curvilinear among men such that underweight and overweight men
57 experience body dissatisfaction (Frederick, Peplau, & Lever, 2006; Kostanski et al., 2004;
58 McCabe & Ricciardelli, 2004; Muth & Cash, 1997).

59 Improved understanding of the complexity of body image in recent years has allowed for a
60 better appreciation of the prevalence of body dissatisfaction among men. Relatedly, improved
61 measures of various dimensions of body image relevant to men have been developed and
62 psychometrically evaluated (for a review see, Cafri & Thompson, 2004). For example, the Drive
63 for Muscularity scale (McCreary & Sasse, 2000) has shown validity and reliability in assessing
64 men's thoughts (e.g., "I wish that I were more muscular") and behavior (e.g., "I lift weights to
65 build up muscle") in relation to muscularity to allow for assessment of body image unrelated to
66 desire for thinness. Similarly, the development and substantial psychometric evaluation of the
67 Male Body Attitudes Scale has demonstrated its value for body image assessment among men
68 (Tylka, Bergeron, & Schwartz, 2005).

69 Research has also advanced such that other nuances of body image among men have been
70 exposed. For example, gender-role orientation (i.e., the extent to which a man identifies with
71 stereotypically masculine traits) is likely to impact body image experiences with regard to
72 pursuing muscular ideals (McCabe & Ricciardelli, 2004). Moreover, men may place greater
73 value on the physical capabilities of their bodies whereas women may place more importance on

74 the physical appearance of their bodies (Martin Ginis et al., 2005). In addition, particular aspects
75 of body dissatisfaction may be more or less pronounced among men compared to women. For
76 example, the domain of discontent is likely to differ between men and women (see Cafri &
77 Thompson, 2004; Hargreaves & Tiggemann, 2006) such that men may experience less
78 dissatisfaction with certain domains of their bodies (e.g., dissatisfaction with hips/thighs; Fiske et
79 al., 2014) and more dissatisfaction in other domains (e.g., dissatisfaction with muscularity/upper
80 torso; Garner, 1997). Indeed, substantial research has accumulated over recent decades to
81 demonstrate the complexity of body image among men (e.g., Frederick et al., 2006; McCabe &
82 Ricciardelli, 2004). Men with body dissatisfaction are also at risk for previously discussed
83 physical and mental health complications (for a review, see McCabe & Ricciardelli, 2004)
84 including muscle dysmorphia (Pope et.al., 1997) and health compromising behaviours such as
85 steroid use or unhealthy dieting (Olivardia, Pope, Borowiecki, & Cohane, 2004). Hence, there is
86 great value in understanding interventions and strategies to support healthy body image among
87 men.

88 One proposed intervention to improve body image is exercise or physical activity (PA).
89 There has been a substantial amount of research focus on PA and body image. Three previous
90 meta-analyses have concluded that PA is positively related to body image (Campbell &
91 Hausenblas, 2009; Hausenblas & Fallon, 2006; Reel et al., 2007). The large majority of the
92 studies included in these meta-analyses (e.g., >80%; Hausenblas & Fallon, 2009) operationalized
93 body image within the subjective evaluation domain (e.g., body satisfaction or dissatisfaction).
94 Correlational data have indeed demonstrated a positive relationship between PA and body image
95 across a variety of samples. Experimental research has further demonstrated a positive
96 relationship such that those who engage in PA experience healthier body image (e.g., more body

97 satisfaction or less body dissatisfaction) compared to those who do not engage in PA. Although
98 the existing meta-analyses have been informative in understanding many aspects of the PA-body
99 image relationship in general, there are several factors that limit our full understanding of the
100 impact of PA on body image among men.

101 Research regarding PA and body image has been disproportionately focused on women. For
102 example, the most recent meta-analysis (Campbell & Hausenblas, 2009) extracted 56 effect sizes
103 for women and only 12 for men. Since the publication of the last meta-analysis in 2009, at least
104 20 studies have been published regarding the relationship between PA and body image among
105 men. Thus, there is value in updating the meta-analytic evidence to include this relatively large
106 number of studies that has focused on men.

107 Previous meta-analyses have also found equivocal evidence regarding the moderating role of
108 sex or gender on the relationship between PA and body image. Although an earlier meta-analysis
109 (Hausenblas & Fallon, 2006) found a larger effect size among women compared to men, the
110 most recent meta-analysis (Campbell & Hausenblas, 2009) found no significant difference in the
111 effect size for women and men. The moderating role of sex in the PA-body image relationship
112 remains unclear. And although it is accepted that the relationship between PA and body image is
113 positive for women *and* men (e.g., Campbell & Hausenblas, 2009), generalizing the overall
114 findings of meta-analyses that are disproportionately focused on women should be cautioned.
115 For instance, there is little known about the moderators of the PA-body image relationship
116 among men as existing meta-analyses have failed to separate female and male samples for
117 moderator analyses. Given the nuances of body image for men and women (e.g., different
118 idealized bodies), there are possible differences in moderating variables that impact the
119 relationship between PA and body image for women and men, respectively. Previous research

120 has considered various moderating variables (for a review see Martin Ginis & Bassett, 2011)
121 such as individual characteristics (e.g., age), PA characteristics (e.g., type and intensity of PA),
122 and body image operationalization characteristics (e.g., drive for thinness versus drive for
123 muscularity). However, our existing knowledge regarding moderator variables is largely
124 reflective of variables impacting the relationship between PA and body image among women
125 given the disproportionate representation of women within the meta-analytic studies from where
126 the conclusions about moderator variables have been drawn. Therefore, there is a need to
127 examine potential moderating variables that are unique to male samples in order to inform future
128 research and interventions.

129 An improved understanding of the mechanisms underlying the effects of PA on body image
130 is also needed. Indeed, there has been a call to further understand the mechanisms such that
131 optimally effective interventions can be designed (see Baranowski, Anderson, & Carmack, 1998;
132 Martin Ginis, Bassett, & Conlin, 2012). A recent review of mechanisms driving the effects of PA
133 on body image (Martin Ginis et al., 2012) found that while actual changes in body composition
134 played a relatively small role in explaining changes in body image resulting from PA, *perceived*
135 changes in body composition, and changes in self-efficacy seem to play a mechanistic role in the
136 PA-body image relationship. Importantly, almost all of the studies included in that review were
137 exclusively female samples. Although it is likely that many mechanisms are shared between
138 women and men, it is plausible that there are unique mechanisms. For example, one study by
139 Martin Ginis and colleagues (2005) specifically identified sex differences in the mechanisms
140 underlying change in body image resulting from PA. Among the women in the sample, change in
141 body image was related to objective *and* perceived changes in fitness and body composition,
142 whereas among men, change in body image was related only to perceived changes in fitness and

143 body composition. There is a need to further understanding the mechanisms underlying the
144 effects of PA on body image among men.

145 Unfortunately, there is no explicit theory or framework to guide PA and body image
146 research so researchers have often drawn on theories developed for the study of body image *or*
147 PA more generally (see Martin Ginis et al., 2012). The framework most frequently employed to
148 guide research regarding PA and body image (Campbell & Hausenblas, 2009) is the exercise and
149 self-esteem model (EXSEM; Sonstroem & Morgan, 1989). Although the EXSEM describes
150 exercise effects on global self-esteem, the model has been operationalized such that it has been
151 applied to understanding the effects of PA on body image within several studies (e.g., McAuley,
152 Blissmer, Katula, Duncan, & Mihalko, 2000; Shaw, Ebbeck, & Snow, 2000; Martin Ginis,
153 Strong, Arent, Bray, & Bassett-Gunter, 2014) . Accordingly, the EXSEM has been useful
154 informing research to examine the relationship between PA and body image, and identifying
155 possible moderating and mediating variables. In recognizing the need for an explicit theory to
156 guide PA and body image research, Martin Ginis and colleagues (2012) developed a preliminary
157 model. This preliminary model draws on the EXSEM and existing literature to identify three
158 possible mechanisms to explain the effects of PA on body image: (a) objective changes in
159 physical fitness, (b) perceived changes in physical fitness, and (c) changes in self-efficacy. The
160 model also identifies two categories of moderator variables that should be considering in PA-
161 body image research: (a) individual characteristics (e.g., age, sex, ethnicity) and (b) PA
162 characteristics (e.g., PA type, PA intensity, PA frequency). These two theories have guided the
163 current review in determining the mediator and moderator variables of interest.

164 In summary, research regarding PA and body image among men has advanced in recent
165 years. Previous meta-analyses regarding PA and body image have been disproportionately

166 focused on women and have not included many of the recent studies of men. Our understanding
167 of the moderators of the PA-body image relationship among men is poor and has not been fully
168 advanced through previous meta-analyses. There is also a need for an improved understanding of
169 the mechanisms underlying this relationship. The purpose of this study was to engage meta-
170 analytic techniques to further our understanding of the relationship between PA and body image
171 specifically among men. Several moderator and mediator variables were examined based on the
172 EXSEM (Sonstroem & Morgan, 1989) and preliminary model for examining the effects of PA
173 on body image (Martin Ginis et al., 2012), as well as previous meta-analyses (e.g., Hausenblas &
174 Fallon, 2006). Specific moderator variables included age, type of body image measure, PA
175 intensity, and PA mode. Additional moderators related to individual characteristics (e.g., BMI,
176 ethnicity) and PA characteristics (e.g., PA frequency) were not included in the current analysis
177 due to insufficient data available. A discussion regarding three potential mechanisms of the PA-
178 body image relationship among men is also included: (a) objective changes in physical fitness,
179 (b) perceived changes in physical fitness, and (c) changes in self-efficacy.

180 **Method**

181 **Literature Search and Eligibility Criteria**

182 Our literature search began by reviewing previous meta-analyses on body image and PA
183 (Campbell & Hausenblas, 2009; Hausenblas & Fallon, 2006; Reel et al., 2007) for potential
184 articles. Searches for additional possible studies were then carried out in the following databases:
185 *PsycINFO*, *Medline*, *SportDiscus*, *Education Resources Information Center (ERIC)*, and
186 *ProQuest Dissertations and Theses*. Searches were conducted in January 2015. In each database
187 search, we used the following combinations of search terms: ([dysmorph*] or [musc*] or
188 [affect*] or [bigorex*] or [body] or [eating] or [physique] or [self] or [social physique]) AND

189 ([physical activity] or [exercise] or [fitness]). Search terms were generated based on the search
190 terms used in previous meta-analyses regarding body image and PA with the addition of body
191 image related terms that are specific to research regarding men (e.g., muscularity, bigorexia).

192 Potential articles were then reviewed for eligibility by two of the co-authors. Each article was
193 subjected to title elimination, followed by abstract elimination, and finally full-text elimination.

194 We also searched the reference sections of the articles that met our inclusion criteria to determine
195 if any additional articles could be retrieved (see Figure 1). An article needed to meet the
196 following criteria to be included in the meta-analysis: (1) included a measure of PA or
197 experimental condition that engaged in PA (e.g., leisure time physical activity, exercise, weight
198 training), (2) include a measure of body image that was consistent with any dimension of body
199 image (e.g., affective, cognitive, subjective evaluation, perceptual), (3) report data such that an
200 effect size could be calculated specifically for men; (4) available in English; (5) examine
201 participants from non-clinical populations; and (6) provide appropriate statistics to compute
202 effect sizes. If the requisite statistical information was missing from a given manuscript, we
203 contacted the corresponding authors for this information. Of the eleven authors that were
204 contacted, one provided the necessary data to incorporate into the analyses.

205 **Data Analysis**

206 Articles that met eligibility criteria were extracted and subsequently reviewed independently
207 by two co-authors with respect to study design and the four moderator variables described below.
208 The rate of agreement between reviewers was 80%. When discrepancies in coding occurred, the
209 authors met to resolve these differences by referring back to the article in question until
210 unanimity was reached. Data were then analyzed as a random-effects model using the software
211 *Comprehensive Meta-Analysis, Version 2* (Borenstein, Hedges, Higgins, & Rothstein, 2005). A

212 random-effects model assumes variability in the effect sizes across the included studies, and is
213 the appropriate model to use in social science research (as opposed to a fixed-effects model
214 which assumes that the average effect size does not vary across studies; Borenstein et al., 2009;
215 Field & Gillett, 2010).

216 Where possible, effect sizes for each study were calculated via means, standard deviations,
217 and sample sizes at baseline and post-intervention of experimental and control conditions in
218 intervention studies (Borenstein et al., 2009; Decoster & Claypool, 2004). For correlational
219 studies, effect sizes were calculated. If such statistics were missing, we used *F*-statistics, *t*-scores,
220 and *p*-values. Each study was given a relative weight based on its precision, which is determined
221 by the study's sample size, standard error, and confidence interval (i.e., more precise data is
222 given a larger relative weight compared to less precise data; Borenstein et al., 2009). Hedges' *g*
223 was used as the effect size metric, as it accounts for differences in sample size and variance
224 across studies (Hedges & Olkin, 1985). Standard errors and 95% confidence intervals were
225 computed to test for the accuracy of the standardized effects obtained.

226 If articles provided more than one effect size (e.g., when studies tested body image at multiple
227 time points), these effect sizes were combined into one overall effect size statistic for that study,
228 so as to not give greater relative weight to these studies (Borenstein et al., 2009). Exceptions to
229 this approach were taken when articles reported the effects of multiple interventions (i.e.,
230 multiple subgroups), each of which was subject to a unique physical activity protocol (e.g., a
231 strength-building intervention versus a cardiovascular training intervention versus a non-training
232 control condition). In these cases, an effect size from each intervention was computed; thus, the
233 article would provide multiple effect sizes to the total number of comparisons within the meta-
234 analysis. Potential unit-of-analysis errors in these studies were corrected by dividing the sample

235 size of the control condition by the number of within-study comparisons. For example, if a study
236 reported data from 20 participants assigned to a strength-building intervention, 20 assigned to a
237 cardiovascular training intervention, and 20 assigned to a no-training control condition, the *n* of
238 the control condition was entered as 10 (i.e., 20 [control group participants] divided by 2
239 [conditions]; Higgins & Green, 2011).

240 Tests of heterogeneity within the meta-analysis were also performed by assessing the
241 variability in the observed effect sizes across studies (*Q* value), as well as the ratio of the true
242 heterogeneity to the total observed variation (I^2). Potential publication bias was examined in
243 three ways. First, the fail-safe *N* statistic was calculated as an estimate of the number of
244 unpublished studies with null findings that would be necessary to reduce the effect size to zero
245 (Rosenthal, 1979). If this value is greater than $5N+10$, then the probability of such a number of
246 studies existing (in the file drawer) is low (Rosenberg, 2005). Second, funnel plots were obtained
247 to provide a visual representation of potential publication bias. Third, sensitivity analyses were
248 conducted by noting the effect size that emerged when a study was removed.

249 **Moderator Analyses**

250 In total, four potential moderator variables were examined: age, type of body image measure,
251 PA intensity and PA mode. For correlational studies, we coded participants' *age* into three
252 categories (i.e., adolescents, adults, or older adults) and the *body image measure* utilized into
253 five categories: (a) body satisfaction, (b) muscularity-related, (c) thinness-related, (d) social
254 physique anxiety, or (e) general (i.e., any measure that did not fit within one of the other four
255 categories). For intervention studies, we coded participants' *age*, *body image measure* utilized,
256 prescribed PA *intensity* into three categories (i.e., low, moderate, or vigorous), and PA *mode*
257 utilized into two categories (i.e., aerobic training or resistance training). For each moderator

258 variable, we calculate an effect size, standard error, 95% confidence interval, Z -value, and p -
259 value to test for the effects of each category on PA, as well as a Q statistic and corresponding p -
260 value to estimate the heterogeneity across these effects (Borenstein et al., 2009).

261 Results

262 Literature Search

263 The literature searches returned 34,758 potentially relevant articles. After removing
264 duplicates, 33,250 articles were subject to title and abstract review. Based on these reviews,
265 33,180 articles were eliminated, while 70 were full-text reviewed. Ultimately, 36 articles met
266 eligibility criteria—see Figure 1 for the PRISMA (Moher, Liberati, Tetzlaff, & Altman, 2009)
267 flow diagram. Of these studies, 9 included multiple subgroups, which resulted in 52 total
268 comparisons (k), a total sample size (n) of 12,519 participants, and 84 individual effect sizes.
269 Overviews of each study with regard to design, sample, and measurement characteristics as well
270 as descriptions of the effect sizes calculated are provided in Table 1.

271 Summary Statistics

272 There was a medium overall effect size for all studies included in the meta-analysis, Hedges g
273 (SE) = 0.567 (0.08), $Z = 7.39$, $p < .001$. However, the heterogeneity across studies was very high,
274 Q (df) = 482.0(51), $p < .001$, $I^2 = 89.4$. We therefore separated studies according to experimental
275 design. This resulted in a medium-to-large effect size for controlled trials ($k = 13$, g (SE) = 0.645
276 (0.19), $Z = 3.44$, $p = .001$), a small effect size for single-group (i.e., uncontrolled) interventions
277 ($k = 8$, g (SE) = 0.281 (0.10), $Z = 2.91$, $p = .004$), and a medium effect size for correlational
278 studies ($k = 34$, g (SE) = 0.660 (0.10), $Z = 5.99$, $p < .001$). This also resulted in much smaller
279 heterogeneity within intervention studies; Q (df) = 58.45 (12), $p < .001$, $I^2 = 79.47$ for controlled

280 and $Q(df) = 21.40(7)$, $p = .003$, $I^2 = 67.28$ for uncontrolled interventions. However, heterogeneity
281 remained very high within correlational studies— $Q(df) = 384.5(30)$, $p < .001$, $I^2 = 92.20$.

282 To further reduce heterogeneity, we excluded outlier studies; that is, those that had
283 abnormally high effect sizes and standardized residuals (outside an absolute value of 3.0),
284 especially when these values were accompanied by very narrow confidence intervals. No
285 experimental studies were excluded on this basis. With regard to correlational studies, this
286 process resulted in a small-to-medium sized effect in the remaining studies, $k = 28$, $g(SE) =$
287 $0.468(0.07)$, $Z = 6.34$, $p < .001$, with heterogeneity being greatly reduced, $Q(df) = 151.8(27)$, p
288 $< .001$, $I^2 = 82.21$. The fail-safe n was 114 for controlled trials and 1268 for correlational studies,
289 both of which are sufficiently large (Rosenberg, 2005). However, the fail-safe n was 41 for
290 uncontrolled interventions which is not sufficiently large. Summary statistics and forest plots for
291 controlled interventions, uncontrolled interventions, and correlational studies are provided in
292 Tables 2, 3, and 4, respectively.

293 Moderator Analyses

294 There were too few studies within the pool of controlled and uncontrolled studies to carry out
295 moderator analyses separately. We, therefore, combined these studies together into one pool in
296 order to assess potential moderators. This resulted in a small-to-medium effect size ($k = 21$, g
297 $(SE) = 0.391(0.09)$, $Z = 4.17$, $p < .001$) with heterogeneity remaining acceptable ($Q(df) =$
298 $80.51(20)$, $p < .001$, $I^2 = 75.16$). In addition, the fail-safe n was 311, which—unlike the results
299 for uncontrolled interventions alone—is sufficiently large. For these reasons, we proceeded with
300 the combination of controlled and uncontrolled interventions for the moderator analyses for
301 variables where there was sufficient data. These results are provided in Table 5 for intervention
302 studies and Table 6 for correlational studies.

303 **Age of Participants.** With regard to age, the moderator analyses suggest that there is a
304 significant relationship between exercise and body image for adult males ($g = 0.34$, $k = 12$ for
305 intervention studies and $g = 0.46$, $k = 16$ for correlational studies). The results were less
306 conclusive for adolescent and older adult populations. With regard to adolescent males, there
307 were significant relationships between PA and body image in correlational studies ($g = 0.47$, $k =$
308 9), but null effects in intervention studies ($g = 0.04$, $k = 3$). However, caution should be exercised
309 in interpreting the latter results, as there were relatively few intervention studies. Likewise, the
310 small number of correlational ($g = 0.16$, $k = 2$) and intervention ($g = 0.27$, $k = 1$) studies limit
311 conclusions about the PA-body image relationship for older adults. It is worth noting, however,
312 that significant effects were shown for both intervention ($g = 1.37$, $k = 5$) and correlational ($g =$
313 0.94 , $k = 1$) studies when adult and older adult samples were combined in the analyses.

314 **Body Image Measure.** In terms of the type of body image measure employed, significant
315 effect sizes were evident for general measures of body image (i.e., measures that did not fit
316 within another category such as muscularity or thinness-related body image; $g = 0.35$, $k = 12$) in
317 both intervention studies and ($g = 0.53$, $k = 15$) in correlational studies. Significant effects were
318 also shown for measures of body satisfaction ($g = 0.62$, $k = 7$) in intervention studies and ($g =$
319 0.37 , $k = 17$) in correlational studies. Muscularity-related body image was strongly associated
320 with PA in correlational studies ($g = 0.90$, $k = 6$); there were no intervention studies that
321 examined the effects of PA interventions on body image operationalized regarding muscularity.
322 Intervention studies did not enhance body image in terms of drive for thinness ($g = -0.31$, $k = 2$);
323 however, it is difficult to draw conclusions with few intervention studies that measured this
324 construct. Finally, although PA was significantly related to social physique anxiety in

325 correlational studies ($g = 0.30, k = 9$), these effects were not evident in intervention studies ($g =$
326 $0.29, k = 5$).

327 **Physical Activity Intensity.** Regarding PA intensity prescribed in PA interventions,
328 there were significant effect sizes of low- ($g = 2.58, k = 3$) and moderate- ($g = 0.38, k = 6$)
329 intensity PA on body image. Interestingly, as this PA intensity reached vigorous levels, the
330 effects became non-significant. However, because there was only one intervention study that
331 examined the effect of vigorous intensity PA on body image ($g = 0.31$) and three studies that
332 examined the effect of moderate-and-vigorous intensity PA on body image ($g = 0.38$), caution
333 must be exercised when interpreting these findings.

334 **Mode of Physical Activity.** Finally, body image improved as a result of interventions
335 that prescribed aerobic PA ($g = 0.61, k = 12$) as well as those that prescribed resistance training
336 ($g = 0.45, k = 4$). Only two studies looked at the *combination* of aerobic and resistance PA on
337 body image, with non-significant effects emerging ($g = 0.11, k = 2$). Hence, although there
338 appears to be promise in using either mode of PA to enhance body image, at present, our
339 understanding of the combined effects of these two modes on body image is limited.

340 Discussion

341 Overall Findings Regarding Physical Activity and Body Image among Men

342 The results of this meta-analysis support the notion that physical activity (PA) is positively
343 associated with body image among men. The relationship seems robust among men and the
344 overall effect size was medium which is somewhat consistent with previous meta-analyses,
345 which have found small to medium sized relationships between PA and body image for men
346 (Campbell & Hausenblas, 2009; Hausenblas & Fallon, 2006; Reel et al., 2007). The review
347 provides an update to the meta-analytic literature which was formerly disproportionately focused

348 on women. Within the current analysis, the effect size for controlled interventions was medium
349 to large, which was higher than that of correlational or single group designs. Earlier meta-
350 analyses included few intervention studies conducted among male samples. Although our
351 analysis included relatively few controlled studies ($k = 13$), this is more than the total number of
352 effect sizes across all study types included in the former most recent meta-analysis (see
353 Campbell & Hausenblas, 2009). Our meta-analytic findings provide an important update to the
354 existing literature regarding the relationship between PA and body image among men. The
355 medium-large sized effect observed within controlled studies supports the pragmatic implications
356 for using PA as an intervention strategy to improve body image among men.

357 In order to understand and optimally design PA interventions for improving body image, it is
358 necessary to have a sound understanding of possible moderator and mediator variables. The
359 current meta-analysis aimed to update knowledge regarding moderators of the relationship
360 between PA and body image among men. Potential mediator variables are also discussed.

361 **Moderator Analyses**

362 The moderator analyses regarding age were somewhat informative. Overall, the largest effects
363 were seen among adult male samples, which is consistent with earlier meta-analytic data
364 suggesting the relationship between PA and body image was largest for adults (Hausenblas &
365 Fallon, 2006). The limited number of studies examining adolescent and older men preclude any
366 conclusive understanding of the PA-body image relationship among these groups. However,
367 earlier work suggesting PA may have the greatest impact on body image among young people
368 (e.g., adolescents and university students; Hausenblas & Fallon, 2006; Reel et al., 2007) should
369 be cautiously interpreted. Overall, our findings support the positive association between PA and
370 body image among adult men but suggest there is a need for further research among younger and

371 older samples of men.

372 The moderator analyses suggest that PA is positively related to body image as
373 operationalized in various ways including body satisfaction, social physique anxiety, drive for
374 muscularity, and general body image. Only one previous meta-analysis has examined “type of
375 body image measure” as a moderator and found that PA had the largest impact on body
376 satisfaction (Reel et al., 2007). Our findings suggest that PA is positively related to various
377 aspects of body image. However, it is possible that certain aspects of body image may not be as
378 amenable to change as others through PA interventions. Studies that operationalized body image
379 as Drive for Thinness did not find a significant relationship between PA and body image. This
380 finding could align with the notion that thinness is not a meaningful indicator of body image for
381 many men (e.g., Olivardia et al., 2004). However, our interpretation is limited by the small
382 sample of studies examining drive for thinness. Future research could consider operationalizing
383 body image in various forms within single studies such as to better understand the relationship
384 between PA and various dimensions of body image among men.

385 PA intensity is another variable that may impact the relationship between PA and body image
386 among men. Two previous meta-analyses found that strenuous or vigorous intensity PA had a
387 larger impact on body image compared to mild PA, which had virtually no effect on body image
388 (Hausenblas & Fallon, 2006; Reel et al., 2007). However, the current meta-analytic data suggest
389 that low to moderate PA was positively related to body image among men. Contrary to earlier
390 findings, no significant relationship was found between vigorous PA and body image. However,
391 these null findings may reflect the small sample of studies that included vigorous PA.
392 Nonetheless, as various PA agencies recommend moderate to vigorous intensity PA for physical

393 and mental health benefits, future research should be conducted to determine whether these
394 recommendations align with improvements in body image among men.

395 Previous meta-analytic data (among men and women) have presented mixed findings
396 regarding mode of PA as a moderator of the PA-body image relationship. While anaerobic PA
397 had the largest effect in one analysis (Reel et al., 2007), combined aerobic and anaerobic PA had
398 the largest effect in another analysis (Hausenblas & Fallon, 2006). Researchers have concluded
399 that the mode of PA does not generally moderate the relationship between PA and body image
400 (e.g., Martin Ginis & Bassett, 2011). Our results corroborate this statement as both aerobic and
401 anaerobic PA were positively related to body image. Based on the current evidence (i.e.,
402 previous reviews and current meta-analysis), it would appear suitable to prescribe anaerobic or
403 aerobic PA. However, further research with regard to mode of PA is necessary given the limited
404 number of studies upon which this conclusion is based.

405 **Mechanisms of Physical Activity Effects on Body Image among Men**

406 Few studies included *any* examination of mechanisms underlying the relationship between PA
407 and body image. A recent review of mechanisms driving the effects of PA on body image
408 (Martin Ginis et al., 2012) found that there is evidence to support three categories of
409 mechanisms: (a) objective changes in physical fitness, (b) perceived changes in physical fitness,
410 and (c) changes in self-efficacy. Although there was limited consideration for mechanisms across
411 the studies included in the meta-analysis, there was evidence from at least one study to support
412 each of the three proposed mechanisms, respectively. Specifically, evidence was found to
413 support objective change in fitness including body composition (McAuley, Bane, Rudolph, &
414 Cox, 1995) and aerobic capacity (McAuley, Marquez, Jerome, Blissmer, & Katula, 2002) as a
415 mechanism underlying improved body image resulting from PA. Evidence was also found to

416 support perceived changes in physical fitness including perceived loss of body fat and perceived
417 gains in strength and muscularity as a mechanism (Martin Ginis et al., 2005). Finally, there was
418 evidence to support changes in self-efficacy as an underlying mechanism as well (McAuley et
419 al., 2002). It seems plausible that there are multiple mechanisms at play in the PA-body image
420 relationship. Unfortunately, we could not perform a statistical examination of mechanisms
421 underlying the PA- body image relationship due to limited data within the studies. Further
422 research is, therefore, needed to better understand mechanisms and other possible moderators of
423 the underlying mechanisms (e.g., individual goals for PA). There is a need for research using
424 study designs that allow for the examination of mediating variables; namely, designs that
425 establish causation (see Frazier, Tix, & Barron, 2004). Such research will allow for further
426 understanding of *how* PA can improve body image (Martin Ginis et al., 2012) among men.

427 **Limitations and Future Directions**

428 The results of this meta-analysis provide an updated review of the literature regarding PA and
429 body image among men. There are several important limitations to consider, many of which
430 reflect limitations within the studies included in the analyses. This discussion highlights
431 important considerations for future research regarding PA and body image among men. Many
432 papers included cross-sectional and correlational designs, or did not include a control group.
433 Future research must employ stronger study designs in order to advance our understanding of the
434 causal relationship between PA and body image, as well as further understand moderating and
435 mediating variables. Relatedly, an additional limitation of the meta-analysis was the high
436 heterogeneity across studies. As a result, outliers were removed and studies were divided by
437 design type in order to conduct the analyses. This left a small number of studies to be included in
438 each analysis, which limits the interpretation of the findings.

439 The results of the moderator analyses provide some insight regarding nuances and pragmatic
440 considerations of the relationship between PA and body image among men. However, it is
441 important to highlight the lack of data, or insufficient data, available to examine certain
442 moderator variables. For example, we were unable to examine characteristics of the participants
443 (e.g., body composition, ethnicity) and PA program (e.g., frequency of PA, intervention length).
444 In many cases, although we were able to conduct analyses to examine a possible moderator
445 variable, our interpretation of the results was limited by the number of studies available. There is
446 a need for further research to examine moderator variables and most importantly, researchers
447 must report on meaningful characteristics of their sample and PA. Specifically, the
448 operationalization of PA and/or description of PA interventions were very poor in many studies.
449 This is a common limitation of PA research (Williams & French, 2011). Relatedly, most studies
450 relied on self-report measures of PA, many of which were not considered to be valid or reliable.
451 Unfortunately, the variability in quality of measurement of PA is a limitation of the current and
452 previous meta-analyses. In order to overcome this limitation and advance research on the effects
453 of PA in relation to body image, it is critical that researchers to develop and utilize measures that
454 are valid and reliable.

455 Generally, the operationalization and measurement of body image was better than that of PA.
456 However, some studies did not clearly operationalize body image which leads to challenges with
457 regard to the synthesis of knowledge across studies. Some studies relied on body image
458 measurement tools with weak or unknown psychometric value. The variability in psychometric
459 properties across measures may have confounded the observed findings in the current review.
460 Indeed, the psychometric properties of the body image measures themselves may play a
461 moderating role. As the literature regarding body image among men has advanced so too have

462 the options for appropriate psychometrically sound measurement tools; these tools should be
463 employed in future work and this paper serves as a call for improved measurement of PA and
464 body image within future research. .

465 **Conclusion**

466 There has been an increase in research focused on PA and body image among men. We
467 provide an update to the meta-analytic literature specifically focusing on PA and body image
468 among men and provide some insight regarding possible moderator variables. It is disappointing
469 to note that the limitations of the PA and body image research existing today are virtually
470 identical to those reported in meta-analyses conducted almost 10 years ago. To advance this area
471 of research and inform the development of effective PA interventions, there is a need for further
472 research regarding moderators and mechanisms of the PA-body image relationship.

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Note: **Articles included in meta-analytic calculations.

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