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A systematic review and meta-analysis of interventions that target the intersection of body image and movement among girls and women

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ABSTRACT

Body image concerns and disengagement from movement-based activities are intertwined and disproportionately higher among girls and women, relative to boys and men. This systematic review and meta-analysis examined interventions targeting the intersection of body image and movement experiences among girls and women. A systematic search until February 14, 2023 yielded 8,101 papers; 31 randomized controlled trials were included. Outcomes included body image, movement behavior, and fitness. Most studies evaluated movement-based interventions ($k = 29$) and were deemed medium ($k = 13$) to high ($k = 12$) risk of bias. The meta-analysis indicated a small, significant improvement in body image at post-test ($d+ = 0.181$, $p < .001$, 95%CI: + 0.074, + 0.288) but not follow-up ($d+ = 0.017$, 95% CI: −0.123, + 0.157). The effect size for fitness ($d+ = 0.720$, $p < .001$, 95%CI: + .393, + 1.051), but not movement ($d+ = 0.036$, 95%CI: −0.088, + 0.161), was significant at post-test. Effect sizes were largest for studies with unimodal and atheoretical interventions, participants in mid-to-late adulthood, small sample sizes, active and waitlist controls, and those deemed as high risk of bias. Higher quality research is needed on the intersection of body image and movement, particularly if problematic disparities in girls' and women's body image concerns and movement participation are to be remedied.

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Body image; girls; interventions; movement; women

Introduction

Twenty years of research indicates that girls and women participate in movement-based activities (i.e. physical activity, exercise, and sport) to a lesser degree than boys and men

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(Guthold et al., 2018, 2020). Activity levels among girls gradually decline from early childhood, with disengagement most prevalent during late adolescence, which subsequently predicts lower participation in adulthood (Bélanger et al., 2015; Neumark-Sztainer et al., 2018). This decline and disengagement is, in part, explained by body image concerns, with girls and women reporting appearance anxiety, unrealistic appearance ideals and pressures, objectifying apparel, and appearance-based teasing from peers and coaches as key barriers to adopting and maintaining movement-based activities (Biddle et al., 2005; Daniels et al., 2020; Koulanova et al., 2021; Slater & Tiggemann, 2011; Vani et al., 2021). Numerous approaches have been developed (e.g. *Healthy Me*; McCabe et al., 2017) and/or selected (e.g. yoga; Alleva et al., 2020) with the aim of improving girls' and women's body image and movement experiences; however, to our knowledge, a systematic review and meta-analysis has yet to examine the effectiveness of these interventions exclusively among girls and women. Given that body image and movement participation are closely intertwined, as well as disproportionately problematic among this demographic (Guthold et al., 2018, 2020), establishing which interventions are effective and recommendable is paramount.

This systematic review and meta-analysis aims to advance our understanding of the relationship between body image and movement by using a bidirectional perspective when identifying and evaluating interventions. That is, girls' and women's body image and movement experiences intersect and subsequently impact one another (Koulanova et al., 2021; Sabiston et al., 2019). For instance, how a person thinks, feels, and behaves towards their body can influence their participation in movement (e.g. motivation, frequency, enjoyment, and performance) and, in the reverse direction, participation in movement can influence a person's satisfaction with, and appreciation for, their body, including what it looks like and how it functions. Therefore, to gain a comprehensive understanding of the interventions that target this bidirectional and reciprocal relationship, this paper considered both body image-based interventions that target movement outcomes and movement-based interventions that target body image outcomes. This differs from previous systematic reviews and/or meta-analyses, which have predominantly taken a unidirectional perspective and examined the impact of movement-based interventions on body image (Campbell & Hausenblas, 2009; Dai et al., 2020; Hausenblas & Fallon, 2006; McIntosh-Dalmedo et al., 2018; Reel et al., 2007; SantaBarbara et al., 2017; Srismith et al., 2020).

Existing reviews into movement-based interventions and body image outcomes

To our knowledge, 12 reviews have examined the impact of movement-based interventions on body image and movement outcomes, with no reviews exclusively examining the impact of body image interventions on movement and body image outcomes. Of the movement-based intervention reviews, one focused on boys and men (Bassett-Gunter et al., 2017), four focused on adolescent girls (Dai et al., 2020; Kerner et al., 2022; McIntosh-Dalmedo et al., 2018; Sick et al., 2022), and the remaining seven covered mixed ages and genders (Alleva et al., 2015; Campbell & Hausenblas, 2009; Hausenblas & Fallon, 2006; Reel et al., 2007; Sabiston et al., 2019; SantaBarbara et al., 2017; Srismith et al., 2020). For the purpose of this review, we focus on those comprising girls and women ($k = 11$).

Of the 11 reviews, two were scoping reviews, five were systematic reviews, and four were systematic reviews and meta-analyses. Using a scoping review approach, Sabiston and colleagues (2019) explored the relationship between body image, physical activity,

and sport across different ages, genders, and ethnicities. Overall, participation in 'physical activity and sport' was associated with lower negative body image and greater positive body image, which were typically conceptualized as body dissatisfaction and body satisfaction by the included studies, respectively. More recently, Sick and colleagues (2022) explored 'sport-specific body image and disordered eating interventions' among girls aged ≤18 years. Of the 14 eligible studies, seven assessed girls' body image, of which only one study, a non-randomized controlled trial, observed significant group differences. Given the nature of these reviews, effect sizes were not aggregated, nor inferential conclusions made about the interventions' effectiveness.

In their systematic review, McIntosh-Dalmedo and colleagues (2018) examined six 'sport and exercise interventions' among girls aged 10–19 years, of which only two were associated with significant improvements in girls' body image. Meanwhile, Dai and colleagues (2020) examined 'physical activity interventions' among girls aged 10–19 years and found seven of the eight studies to be associated with significant improvements. More recently, Kerner and colleagues (2022) examined 'body image programs and interventions in physical education' among girls aged 8–18 years, with a majority of studies ($k = 15$ out of 19) reporting a positive impact on girls' body image. Two systematic reviews have been conducted among mixed ages and genders, including SantaBarbara and colleagues' (2017) review on the effects of 'resistance training' on body image. Eight of the 11 studies were associated with significant improvements; however, only three of the eight studies were considered high quality, one of which pertained to young women. More recently, Srismith and colleagues (2020) assessed 'longitudinal physical activity interventions' among adults and of the 34 studies, 26 reported significant body image improvements among participants. Notably, despite recommended reporting guidelines (Page et al., 2021; Rethlefsen et al., 2021), none of the systematic reviews reported on, or synthesized, effect sizes for the included studies; thus, limiting comparisons and possible conclusions about the interventions' effectiveness at improving body image.

Of the four systematic reviews and meta-analyses, three examined the relationship between 'exercise interventions' and body image among mixed ages and genders, with all three finding small to moderate improvements in body image following intervention participation (i.e. Hedges' $g = 0.29$ in Campbell & Hausenblas, 2009; Hedges' $g = 0.35$ in Hausenblas & Fallon, 2006; Cohen's $d = 0.45$ in Reel et al., 2007). Moderating variables were also examined across all three reviews, including age, gender, ethnicity, body weight, and exercise type, intensity, frequency, duration, and length; however, effects were inconsistent. Hausenblas and Fallon (2006) found marginally greater effects among women than men ($g = 0.43$ vs. 0.39, respectively), and greater effects among adolescents ($g = 0.71$) compared to young ($g = 0.25$) and older ($g = 0.46$) adults. Alternatively, Campbell and Hausenblas (2009) reported no moderating effects for gender, larger effects among adults ($g = 0.44$) and older adults ($g = 0.33$), and smaller effects among school ($g = 0.16$) and university students ($g = 0.22$).

Using a different meta-analytic approach, Alleva and colleagues (2015) reviewed change techniques used in body image interventions and their subsequent impact on body image outcomes. Two physical activity change techniques were identified: physical activity behavior and the discussion of physical activity (e.g. the benefits of physical activity, developing behavioral plans). Engaging in physical activity had no effect on body image ($k = 22$, $R^2 = 2.91$, $\beta = -0.01$, $p > 0.05$) and discussion about physical activity

led to poorer body image ($k = 11$, $R^2 = 12.65$, $\beta = -0.36$, $p < 0.05$). The authors attributed these adverse effects to the inadvertent emphasis that discussions about physical activity may place on changing one's appearance (e.g. the need to lose weight).

Remedying the limitations of existing reviews

Trends across reviews were mixed and at times contradicting, which can be attributed, in part, to limitations within and across the included studies, as well as the reviews themselves. First, a majority of included studies narrowly defined or conceptualized body image as satisfaction with one's appearance. This is an outdated perspective and does not align with ongoing theoretical advancements in the body image field, which postulate that positive and negative body image are separate, multifaceted constructs that comprise behavioral, affective, and cognitive components (Andersen & Swami, 2021; Tylka & Wood-Barcalow, 2015). Subsequently, a majority of the abovementioned reviews, particularly those published after these theoretical advancements (i.e. post-2010), tended to adopt this unidimensional definition and conceptualization of body image. For instance, many used general (e.g. body attitudes, physical self-concept) and/or negative search terms (e.g. body anxiety, body concerns, body dissatisfaction), with very few incorporating terms that pertained to positive body image (e.g. body acceptance, body appreciation, functionality satisfaction).

Second, reviews rarely defined or conceptualized the intervention of interest. For example, McIntosh-Dalmedo and colleagues (2018) examined 'sport and exercise interventions' among 10–19-year-old girls, while Dai and colleagues (2020) assessed 'physical activity interventions' among the same demographic. No definitions for 'sport and exercise interventions' or 'physical activity interventions' were provided; however, there were clear overlaps in how the authors conceptualized their respective interventions. That is, both included multisession strength-based training in schools, but neither review reported on the same two studies. What is more, these two reviews told two different stories about the interventions' effectiveness (e.g. two out of six interventions were effective [McIntosh-Dalmedo et al., 2018] vs. seven out of eight [Dai et al., 2020]).

Collectively, these methodological limitations have implications for the scope and quality of a review, including identifying eligible approaches, and subsequently synthesizing, analyzing, and interpreting the data. For instance, omitting or using outdated definitions of key variables and target interventions can lead to the exclusion of relevant and eligible papers, which in turn yields small-sampled reviews (e.g. $k = 6$ in McIntosh-Dalmedo et al., 2018 and $k = 8$ in Dai et al., 2020). Subsequently, small-sampled reviews limit the type of data analyses available to authors (e.g. meta-analyses), which in turn hinders the conclusions and recommendations that can be made.

Overall, previous reviews provide preliminary insights into the effectiveness of interventions that target the intersection of girls' and women's body image and movement experiences. However, due to the scope (e.g. Sabiston et al., 2019; Sick et al., 2022) and timeframe (e.g. Campbell & Hausenblas, 2009; Hausenblas & Fallon, 2006; Reel et al., 2007) of certain reviews, as well as the abovementioned limitations of others (e.g. Dai et al., 2020; Kerner et al., 2022; McIntosh-Dalmedo et al., 2018; SantaBarbara et al., 2017; Srismith et al., 2020), inferential conclusions about these interventions' effectiveness, particularly among girls and women, remains limited and in need of updating. In

taking a bidirectional perspective of body image and movement, along with adopting modern conceptualizations of these variables, we aim to provide a more robust review of extant interventions that target this at-risk demographic. Further, in examining both girls and women together, rather than separately or with other genders as per previous reviews, we aim to yield an appropriate number of studies that will provide insights into developmental differences that may impact intervention effectiveness.

The present review

The present review considered interventions that targeted the intersection of body image and movement experiences among girls and women; these included:

1. Movement-based interventions (i.e. the primary intervention involves completing a physical activity, exercise, or sport) that targeted a body image outcome with or without a movement outcome; and
2. Body image-based interventions (i.e. the primary intervention involves targeting individuals' body image attitudes and behaviors through discussion and/or writing activities) that targeted a movement outcome with or without a body image outcome.

The overarching aim of this review was to remedy the limitations of previous efforts by providing a more robust synthesis, analysis, and overview of the interventions seeking to improve the intersection of girls' and women's body image and movement experiences. This will be achieved by:

1. Identifying randomized controlled trials of movement-based or body image-based interventions that target girls' and women's body image and/or movement experiences; and
2. Estimating the impact of these interventions on body image and movement outcomes, and evaluating characteristics of the interventions (i.e. utilized a theoretical framework, unimodal vs. multimodal, intervention length) and methodology (i.e. target age, sample size, type of control condition, risk of bias) that moderate intervention effects on body image and movement outcomes.

Materials and methods

This review was conducted in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement (PRISMA; Page et al., 2021; Rethlefsen et al., 2021) and the American Psychological Association Meta-Analysis Reporting Standards (MARS; Appelbaum et al., 2018). Study methods and analyses were pre-registered with the PROSPERO registry for systematic reviews prior to commencement (April 26, 2021; ref no. CRD42021243758).

Defining body image and movement

In the preceding decade, research has steered away from the unidimensional conceptualization of body image (i.e. how [dis]satisfied a person is with their appearance and/or

body), toward a more complex and holistic understanding of how a person thinks, feels, and behaves towards their body. Today, the body image research field assumes that positive body image (i.e. an overarching acceptance, appreciation, and respect for one's body, and the rejection of harmful societal appearance ideals; Tylka & Wood-Barcalow, 2015) and negative body image (i.e. dissatisfaction with one or more aspects of one's body, and engaging in behaviors to reduce this discomfort; Cash & Smolak, 2011) are separate, multifaceted constructs, and that the presence of positive body image does not represent the absence of negative body image experiences (Tylka & Wood-Barcalow, 2015). In this review, we use the term *body image* when referring generally to how a person thinks, feels, and behaves towards their body, including its appearance and how it functions (Cash & Smolak, 2011) and, where appropriate, we distinguish between the positive or negative constructs (e.g. including search strategy terms related to both constructs). Further, when describing specific studies, we adopt the terminology of the authors and refer to the specific body image construct being targeted or assessed (e.g. body dissatisfaction, body appreciation).

The terms movement, physical activity, exercise, and sport are related, but they are not synonymous. Movement is broadly defined as the changing of your physical position (Caspersen et al., 1985). More recently, a broader definition for physical activity was proposed: 'People moving, acting, and performing within culturally specific spaces and contexts, and influenced by a unique array of interests, emotions, ideas, instructions, and relationships' (Piggin, 2020, p. 5). Exercise is a subcategory of physical activity, defined as planned, structured, and repetitive bodily movement to improve or maintain physical fitness (e.g. aerobic dance classes; Caspersen et al., 1985). Lastly, sport can be defined as a subcategory of exercise undertaken individually or as part of a team. Participants adhere to a common set of rules or expectations, and a defined goal usually exists (e.g. soccer; Khan et al., 2012). In this review, we refer to *movement* or *movement-based activities*, as it is more inclusive, holistic, and representative of the full spectrum of activities that can foster and deepen one's relationship with their body. This term is also less prescriptive, and therefore may be less triggering for individuals with a history of negative experiences with, and/or biases toward, physical activity, exercise, and sport (Boyd et al., 2007; Hallward et al., 2022; Hockin-Boyers & Warin, 2021). When describing specific studies and their respective findings, the original authors' terminology is retained to describe the type of movement (e.g. exercise or sport) and/or the activity (e.g. aerobics).

Literature search and study selection

Four strategies were used to identify studies for inclusion. First, we conducted a systematic computerized search using the databases PsycINFO, SPORTDiscus, CINAHL Plus, and MEDLINE (accessed via EBSCO), and the Cochrane Central Register of Controlled Trials. Boolean combinations, alternative spellings, and abbreviations of the following search terms were used: movement; physical activity; exercise; fitness; sport; boxing; dancing; running; yoga; resistance training; strength training; endurance training; weight training; aerobic training; anaerobic training; appearance; body image; body anxiety; body attitude; body checking; body concern; body esteem; body evaluation; body satisfaction; body dissatisfaction; body surveillance; body shame; body acceptance; body appreciation; body functionality; body positivity; body pride; physical self-perception; intervention; trial;

program; cohort; randomized controlled trial; training. Second, we reviewed the reference lists of included studies (i.e. an ancestry approach). Third, we searched for gray literature and unpublished studies on ClinicalTrials.gov, SportRxiv, and PsyArXiv, using the same search terms. Fourth, Emeritus Professor Michael Levine sent an email to the Levine Prevention/Sociocultural Factors TinyLetter email group (consisting of 1,065 body image researchers across 49 countries, as at July 8, 2022), requesting published and unpublished research on our behalf. The full search strategy is available from the projects' Open Science Framework page: https://osf.io/f3ya8/?view_only=635d344c3cce4eaeb52cda0bf9bbface.

The last search was conducted on February 14, 2023. Searches were not limited by language, country of publication, date, or publication status. Two authors (AT and HSB) independently screened records (i.e. title and abstract) obtained from the literature search. Duplicates and irrelevant papers were removed. If the record indicated that the research included a body image or movement intervention and measured body image and/or movement outcomes, then the full-text article was consulted. If the full-text article did not provide sufficient information to determine eligibility or to calculate effect sizes, or reported results on mixed-gender samples, the corresponding authors were e-mailed using up-to-date contact information obtained via online searches. If the authors did not respond after two attempts (over approximately one month) or were unable to provide the requested data within a specified time frame, the study was excluded.

Inclusion and exclusion criteria

Included studies investigated the effect of: 1) a movement-based intervention on body images outcomes with or without a movement outcome or 2) a body image-based intervention on movement outcomes with or without a body image outcome. Eligible interventions could be supervised or unsupervised, individual or group-based, and comprising a single session or multiple sessions. Additional inclusion criteria were studies that: 3) employed any randomized controlled trial design; 4) reported separate outcomes for girls and/or women or could provide this data upon request if genders were grouped together for analyses; and 5) included at least one quantitative measure of body image and/or movement at baseline and post-intervention.

Studies were excluded if they: 1) described the effect of a movement-based intervention on movement outcomes only; 2) described the effect of a body image-based intervention on body image outcomes only; 3) included mixed-gender samples without providing separate data for girls and/or women, and could not provide this data on request; or 4) did not include a true control group (e.g. studies that compared two movement-based interventions). We did not exclude studies based on mode of delivery, intensity, duration, or length of the intervention. Two authors (AT & HSB) independently coded each study. Multiple rounds of revisions were conducted by two other authors from the review team (EM & KS) to check for inconsistencies in the extracted information.

Effect size estimation

Body image and movement were the primary outcomes. Due to the small number of studies assessing positive body image constructs (e.g. body acceptance, body

appreciation), relative to general or negative body image constructs (e.g. physical self-concept, body dissatisfaction), all body image measures were grouped into one category. Body image measures were, therefore, defined as those assessing the way an individual thinks, feels, and behaves towards their body, its appearance, and how it functions. Movement-related measures were categorized into either behavior-related outcomes (e.g. session attendance), psychological-related outcomes (e.g. exercise self-efficacy), or fitness-related outcomes (e.g. muscle endurance).

For each primary outcome, Cohen's *d* was calculated by subtracting the mean pre- to post-test change of the control group from the mean pre- to post-test change of the experimental group, and then dividing the difference by the pooled pre-test standard deviation. When a scale measured outcome deterioration (e.g. body dissatisfaction), the scores were reversed based on the scale's maximum possible range. This allowed us to obtain a homogeneous set of effect sizes referring to overall improvements in the primary and secondary outcomes across studies, necessary for output interpretation of the meta-analyses.

When multiple measures of an outcome were assessed within a study, a mean weighted Cohen's *d* was calculated. First, we calculated effect sizes for each measure and then calculated a weighted mean effect inversely proportional to variance. While adopting an aggregation approach might introduce bias (Hagger, 2022), the adoption of a weighted average allows for the adjustment of sample size bias and effect size dependency bias (Alleva et al., 2015; Hunter & Schmidt, 2004). Sensitivity analyses showed conclusions are invariant to using a simple mean or a weighted mean.

We calculated a separate Cohen's *d* for the effect between pre- and post-test, and between pre-test and follow-up timepoints. When both intention-to-treat and per-protocol analyses were conducted, we calculated effect sizes using the intention-to-treat data to reduce attrition bias (Alleva et al., 2015). When multiple approaches were tested in the same study, we calculated Cohen's *d* by comparing each intervention group to the control group. We did not include comparisons between intervention groups as these analyses were beyond this paper's scope. Cohen's *d*s were checked by two independent data analysts (CG and PW) and any discrepancy was resolved by manually re-calculating the effect size. Effect sizes were interpreted using Cohen's guidelines where $d+ = 0.20$, 0.50, and 0.80 constitute small, medium, and large effects, respectively (Cohen, 1992).

Recorded variables

Risk of Bias within individual studies

Risk of bias within individual studies was assessed using the Cochrane Collaboration's Tool for Assessing Risk of Bias 2 (RoB 2; Higgins et al., 2016; Sterne et al., 2019), which involves rating bias for each study related to: 1) the randomization process; 2) deviations from the intended approach; 3) missing outcome data; 4) measurement of the outcome; 5) selection of the reported results; 6) the timing of identification or recruitment of participants in cluster-randomized trials; and 7) period and carryover effects in crossover trials. Two authors (AT and KS) independently assessed all studies. Cohen's kappa (κ; Cohen, 1960) was calculated to determine interrater reliability for the overall risk of bias score, showing good agreement (80.6%) between scores ($\kappa = 0.708$, $p < 0.001$). Discrepancies were resolved through discussion between the raters and consultation with the rest of the authoring team.

Moderator variables

Variables were coded as follows: theoretical framework, where 1 = yes and 2 = no; intervention modality, where 1 = unimodal and 2 = multimodal; intervention length (in hours, continuous variable); age of participants, where 1 = childhood (0–11 years), 2 = adolescence (12–17 years), 3 = early adulthood (18–35 years), and 4 = mid-to-late adulthood (>35 years); sample size, where 1 = small sample (single arm sample size ≤35) and 2 = large sample (single arm sample size >35); type of control condition, where 1 = active control, 2 = waitlist control, and 3 = assessment only condition; risk of bias, where 1 = low risk, 2 = medium risk, and 3 = high risk.

Meta-analytic strategy

All analyses were pre-specified and conducted using SPSS 28 and R Studio. Although statistically possible (Ryan, 2015), we chose not to perform any meta-analysis or moderator analyses on groups of two studies or less, since such random effect analyses are exposed to a high risk of inaccuracy in the estimation of heterogeneity and overall effect size (Hagger, 2022). Given the varying characteristics of the movement and body image interventions in this meta-analysis (Hagger, 2022), and to enhance the generalizability of the findings (Field & Gillett, 2010), we calculated the sample-weighted average effect sizes applying a random-effects model. We assessed risk of bias within individual studies and heterogeneity between studies by calculating the sample-weighted Cohen's *d* and respective 95% confidence intervals (CIs) for approaches deemed low risk, medium risk, or high risk. For each outcome and the relevant time points, we calculated the overall effect size (*d*+) and assessed intervention effect heterogeneity with multiple indicators, as they pose different advantages and disadvantages: 95% CIs, 95% Prediction Intervals (PIs), the I^2 statistic, and by producing a forest plot. A 95% CI in a random-effects model contains setting-specific highly likely values for the overall treatment effect (*d*+; Sánchez-Meca & Marín-Martínez, 2008). A 95% PI in a random-effects model contains highly probable values for the overall treatment effect (*d*+) for settings similar, but not identical, to those considered in the meta-analysis; note this is imprecise if calculated using a low number of small studies (IntHout et al., 2016). Lastly, I^2 describes the percentage of variation across studies due to heterogeneity rather than chance (Hagger, 2022; Higgins & Thompson, 2002; IntHout et al., 2016). I^2 is sample-size dependent, with very large studies likely to yield a high I^2 and small studies often obtaining an I^2 of 0.

Publication Bias

To assess for publication bias, we created funnel plots (i.e. a scatterplot of each effect size against its standard error) for each outcome at each time point. We performed a visual inspection of the plot to assess the possibility of 'missing' studies (especially with negative or null effects; Simmonds, 2015). We used Egger's regression to statistically test for funnel plot asymmetry (Egger et al., 1997), that is, regressing the interventions' effect estimate on its standard error, weighted by the inverse of the variance of the intervention effect. Regarding significant Egger's regressions, we planned to Winsorize the data and apply the Trim and Fill procedure (Duval & Tweedie, 2000). Winsorizing involves limiting extreme values in studies' effect sizes to reduce the potential effect of outliers. We planned to Winsorize the data at the 90th and 80th percentiles and then re-run the

meta-analyses on the relevant outcomes and time points to assess the effect of the smallest and biggest effect sizes on the overall effect. The Trim and Fill procedure consists of trimming the studies causing funnel plot asymmetry, allowing the overall effect estimate to be re-centered, as it will be produced by studies minimally impacted by publication bias. Next, the missing studies are imputed (filled) in the funnel plot based on the bias-corrected overall estimate (Shi & Lin, 2019). The Trim and Fill procedure provides an estimate of the number of missing studies, as well as an adjusted overall effect calculated by performing another meta-analysis including the filled studies (Duval & Tweedie, 2000).

Moderator analyses and meta-regressions

We performed moderator analyses and meta-regressions on body image at post-test only. This choice was underpinned by the results of the overall intervention effects analyses, the classification of body image as one of our primary outcomes, and a sufficient number of studies measuring body image at post-test to run moderator analyses. When looking at intervention-related variables, we ran moderator analyses on intervention components and used meta-regression to test the association between length of the interventions (in hours, continuous variable) and effect sizes associated with body image at post-test. We also explored the moderating effect of methodology-related variables, including theoretical basis (i.e. theoretical vs. atheoretical), small sample bias, type of control group, risk of bias, and targeted age. To test for small sample bias, we estimated overall Cohen's *d* separately for studies including either $\leq$35 participants per group (i.e. small samples) or >35 participants per group (i.e. large samples; Coyne et al., 2010). Similarly, to estimate the effect of risk of bias within individual studies, we ran subgroup analyses with the Cochrane risk of bias as a moderator, estimating the overall Cohen's *d* for studies deemed low risk, medium risk, or high risk.

Analyses summary

We ran three meta-analyses to test intervention effects at post-test on body image, movement behavior, and fitness. It was not possible to perform meta-analyses on psychological correlates of movement, as variables grouped under this outcome were only included in one study (Annesi et al., 2011). We then tested intervention effects at follow-up, running one meta-analysis on body image, as this was the only outcome with more than two studies at follow-up. Finally, we conducted subgroup analyses on body image at post-test, investigating the following moderators: intervention components, intervention length, theoretical basis, sample size, type of control group, Cochrane risk of bias, and targeted age.

Results

Study selection

As of February 14, 2023, the search protocol yielded 8,101 papers (see Figure 1). After removing duplicates ($n = 486$), 7,615 papers were screened based on title and abstract. Of these, 7,481 were excluded and 134 were sought for retrieval, of which 32 could not be retrieved. One hundred and two articles were assessed for eligibility, of which the following were excluded: 38 studies did not describe a randomized controlled trial, 15

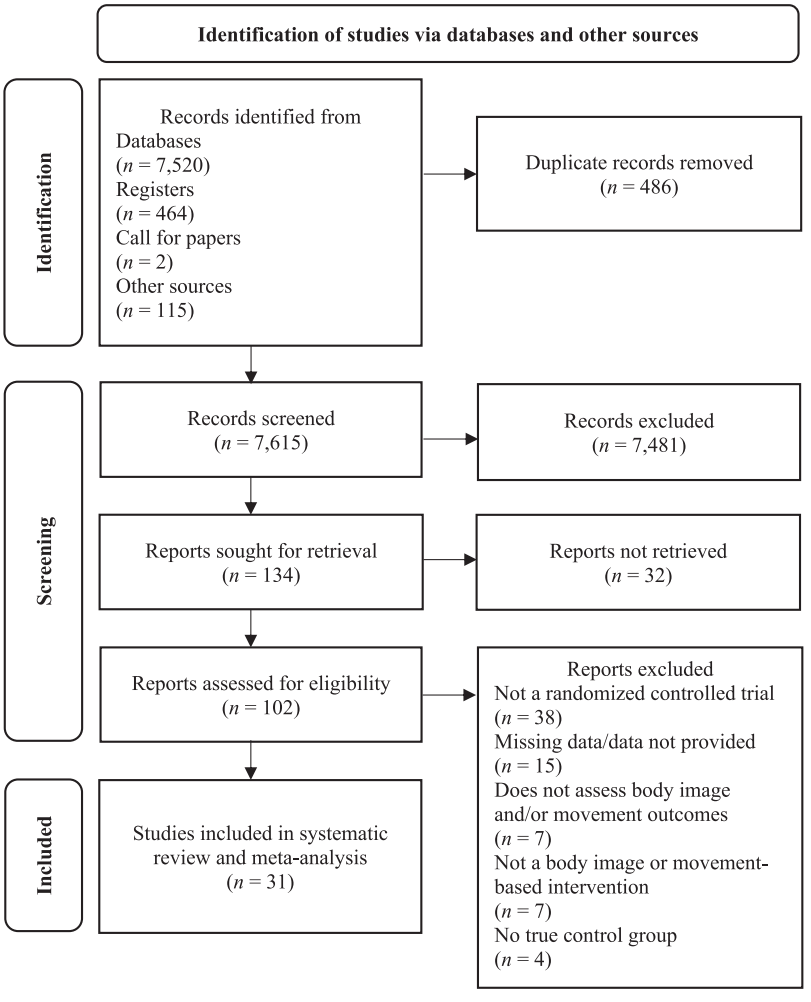

Figure 1. PRISMA Flowchart of Study Selection.

studies contained missing data, 7 studies lacked body image and/or movement outcomes, 7 studies did not describe a body image or movement-based intervention, and 4 studies lacked a true comparison group.

Study and intervention characteristics

The final sample of $k = 31$ studies (participants $N = 4{,}861$; see Table 1) involved studies published between 1998 and 2022, which were conducted in 17 countries: the United States ($n = 6$); the United Kingdom ($n = 4$); Brazil ($n = 3$); Canada ($n = 2$); Iran ($n = 2$); Turkey ($n = 2$); one study in Australia, Austria, Costa Rica, Denmark, France, Germany, Netherlands, Norway, Spain, and Sweden; one study included participants from both the United Kingdom and the United States; and one study included participants from both Ireland and the United Kingdom. Four studies were conducted with children (0–11 years), eight with adolescents (12–17 years), ten with participants in early adulthood (18–35 years), and nine with participants in mid-to-late adulthood (>35 years).

Table 1. Characteristics of the Included Studies.

			Target Population		Intervention Group			Control Group		
Author (Year)	Country	Study Design	Age (Years)	Health Status	Description	Theoretical Framework	Modality	Control Group Type	Description	Cochrane Risk of Bias Score
Movement-Based Interventions										
Alleva et al. (2020)	Netherlands	Individual	18–35	General population	Hatha yoga (10 × 60 min weekly classes)	FA	Unimodal	2	n/a	Low
Annesi et al. (2011)	United States	Individual	>35	General population	One-on-one sessions with wellness specialist (6 x one-on-one; 3 x weekly exercise sessions)	SCT	Multimodal	1	Non-personalized one-on-one sessions with wellness specialist nutrition and weight loss education	Medium
Arbour and Ginis (2008)	Canada	Individual	>35	General population	Self-monitoring goal of 3 days of 3,500 pedometer-determined steps per week; formulate action plans for 3 days of the week	None specified	Multimodal	1	Self-monitoring goal of 3 days of 3,500 pedometer-determined steps per week (no action plan)	High
Aşçıı et al. (1998)	Turkey	Individual	18–35	General population	Intervention 1: aerobic dance; intervention 2: step aerobics	None specified	Unimodal	3	n/a	High
Baptista et al. (2012)	Brazil	Individual	>35	General population	Belly dance (60 min classes twice a week for 16 weeks)	None specified	Unimodal	2	n/a	Low
Burgess et al. (2006)	United Kingdom	Crossover	12–17	Individuals with high body image dissatisfaction and low physical self-perceptions and physical activity levels	Aerobic dance classes (50 min classes twice a week for 6 weeks)	CMT	Unimodal	1	Physical education classes as usual (including swimming [50 min classes twice a week for 6 weeks], as part of the British national curriculum)	Medium
Carpio-Rivera et al. (2021)	Costa Rica	Individual	18–35	General population	Intervention 1: low-intensity aerobic exercise; intervention 2: high-intensity aerobic exercise; intervention 3: low-intensity resistance training; intervention 4: high-intensity resistance training (3 × 30 min weekly sessions)	None specified	Unimodal	1	Table game 'Jenga'	High
Christiansen et al. (2018)	Denmark	Cluster	12–17	General population	Physical activity intervention program (6 courses; 4 × 90 min + 3 × 30 min weekly activity)	SDT	Multimodal	3	n/a	High
Cowley et al. (2021)	United Kingdom & Ireland	Individual	12–17	General population	Physical activity intervention program (18 sessions; 3 × 50 min weekly sessions)	SDT	Multimodal	2	n/a	Low

Dittrich et al. (2008)	Austria	Individual	18–35	Patients with migraine	Aerobic exercise (12 sessions; 2 × 60 min weekly sessions)	None specified	Unimodal	3	n/a	High
Duncan et al. (2009)	United Kingdom	Individual	0–11	General population	Plyometric type exercises run in a circuit (12 sessions; 2 × 40 min weekly sessions)	None specified	Unimodal	1	Physical education classes as usual	High
Estey et al. (2022)	United Kingdom & United States	Individual	18–35	General population	Psychoeducational content, yoga (hatha, Thai, restorative, yin, nidra), meditation (120 min x 7 weekly sessions)	ESM, ET	Multimodal	2	n/a	Medium
Gehrman et al. (2006)	United States	Individual	0–11	General population	Behavioral training, non-competitive games and weight-bearing activities, activity logs (120 min x 8 weekly sessions)	None specified	Multimodal	1	Injury prevention training	Low
Hajihosseini (2015)	Iran	Individual	12–17	General population	Fitness training (muscle strength, endurance, aerobic, flexibility training; 32 sessions; 2 × 30 min weekly sessions)	None specified	Unimodal	1	Physical education classes as usual	Medium
Halliwell et al. (2018)	United Kingdom	Cluster	0–11	General population	Yoga (4 × 40 min weekly classes)	ET	Unimodal	1	Physical education classes as usual	Low
Halliwell et al. (2019)	United Kingdom	Individual	18–35	General population	Yoga (4 × 60 min weekly classes)	ET	Unimodal	1	Received yoga leaflets to provide feedback on	Medium
Huang et al. (2007)	United States	Individual	12–17	General population	1-year intervention designed to increase physical activity, reduce sedentary behaviors, and improve dietary behaviors	None specified	Multimodal	1	Sun exposure protection	High
Junkin (2007)	Canada	Individual	>35	General population	Hatha yoga (2 × 60 min weekly sessions + 1-2 × 30 min independent sessions at home)	EXSEM	Unimodal	3	n/a	High
Khalili et al. (2022)	Iran	Individual	>35	Individuals scoring ≥ 15 on social physique anxiety and ≥ 20 on disordered eating	Group walking program (3 × 30 min weekly sessions over 8 weeks)	None specified	Unimodal	3	n/a	High
Legrand and Crombez-Bequet (2022)	France	Individual	18–35	Women who filed for domestic violence	Moderate to vigorous physical activity program: 25 min walking/running, 10 min strength training (pushups, planks, side planks; 2 × 35-40 min weekly sessions over 6 weeks)	EXSEM	Unimodal	1,3	Counselling sessions (1 × 80 min over 6 weeks); no intervention	Medium
Lindwall and Lindgren (2005)	Sweden	Individual	12–17	General population	Physical activity intervention program (2 × 60 min weekly sessions over 6 months)	EP	Multimodal	3	n/a	Medium
Lofrano-Prado et al. (2022)	Brazil	Individual	12–17	General population	Behavioral counseling and recreational physical activity (2 × 60 min weekly sessions over 12 weeks)	ART, SE	Multimodal	1	Behavioral counseling only	High

(*Continued*)

Table 1. Continued.

			Target Population		Intervention Group			Control Group		
Author (Year)	Country	Study Design	Age (Years)	Health Status	Description	Theoretical Framework	Modality	Control Group Type	Description	Cochrane Risk of Bias Score
Martínez-Rodríguez et al. (2021)	Spain	Individual	>35	General population	Nutritional education and aquatic resistance interval training (42 × 60 min sessions)	None specified	Multimodal	1	Nutritional education only	Medium
Mehnert et al. (2011)	Germany	Individual	>35	Patients with breast cancer	Physical exercise training (2 × 90 min weekly sessions over 10 weeks)	None specified	Unimodal	2	n/a	Medium
Mendonça et al. (2015)	Brazil	Individual	>35	General population	Intervention 1: strength training; intervention 2: dance training; intervention 3: hydro gymnastics (3 × 50-60 min weekly sessions over 16 weeks)	None specified	Unimodal	3	n/a	Medium
Sandel et al. (2005)	United States	Individual	>35	Patients with breast cancer	Dance and movement program (18 × 60 min sessions over 12 weeks)	None specified	Unimodal	2	n/a	Low
Scott (2005)	United States	Individual	18–35	General population	Intervention 1: exercise and education; intervention 2: exercise only (6 × 60 min weekly sessions)	None specified	Multimodal; Unimodal	3	n/a	Medium
Karaahmet et al. (2022)	Turkey	Individual	18–35	Pregnant women	Yoga (3 × 40 min weekly sessions over 4 weeks)	None specified	Unimodal	3	n/a	Medium
Zabinski et al. (2001)	United States	Individual	18–35	General population	Fitness for Life program (2 × 60 min lecture + 90 min practical sessions weekly over 15 weeks)	SCT, TM	Multimodal	1	The control condition met once per week and covered general health topics in a lecture format	Medium
Body Image-Based Interventions										
McCabe et al. (2017)	Australia	Cluster	0–11	General population	Healthy Me (strengths-based approach to enhance positive body image) (4 × 60 min weekly sessions over 4 weeks + recap session 3 months after program completion)	SCT	Multimodal	2	n/a	High
Sundgot-Borgen et al. (2020)	Norway	Cluster	12–17	General population	Healthy Body Image program (3 × 90 min monthly workshops)	ET, ML	Multimodal	3	n/a	High

Note. **Theoretical framework:** ART = Affective-Reflective Theory; CMT = Competence Motivation Theory; *EP* = Empowerment Process; ESM = Embodied Self Model; ET = Embodiment Theory; EXSEM = Exercise and Self-Esteem Model; FA = Functionality Appreciation; ML = Media Literacy; SCT = Social Cognitive Theory; SDT = Self-Determination Theory; SE = Self-Efficacy; TM = Transtheoretical Model. **Control group type:** 1 = active control condition; 2 = waitlist control condition; 3 = assessment only condition. **Participant age:** 0–11 years = childhood; 12–17 years = adolescence; 18–35 years = early adulthood; > 35 years = mid-to-late adulthood.

Most studies assessed the effect of movement-based interventions on body image outcomes with ($k = 9$) and without movement outcomes ($k = 20$), while only two studies assessed the effect of body image-based interventions on movement outcomes, and of these, only one assessed body image. A majority of body image measures were assessments of general (e.g. physical self-perceptions) or negative (e.g. body dissatisfaction) constructs, with only four studies assessing positive body image (e.g. body appreciation, positive body connection, functionality satisfaction). Seventeen studies assessed unimodal interventions, 13 assessed multimodal interventions, and one study included a unimodal and multimodal intervention (see Table 1). Less than half ($k = 15$) utilized theoretical frameworks to inform the development, selection, and/or evaluation of the intervention.

Overall intervention effect sizes

Table 2 presents the weighted average effect sizes for all outcomes and relevant time points of the included studies, as well as a reference to the questionnaires included in each weighted average effect size. Table 3 shows the overall effect of the interventions on the outcomes at post-test and follow-up, and 95% CIs, 95% PIs, and I^2 values for all outcomes.

Body image

At post-test, the sample-weighted improvement in body image was significant and of small magnitude ($d+ = 0.181$); while 95% CIs suggested reliability (i.e. did not cross zero), the 95% PIs suggested non-reliability (i.e. crossed zero). The I^2 was low, indicating low heterogeneity. At follow-up, the sample-weighted improvement in body image was not significant and of small magnitude ($d+ = 0.017$). Both the 95% CIs and 95% PIs indicated non-reliability (i.e. both crossed zero). The I^2 was zero, suggesting absence of heterogeneity.

Movement behavior

At post-test, sample-weighted improvement in movement behavior was not significant, of small magnitude ($d+ = 0.036$), and not reliable (i.e. the 95% CIs and PIs crossed zero). The I^2 was zero, suggesting absence of heterogeneity.

Fitness

Sample weighted improvements in fitness at post-test were significant and of medium magnitude ($d+ = 0.720$). While 95% CIs suggested reliability (i.e. did not cross zero), 95% PIs suggested non-reliability (i.e. crossed zero), and I^2 indicated no heterogeneity (i.e. was zero). Notably, a significant meta-analysis with I^2 equal to zero should be interpreted with caution: as suggested by large 95% PIs, the assessment of the exact amount of heterogeneity is unreliable and unlikely to be exactly zero (although small values are possible) when the meta-analysis is run on a few small studies (IntHout et al., 2016).

Risk of Bias within individual studies

Figure 2 shows the risk of bias for each intervention (McGuinness & Higgins, 2021). Six studies were rated as low risk of bias (19.4%), 13 studies were rated as having medium

Table 2. Effect Sizes for Studies Included in the Meta-Analysis and Summary of Measures.

			Body Image			Movement Behavior		Fitness	
			Weighted Cohen's *d*			Weighted Cohen's *d*		Weighted Cohen's *d*	
Study	*NC*	*NE*	T2	T3	Measures	T2	Measures	T2	Measures
Alleva et al. (2020)	56	58	0.23		1–6				
Annesi et al. (2011)	64	73	0.37		7, 8		1		
Arbour and Ginis (2008)	17	25	0.76		9, 10		2		
Aşçı_1 et al. (1998)	15	15	0.41		11–16				
Aşçı_2 et al. (1998)	15	15	0.28		11–16				
Baptista et al. (2012)	40	40	0.33	−0.01	17			0.79	1
Burgess et al. (2006)	25	25	0.08		18–28		3		
Carpio-Rivera_1 et al. (2021)	14	12	0.08		29				
Carpio-Rivera_2 et al. (2021)	14	12	0.33		29				
Carpio-Rivera_3 et al. (2021)	14	10	0.55		29				
Carpio-Rivera_4 et al. (2021)	14	14	0.25		29				
Christiansen et al. (2018)	655	580	0.04		26				
Cowley et al. (2021)	20	22	0.58		30	0.07	2, 3	0.40	2–4
Dittrich et al. (2008)	15	15	0.17		31, 32				
Duncan et al. (2009)	19	15	1	0.48	33				
Estey et al. (2022)	73	84	0.22	−0.08	34, 35				
Gehrman et al. (2006)	19	33	0.01		36–38				
Hajihosseini (2015)	21	20	0.91		39				
Halliwell et al. (2018)	96	91	−0.25	−0.1	40–42				
Halliwell et al. (2019)	19	21	0.61	0.8	2, 43–45				
Huang et al. (2007)	174	175		0.01	36				
Junkin (2007)	30	21	0.41		11–15, 46–49	0.18	3		
Khalili et al. (2022)	31	31	0.89		50, 51				
Legrand & Crombez-Bequet_1 (2022)	11	11	0.63		52–55				
Legrand & Crombez-Bequet_2 (2022)	10	11	0.62		52–55				
Lindwall and Lindgren (2005)	54	56	0.18		11–15, 50				5
Lofrano-Prado et al. (2022)	20	20	−0.15		51, 56				
Martínez-Rodríguez et al. (2021)	17	17	−0.14		56				
McCabe et al. (2017)	168	163	0.14	0.14	57–60	0.08	3		
Mehnert et al. (2011)	28	30	−0.24		61			0.71	5
Mendonça_1 et al. (2011)	25	25	0.02		62, 63				
Mendonça_2 et al. (2011)	25	18	0.07		62, 63				
	25	21	0.08		62, 63				

(*Continued*)

Table 2. Continued.

			Body Image			Movement Behavior		Fitness	
			Weighted Cohen's *d*			Weighted Cohen's *d*		Weighted Cohen's *d*	
Study	*NC*	*NE*	T2	T3	Measures	T2	Measures	T2	Measures
Mendonça_3 et al. (2011)									
Sandel et al. (2005)	19	19	0.2	−0.04	64				
Scott_1 (2005)	35	60	0.18		50				
Scott_2 (2005)	35	58	0		50				
Sundgot-Borgen et al. (2020)	217	479				0	3		
Karaahmet et al. (2022)	69	71	−0.02		65				
Zabinski et al. (2001)	97	80	−0.14		36, 37				

Note. *NC* = Number of participants in the control condition; *NE* = number of participants in the experimental condition. Measures are described below.]

Body Image]
1. Functionality Appreciation Scale]
2. Body Appreciation Scale-2]
3. Body Compassion Scale]
4. Multidimensional Body-Self Relations Questionnaire – Appearance Evaluation Subscale]
5. Self-Objectification Beliefs and Behaviors Scale]
6. Physical Body Experiences Questionnaire]
7. Tennessee Self-Concept Scale – Physical Self-Concept Subscale]
8. Multidimensional Body-Self Relations Questionnaire – Body Areas Satisfaction Subscale]
9. Adult Body Satisfaction Questionnaire – Satisfaction with Physical Functioning Subscale]
10. Adult Body Satisfaction Questionnaire – Satisfaction with Physical Appearance Subscale]
11. Physical Self-Perception Profile – Sports Competence Subscale]
12. Physical Self-Perception Profile – Physical Condition Subscale]
13. Physical Self-Perception Profile – Body Attractiveness Subscale]
14. Physical Self-Perception Profile – Strength Subscale]
15. Physical Self-Perception Profile – Physical Self-Worth Subscale]
16. Body Image Questionnaire]
17. Body Dysmorphic Disorder Examination]
18. Body Attitudes Questionnaire – Attractiveness Subscale]
19. Body Attitudes Questionnaire – Disparagement Subscale]
20. Body Attitudes Questionnaire – Feeling Fat Subscale]
21. Body Attitudes Questionnaire – Salience Subscale]
22. Body Attitudes Questionnaire – Lower Body Fatness Subscale]
23. Body Attitudes Questionnaire – Strength and Fitness Subscale]
24. Children and Youth Physical Self-Perception Profile – Sports Competence Subscale]
25. Children and Youth Physical Self-Perception Profile – Physical Condition Subscale]
26. Children and Youth Physical Self-Perception Profile – Body Attractiveness Subscale]
27. Children and Youth Physical Self-Perception Profile – Strength Competence Subscale]
28. Children and Youth Physical Self-Perception Profile – Physical Self-Worth Subscale]
29. Contour Drawing Rating Scale]
30. Body Appreciation Scale]
31. Body Image Scale – Negative Body Appraisal]
32. Body Image Scale – Body Vitality]
33. Body Esteem Scale for Children]
34. Eating Disorder Examination Questionnaire – Shape Concern Subscale]
35. Eating Disorder Examination Questionnaire – Weight Concern Subscale]
36. Eating Disorders Inventory-2 – Body Dissatisfaction Subscale]
37. Eating Disorders Inventory-2 – Drive for Thinness Subscale]
38. Weight Concerns Scale]
39. Physical Self-Description Questionnaire]
40. Body Esteem Scale for Children – Appearance Subscale]
41. Objectified Body Consciousness Scale-Youth – Body Surveillance Subscale]
42. Body Appreciation Scale-2 for Children]
43. Experience of Embodiment Scale – Positive Connection with the Body Subscale]

(*Continued*)

Table 2. Continued.

Study	*NC*	*NE*	Body Image Weighted Cohen's *d* T2	Body Image Weighted Cohen's *d* T3	Body Image Measures	Movement Behavior Weighted Cohen's *d* T2	Movement Behavior Measures	Fitness Weighted Cohen's *d* T2	Fitness Measures
44. Multidimensional Body-Self Relations Questionnaire – Body Areas Satisfaction Subscale]									
45. Objectified Body Consciousness Scale – Body Surveillance Subscale]									
46. Body Esteem Scale – Sexual Attractiveness]									
47. Body Esteem Scale – Weight Control]									
48. Body Esteem Scale – Physical Condition]									
49. Body Image Visual Analog Scale]									
50. Social Physique Anxiety Scale]									
51. Eating Attitudes Test]									
52. Physical Self-Perception Profile, French version – Physical Self-Esteem Subscale]									
53. Physical Self-Perception Profile, French version – Physical Condition Subscale]									
54. Physical Self-Perception Profile, French version – Strength Subscale]									
55. Physical Self-Perception Profile, French version – Body Attractiveness Subscale]									
56. Body Shape Questionnaire]									
57. Body Esteem Scale]									
58. Muscle Esteem Scale]									
59. Body Change Inventory for Preadolescents]									
60. Sociocultural Influences on Body Image and Body Change Questionnaire]									
61. Body Image Questionnaire, German version]									
62. Satisfaction with physical appearance]									
63. Body Image Perception, Portuguese version]									
64. Body Image Scale]									
65. Body Exposure During Sexual Activity Questionnaire]									
Movement Behavior]									
1. Session attendance]									
2. Number of steps walked]									
3. Self-reported physical activity]									
Fitness]									
1. Functional capacity]									
2. Cardiorespiratory fitness]									
3. Muscular strength]									
4. Muscular endurance]									
5. Cycle ergometry test]									

Table 3. Overall Effect of Interventions on Target Outcomes.

Outcome	*N*	*k*	*d*+	95% Confidence Intervals	95% Prediction Intervals	I^2%
Post-Test						
Body Image	3,816	37	0.181**	+0.074, +0.288	−0.101, +0.463	18.7%
Movement Behavior	1,120	4	0.036	−0.088, + 0.161	−0.237, + 0.310	0.0%
Fitness	180	3	0.722**	+0.393, +1.051	−1.410, +2.854	0.0%
Follow-Up						
Body Image	1,216	8	0.017	−0.123, + 0.157	−0.158, + 0.192	0.0%

Note. *N* = total sample size associated with said outcome; *k* = number of effect sizes; *d*+ = sample-weighted average effect size; I^2 = heterogeneity statistic.
**$p < 0.001$.

risk (41.9%), and 12 studies were rated high risk (38.7%). Scores of medium or high risk of bias most frequently occurred due to unclear randomization processes, lack of participant and researcher concealment related to allocation and assessment of outcome measures, inappropriate analyses or missing information regarding pre-specified analyses, and high attrition rates (Figure 2).

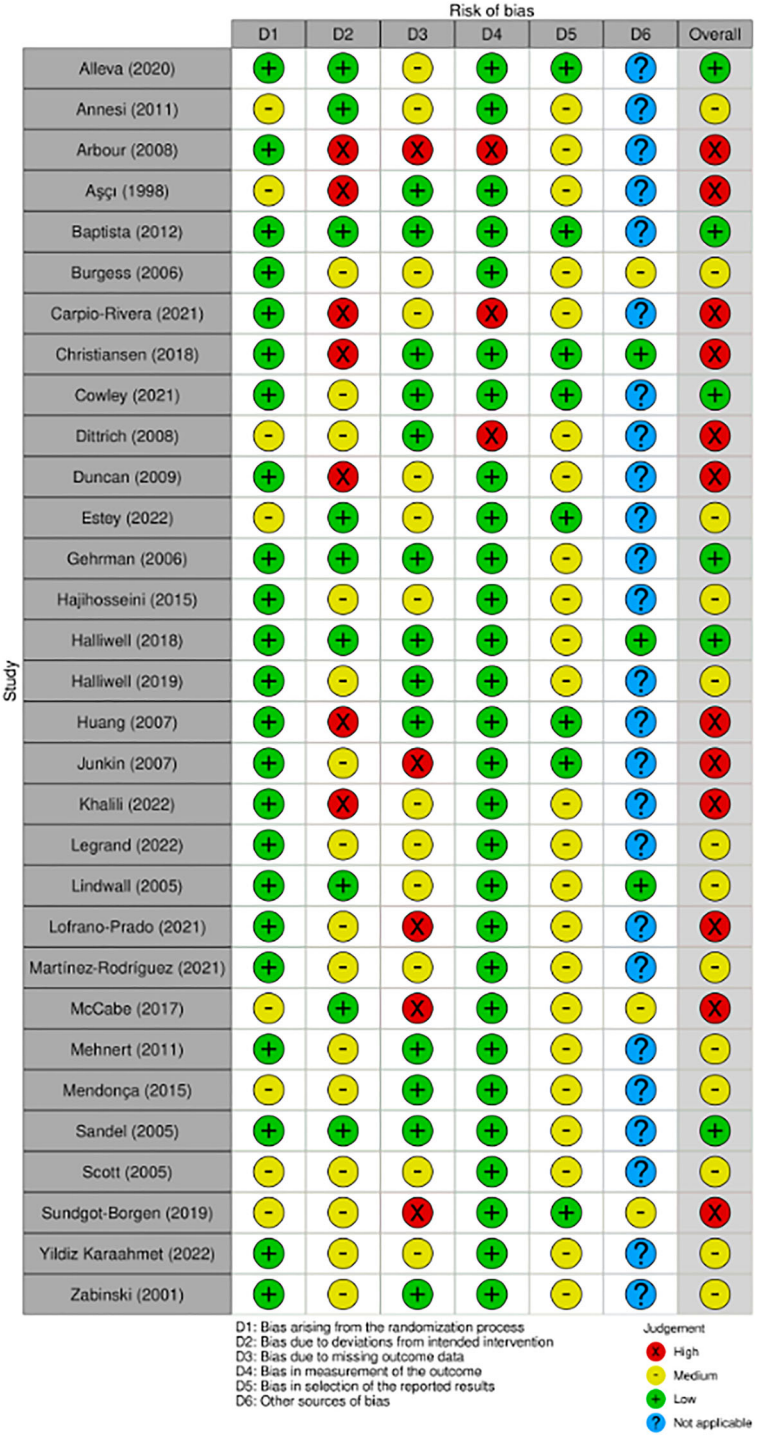

Figure 2. Cochrane Risk of Bias Assessment for the Included Studies.

Note. Domain 6 ('Other sources of bias') refers to risk of bias arising from the timing of identification or recruitment of participants in cluster-randomized trials and the risk of bias arising from period and carryover effects in crossover trials.

Risk of Bias across studies

For all outcomes, at post-test and follow-up, funnel plots were symmetrical, and all Egger's regressions were non-significant with the only exception of body image at post-test, for which Egger's regression was barely significant ($p = 0.021$) (see Table 4; Figure 3; Appendix A, Figures S1–S3), indicating overall low risk of publication bias in the distribution of effect sizes. For this reason, and in line with the meta-analytic strategy previously outlined, we did not proceed with Winsorization and the Trim and Fill procedure.

Subgroup analyses for body image at post-test

Intervention variables

Theoretical framework. The sub-group analysis found a non-significant overall effect size for studies testing theory-based interventions. However, we found a significant overall effect for studies testing atheoretical interventions (Table 5; Appendix B, Figure S4).

Intervention modality. The sub-group analysis found a significant overall effect size for studies implementing unimodal interventions. This was not observed for studies testing multimodal interventions (Table 5; Appendix B, Figure S5).

Intervention length. The meta-regression found that the length of interventions had a non-significant effect on effect sizes associated with body image at post-test ($\beta = -0.003$, $p = 0.297$) (Appendix B, Figure S6).

Methodology variables

Targeted age. Moderating effects were not observed for three age groups: childhood, adolescence, and early adulthood. There was, however, a significant overall intervention effect for interventions targeting mid-to-late adulthood (Table 5; Appendix B, Figure S7). Only one study in this age group was associated with a significant Cohen's *d* and was deemed as high risk of bias (Khalili et al., 2022).

Sample size. There was a significant overall effect size for studies with ≤35 participants. This was not observed for studies with >35 participants per arm (Table 5; Appendix B, Figure S8).

Table 4. Egger's Regressions for Overall Intervention Effects.

Standard Error of Effect Size	β	*t*	*p*	95% Confidence Intervals
Post-Test				
Body Image	0.657	2.501	0.021	+0.124, +1.190
Movement Behavior	0.435	0.470	0.684	−3.544, + 4.414
Fitness	−1.245	−0.654	0.631	−25.448, + 22.957
Follow-Up				
Body Image	0.919	1.191	0.279	−0.969, + 2.808

Note. β = beta from Egger's regression; *t* = *t*-statistic from Egger's regression.

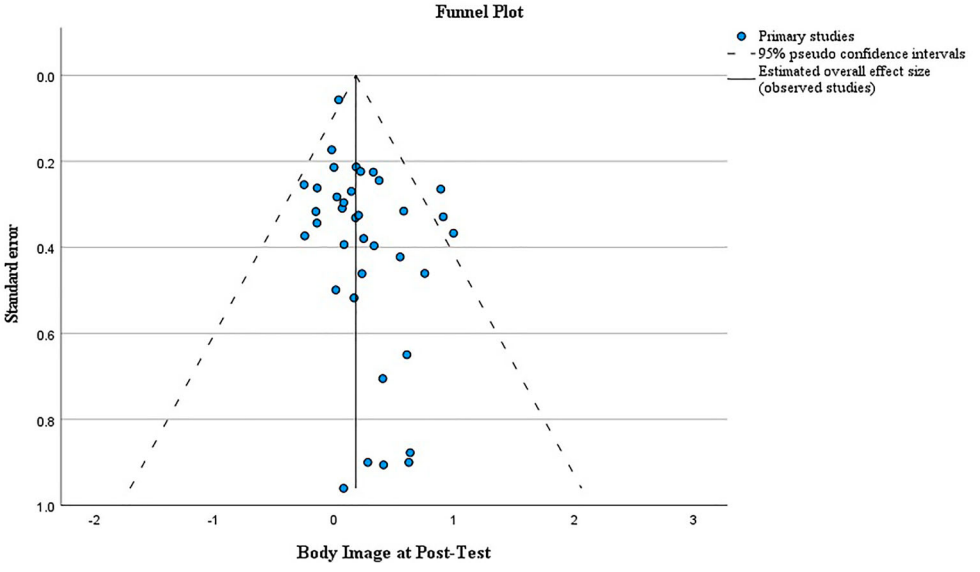

Figure 3. Funnel Plot for the Overall Effect of the Interventions on Body Image at Post-Test.

Type of control condition. There was a significant overall effect size for studies utilizing an active control condition as well as a waitlist control. This effect was non-significant for studies utilizing an assessment only control condition (Table 5; Appendix B, Figure S9).

Table 5. Subgroup Analysis of Body Image at Post-Test.

Moderator	*N*	*k*		95% CIs	95% PIs	I^2%
Program Components						
Unimodal	1,364	25	.242**	+0.075, +0.408	−0.220, +0.704	26.3%
Multimodal	2,452	12	.089	−0.017, + 0.194	−0.058, + 0.236	2.8%
Theoretical Basis						
Theoretical	2,853	17	0.067	−0.024, + 0.158	−0.031, + 0.165	0.0%
Atheoretical	963	19	0.287**	+0.105, +0.468	−0.205, +0.779	31.0%
Sample Size						
Group Size ≤35	960	25	0.315**	+0.135, +0.494	−0.139, +0.768	22.1%
Group Size >35	2,856	12	0.062	−0.026, + 0.149	−0.038, + 0.161	0.0%
Type of Control Condition						
Active Control	938	15	0.246*	+0.014, +0.478	−0.381, +0.873	35.3%
Waitlist Control	820	7	0.235*	+0.022, +0.447	−0.045, +0.514	0.0%
Assessment Only	2,058	15	0.181	−0.019 + 0.243	−0.121, + 0.345	10.9%
Risk of Bias						
Low Risk of Bias	513	6	0.183	−0.098, + 0.463	−0.396, + 0.761	18.7%
Medium Risk of Bias	1,314	17	0.118	−0.019, + 0.256	−0.031, + 0.268	0.0%
High Risk of Bias	1,989	14	0.322**	+0.087, +0.558	−0.288, +0.933	42.1%
Targeted Age						
Childhood	604	4	0.202	−0.330, + 0.734	−1.965, + 2.369	63.0%
Adolescence	1,518	6	0.251	−0.083, + 0.585	−0.671, + 1.172	54.3%
Early Adulthood	1,053	16	0.122	−0.036, + 0.28	−0.051, + 0.296	0.0%
Mid-Late Adulthood	641	11	0.254*	+0.047, +0.461	−0.170, +0.678	20.0%

Note. *N* = total sample size associated with said outcome; *k* = number of effect sizes; *d*+ = sample-weighted average effect size; 95% CIs = 95% confidence intervals; 95% PIs = 95% prediction intervals; I^2 = heterogeneity statistic.
**$p < 0.01$.
*$p < 0.05$.

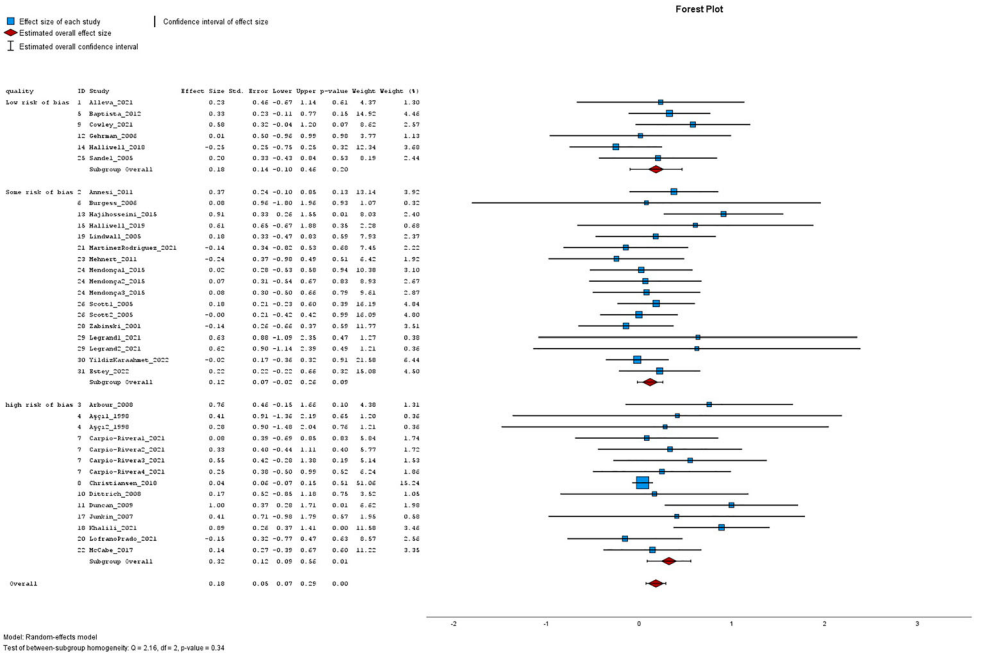

Figure 4. Forest Plot for Moderation by Risk of Bias (Low vs. Medium vs. High Risk) on Body Image at Post-Test.

Risk of Bias. There was a significant overall effect size for studies deemed high risk. This effect was non-significant for studies deemed low risk or medium risk (Table 5; Figure 4).

Discussion

This systematic review and meta-analysis examined interventions that target the intersection of body image and movement experiences among girls and women. Overall, a majority of interventions were movement-based that targeted a body image outcome with ($k = 9$) or without ($k = 20$) a movement outcome. This pattern confirms previous commentary, which notes the favoring of research into the causal relationship of movement participation on body image, with less consideration given to the bidirectional or reciprocal relationship between these two variables (Kerner et al., 2022; Sabiston et al., 2019).

With respect to improvements in body image, the overall effect size at post-test was small and did not extend to follow-up. These effects both mirror and build upon previous meta-analyses (Campbell & Hausenblas, 2009; Hausenblas & Fallon, 2006; Reel et al., 2007), which found small to moderate improvements in body image at post-test following participation in exercise-based interventions. These reviews, however, did not report on follow-up data and therefore this meta-analysis provides initial insights into the longitudinal effects of this intervention approach. Regarding improvements in movement-related outcomes, the overall effect size for movement behavior at post-test was non-significant, and while the overall effect size for fitness at post-test was significant, it did not extend to follow-up. These findings somewhat mirror the small number of meta-analyses conducted on movement-based interventions targeting movement-related outcomes among girls

(Biddle et al., 2014; Owen et al., 2017; Pearson et al., 2015) and women (Reed et al., 2017), which report modest effects associated with this intervention approach, and heeded the need for greater quality research.

With respect to moderators, intervention effects were largest for studies with unimodal and atheoretical interventions, participants in mid-to-late adulthood, small sample sizes, active and waitlist controls, and those deemed high risk. Effects pertaining to sample size and control condition mirrored the findings of Alleva and colleagues (2015), while effects pertaining to risk of bias both mirrored (Alleva et al., 2015; Pearson et al., 2015) and contradicted (Biddle et al., 2014; Owen et al., 2017) previous reviews. Lastly, the current moderating effects of intervention modality and theoretical approach were contradictory to a majority of research, which supports the use of theoretically informed multimodal or multicomponent interventions, particularly when targeting multifaceted variables such as body image and movement (Alleva et al., 2015; Biddle et al., 2014; Owen et al., 2017; Pearson et al., 2015). Explanations for these discrepancies are considered in the proceeding sections.

Overall, this paper largely mirrors previous findings on related topics, as well as builds on them by synthesizing the research on body image and movement interventions from a bidirectional perspective. In doing so, this review provides the first inferential conclusions about the immediate and longer-term effectiveness of such interventions across the developmental lifespan. That is, a majority of studies targeting the intersection of girls' and women's body image and movement experiences used movement-based approaches, which had a modest and unsustained impact on body image and fitness, and no significant impact on behavioral movement outcomes.

Movement-based interventions and body image

It is evident that research favors the use of movement-based approaches; however, several intervention and methodological features require consideration and improvement, before additional approaches are developed and/or selected, and subsequently disseminated and implemented within communities. First, a majority of these interventions were not underpinned by a theoretical framework ($k = 16$ of 29), and even when a theoretical approach was specified (e.g. Affective-Reflective Theory; Exercise and Self-Esteem Model), very few authors identified the mechanisms through which changes in body image and/or movement would occur. While previous reviews indicate that theoretical frameworks increase intervention effectiveness (Alleva et al., 2015; Owen et al., 2017; Pearson et al., 2015), some suggest the link between these two variables is weak and requires further consideration (Biddle et al., 2014; Mears & Jago, 2016; Owen et al., 2017). For instance, Owen and colleagues (2017) suggest that theoretical fidelity is more crucial to intervention effectiveness and is infrequently reported. That is, it is one thing to state which theoretical framework informed the development and/or selection of an approach, it is another, however, to illustrate how the intervention theoretically leads to change.

Second, most studies conceptualized body image as appearance and/or body satisfaction, with few studies assessing positive body image components. In recent years, the body image field has discouraged the use of body satisfaction as the sole and/or primary outcome for body image, as improvements in this construct do not necessarily

reflect an adaptive and/or positive relationship with one's body (Andersen & Swami, 2021; Tylka & Wood-Barcalow, 2015). For instance, research suggests that the impact of movement on body satisfaction is mediated by perceived and/or objective changes in participants' appearance, with these changes typically in accordance with societal beauty standards and ideals (e.g. weight loss, increased muscle tone; Ginis et al., 2012). This is problematic for two reasons. First, an individual's satisfaction with their body is dependent on engaging in a movement regime that maintains an appearance ideal congruent with societal pressures and ideals. Second, exercising primarily for appearance-related reasons increases a person's risk of experiencing low self-esteem, mood, and eating disorders, whereas those motivated by enjoyment and health are at less risk of adverse mental and physical health outcomes (DiBartolo et al., 2007; Gonçalves & Gomes, 2012; Homan & Tylka, 2014; Hurst et al., 2017; Mond et al., 2006; Tylka & Wood-Barcalow, 2015).

Third, contrary to a majority of research, the unimodal movement-based interventions in this review produced larger effects than multimodal approaches. This discrepancy may be due to sample characteristics, with nearly half of the current unimodal interventions applied to selected or at-risk samples ($k = 7$ of 17), relative to the universal samples observed in the multimodal category. That is, intervention effects tend to be larger among selected or at-risk samples due to greater room for outcome improvement, relative to universal samples where effects tend to be smaller due to floor effects (Kusina & Exline, 2019). Relatedly, additional research is needed on the impact of theoretically informed multimodal or multicomponent interventions that do not center around movement, and how these approaches may appeal to selected or at-risk samples (e.g. those who are inactive and in the pre-contemplative motivation phase and/or those who experience body image concerns as a significant barrier to being active). Further, most of the reviewed studies examined behavioral elements of movement (e.g. session attendance). More research is required on how enhancing body image may impact other movement-related constructs, including psychological (e.g. self-efficacy) and fitness (e.g. VO_2 max capacity) outcomes.

Given the overall modest and unsustained effects of movement-based interventions on body image and fitness outcomes, and the null effects on behavioral movement outcomes, it is plausible to assume that once an intervention was completed, participants did not maintain their participation and/or apply their learnings to other movement types. When developing and/or selecting an approach, authors are urged to use theoretical frameworks to inform and describe how a particular intervention will lead to adaptive and sustainable change in participants' body image and movement, including whether this is a behavioral, affective, or cognitive change. For instance, if authors adopt the Exercise and Self-Esteem Model (Sonstroem & Morgan, 1989), they need to explain what intervention content and/or techniques are selected on the basis of this model, and how engaging with this said content and techniques will lead to outcome change. Further, researchers are encouraged to move away from the narrow and unidirectional perspective of examining the effects of movement on body satisfaction and consider what type of activities foster a bidirectional relationship between movement and body image, with both variables conceptualized in line with recent theoretical developments. Examples of how this can be done from the reviewed studies include Alleva and colleagues (2020), Cowley and colleagues (2021), and Halliwell and colleagues (2018, 2019).

Additional limitations of included studies

There are several remaining limitations within and across the current studies that require consideration in future research. First, most studies were conducted with heterogeneous samples consisting of participants from Western, Educated, Industrialized, Rich, and Democratic (WEIRD) countries (e.g. Australia, Canada, Netherlands). Research into the intersection of body image and movement is largely non-existent among low- and middle-income countries and requires exploration (Tinoco et al., 2023). Second, studies did not always define or justify the selection of a particular control condition (e.g. comparing a movement-based intervention to a movement-based control condition [i.e. swimming]). This relates to the broader issue of conceptualizing an intervention, and identifying which components (e.g. content, techniques, and activities) are expected to elicit outcome change, and how these will be tested against an appropriate control. Third, the follow-up period varied greatly between studies, with some studies omitting follow-up altogether. Further, although all studies included pre- and post-test assessments, many did not specify the time frame between these assessments nor their proximity to the beginning and ending of intervention delivery. Fourth, a majority of studies were rated as medium or high risk of bias, with only six papers deemed as low risk. Given that accessible and cost-effective methods for conducting best practice are readily available to authors, including trial registration protocols and reporting guidelines, these should be incorporated into standard research practice (e.g. the CONSORT Statement; Schulz et al., 2010). Relatedly, standardization and transparency in reporting would have reduced the number of excluded studies due to missing data (e.g. separate reporting for gender).

Limitations of the current review

Similar to the included studies, this review is not without limitations. Although search terms were determined by: 1) the expertise of the core research team; 2) primary consultation of the literature; 3) input from information specialists; and 4) the Cochrane Handbook for Systematic Reviews of Interventions guidelines, we acknowledge that our search terms did not include an exhaustive list of movement types, including more modern approaches (e.g. CrossFit, exergames, Pilates). However, given that studies evaluating these approaches were captured in the initial search and subsequently screened out for ineligibility (e.g. did not contain a body image measure, non-randomized controlled trial), we are confident that the search strategy was comprehensive, while being pragmatic about the search functions and capabilities of different databases.

Also, whilst this review asserts that positive and negative body image are separate constructs, and therefore should be analyzed as such, this was not feasible due to the methodological decisions and trends within and across the included studies. Specifically, most studies opted to assess appearance or body (dis)satisfaction components of body image, with only a handful of studies assessing positive body image constructs (i.e. body appreciation, positive body connection, functionality satisfaction; Alleva et al., 2020; Cowley et al., 2021; Halliwell et al., 2018, 2019). Given the small number of studies and outcomes, a meta-analysis on positive body image components was not feasible. Therefore, in the

interest of providing inferential conclusions about the included interventions, we combined all components of body image and reversed scales that measured outcome deterioration (e.g. appearance dissatisfaction). While we acknowledge that this is not ideal, alternative methods, such as conducting separate analyses or removing studies from analyses would have misrepresented the literature.

Conclusions

Due to the disproportionate number of girls and women who disengage and drop out from movement-based activities due to body image concerns, the interest in the intersection of these two constructs is growing exponentially. Overall, the current interventions were effective at eliciting small, but unsustained improvements in girls' and women's body image and fitness outcomes, and ineffective at improving behavioral movement outcomes. To create effective interventions, collective change needs to occur within and across the body image and movement research fields. Researchers are urged to approach body image from a modern, holistic, and multifaceted perspective, which moves beyond satisfaction with one's physical appearance. Further, researchers are encouraged to adopt, or at least consider, the bidirectional perspective between body image and movement when developing and/or selecting approaches and the targeted outcomes. Lastly, researchers are expected to use theoretical frameworks to inform and describe how an approach will lead to sustainable changes in girls' and women's body image and movement experiences. Collectively, these efforts should lead to higher quality research and more impactful interventions, which ultimately seek to increase the number of girls and women who have positive and sustainable relationships with their bodies and movement.

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* *Indicates studies included in the meta-analysis.*

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Appendices

Appendix A. Overall effects

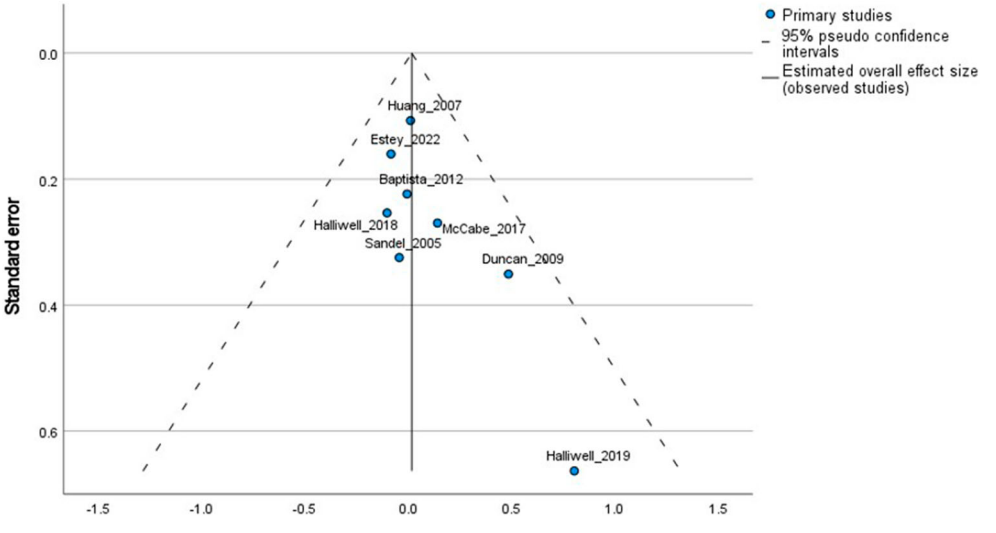

Figure S1. Funnel Plot for the Overall Effect of the Interventions on Body Image at Follow-Up.

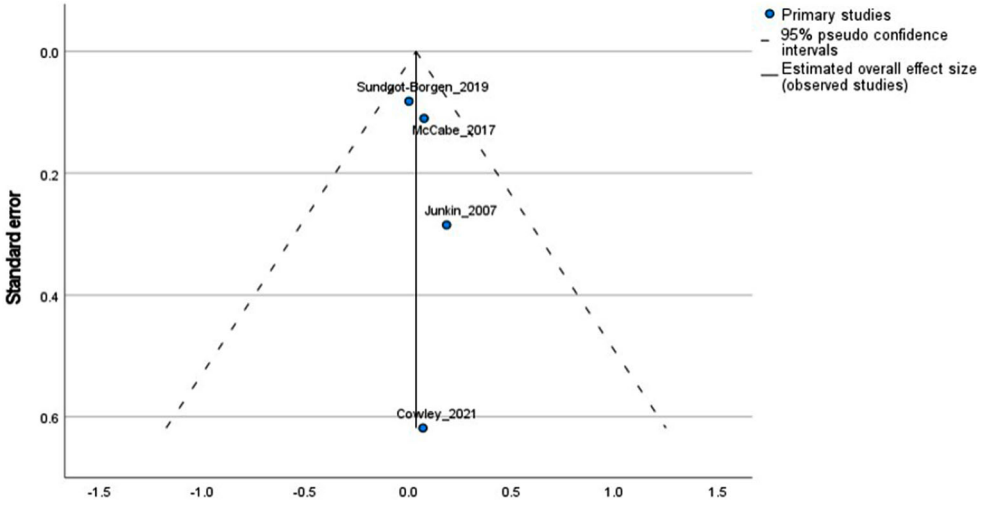

Figure S2. Funnel Plot for the Overall Effect of the Interventions on Movement Behavior at Post-Test

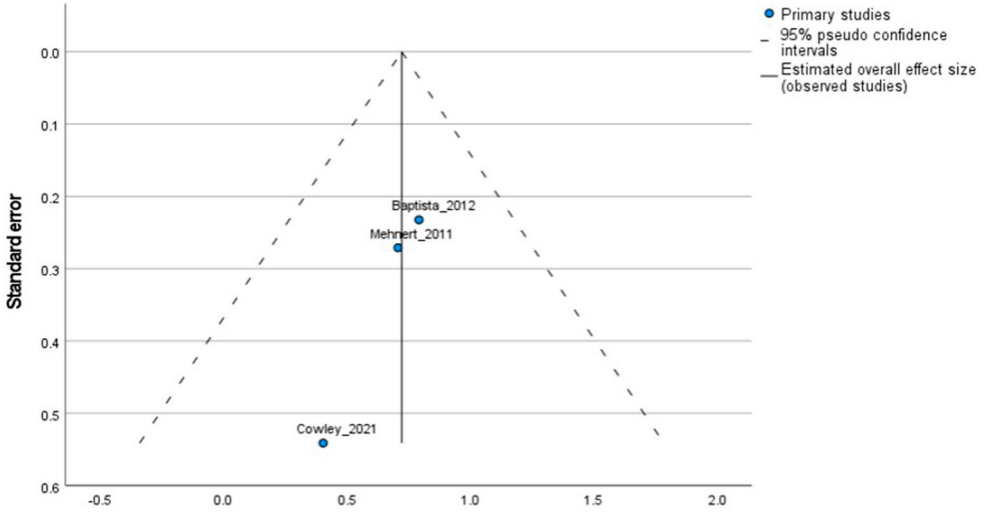

Figure S3. Funnel Plot for the Overall Effect of the Interventions on Fitness at Post-Test

Appendix B. Subgroup analyses on body image at post-test

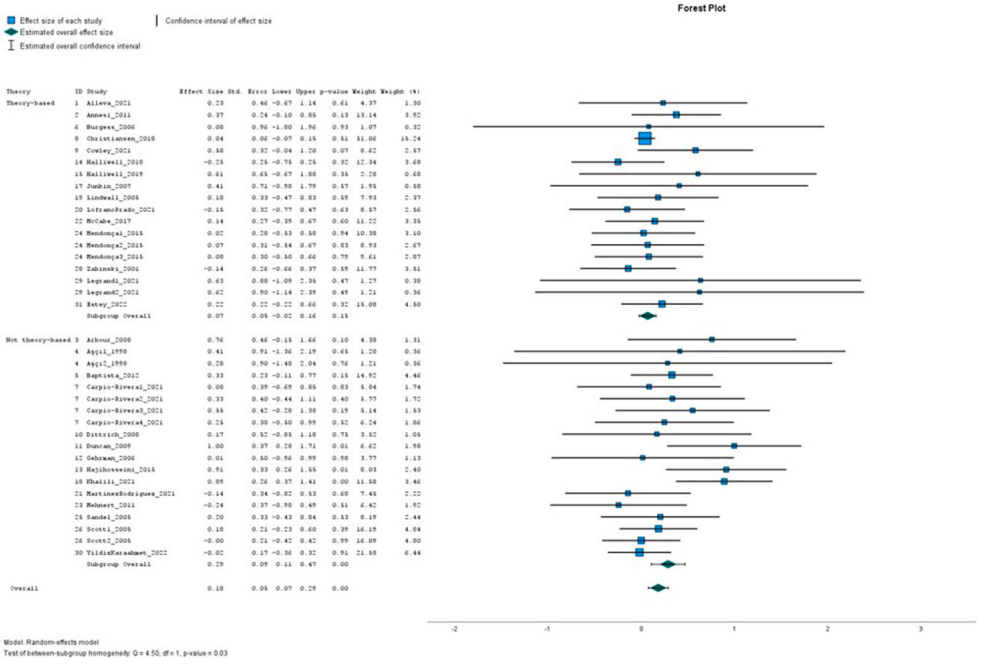

Figure S4. Forest Plot for Moderation by Theoretical Basis (Theory-Based Interventions vs. Atheoretical Interventions) on Body Image at Post-Test

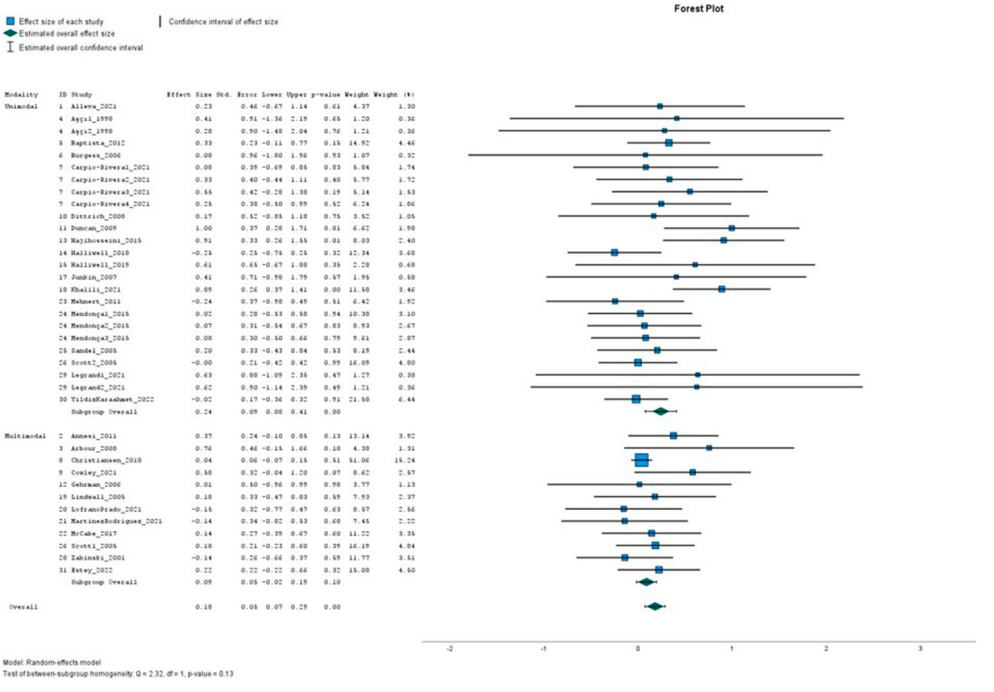

Figure S5. Forest Plot for Moderation by Intervention Modality (Unimodal vs. Multimodal Interventions) on Body Image at Post-Test

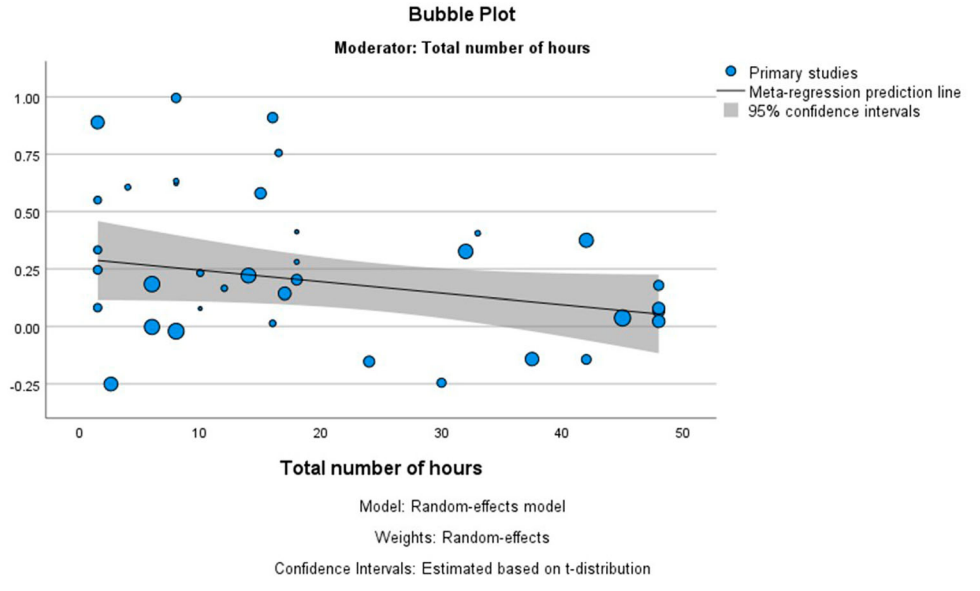

Figure S6. Bubble Plot for Moderation by Intervention Length (Total Number of Hours) on Body Image at Post-Test

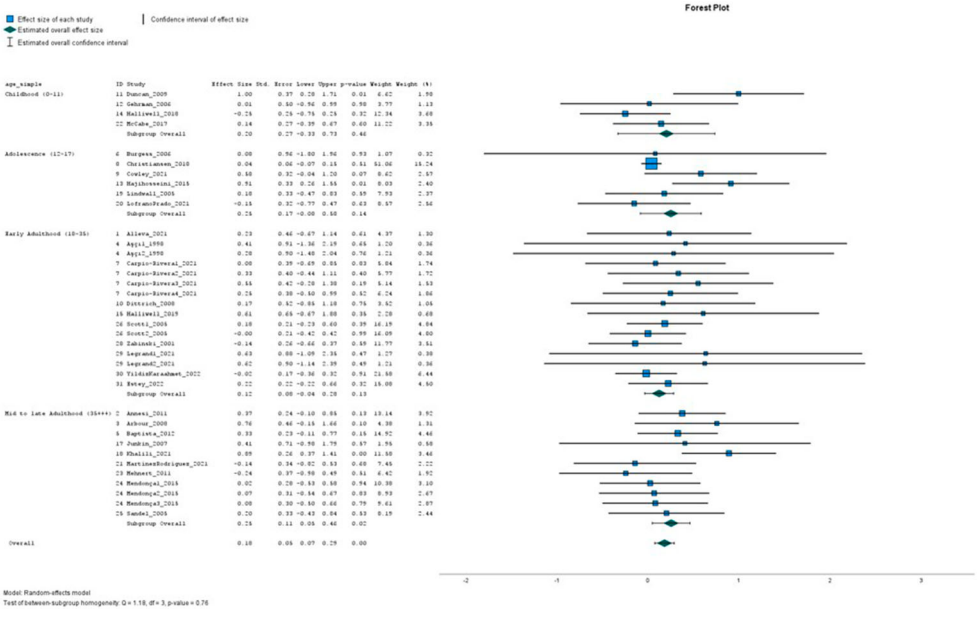

Figure S7. Forest Plot for Moderation by Targeted Participant Age (Childhood vs. Adolescence vs. Early Adulthood vs. Mid-to-Late Adulthood) on Body Image at Post-Test

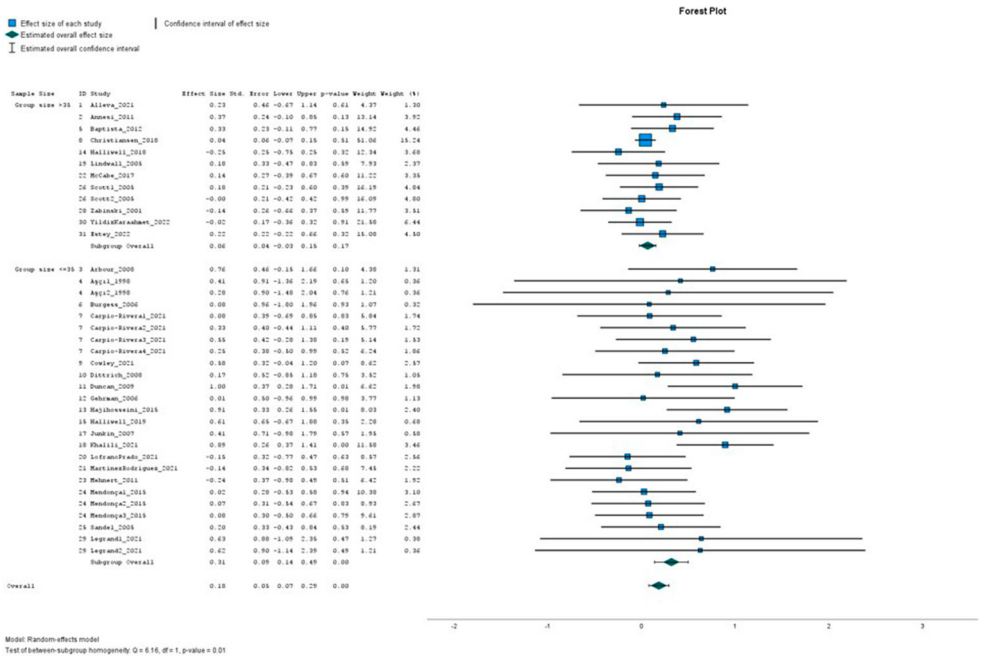

Figure S8. Forest Plot for Moderation by Sample Size (≤35 Participants vs. > 35 Participants per Intervention Arm) on Body Image at Post-Test

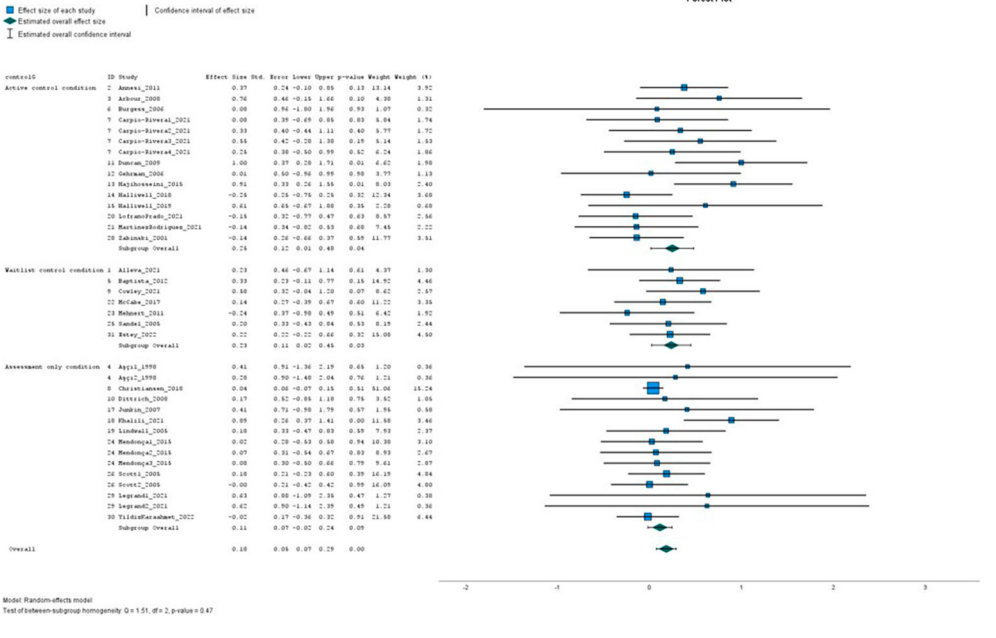

Figure S9. Forest Plot for Moderation by Type of Control Condition (Active vs. Waitlist vs. Assessment-Only) on Body Image at Post-Test