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The Effect of Exercise on Global Self-Esteem: A Quantitative Review

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The purpose of this study was to quantitatively review the body of research on exercise and global self-esteem (GSE). This review focuses specifically on studies using adults and also incorporates both published and unpublished works. Computer and manual searches identified 113 studies matching the selection criteria. Each study was coded according to 20 study features. A total of 128 effect sizes (*d*) were derived. As indicated by effect-size magnitude, participation in exercise brought about a small change in GSE ($d = +0.23$). Change in physical fitness and type of program were significant moderators of the effect of exercise on GSE. Larger effect sizes were observed for those who experienced significant changes in physical fitness and those participating in exercise or lifestyle programs as opposed to skills training.

Key Words: meta-analysis, self-concept, physical activity

The self is one of the most widely utilized psychological constructs in contemporary society (Harter, 1999; Hattie, 1992). In Western culture, the academic literature and popular press presuppose that everyone not only has a sense of self but that the self we have is a social phenomenon (Cooley, 1902; James, 1890/1950; Mead, 1934). Stated differently, who we are is thought to be reciprocally influenced by our relationships with others, providing the key to understanding how and why we think, feel, and behave as we do, as well as the impetus for enriching our lives and relationships.

Researchers interested in exercise and physical activity have also recognized the importance of self-related phenomena. This is because exercise participation is linked to mental and psychological benefits (Gauvin, Spence, & Anderson, 1999; Landers & Arent, 2001). Involvement in regular exercise and physical activity programs that improve skill, knowledge, fitness, and health are linked to enhanced self-perceptions (Fox, 1997). These changes may then generalize to more favorable views about the self, leading to an improved sense of well-being (Berger & McInman, 1993; Morgan, 1985).

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If people experience a more favorable view of themselves as a result of participating in physical activity, they should be more likely to continue participating (Sonstroem, 1997b, 1998). Studying and understanding this connection is important because despite the well-documented physical, psychological, and social benefits of regular physical activity (Bouchard, Shephard, & Stephens, 1994; Gauvin et al., 1999), physical inactivity remains pervasive. It is estimated that upward of two-thirds of the industrialized world does not achieve minimum physical activity guidelines (Oja, 1995; U.S. Department of Health and Human Services, 1996). Physical inactivity thus constitutes a major public health concern (U.S. Dept. HHS, 1996), along with related social and economic costs (Colditz, 1999; Katzmarzyk, Gledhill, & Shephard, 2000).

These notions have made the self and self-related phenomena an important topic of study in exercise psychology. In particular, self-esteem has been proposed as the variable with the highest payoff for reflecting psychological benefits obtained from participation in regular exercise (Folkins & Sime, 1981; Hughes, 1984). In turn, self-esteem has been implicated as a central aspect of psychological health and well-being (e.g., Greenberg, Solomon, Pyszczynski, et al., 1992; DiLorenzo, Bargman, Stucky-Ropp, et al., 1999; Rosenberg, 1965) and, as mentioned, is a possible key in helping to solve the problem of lack of exercise participation. Thus an abundance of literature has attempted to establish a link between physical activity participation and self-esteem.

Literature reviews (e.g., Gruber, 1986; Sonstroem, 1984) have noted that approximately 60% of studies reviewed report a positive association between physical activity participation and high self-esteem. This has led to the widespread assumption that enhanced overall or global self-esteem is an automatic outcome of participation in physical activity. However, recent studies (Calfas & Taylor, 1994; McAuley, Mihalko, & Bane, 1997; McAuley, Blissmer, Katula, Duncan, & Mihalko, 2000) have questioned the magnitude of change that may be expected for global self-esteem as a result of participating in physical activity.

Additionally, so far only one meta-analysis examining the effect of exercise on self-concept[1] has included adults (McDonald & Hodgdon, 1991), and its results have several limitations. First, this study explored only aerobic forms of exercise (e.g., jogging, dancing) and their link to self-concept. Given the rising popularity of other forms of exercise (e.g., weight training, flexibility training, leisure activities) and the differential value these might have in different segments of the population (e.g., the elderly might value leisure forms of activity as opposed to jogging; Martin & Sinden, 2001), exploring self-esteem and its relationship to other forms of exercise would also be advantageous. In fact, other meta-analyses found that weight training was more effective than aerobic exercise for enhancing mood (Arent, Landers, & Etnier, 2000; North, McCullagh, & Tran, 1990).

Second, McDonald and Hodgdon only included *published* studies on self-concept and exercise, which is somewhat problematic if we consider the tendency for journals to publish findings that are statistically significant as opposed to non-significant (Spence & Blanchard, 2001). Thus, those researchers who do not find significant statistical evidence where self-esteem and exercise are concerned could be influenced to not submit their findings, or to be rejected when they do submit them. Thus it is possible that the published literature overstates the significance of findings where self-concept or self-esteem and exercise are concerned.

Finally, McDonald and Hodgdon combined different aspects of "self" such as global self-esteem, physical self-concept, and body cathexis. They justified this procedure by claiming that the constructs were highly correlated. However, since clear theoretical distinctions have been made between these constructs, particularly in how they relate to physical activity (Fox & Corbin, 1989; Sonstroem & Morgan, 1989), it is important to summarize them independently. Moreover, Harter (1999) recently noted that aggregating specific self-evaluations into a single global score masks the meaningful distinctions between one's sense of adequacy across varying domains.

The division of self-esteem into subdomains has been the basis of Sonstroem and Morgan's (1989) multidimensional Exercise and Self-Esteem Model (EXSEM). This model has been advocated as an important theoretical guide to employ for study and further advancement in understanding exercise and self-esteem (see Fox, 1997, 2000; Marsh, 1997; McAuley et al., 2000). Moreover, it has been noted that employing the EXSEM to study self-esteem in the physical activity domain will provide researchers with examinations of processes and pathways (i.e., mechanisms) that relate to changes in self-esteem (Sonstroem & Morgan, 1989).

The EXSEM is based on a multifaceted hierarchical model of self-esteem (see Shavelson, Hubner, & Stanton, 1976). In brief, the model is hierarchically arranged according to increasing situational specificity, with global self-esteem (GSE) residing at the top, physical self-competence and physical acceptance in the middle, and physical self-efficacy at the lower level. Constructs at the base/lower level feed into and affect the global elements, but are more closely related to the situation/context at hand. Sonstroem and Morgan (1989) have only included those elements in the model that have been shown in previous research to be typically associated with exercise behavior. This is a competence-based model in which changes in physical fitness are proposed to lead to enhanced self-efficacy, which in turn bolsters physical competence that then results in an increased perception of global self-esteem.

Hypothesized Moderators of Effect of Exercise on Self-Esteem

Because few studies have used the EXSEM in experimental designs (see Alfermann & Stoll, 2000; Caruso & Gill, 1992; Glassford, 1993; McAuley et al., 2000), the model cannot be tested in this meta-analysis. However, the EXSEM can still be used to help generate hypotheses about how exercise affects GSE and which factors may influence or moderate that relationship. Based on the original hypotheses proposed for the model (Sonstroem & Morgan, 1989) and other writings of Sonstroem (1984, 1997a, 1998), we have identified the following variables as potential moderators of the effect of exercise on GSE.

First, changes in physical fitness[2] are thought to be the mechanism through which exercise could affect self-efficacy and subsequently GSE. Thus, *exercise participants who experience changes in physical fitness should experience larger changes in GSE as opposed to those who do not experience such changes.*

Second, if physical fitness change is a potential moderator of the exercise/GSE relationship, then initial physical fitness level should also be considered a potential moderator, since *less physically fit individuals should experience more of a change in GSE as a result of exercising compared to more physically fit individuals.*

Third, similar to the case for initial physical fitness level, initial self-esteem level should also serve as a moderator of exercise on GSE. Thus, *participants with initially lower GSE scores should experience the most change in self-esteem as a result of exercise and changes in fitness*.

Finally, since training volume and dose are related to changes in physical fitness (McArdle, Katch, & Katch, 1986), aspects of the exercise program such as frequency, duration, intensity, and length of the program should be related to changes in GSE. Specifically, *programs that take place over a longer period, with exercise bouts of higher frequency, intensity, and duration, should lead to larger changes in GSE vs. programs of shorter length with lower doses of exercise*.

Despite the vast number of studies exploring the GSE and exercise relationship, it should be clear that while the potential benefit of physical activity on GSE has long been espoused in the sport and exercise literature (Folkins & Sime, 1981; Hughes, 1984), the foregoing studies and their limitations have put into question the exact magnitude of change in GSE that results from participation in physical activity. Therefore, the primary purpose of this paper was to take the limitations of previous research into consideration and present the findings of a more comprehensive meta-analysis in order to explore the effect of exercise on GSE. To accomplish this purpose, the current meta-analysis included published and unpublished studies (e.g., dissertations, theses) and also explored the effects of other forms of exercise (e.g., weight training) in addition to aerobic exercise on GSE.

Method

Literature Search and Study Selection

Search Strategy. We conducted computer-based information searches in *Current Contents* (July 1993–Sept. 2001), *Dissertation Abstracts* (1865–Dec. 2003), *Medline* (1966–Dec. 2003), *PsycINFO* (1960–Dec. 2003), and *Sport Discus* (1975–Dec. 2003). Also, manual searches were done through *Current Contents* (1987–June 1993), *Physical Education Index* (1983–1993), and *Completed Research in Health, Physical Education, and Recreation* (1968–1995). Reference lists of all major reviews and primary studies were checked for unidentified references. To find relevant studies on exercise and GSE, the keywords used in the searches included, but were not limited to, terms such as: exercise, physical activity, self-esteem, self-concept, and self-perception. The search was limited by language in that only studies published in English were included. In an attempt to obtain unpublished material, we emailed researchers with recent publications on the topic and asked if they would share any unpublished manuscripts or data in their possession. The final cutoff date for articles to be included in this review was December 2003.

Inclusion/Exclusion Criteria. The criteria for including studies in the final sample were as follows: (a) Information had to be reported in a study format, either published or unpublished, as opposed to a case study or editorial; (b) the dependent variable had to be a global measure of self-concept, self-esteem, or self-perception; (c) the independent variable had to include exercise/physical activity as an intervention; (d) because of the large number of studies found in our initial search on the topic, we decided to limit our focus to adults and thus required that study participants be at least 18 years of age or that the mean age of the sample likewise be 18 years or older; (e) studies had to include a nonexercising control group or a control group that was maintaining its usual level of physical activity; (f) the training program had to last more than 1 week; and (g) outcomes of the intervention had to be quantified and sample size be provided.

Included Studies. The original search resulted in 426 potential studies. Based on our inclusion criteria, 113 studies (42 published, 71 unpublished) revealing 128 effect sizes were included in the analysis.[3] In total, 7724 participants were included in these studies.

Coding of Studies

Once studies were identified for inclusion, they were collected, coded for moderator effects, and an estimate of treatment effect was calculated.

Hypothesized Moderator Variables. Based on the original hypotheses proposed for the EXSEM (Sonstroem & Morgan, 1989) and other writings of Sonstroem (1984, 1997a, 1998), we hypothesized that changes in physical fitness, initial self-esteem level, initial physical fitness level, and dose of exercise (frequency, duration, intensity, and length of program) would explain any variation in the effect of exercise on GSE.

Additional Moderator Variables. Further, for each study we recorded the characteristics of the sample (age, sex, population, health status), methodology (self-term, questionnaire, participant assignment, control condition), and treatment (type of intervention, mode of exercise, type of physical fitness measure). In order to address concerns about publication bias, we also coded the studies for publication status, i.e., published vs. unpublished. Finally, based on a subjective assessment of internal validity, we rated each study on a scale from 1 (poor) to 3 (good) for methodological quality.

The factors considered for this rating were assignment of participants to conditions, dropout rate, dose of exercise, and assessment of physical fitness. This rating was applied in a hierachical fashion. First we assessed the method of assignment of participants to conditions and the dropout rate. If participants were not randomly assigned to conditions and/or the dropout rate was greater than 50%, the study was rated as poor. Second, if these conditions were met and a specific dose of exercise was required and/or the physical fitness of participants was measured before and after the intervention, the study was rated as good. Otherwise the study was rated as being only fair. For example, studies were rated as good if random assignment was used to allocate participants to groups, the dropout rate was less than 50%, and assessments of physical fitness were conducted before and after the intervention. Publication status and study quality were included as methodology moderators. Coding was undertaken independently by two coders. Their initial agreement rate was 84%. Disagreements between the two coders were resolved through discussion and further review of the disputed studies.

Effect Size Computation. Hedges and Olkin's (1985) procedure to derive and analyze effect sizes was used. Specifically, the effect size, g, was defined as the difference between the means of the experimental group and the control group divided by the pooled within-group standard deviation. The pooled standard deviation is considered to be a representative indicator of within-study variance (Hedges & Olkin, 1985). If descriptive statistics were not available, then estimates of g were calculated from other statistics such as t, F, or p (see Dunlap, Cortina, Vaslow, & Burke, 1996; Glass, McGaw, & Smith, 1981; Ray & Shadish, 1996).

Effect sizes are positive if exercisers exhibit higher levels of GSE. The effect sizes were corrected, *d*, for the bias from *g*'s overestimate of the population effect size for small samples (Hedges & Olkin, 1985). Statistical significance of *d* was determined by the presence or absence of 0 within the 95% CI for *d*. The absence of 0 from the CI indicates a significant effect size. A *d* of 1 indicates a change in magnitude equivalent to 1 *SD*. According to Cohen (1992), effect sizes can be categorized as small ($d = 0.2$), medium ($d = 0.5$), or large ($d = 0.8$).

Unit of Analysis. The unit of analysis was the study finding. Multiple effect sizes within outcomes were taken from studies only if different samples were used to produce these effect sizes (e.g., males vs. females).

Missing Data. An effect size of 0 was imputed if complete descriptive (i.e., means, variances, and sample size) and/or inferential statistics were unavailable and it was clear that there was no treatment effect (i.e., $\text{Mean}_{\text{exp}} - \text{Mean}_{\text{cont}} = 0$). Also, if a result was only described as not significant and *n* and/or direction of change could not be determined, then 0 was substituted for the effect size (see Lou, Abrami, Spence, et al., 1996). However, if a result was described as not significant, and *n* and direction of change could be determined, then the effect size was calculated based on the value of *t* for $p = .05$ and divided by a factor of 2 (Sedlmeier & Gigerenzer, 1989). Overall, 0 was substituted in 6 cases (5%) and $t/2$ was substituted in 4 cases (3.4%).

Combining Effect Sizes. Because a great effort was made to identify and obtain every study conducted on the topic, a fixed-effects model (Hedges & Olkin, 1985) was used when combining effect sizes. That is, we assumed that the studies in our meta-analysis constituted the universe of studies. When calculating the overall average effect size for each outcome, *d*+, we weighted each study's effect size by the reciprocal of its variance before averaging it with other effect sizes. This procedure typically gives additional weight to effect sizes that come from studies with larger sample sizes (Hedges, 1994).

Data Analysis

To detect whether the studies shared a common effect size, we tested the homogeneity of the set of effect sizes with a homogeneity statistic, Q_t, which has an approximate chi-square distribution with $k - 1$ degree of freedom, where k is the number of effect sizes (Hedges & Olkin, 1985). If the resulting chi-square was significant, the effect sizes were determined to be heterogeneous. In such a case, Hedges and Olkin (1985) recommend that the total homogeneity statistic be partitioned into a between-classes effect and a test of the homogeneity of the effect sizes be conducted within each class. The between-classes effect was estimated by Q_b, which has an approximate chi-square distribution with $p - 1$ degree of freedom, where p is the number of classes. A large value of Q_b indicated that there were significant differences among the classes of effect sizes. As suggested by Hedges (1994), for any variable with more than two levels, statistically significant between-classes effects were followed-up with fixed-effects contrasts (Bonferroni method). The homogeneity of the effect sizes within each class was estimated by Q_{wi}, which has an approximate chi-square distribution with $m - 1$ degree of freedom, where m is the number of effect sizes in the class.

Results

Based on the average weighted effect size ($d+ = 0.23$, $SE = 0.02$), adults in the studies in this analysis experienced approximately 1/4 of a standard deviation increase in GSE when they participated in physical activity or exercise. While this change was deemed small, it was significantly different from zero (95% CI, .18/.28) and the effect sizes were found to be homogeneous, $Q_t(127) = 144.39$, $p = .14$. This weighted effect size was similar in magnitude to the unweighted median effect size ($M = 0.24$) and the unweighted mean effect size ($d = 0.27$). Because of concerns about the imputing of zero for those cases in which the findings were nonsignificant, and since it was not possible to calculate an effect size, we also calculated the average weighted effect size with those cases removed. Again, there was very little difference between the effect size with zero removed ($d_{0-} = 0.24$, $SE = 0.02$, 95% CI, .19/.28) and the average weighted effect size.

Even though the effect sizes for GSE were homogeneous, we proceeded with an analysis of both the hypothesized and additional moderators as Rosenthal (1995) recommends.[4] Because the additional moderators were tested in an exploratory fashion, we used a Bonferroni inequality to obtain a more conservative alpha of .004 (i.e., .05/13 categorical tests) to determine statistical significance. Tables 1 and 2 provide the average weighted effect size for each level of each moderating variable, along with indicators of between-group differences (Q_b) and within-group homogeneity (Q_w).

Hypothesized Moderators of Exercise on Self-Esteem

We tested if any of the following variables served as significant moderators of exercise on GSE: change in physical fitness, initial fitness level, initial self-esteem level, exercise intensity, exercise frequency, exercise duration, and length of program. Change in physical fitness, $Q_b\ (2) = 3.78$, $p < .05$, was the only significant hypothesized moderator of GSE. Significant changes in physical fitness ($d = 0.32$) were associated with greater changes in GSE when compared to those cases where no changes occurred ($d = 0.15$). Furthermore, the effect size for the latter category did not differ significantly from zero. In terms of initial physical fitness level and initial self-esteem level, while not significant, the direction of change was as we expected. Thus persons with lower initial physical fitness ($d = 0.29$) and lower initial self-esteem ($d = 0.28$) demonstrated larger changes in GSE as a result of exercise than did those reporting moderate initial physical fitness levels ($d = 0.20$) and moderate initial self-esteem ($d = 0.22$). A nonsignificant trend was also observed for exercise frequency in that the more frequent the participation, the larger the increase in GSE.

Additional Moderators of Exercise on Self-Esteem

Sample Variables. None of the sample variables served as significant moderators of exercise and GSE. Although population was a significant moderator when tested at an alpha of .05, it was not significant when the more conservative alpha of .004 was used. No significant within-class variability was detected at the variable level; however, the effect sizes in the subcategories of women, $Q_w\ (56) = 76.18$, $p < .05$, and the psychologically unhealthy, $Q_w\ (13) = 24.21$, $p < .05$, were heterogeneous.

Table 1 Summary Statistics for Hypothesized Moderators of Exercise and Self-Esteem

Variable	Q_b	*k*	*d*+	*SE*	95% CI	Q_w
Initial fitness level	3.10					141.04
Low		53	.29	.05	.20/.38	60.71
Moderate		73	.20	.03	.14/.26	80.33
Initial self-esteem level	0.91					136.52
Low		28	.28	.06	.16/.41	25.83
Moderate		98	.22	.03	.17/.27	110.69
Exercise intensity	0.81					125.36
Low (< 45%)		21	.26	.07	.13/.40	29.85
Moderate		70	.21	.03	.15/.28	76.56
High (70%+)		25	.26	.05	.15/.37	18.95
Exercise frequency	3.27					125.41
< 3 times/wk		33	.22	.05	.13/.31	45.43
3 times/wk		63	.23	.04	.15/.30	67.91
> 3 times/wk		14	.36	.07	.22/.50	12.07
Exercise duration	2.18					128.71
0–30 min		20	.32	.08	.15/.48	13.25
31–45 min		24	.19	.06	.07/.31	42.72
46–60 min		47	.24	.04	.16/.32	49.68
> 60 min		7	.13	.13	–.13/.38	7.94
Length of program	0.52					113.59
< 9 wks		39	.24	.05	.14/.33	61.48*
9 to 14 wks		53	.26	.04	.18/.33	52.72
> 14 wks		20	.21	.05	.11/.31	14.51
Change in physical fitness	3.79*					63.20
Yes		59	.32	.04	.25/.40	52.68
No		16	.15	.08	.00/.31	10.53

Note: CI = confidence interval; Q_b = measure of between-group effect; *k* = number of effect sizes; *d*+ = average weighted effect size; *SE* = standard error of *d*+; 95% CI = 95% confidence intervals for *d*+; Q_w = measure of within-group homogeneity.

* $p < .05$

Methodological Variables. None of the methodological variables served as significant moderators of GSE. While no significant within-class variability was detected at the variable level, the effect sizes in the subcategories of unpublished studies, Q_w (79) = 103.58, $p < .05$, and poor quality studies, Q_w (54) = 73.60, $p < .05$, were heterogeneous. In all, 43% of the effect sizes were from poor quality studies and 63% were from unpublished sources. Of the effect sizes from poor quality studies, 89% were from nonequivalent designs (i.e., no random assignment or matching), 84% were from unpublished sources, and 61% were from studies in which physical fitness was not measured. As shown in Table 3, there was a relationship between

Table 2 Summary Statistics for Additional Moderators of Exercise and Self-Esteem

Variable	Q_b	k	$d+$	SE	95%CI	Q_w
Sample Variables						
Age	2.01					113.63
Young		58	.24	.03	.17/.30	64.41
Middle-age		32	.30	.06	.19/.41	33.64
Older adults		18	.18	.08	.03/.33	15.58
Sex	1.00					143.31
Women		57	.21	.04	.14/.29	76.18*
Men		21	.28	.05	.17/.38	15.57
Mixed sample		49	.22	.04	.15/.30	51.56
Population	8.02					136.29
Public		48	.32	.04	.24/.41	44.00
Students		55	.19	.03	.12/.25	64.43
Patients		15	.28	.09	.10/.46	20.54
Other		9	.12	.09	–.06/.30	7.31
Health status	0.64					143.67
Healthy		97	.22	.03	.17/.27	111.13
Physically unhealthy		15	.23	.08	.06/.40	8.33
Psychologically unhealthy		14	.29	.08	.13/.46	24.21*
Methodological Variables						
Self term	0.05					142.29
Self-esteem		44	.23	.04	.14/.31	49.48
Self-concept		83	.24	.04	.18/.30	92.81
Scale	3.52					140.87
R-SES		27	.18	.05	.08/.28	20.57
TSCS		67	.24	.03	.18/.31	65.97
SCS		8	.39	.10	.18/.59	13.22
Other		26	.20	.05	.10/.31	41.11*
Publication status	0.22					144.17
Published		48	.24	.04	.17/.32	40.59
Unpublished		80	.22	.03	.16/.28	103.58*
Control group	0.16					144.22
No treatment		110	.23	.03	.18/.28	121.33
Other treatment		13	.24	.08	.07.40	17.83
Some exercise		5	.18	.14	–.09/.44	5.06
Group assignment	6.60					137.82
Random		54	.26	.04	.18/.34	54.63
Matching		9	.48	.11	.26/.71	6.05
Nonequivalent		65	.20	.03	.14/.26	77.14

(continued)

Table 2 (*Continued*)

Variable	Q_b	k	$d+$	SE	95%CI	Q_w
Study quality	5.29					139.10
Poor		55	.17	.04	.10/.24	73.60*
Fair		52	.27	.04	.20/.35	52.11
Good		21	.31	.07	.18/.45	13.39
Treatment Variables						
Type of program	14.80**					129.58
Exercise [a]		109	.26	.03	.21/.31	111.26
Lifestyle [a]		8	.36	.11	.13/.58	7.54
Skills training [b]		11	–.03	.07	–.17/.11	10.79
Exercise mode	4.78					131.85
Aerobic		59	.25	.04	.18/.32	68.56
Aerobic & other		31	.22	.05	.12/.32	25.42
Martial arts		4	.00	.12	–.22/.23	2.85
Flexibility		9	.20	.10	.00/.40	12.46
Strength		15	.26	.06	.14/.37	20.83
Mix		5	.18	.10	–.02/.38	1.72
Type of fitness measure	4.23					48.44
Aerobic		27	.32	.06	.20/.44	33.68
Body composition		4	.38	.19	–.01/.76	6.13
Strength		8	.37	.08	.22/.53	2.11
Other		5	.19	.15	–.11/.48	2.15
Combined fitness		5	.18	.11	–.03/.38	2.16
Combined fitness & body comp.		10	.41	.09	.24/.58	2.22

Note: CI = confidence interval; Q_b = measure of between-group effect; k = number of effect sizes; $d+$ = average weighted effect size; SE = standard error of $d+$; 95% CI = 95% confidence intervals for $d+$; Q_w = measure of within-group homogeneity; R-SES = Rosenberg Self-Esteem Scale; TSCS = Tennessee Self-Concept Scale; SCS = Self-Cathexis Scale. [a, b] Variables with different superscripts differ significantly at $p < .01$.
*$p < .05$; **$p < .001$

Table 3 Prevalence of Study Quality Among Published and Unpublished Studies

Study quality	Published ($n = 48$)	Unpublished ($n = 80$)	χ^2 (1)
Poor	9	46	24.89***
Fair	28	23	0.49
Good	11	11	0.00

***$p < .001$

publication status and study quality, χ^2 (2, N = 128) = 18.54, $p < .001$, with effect sizes from poor quality studies being more likely to remain unpublished, χ^2 (1, N = 55) = 24.89, $p < .001$.

Treatment Variables. Type of program, Q_b (2) = 14.80, $p < .001$, was a significant moderator of GSE. Those participating in exercise (d = 0.26) or lifestyle enrichment programs (d = 0.36) experienced a larger increase in GSE than those in skills training activities (d = –0.03).[5] Also, the effect sizes for both exercise and lifestyle programs were larger than zero. The other variables, exercise mode and type of fitness change, were not significant moderators of GSE.

Sample Size and Power Issues

In this meta-analysis, the unweighted median effect size (M = 0.24), the unweighted mean effect size (d = 0.27), and the weighted mean effect size (d_+ = 0.23) indicate a small treatment effect for exercise on GSE across studies. However, in order for this small treatment effect to be detected as being significant (at α = .05, two-tailed test, and power = .80) in any one study, the sample sizes of studies would have to range between 200 and 235 (Overall & Doyle, 1994). The total sample sizes actually ranged from 12 (dePiano, dePiano, Carter, & Wanlass, 1984) to 343 (Wescott, 1980), with 95% of effect sizes coming from sample sizes less than 200. Furthermore, since the average number of participants per effect size was 61 and the median was 41, it appears that some small treatment effects went undetected and were classified as nonsignificant.[6]

In answer to the question of whether unpublished studies were more underpowered than published ones, results revealed that there was no significant difference between the average sample size of unpublished (n = 58.55) vs. published (n = 63.81) studies. Furthermore, the median sample sizes were almost identical for unpublished (M = 40.5) and published (M = 42) studies.

Discussion

The current findings demonstrate that exercise participation leads to small yet significant increases in GSE. The effect sizes in this case were homogeneous. Thus while there is a positive and reliable effect of exercise on self-esteem, this relationship is small at the global level. These results are in contrast with McDonald and Hodgdon's (1991) meta-analysis which found that exercise leads to moderate changes in global self-esteem. Some light can be shed on why these findings differ if considered in terms of multidimensional or hierarchical models of self-esteem discussed earlier (e.g., Sonstroem & Morgan, 1989). In this regard it has been noted that the smallest change in self-esteem occurs at the global level. Part of the reason for this is that exercise participation is thought to have the greatest influence on self-esteem at domain-specific levels (e.g., physical self-worth, physical competence).

While McDonald and Hodgdon (1991) included domain-specific self-evaluations in their study, these were subsumed into, and used interchangeably with, a global construct, i.e., self-concept. Given that the current meta-analysis employed *only* measures of GSE, it is possible that McDonald and Hodgdon's (1991) findings regarding self-esteem and exercise participation were larger because of their inclusion of these domain-specific components.

It has been claimed that self-concept is the psychological construct with the most potential for change because of participation in an exercise program (e.g., Folkins & Sime, 1981; Hughes, 1984). In comparison with meta-analyses of other psychological constructs, it appears that state anxiety (d = –0.34, Long & van Stavel, 1995; d = –0.25, Petruzzello, Landers, Hatfield, Kubitz, & Salazar, 1991) and depression (d = –0.72, Craft & Landers, 1998; d = –0.59, North et al., 1990) show just as much if not more change than GSE as a result of exercise. Thus, from the results of the present meta-analysis it appears that the benefits of exercise for GSE are overstated in the literature on physical activity and exercise. Much of this optimism about the potential effectiveness for exercise increasing GSE is probably the result of the McDonald and Hodgdon (1991) review. Also, earlier reviews (e.g., Folkins & Sime, 1981) base their claims about the benefits of exercise on the results of a few studies, some with unique populations (e.g., mentally retarded students).

Effects of the Exercise Program

The only two significant moderators of exercise on GSE were type of program and change in fitness. In the former, exercise and lifestyle programs resulted in small to moderate increases in self-esteem, respectively, while skills training activities had no effect on self-esteem. The fact that skills training activities had no effect on GSE is somewhat surprising, considering that participation in such activities should lead to enhanced physical competence which is one of the antecedents of GSE in the EXSEM (Sonstroem & Morgan, 1989).

Alternatively, changes in physical fitness are related to significant increases in GSE. While this latter finding supports one of the original tenets of the EXSEM, Sonstroem (1997a) has since modified the claim that increased physical fitness is required for enhanced GSE and placed more of an emphasis on "perceptions of improvement" in physical fitness. The idea that perception of fitness is a mediator of the relationship between exercise and mental health has become popular in the literature (see Heaps, 1978; O'Donoghue, 1990; Plante, 1999; Plante Coscarelli, Caputo, & Oppezzo, 2000; Plante, LeCaptain, & McLain, 2000).

We cannot comment on the role that perceived changes in physical fitness played in our analysis because it was not measured in the original studies. Future studies should test whether perceived physical fitness serves as a mediator or moderator of the effect of exercise on GSE. However, it does appear from our analysis that increases in actual physical fitness are related to enhanced GSE. Thus, participation in programs that lead primarily to enhanced physical fitness vs. enhanced physical competencies may be more effective for improving the self-esteem of adults. One caveat is that approximately 40% of effect sizes came from studies in which actual physical fitness was not measured. Thus, along with perceived fitness, future studies of exercise and self-esteem should test for changes in actual physical fitness.

Given that change in physical fitness is a significant moderator of the effect of exercise on GSE, the overall lack of support for a dose-response (i.e., intensity, frequency, duration, or length of program) relationship might be surprising. However, it has been argued that little data supports the existence of a strong dose-response relationship for exercise and most psychosocial variables (Gauvin et al., 1999; Rejeski, 1994). Similar to the case that has been made for the role of perceived changes in fitness, perhaps it is the subjective perception of the dose (Dishman, 1994) that is more important in determining the effect of exercise on GSE.

Methodological Issues

No moderator effects were observed for methodological variables in the literature on exercise and self-esteem. The fact that there was no difference in effect size between published and unpublished studies suggests it is not because of a lack of treatment effect that the unpublished studies remain unpublished. Since 58% of unpublished effect sizes were derived from studies deemed to be of poor quality, it is likely the quality of those studies that explains why they remain unpublished. An interesting trend was observed for study quality in that studies rated as either fair ($d = 0.27$) or good ($d = 0.31$) had larger effect sizes than those rated as poor ($d = 0.17$). While no significant within-class variability was detected for study quality overall, the effect sizes in the poor category were heterogeneous, suggesting that some other factor may explain the effect size for that group.

Based on the sample sizes of the studies in this meta-analysis, it can be surmised that GSE studies are generally undersized and underpowered. That is, researchers are not using samples of sufficient size to provide adequate power in their studies in order to detect significant findings for the effect of exercise on GSE. This was the case regardless of whether studies were published or unpublished. In fact, 95% of the effect sizes in this analysis came from sample sizes too small to detect the average weighted effect size to be significant. Thus it is likely that lack of statistical power has contributed to some of the confusion surrounding exercise and GSE.

Limitations of This Review

A potential limitation of this meta-analysis was the choice to use a fixed-effects as opposed to a random-effects model when analyzing our effect sizes. In the fixed-effects model it is assumed that the population effect size is the same for all studies in the analysis. The alternative is that the population effect sizes vary randomly from study to study. As a result, the error term in the fixed-effects model uses only the within-study variability while the error term in the random-effects model includes both the within-study variability and the variability due to differences between studies (Hedges & Vevea, 1998). Thus when a fixed-effects model is used, it is assumed that all the studies conducted on a particular topic have been included, whereas in a random-effects model it is assumed that only a sample of the studies that could be done have been found (Hedges, 1994).

Technically, any findings and subsequent conclusions drawn from a fixed-effects model should be limited to the studies in that analysis. If one wants to make more general conclusions about the research topic, then a random-effects approach is more appropriate. Therefore the findings and conclusions of this meta-analysis should be limited to the studies reviewed. Because every effort was made to find studies of exercise and GSE, as evidenced by the fact that approximately two-thirds of the studies included were unpublished, we believe our findings closely approximate the universe of studies on the topic and thus provide insight on the population effect size.

Conclusions and Future Directions

In summary, participation in physical activity results in small significant improvements in global self-esteem. From a statistical point of view, these improvements are small. However, more studies are needed in order to determine the clinical or practical significance of such changes. Further, it appears that increases in actual physical fitness are required for enhanced self-esteem to occur. Based on these findings, we suggest, as previous research by McAuley and colleagues (1997; 2000) has done, that the link between GSE and physical activity participation has been to some degree overstated.

For many years, self-esteem research in the exercise domain has remained largely descriptive, with studies documenting group differences in self-esteem in various settings such as work, school, or sport. However, multidimensional models have allowed researchers who are interested in self-esteem and its role in exercise participation to learn more about the specific subcomponents of the physical self and its link to the global self (Fox, 1997, 2000). Despite this, if we are to progress beyond the documentation of links between specific subcomponents of the self and related behaviors and map changes in self-perception more precisely, future research must focus more directly on the mechanisms of change involved in the self-system.

The current findings reinforce the call for more studies that focus on domain-specific self-evaluations if the mechanisms through which self-esteem affects exercise participation and vice versa are to be identified. Our findings also underscore the need for future studies to include specific measures of physical fitness and competencies or attributes (e.g., physical self-worth, perceived fitness) that might be expected to be most responsive to intervention and change (Baranowski, Anderson, & Carmack, 1998; Kraemer, Stice, Kazdin, Offord, & Kupfer, 2001).

To conclude, despite the current meta-analytic finding that physical activity participation results in small improvements in GSE, the potential payoff from a more focused exploration of multidimensional self-esteem change in the exercise domain is high. Not only is this topic understudied but, as the research of McAuley and colleagues (1997, 2000) indicates, it has great potential from a practical standpoint for designing exercise interventions in areas such as rehabilitation from illness and/or injury and weight management.

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Note: References marked with an asterisk indicate studies included in the meta-analysis.

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Notes

[1] When exploring the self in the physical domain, the terms self-esteem and self-concept tend to be used interchangeably; there is no one unified, operational definition per se. McDonald and Hodgdon (1991) used the two terms in a unified form, and for the purposes in this paper so do we.

[2] According to Caspersen et al. (1985), physical fitness consists of both health related components (cardiorespiratory endurance, muscular endurance, muscular strength, body composition, flexibility) and performance related components (muscular speed, speed, agility, balance, reaction time).

[3] An interesting phenomenon in this meta-analysis was that approximately two-thirds ($n = 80$) of the effect sizes came from unpublished sources. This is a much greater proportion of unpublished effect sizes than is typically seen in meta-analyses. In fact, the majority of meta-analyses in sport and exercise psychology include no unpublished works (see Gauvin et al., 1999).

[4] Rosenthal (1995) does not agree that moderator analyses should only proceed after the detection of significant heterogeneity of variance among a set of effect sizes. He argues that scientific progress can result from scientists "continually reducing the magnitude of sampling error by increasing their understanding of moderator variables" (p. 186). While Overton (1998) claims such exploratory analyses are justified in meta-analyses as long as they are preceded by homogeneity testing and conducted on a priori hypothesized moderators, Rosenthal states that "planned contrasts should be computed without reference to the overall *F*, and even unplanned contrasts can be computed with appropriate adjustments of their levels of significance" (p. 188).

[5] Lifestyle programs included exercise along with stress reduction and nutrition counseling. Skills training activities were those in which the goal was primarily to develop competence in a skill as opposed to enhancing physical fitness. Such activities included martial arts and physical education courses.

[6] One reviewer of this paper inquired about the statistical power of our analysis. According to Field (2001), we have sufficient power, based both on number of studies ($k = 118$) and average sample size ($n = 61$), at an overall level to detect any significant effect sizes. True, we may be underpowered in several levels of our moderator variables. However, none of the effect sizes for these levels is greater than $d = .15$. Thus we do not think we are missing any substantial effects in those categories due to low power.

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