PHYSICAL ACTIVITY, SELF-ESTEEM, AND SELF-EFFICACY RELATIONSHIPS IN OLDER ADULTS: A RANDOMIZED CONTROLLED TRIAL[1,2]

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ABSTRACT

A randomized controlled trial examined the growth and form of multidimensional self-esteem over a 12-month period (6-month exercise intervention and 6-month follow-up) in 174 older adults engaged in either a walking or stretching/toning program. The extent to which changes in physical fitness parameters and physical self-efficacy were related to changes in perceptions of attractive body, strength, physical conditioning, and physical self-worth was also determined. Latent growth curve analyses showed a curvilinear pattern of growth in esteem with significant increases at all levels of self-esteem upon completion of the intervention followed by significant declines at 6 months postintervention in both groups. Frequency of activity and changes in physical fitness, body fat, and self-efficacy were related to improvements in esteem perceptions relative to attractive body, strength, and physical condition. Model fitting procedures suggested that the best fit of the data was to a model in which the influence of changes in efficacy and physical parameters on physical self-worth were mediated by perceptions of attractive body and physical condition.

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INTRODUCTION

Self-esteem is considered to encompass the affective and evaluative components of self-concept. Long considered a focal aspect of psychological health and well-being (1), it is not surprising that numerous studies have attempted to establish the link between physical activity participation and self-esteem. Several major reviews of this literature exist (2–4) and approximately 60% of studies reviewed report a positive association between physical activity participation and higher levels of self-esteem (5). Although this has led to a widespread lay acceptance of enhanced self-esteem being an automatic outcome of physical activity participation, there are several shortcomings with this literature (6). First, the majority of studies in this area have been cross-sectional, examining relationships between exercise and self-esteem at one point in time. Second, there has been an overreliance on the assessment of global self-esteem, a relatively stable entity, to the exclusion of measures of domain-specific esteem and the examination of multidimensional and hierarchical models of self-esteem (7). Third, there are few existing studies that assess relations among changes in multidimensional esteem as a function of exercise interventions. Finally, no studies exist that comprehensively assess exercise effects on esteem over multiple time points.

In an attempt to better understand the often documented relationship between exercise and self-esteem, Sonstroem and Morgan (8) proposed an exercise and self-esteem model (EXSEM). This model (see Figure 1) hypothesized that exercise-induced changes in global esteem are mediated by changes in physical competence and physical acceptance. Additionally, changes in physical competence are hypothesized to be enhanced through changes in physical self-efficacy resulting from improvements in physical parameters (e.g. fitness) brought about by exercise. This EXSEM model has been expanded (9) to incorporate the Physical Self-Perception Profile (PSPP) developed by Fox and Corbin (10). This profile posits global self-esteem to be related to physical self-worth (esteem) at the domain level and that underlying this level are perceptions of physical conditioning, attractive body, physical strength, and sports competence at the subdomain level. These subdomains are, in turn, influenced by physical self-efficacy. The measure and the relations theorized among its components have been validated in adult samples and the psychometric properties appear adequate. Sonstroem et al. (9) administered the PSPP (10,11) to middle-aged and older adults, successfully demonstrating that physical self-worth mediated relations between global self-esteem and subdomain levels of sport confidence, physical conditioning, attractive body, and strength. Sonstroem et al. (9) also demonstrated that the PSPP can effectively discriminate between exercisers and nonexercisers and degree of exercise involvement for both males and females.

Two recent studies have examined the structural relations among the hypothesized constructs in the EXSEM model. Baldwin and Courneya (12) provide some limited support for the model in

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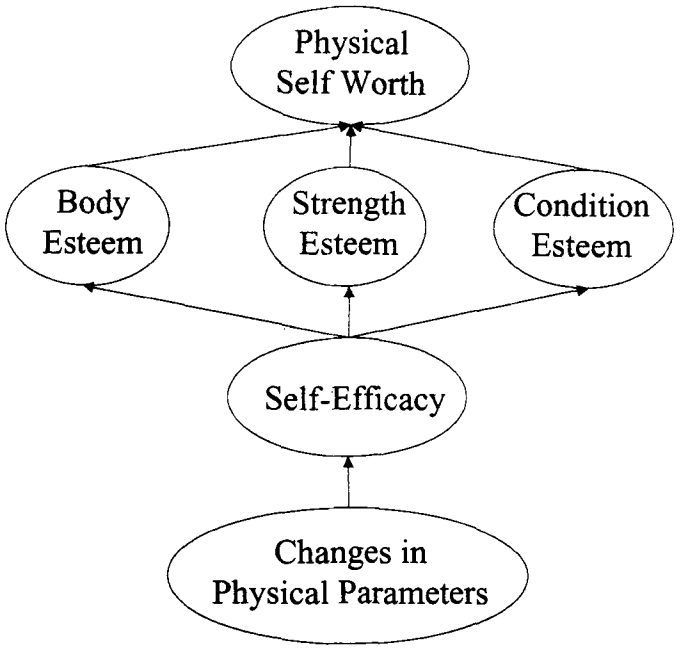


FIGURE 1: Hypothesized relationships of the expanded Exercise and Self-Esteem Model (EXSEM) (13).

that they were able to demonstrate that self-reported strenuous exercise influenced global esteem through the mediation of physical self-worth and physical acceptance in breast cancer survivors. In a more comprehensive study of female aerobic dance participants, Sonstroem, Harlow, and Joseph (13) presented further evidence for the validity of the PSPP and the predicted associations between the subdomains of attractive body and physical condition and degree of exercise and dance participation. In addition, they were able to verify the expanded EXSEM structure which proposes efficacy's influence on physical self-worth to be mediated by subdomains of esteem and physical self-worth to directly influence global esteem. Unfortunately, the Baldwin and Courneya (12) and Sonstroem et al. (13) studies involved one measurement time point. However, as proposed, the EXSEM is concerned with relations among changes in self-esteem, self-efficacy, and physical measures (e.g. weight, fitness, performance, etc.) that result from exercise participation over time.

In a study of middle-aged adults involved in a 5-month walking intervention, McAuley et al. (6) reported changes in self-efficacy and physical fitness to have a significant influence on physical self-worth independent of changes at the subdomain level. Additionally, the walking program had its greatest influence on changes in esteem at the physical condition and physical self-worth levels suggesting the exercise intervention to be influential in those areas of esteem most relevant to the domain of activity. Although McAuley et al. (6) examined relationships among changes in efficacy, fitness, and esteem, they employed correlational/multiple regression techniques to do so. In essence, they did not formally test relationships among constructs proposed by the EXSEM model. To do so requires measures of all constructs assessed prior to and following an exercise intervention and appropriate tests of the structural relations.

As noted, most reviews of the exercise–self-esteem relationship conclude that, despite numerous methodological shortcomings, exercise participation is related to self-esteem (5) and that exercise interventions can enhance self-esteem, particularly physical self-esteem (6). Indeed Marsh (14) and Marsh and Sonstroem (15) have noted that rather than focusing on global measures of esteem, if one is interested in physical activity effects, then a stronger emphasis should be placed on physical self-esteem to gauge the extent of such effects. Given the structure of physical self-esteem proposed by the PSPP (10), one might expect different modes of activity to have differential effects on the various subdomains of physical esteem. For example, aerobic activity may be expected to have a stronger influence on physical conditioning esteem, whereas a weight training program may have a more substantial effect on strength esteem. However, there is little empirical evidence contrasting different activity mode effects on esteem. Additionally, because there have been few longitudinal studies of exercise effects on self-esteem, little is known about the growth pattern of esteem once exercise interventions are terminated. For example, it is well-established that exercise interventions lead to increases in other self-perceptions such as self-efficacy (16) and that these increases are followed by declines in efficacy at follow-up several months later (17,18). Whether any changes in self-esteem brought about by exercise operate in a similar manner remains to be determined.

Thus, the present study had three objectives. First, in the context of older adults, we were interested in determining whether differential modes of activity (walking and stretching/toning) affected multidimensional self-esteem in the same manner. Second, we examined the growth form of self-esteem over three time points which included a 6-month exercise intervention and then a 6-month follow-up assessment. Finally, we endeavored to test the structural relations (see Figure 1) hypothesized by the EXSEM model (9) as a function of the 6-month randomized controlled exercise trial.

METHOD

Participants

Sedentary, older (M age = 65.5 years) adults were recruited to participate in a 6-month randomized controlled exercise trial. Inclusion criteria for participation in the program were: (a) aged 60 to 75 years, (b) sedentary, as defined by a lack of regular involvement in exercise during the previous 6 months verified by exercise history and assessment of aerobic capacity by maximal graded exercise testing, (c) healthy to the degree that participation in exercise testing and an exercise program would not exacerbate any existing symptomology, (d) personal physician's clearance for participation, (e) adequate mental status, as assessed by the Pfeiffer Mental Status Questionnaire (19), and (f) willingness to be randomly assigned to treatment condition.

Recruitment and Adherence

We employed a variety of strategies to recruit participants into the trial. These strategies involved use of the local media and included advertisements in the local newspapers, announcements and short "infomercials" on local radio shows known to have a large senior listening audience, and announcements on public service sections of local television news programs. In addition, we posted flyers advertising the trial in grocery stores, churches, senior centers, and other similar locations around the area. The announcements and flyers detailed the opportunity for older adults to participate in a 6-month professionally supervised exercise program at no cost. Interested individuals meeting the criteria were instructed to contact us by telephone for further information.

An initial pool of 596 individuals indicated interest in participation and were contacted by telephone for preliminary

screening. Following this screening, 363 individuals were declared ineligible or declined further participation. Subsequent voluntary withdrawals and medical exclusions resulted in 174 participants (49 males, 125 females) beginning the exercise trial. Of these participants, 153 individuals completed the 6-month trial for an overall adherence rate of 88%. Attendance rates did not differ significantly between treatment conditions ($t = .88, p > .30$). The program consisted of a total of 70 activity days with the mean number of days attended being 56.67 ($SD = 14.14$). Average attendance by condition was 57.61 ($SD = 13.49$) for the toning group and 55.72 ($SD = 14.78$) for the aerobic group. Six months after the completion of the trial, 116 individuals returned for physiological assessment (67%) and 152 (87%) respondents completed psychological measures.

Group Assignment

Participants were assigned to one of two treatment conditions, an aerobic activity program (walking) or a stretching and toning program. To minimize differences between the two treatment conditions on important baseline variables such as medication use, age, and gender, the participants were randomized using a modified version of the baseline–adaptive randomization scheme of Begg and Iglewicz (20) as described in McAuley et al. (17).

Treatment Conditions

Aerobic Exercise Group: The goal of the aerobic exercise program was to influence physical fitness as typified by cardiorespiratory endurance through a program of regular walking (see Boileau et al. [21] for details of these effects). Basic principles and guidelines for exercise programming (22) were followed, with the intensity level beginning at light levels (50%–55% VO_2max) and gradually increasing to more moderate levels (65%–70% VO_2max) by the midpoint of the program. Frequent assessment of heart rate and ratings of perceived exertion under the supervision of trained exercise staff ensured that participants were exercising at appropriate levels of intensity. Additionally, exercise duration was also gradually increased beginning at 10–15 minutes per session and increasing until participants were exercising for 40 minutes per session. The exercise sessions were conducted by trained exercise specialists and employed brisk walking in a local indoor shopping mall. Strong emphasis was also placed on those activities that constitute the warm-up and cool-down components of each activity session in order to minimize discomfort and potential injury. The exercise program was conducted three times per week for 6 months.

Stretching and Toning Group: This group of individuals met on the same basis as the aerobic exercise group (i.e. three times per week for 6 months) in a large gymnasium, were led by an experienced exercise leader, and therefore received the same amount of attention as our treatment group. The focus of this program was on the provision of an organized program of stretching, limbering, and mild strengthening for the whole body designed specifically for older individuals. Each individual was provided with their own exercise mat and rubber resistance tubing. The program included: (a) strengthening exercises consisting of one set of 8–12 repetitions per major muscle group and (b) flexibility exercises for all large muscle groups held for approximately 20–30 seconds. Each stretching/toning session lasted for approximately 40 minutes with 10-minute warm-up and cool-down periods (23).

Measures

Demographics and Health and Physical Activity History: Each subject completed an inventory providing demographic information, details of their medical history, and life-style/exercise habits prior to participation in the physical fitness assessment. Relevant health information was obtained to establish their capability to participate in the trial based on the criteria established by the American College of Sports Medicine Guidelines for Exercise Testing and Training (22).

Assessment of Aerobic Capacity: Aerobic endurance capacity was determined for all subjects prior to and following the intervention as well as at the 6-month follow-up. Because many older individuals are unable to attain an objective verifiable VO_2max, we assessed VO_2peak at the point of test termination due to volitional exhaustion. Evidence of maximal exertion was corroborated by a respiratory exchange ratio >1.0 and/or a heart rate approaching the age-predicted maximum (i.e. 220-age). This measure of aerobic endurance capacity was assessed on a motor-driven treadmill by employing a modified Balke protocol (22) with a physician and nurse present at all times. A detailed account of the graded exercise test protocol can be found in Boileau et al. (21).

Exercise Participation: Frequency of physical activity was determined from daily attendance logs kept by the participants and corroborated by similar logs kept by the exercise leader. Because exercise participation effects are sometimes independent of physical fitness effects on psychosocial function, we elected to include this variable along with changes in physical fitness parameters in tests of the EXSEM model.

Body Composition: Body composition was measured by total body electrical conductivity (TOBEC) (Model HA-2, EM-Scan, Inc., Springfield, IL). This measure estimates the fat-free body weight (FFB) by quantifying the perturbation of an electrical magnetic field resulting from the content of conductive components in the body (i.e. water and electrolyte). Age- and gender-adjusted equations were used to estimate the FFB developed by employing a reference four-component model of body composition. Body fat was calculated as the difference between total body weight and the estimate of FFB.

Domain-Specific Self-Esteem: The Physical Self-Perception Profile (10,11) is a 30-item instrument used to assess self-esteem relative to several domains of physical functioning in a hierarchical, multidimensional fashion. The instrument contains a general 6-item physical self-worth scale (PSW) and four subdomain scales specific to perceived sport competence, physical condition, attractive body, and strength, with 6 items per scale. However, given the nature of the sample (sedentary older adults) and the modes of activity (walking and stretching/toning), we elected to delete those items that comprised the sports competence dimension. Sample items characterizing each of the scales used are as follows: "I am extremely proud of who I am and what I can do physically" (Physical self-worth); "Compared to most, I always maintain a high level of physical conditioning" (Physical condition esteem); "I am often admired because my physique/figure is considered attractive" (Body attractiveness esteem); and "I am not as good as most at dealing with situations requiring physical strength" (Strength esteem). Participants indicated on a 4-point scale the degree to which each item was characteristic or true of them. Responses range from 1 (*not at all true*) to 4 (*completely true*). Fox and Corbin (10) provide internal consistency coefficients ranging

from .81 to .92 and test–retest reliability coefficients ranging from .81 to .88 over a 23-day lapse period. Fox and Corbin (10) have also provided extensive factorial, construct, and predictive validity for the PSPP. Internal consistencies for each dimension in the present study were in excess of .79.

Global Self-Esteem: Global self-esteem was assessed via the Rosenberg Self-Esteem Scale (RSE) (1). The RSE has been widely used in several domains of self-esteem research including physical activity (24). This scale consists of 10 items asking participants to indicate their level of agreement/disagreement with each statement. Internal consistency for this measure in the present study exceeded .83 at all measurement points.

Self-Efficacy: Physical self-efficacy was assessed by the Perceptions of Physical Ability (PPA) subscale of Ryckman, Robbins, Thornton, and Cantrell's (25) Physical Self-Efficacy Scale. Social cognitive theory (26) would suggest that more specific measures of efficacy (e.g. relative to exercise performance) are preferred to general measures. However, given that the PSPP assesses multiple domains of physical self-esteem, it would appear that a more general physical efficacy measure is more appropriate in this instance. The 10 items representing PPA include items reflecting strength, agility, reflexes, and physical condition. Participants indicate the extent to which they believe each item reflects their own capabilities on a scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). Thus, the scores could range from 10–60. The internal consistencies in the current sample were acceptable exceeding .82.

Procedures

A questionnaire packet assessing basic demographic information, physical activity, and general medical history, and the self-efficacy, physical self-perception, and global self-esteem measures were completed by each participant prior to the baseline physiological assessments. This questionnaire was returned at the first of two baseline sessions attended by participants. This session was essentially an orientation session in which the maximal graded exercise test protocol was explained and body composition assessed. At this session, participants were also fitted with electrodes and the mouthpiece for collecting expired gases and allowed to walk on an inclined motorized treadmill in an effort to reduce apprehension and novelty and orient them to the test procedure. At the second session, all participants completed a graded maximal exercise test as described elsewhere (21).

As noted above, participants then completed a 6-month exercise program (either walking or stretching and toning). At the end of this program, individuals again completed the self-efficacy and self-esteem measures as well as body composition and aerobic capacity assessments. Six months following termination of the exercise intervention, 152 participants returned completed psychological inventories by mail.

Treatment of Missing Data and Analytical Plan

Missing Data: As noted earlier, 174 participants entered the exercise intervention phase of the trial. With respect to the esteem data, there were 11.5% and 17% (toning group) and 6.5% and 8.5% (walking group) missing esteem data at 6 and 12 months, respectively. Typical approaches to the analysis of such data would employ listwise deletion procedures, using only data that were complete at all three time points. This necessitates the discarding of potentially useful data and the likelihood of sampling bias if the missing data are not missing completely at random (27). To overcome this problem, we employed a raw maximum likelihood estimation procedure implemented in the structural equation modeling program AMOS (28). In this procedure, the log-likelihood of the data is calculated providing reliable standard errors for the missing data case. Such multiple imputation approaches are superior to single imputation techniques in that subsequent analyses uphold inferences that validly reflect sampling variability due to missing values (29). Thus, our analyses are based on a sample size of 174 ($n = 89$ in the stretching and toning group and $n = 85$ in the walking group).

Analytic Plan: Our interest was in examining: (a) the differential effects of the two activity interventions on the form and shape of multidimensional self-esteem over time and (b) testing the veracity of proposed relationships among changes in esteem, self-efficacy, and changes in selected physical parameters brought about by the 6-month intervention. Because we have repeated measures over time, we elected to employ latent growth curve methodology within a multiple samples framework to examine developmental growth in esteem for the two groups over the course of the trial and follow-up (30–33). This approach first requires fitting a regression curve to the repeated measures of each individual's data. At this point, the parameters for each participant's curve become the primary interest as opposed to the original data (30). An important element of latent growth curve methodology (LGM) is its ability to detail not only individual developmental trajectories but also individual differences in those trajectories over time (31). For a more thorough exposition of LGM approaches, the reader is directed to Duncan, Duncan, Strycker, Li, and Alpert (29), Merideth and Tisak (31), and Muthen (34).

We employed an associative three-factor latent growth curve model to determine growth form in multidimensional self-esteem over time. In this model, each measured construct is treated as a single factor at each time point, thereby examining the repeated measures over time. In essence, the associative model allows us to conduct a double multivariate repeated measures analysis of variance within a structural equation framework. Subsequent analyses allowed us to determine whether there was significant growth over time in esteem, the form of that growth, and whether there was a significant difference between the two exercise modalities in esteem growth.

In the second stage of our analyses, we conducted structural equation models to test the expanded EXSEM model (9). Recall that this model proposes distinct hierarchical relationships among changes in levels of self-esteem, self-efficacy, and physical parameters (e.g. aerobic capacity, percentage body fat, and frequency of exercise participation). Consequently, our analyses were conducted on changes in the variables identified above brought about by the 6-month intervention.

RESULTS

Biometric data, exercise history, and medical status for the two treatment groups at baseline are shown in Tables 1 and 2. The sample was predominantly Caucasian, relatively well-educated, overweight, and of low cardiovascular fitness. T-tests comparing participants in the aerobic and stretching/toning conditions indicated that the two conditions did not differ significantly at baseline on any of the demographic, health status, or psychosocial variables (all $ps > .10$). Preliminary analyses indicated a significant difference over the course of the program in fitness change ($p < .01$) with the aerobic group showing a modest increase in VO_2peak (5.1%) whereas the stretching/toning condition witnessed a decrease in VO_2peak (−2.1%). Additionally, there was a significant ($p < .05$) decrease in body weight in the aerobic group (−2.1%) relative to the stretching/toning group (−1.1%). With respect to

TABLE 1
Means and Standard Deviations for Biometric Data at Baseline for the Total Sample and by Treatment Group

Variable	Total Sample (N = 174)		Aerobic (n = 85)		Toning (n = 89)	
	M	*SD*	*M*	*SD*	*M*	*SD*
Age	66.71	(5.35)	67.42	(5.24)	66.02	(5.40)
Weight	80.28	(16.39)	79.87	(16.17)	80.68	(16.68)
% Fat[a]	.42	(.08)	.42	(.08)	.41	(.07)
VO_2peak (Ml/kg/min)[b]	21.53	(4.87)	21.24	(4.64)	21.79	(5.08)
Heart $rate_{max}$	151.58	(18.11)	151.42	(18.54)	151.72	(17.80)
Respiratory exchange rate (RER)[b]	1.04	(.09)	1.05	(.10)	1.03	(.09)
Time on treadmill	11.34	(3.71)	11.23	(3.30)	11.45	(4.09)
Systolic blood pressure	141.38	(22.93)	142.09	(23.56)	140.69	(22.41)
Diastolic blood pressure	83.37	(10.75)	83.15	(10.02)	83.58	(11.46)
Heart $rate_{rest}$	76.09	(11.93)	77.23	(11.48)	75.00	(12.33)

[a] Total N = 171, Toning n = 86.
[b] Total N = 153, Aerobic n = 73, Toning n = 80.

body fat, neither group evidenced any overall change over the course of the trial. Further particulars of the physiological changes are documented in Boileau et al. (21).

Effects of Mode of Activity on Self-Esteem Change Over Time

Table 3 shows estimated means and standard errors at all three time points for all of the esteem measures. These estimates take on a curvilinear growth pattern with both exercise groups exhibiting significant linear improvements in all esteem measures following completion of the intervention, followed by small but significant negative growth at 6-month follow-up. Only in the case of strength esteem did the two exercise conditions differ with the toning group showing significantly greater improvements over the course of the trial, χ^2 (1) = 4.85, $p < .05$, and smaller reductions at follow-up, χ^2 (1) = 6.283, $p < .01$, than the walking group. Calculation of fit indices suggested that a multivariate associative model demonstrating linear growth as a function of the exercise interventions and negative growth at follow-up was an acceptable fit to the data, χ^2 (33) = 33.19, $p = .46$, comparative fit index (CFI) = .92, and root mean square error of approximation (RMSEA) = .02.[3]

Structural Relations Among Multiple Dimensions of Esteem

In this set of analyses, standard structural equation methods were employed to test the hierarchical model of the relations depicted in Figure 1. This model is adapted from the EXSEM model proposed by Sonstroem et al. (13). Specifically, we followed the recommendations of Marsh (14) and Marsh and Sonstroem (15) and elected not to include global esteem in the model due to the rather minimal changes taking place at this level of the hierarchy and its low association with other model parameters. Consequently, changes in physical activity variables (aerobic fitness, percentage of body fat, and frequency of activity during the intervention) were hypothesized to influence changes in esteem at the subdomain level (attractive body, physical condition, and strength) via the mediation of physical self-efficacy. In turn, these changes were proposed to influence physical self-worth. Mean level change in the variables of interest and the correlations among these changes are shown in Table 4. As the focus of our analyses was on relationships among change in the constructs of the EXSEM brought about by the 6-month intervention, and to simplify the analyses given the relatively small sample size, difference scores for the two time points (preexercise and postexercise intervention) were constructed. The difference score is mathematically equivalent to the linear slope of a simple two-factor latent growth curve model for two time points. In this case, however, the intercept is eliminated. This model was tested within a multiple sample framework which allowed us to test the overall fit of the model and to determine whether relations among the constructs differed across the two treatment conditions.

Initial model fitting procedures suggested that such a model fit the data reasonably well, χ^2 (54) = 87.60, $p = .002$, CFI = .91, RMSEA = .06, but that there was room for improved fit. In this model, only changes in VO_2max were related to changes in physical efficacy. However, examination of a saturated path model indicated that significant direct paths also existed between changes in percentage body fat and attractive body, changes in VO_2max and physical condition, and frequency of activity and changes in strength and physical condition elements of esteem. Subsequent model fitting procedures systematically tested models which allowed these paths to exist and used backward elimination to free up nonsignificant paths. This "model trimming" was continued until there was no significant reduction in the chi-square and resulted in a model that was a significant improvement on the original model tested, χ^2 (2) = 24.09, $p < .001$ (see Figure 2). In essence, this better fitting model includes two more paths than the originally hypothesized model (hence df = 2); however, efficacy is now a direct path to esteem rather than a mediating variable. Fit indices for this latter model were indicative of an acceptably fitting model, χ^2 (52) = 63.51, $p > .13$, CFI = .92, RMSEA = .035. As can be seen in Figure 2, efficacy and the physical parameters influence physical self-worth largely through the mediation of perceptions of attractive body and physical conditioning.

In this trimmed model, we constrained all of the specified paths to be equal across treatment conditions to test the overall fit of the model. To determine whether these paths corresponded across exercise conditions, subsequent analyses involved freely estimating each path and comparing it across groups. This procedure revealed the path between changes in VO_2max and physical condition to be significant only in the walking group ($\beta = .25$, $p < .05$) and the path between strength and physical self-worth to be nonsignificant in the toning group and approaching significance ($\beta = .163$, $p < .07$) in the walking group. These differences were not, however, significant across groups. The path from attractive body to physical self-worth was significantly stronger in the toning condition ($\beta = .49$) than in the walking condition ($\beta = .30$), χ^2 (1) = 5.15, $p < .05$.

The EXSEM model for the walking group suggests that increases in self-efficacy were positively associated with increases in esteem perceptions of attractive body, physical condition, and strength (see Figure 2). At the same level, reductions in body fat were significantly associated with enhanced perceptions of attractive body, whereas increased cardiorespiratory fitness was associated with esteem related to physical condition. Attending more activity sessions during the 6-month intervention led to increased perceptions of strength and physical condition. In turn, increases in perceptions of attractive body and physical condition esteem were significantly related to improvements in physical self-worth. Although the strength of these relationships differed somewhat, they were generally replicated in the stretching/toning group, with the exception of the cardiorespiratory fitness–physical condition relationship, which was nonsignificant. Finally, the respecified model was able to account for 54% and 40% of the variation in

[3] Values greater than .90 for the CFI and less than .05 for the RMSEA are indicative of a very good fit of the model to the data.

TABLE 2
Percentages for Demographic and Health Status Variables by Total Sample and Treatment Group

Variable	Total		Aerobic		Toning	
	M (n = 49)	F (n = 125)	M (n = 26)	F (n = 59)	M (n = 23)	F (n = 66)
Demographics						
Marital status (%)						
Married	85.1	46.4	88.5	42.4	82.6	50.0
Divorced/Separated	6.1	16.8	3.8	13.6	8.7	20.0
Single	2.0	4.8	0.0	5.1	4.3	4.5
Widow/Widower	4.1	31.2	3.8	39.0	4.3	24.2
Education (%)						
10^{th}–11^{th} grade	2.0	2.4	0.0	3.4	4.3	1.5
High School	14.3	25.6	7.7	20.3	21.7	30.3
1–3 years college	18.4	25.6	15.4	37.3	21.7	15.2
College graduate	28.6	24.0	46.2	18.6	8.7	28.8
Master's degree	22.4	16.8	23.1	15.3	21.7	18.2
Ph.D.	10.2	4.8	3.8	5.1	17.4	4.5
Annual income (%)						
<$5000	0.0	2.0	0.0	0.0	0.0	1.5
$5000–10,000	2.0	3.2	3.8	1.7	0.0	4.5
$10,000–15,000	2.0	9.6	3.8	11.9	0.0	7.6
$15,000–20,000	2.0	8.0	3.8	10.2	0.0	6.1
$20,000–25,000	8.2	9.6	3.8	8.5	13.0	10.6
$25,000–30,000	4.1	15.2	7.7	11.9	0.0	18.2
$30,000–40,000	18.4	18.4	11.5	22.0	26.1	15.2
>$40,000	55.1	29.6	61.5	32.2	47.8	27.3
Ethnicity (%)						
African–American	2.0	2.4	3.8	3.4	0.0	1.5
White	93.9	94.4	96.2	91.5	91.3	97.0
Hispanic	0.0	0.8	0.0	1.7	0.0	0.0
Native American	2.0	0.8	0.0	1.7	4.3	0.0
Current medication						
Cardiovascular (%)	20.4	12.0	19.2	11.9	21.7	12.1
Antihypertensive (%)	26.5	26.4	26.9	23.7	26.1	28.8
Neuroleptic (%)	0.0	2.4	0.0	0.0	0.0	4.5
Antidepressant (%)	4.1	11.2	7.7	6.8	0.0	15.2
Immunosuppressant (%)	0.0	0.8	0.0	0.0	0.0	1.5
Estrogen replacement (%)		28.0		22.0		33.3
Disease status						
CVD (%)	10.2	6.4	11.5	5.1	8.7	7.6
Hypertension (%)	34.7	35.2	38.5	30.5	30.4	39.4
Cerebrovascular (%)	0.0	2.4	0.0	1.7	0.0	3.0
Arthritis (%)	14.3	26.4	7.7	25.4	21.7	27.3
Diabetes (%)	18.4	4.8	23.1	6.8	13.0	3.0
Cancer	12.2	9.6	11.5	11.9	13.0	7.6

physical self-worth in the toning and walking groups, respectively. In all likelihood, this difference in variation was due to the stretching and toning condition providing more opportunities to enhance the various subdomains of esteem that underlie physical self-worth.

DISCUSSION

Findings from this randomized controlled trial of physical activity in older adults serve to increase our understanding of both the pattern of self-esteem growth resulting from exercise and the underlying structure of physical esteem and its determinants. Relative to the exercise intervention and follow-up effects, there appears to be little difference in the growth and form of esteem as a function of exercise mode. That is, a stretching and toning intervention served to enhance multidimensional self-esteem in much the same way as the aerobic (walking) condition with overall physical self-worth, as well as esteem related to attractive body, physical conditioning, and strength increasing over the 6-month exercise trial. Similarly, at 6-month follow-up, modest but significant declines occurred in all measures across groups. The latent growth curve analyses revealed only one difference in treatment conditions and that was relative to strength esteem. In the case of the stretching and toning condition, significantly greater increases at program end and significantly smaller decreases at follow-up were found in this group as compared to the walking group. This is certainly to be expected given the toning component of this condition which involved the use of resistance bands. Thus, improving self-esteem through physical activity does not appear to be limited to aerobic activity. Moreover, it is clear that changes in self-esteem brought about by physical activity are greater at the subdomain levels than at more global levels, supporting a multidimensional perspective (7).

It has been previously argued that participation in physical activity may have its greatest potential psychological benefit for the enhancement of self-esteem (35,36). The present data certainly suggest that enhancements at various hierarchical levels of esteem can be realized with physical activity participation. However, the curvilinear growth pattern of esteem also indicates that gains

attained through exercise interventions may be easily eroded once the formal program has been terminated. Such erosion is likely due to reduced activity participation during follow-up. Indeed, participants were asked at follow-up whether or not they had continued to be active at the levels of frequency, duration, and intensity achieved during the structured program. Responses indicated that only 51.3% of participants in the walking condition and 75% of the strength and toning condition participants had continued to be active at program levels. The latter adherence rate is quite good and the differences between the two exercise regimens are in all likelihood due to the nature and content of the exercise modes. For example, the stretching and toning protocol is more easily incorporated into home-based physical activity regimens than is walking. Not being a central focus of the study, we do not have qualitative or quantitative data to support such an explanation. Future studies might well incorporate such approaches. Clearly, if the gains in esteem realized through physical activity interventions are to be maintained, then provisions must be in place to ensure continued activity participation in the absence of formal programs associated with controlled trials. Strategies such as monthly newsletter/reminders, booster telephone calls, carefully planned follow-up exercise prescriptions, and "buddy groups" may serve to maintain exercise participation levels and, in turn, levels of self-esteem.

These data represent the first long-term trial testing the veracity of the expanded EXSEM model (13) in which changes in physical parameters appear associated with changes in self-efficacy. In turn, these latter changes are related to improvements in those particular physical elements of esteem that are proposed to undergird physical self-worth (10). The structural analyses testing the proposed relationships were, in general, supportive of the proposed hierarchy. Initial analyses suggested that only changes in aerobic capacity were related to self-efficacy and that significant direct paths existed between the changes in physical parameters and changes in the subdomain levels of esteem. Subsequent alternative model testing including these latter paths led to a more parsimonious fit of the model to the data. In essence, the best-fitting model had changes in physical efficacy and changes in physical parameters operating on a parallel level. With respect to other relationships in the model, physical efficacy was significantly related to all of the subdomains of physical esteem, supporting our contention that a more general physical measure may be more appropriate given the content of the interventions and the nature of the esteem dimensions. However, the fact remains that the effects of physical activity/fitness parameters on dimensional self-esteem were direct rather than indirect through the mediation of self-efficacy. Bandura (26) has argued that a lack of specificity weakens the predictive power of self-efficacy. Subsequent studies utilizing efficacy measures specific to each objective physical measure as indicators of an overall latent efficacy construct may further enhance the relationships between efficacy and changes in these physical measures. In this manner, the mediational role of efficacy proposed by the EXSEM may be more readily apparent.

Interestingly, the pattern of relations demonstrated unique effects of the two exercise conditions on different parameters of the model. For example, changes in VO_2max were significantly related to percepts of physical condition, but only in the walking condition. Additionally, body fat reductions were more strongly related to improved perceptions of attractive body in the walking condition than the stretching and toning condition (see Figure 2). Given that both cardiorespiratory fitness improvements and decreases in body fat are common physical outcomes of aerobic activity, such findings are to be expected and support the notion of saliency in esteem development. That is, those aspects that are more conducive to change by a particular mode of activity are more likely to influence the dimensions of self-esteem most relevant to that activity. Whereas objective changes in physiological variables have been proposed to influence changes in esteem via changes in efficacy, it is of interest to note that the more often individuals participated in activity during the intervention, the greater the improvement in strength and physical condition aspects of esteem. This might suggest that the impact of exercise on psychosocial change is not simply the result of some biological stimulus (5,37).

TABLE 3
Means (*SE*) Values for Esteem Measures at Baseline, Postintervention, and Follow-Up

Measure	Walking	Toning
Body Esteem		
Baseline	11.25 (.43)	12.30 (.46)
Postintervention	12.56 (.46)	13.78 (.47)
6-month follow-up	12.32 (.44)	13.29 (.44)
Strength Esteem		
Baseline	12.36 (.43)	12.42 (.41)
Postintervention	13.27 (.45)	13.72 (.44)
6-month follow-up	12.71 (.44)	13.53 (.40)
Condition Esteem		
Baseline	12.39 (.36)	12.58 (.39)
Postintervention	15.16 (.41)	15.83 (.44)
6-month follow-up	14.55 (.41)	14.75 (.46)
Physical Self-Worth		
Baseline	13.31 (.43)	13.48 (.42)
Postintervention	15.06 (.44)	15.67 (.45)
6-month follow-up	14.58 (.49)	15.11 (.43)
Global Esteem		
Baseline	39.62 (.54)	40.90 (.48)
Postintervention	40.74 (.60)	41.59 (.49)
6-month follow-up	39.89 (.60)	41.29 (.56)

Note: All differences between baseline and postintervention and postintervention and 6-month follow-up are significant.

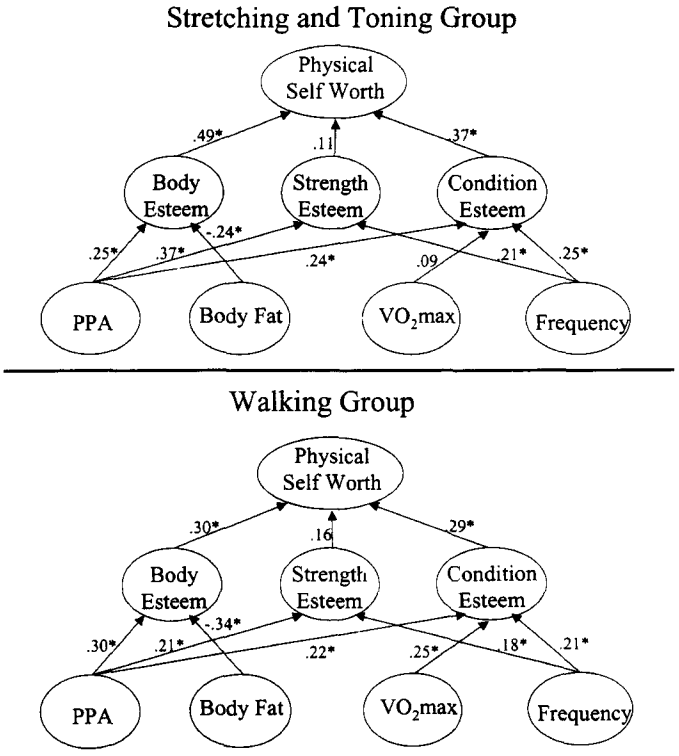
However, our findings do, to a certain extent, support the mediating role of subdomain measures of esteem in efficacy and physical activity relationships with physical self-worth. In both exercise conditions, perceptions of attractive body and physical condition were significantly related to physical self-worth, whereas strength-related esteem was not. It is well-established in the literature that physical appearance/body esteem is closely associated with self-esteem across the life span (38) and that an attractive body may be synonymous with self-esteem for many individuals (39). In addition, the physical conditioning aspects of both activity interventions (e.g. walk incremental distances, become more flexible, etc.) are likely to underlie the influence of physical conditioning on physical self-worth. Finally, the mild strengthening components of the stretching and toning condition were probably of insufficient salience for strength esteem to influence overall physical self-worth.

That differential modes of physical activity can enhance self-esteem in older adults and that multiple parameters act as determinants of this change are heartening public health messages. Interest in issues relative to health-related quality of life (HRQL) across the life span have recently taken on considerable importance at the public and federal health policy level (40). Contemporary approaches to HRQL research espouse a multidimensional and hierarchical approach similar to that of current self-esteem models. Certainly, self-esteem could be considered an important component of the emotional function dimension of HRQL (41). The

TABLE 4

Estimated Mean Change, Standard Errors (*SE*), and Correlations Among Changes in Physical Parameters, Self-Efficacy, and Multidimensional Self-Esteem by Treatment Condition

	Mean	*SE*	1	2	3	4	5	6	7	8
					Stretching and Toning Group					
1) Self-Efficacy (PPA)	2.16	.53	1.00							
2) Body Fat	0.00	.00	−.09	1.00						
3) VO_2max	−1.03	.37	−.25	−.13	1.00					
4) Frequency	58.04	1.44	−.03	−.12	.19	1.00				
5) Physical Self-Worth	2.24	.35	.24	−.05	.12	.26	1.00			
6) Condition Esteem	3.17	.32	.18	.00	.15	.38	.55	1.00		
7) Strength Esteem	1.14	.35	.34	.01	.05	.47	.39	.60	1.00	
8) Body Esteem	1.49	.29	.29	−.26	−.04	.13	.68	.43	.29	1.00
					Aerobic Group					
1) Self-Efficacy (PPA)	1.35	.60	1.00							
2) Body Fat	.00	.00	−.03	1.00						
3) VO_2max	.55	.30	.01	−.24	1.00					
4) Frequency	56.92	1.53	.12	−.23	.29	1.00				
5) Physical Self-Worth	1.66	.34	.34	−.09	.19	.22	1.00			
6) Condition Esteem	2.70	.34	.24	−.11	.30	.24	.53	1.00		
7) Strength Esteem	.83	.33	.23	.17	−.05	.04	.46	.35	1.00	
8) Body Esteem	1.24	.31	.29	−.29	.21	.12	.47	.41	.39	1.00



* paths significant at $p < .05$

FIGURE 2: Path coefficients of best-fitting EXSEM models for aerobic and stretching/toning conditions.

ability to effectively measure self-esteem relative to physical activity (10) and the application of models such as the expanded EXSEM (13) may lead to significant gains in our understanding of physical activity's influence on HRQL, particularly in the elderly.

There are several limitations in this study which must be considered. Although this study tested the hypothesized structural relations among variables in the EXSEM, it did so only over a single intervention period. Subsequent research might overcome this limitation by replicating and extending the present findings, especially under longitudinal circumstances. Interventions with measures of relevant variables at multiple time points would be able to take full advantage of the sophistication and comprehensive approaches to types of analyses that are afforded by latent growth curve methods. Additionally, our aim was to compare a traditional aerobic activity program with a stretching/toning activity (in essence, an attentional control group for comparing effects of gains made in physical fitness). Although we assessed strength esteem, we had no measures of participants' strength from which to determine the actual effect of strength improvements on esteem. Future studies might include such an intervention and appropriate measures of strength in order to provide a more complete understanding of how physical activity components influence self-esteem. Indeed, the recent interest in the roles played by strength training (42) in psychosocial function and the accumulation of activity (versus continuous activity) effects on physical fitness (43) in older adults offer some intriguing avenues for future research in activity effects on, and the determinants of, physical self-esteem in this population. In spite of our excellent adherence rate during the intervention (88%), we were only able to bring back 67% of the sample for physiological testing. Although there were no significant differences in esteem variables between those who returned for physiological testing and those who did not, this is a problem that needs to be addressed. In many ways, it is understandable that older adults would not wish to be subjected to a second graded maximal exercise test, but the development of strategies designed to ensure minimal attrition for testing need to be developed.

In conclusion, findings from the present study enhance our understanding of the development of multidimensional self-esteem in older adults and the role that physical activity may play in this development. Further examination of social, cognitive, behavioral, physiological, and environmental influences on self-esteem in the exercise environment is called for, as is further validation of the measures and the models employed in this area.

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