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Longitudinal Examination of the Exercise and Self-Esteem Model in Middle-Aged Women

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Abstract

This 2-year prospective study examined the exercise and self-esteem model in middle-aged women ($N = 143$) previously enrolled in a randomized controlled exercise trial. Across the 2-year period, increases in physical activity (PA) and self-efficacy and reductions in body mass index (BMI) were associated with improved subdomain self-perceptions relative to physical condition, and reductions in BMI were associated with improved subdomain self-perceptions relative to physical condition and body attractiveness. The effects of PA, self-efficacy, and BMI on changes in physical self-worth and global self-esteem were mediated by changes in self-perceptions relative to physical condition and body attractiveness. The results of this longitudinal analysis support the hierarchical and multidimensional structure of self-esteem and indicate that middle-aged women can enhance how they perceive their condition and body attractiveness by continued participation in physical activity, increasing their self-efficacy, and maintaining healthy BMI levels.

Keywords

exercise; self-esteem; physical activity; psychology

Self-esteem plays a key role in the explanation of human behavior and represents an important indicator of emotional and social adjustment (Fox, 2000; Sonstroem & Potts, 1996). People with higher levels of self-esteem appear to be more emotionally stable and more resilient to stress, possess higher motivation, strive to pursue more difficult goals and persist in achieving those goals (Biddle, 1997). People low in self-esteem, on the other hand, seem to be more susceptible to negative affect such as depression, anxiety, body dissatisfaction, eating disorders and suicidal tendencies (Davis, 1997; Harter, 1996; Hattie, 1992). Healthy self-esteem is thus an essential component of well-being and quality of life and has been also linked to positive health behaviors and subsequent health outcomes.

With increasing age and experience, self-esteem becomes more differentiated (Harter, 1996; Marsh, 1998) and its importance increases in adjustment to various life transitions. In women, midlife coincides with the transition into menopause, a period of hormonal and clinical changes that contribute to weight gain and increased reporting of psychological, somatic, sexual/urogenital, and vasomotor symptoms. Although the menopausal transition is an individualized experience, many women report impairments in mental health including decrements in self-esteem (Bosworth et al., 2001; Dennerstein, Dudley, Hopper, Guthrie, & Burger, 2000). Reduced self-esteem may put women at higher risk for other negative outcomes such as increased anxiety, depression, or negative health behaviors, all of which have been shown to increase menopausal symptoms, disease risk, and generally result in a more distressful menopausal experience. In addition, self-esteem has been suggested as a variable possibly accounting for differences in quality of life in menopausal women (Deeks, 2003; Elavsky, 2009; Elavsky & McAuley, 2005). Physical activity is one behavioral modality that may help combat the negative consequences of menopause and it has been

shown to enhance various aspects of mental health, including self-esteem (McAuley, Blissmer, Katula, Duncan, & Mihalko, 2000; McAuley & Rudolph, 1995; Sonstroem & Potts, 1996).

Contemporary approaches to studying the effects of physical activity on self-esteem emphasize multifaceted, hierarchical conceptualizations of self-esteem because they better explain the complex nature of self-esteem (Fox & Corbin, 1989; Marsh & Shavelson, 1985). In these approaches, general or global self-esteem is posited at the top of the hierarchy, subsuming domain-specific self-esteem (e.g., academic, social, physical). Each of the domains is influenced by self-perceptions in more specific subdomains. For example, self-esteem in the physical domain, referred to as physical self-worth, may vary across various subdomains, such as self-perceptions related to one's physical appearance, strength, or physical abilities. As one moves from the top to the baseline of the hierarchical structure, self-esteem becomes more variable (i.e., easier to change) and more situation specific. The exercise and self-esteem model (EXSEM; Sonstroem, Harlow, & Josephs, 1994; Sonstroem & Morgan, 1989) provides a useful framework for studying the mechanisms of the relationship between physical activity and self-esteem. In this model, positive changes in physical parameters associated with physical activity (e.g., increased fitness, reduced weight) are hypothesized to lead to increases in the perceptions of self-efficacy (i.e., beliefs in personal capabilities). Enhanced self-efficacy is then hypothesized to lead to enhanced self-perceptions in various physical subdomains (e.g., esteem relative to strength, endurance, body) which in turn increase global physical self-worth. Although self-efficacy was originally thought to mediate the effects of changes in physical outcomes and subdomain self-perceptions, McAuley et al. (McAuley et al., 2000, 2005) have presented evidence to indicate that self-efficacy may actually operate on a parallel level with physical activity outcomes, influencing global self-esteem through the mediation of subdomain self-perceptions and physical self-worth. Recent evidence additionally suggests that changes in physical parameters (e.g., fitness) may mediate the impact of physical activity on global self-esteem (Spence, McGannon, & Poon, 2005) or moderate the impact of physical activity on physical self-concept (Schneider, Dunton, & Cooper, 2008).

Several aspects of the EXSEM are of particular relevance for women during the menopausal transition. Women's perceptions of their body attractiveness have been shown to be particularly relevant for the formation of physical self-worth (Deeks, 2003; Harter, 1990, 1996). It has been suggested that for some women, physical appearance may be synonymous with physical or even global self-esteem (Davis, 1997; McAuley et al., 2000; Sonstroem et al., 1994). Outcomes such as weight loss or increased body attractiveness are also important motives for exercise participation and impact subsequent adherence rates (Davis, 1997; Davis, Fox, Brewer, & Ratusny, 1995; McAuley, Bane, Rudolph, & Lox, 1995). Because the menopausal transition leads to weight gain and increases in central adiposity, it may place women at increased risk for diminished self-esteem across the menopausal transition (Jones, 1994; Misra, Alexy, & Panigrahi, 1996; Wilbur, Miller, & Montgomery, 1995; Winterich & Umberson, 1999). Consequently, if physical activity can improve body composition outcomes, increase self-efficacy, and improve physical self-perceptions, it may represent the ideal self-esteem enhancing intervention strategy in this population.

However, surprisingly little research has been conducted examining the effects of physical activity on self-esteem in middle-aged women. Investigations conducted in menopausal women have focused primarily on postmenopausal women or on middle-aged women that were not representative of women across the menopause spectrum. In addition, the majority of these studies were cross-sectional and not always rooted in validated theoretical models. Longitudinal investigations of the physical activity and self-esteem relationship are scarce, and lacking, in particular, are long-term follow-up investigations of participants leaving

structured or formalized exercise programs. Other studies have documented decreases in intervention-produced gains in self-efficacy and self-esteem outcomes during as well as following the cessation of structured programs (Hallam & Petosa, 1998; McAuley et al., 2000; McAuley, Jerome, Marquez, Elavsky, & Blissmer, 2003) but more longitudinal data are needed to evaluate the magnitude of such potential losses and to shed light on how best to offset these reductions. Given the scarcity of studies and the increasing preference for natural approaches to menopause management among women, this study examined prospectively the relationship between physical activity, self-efficacy and multidimensional self-esteem in a sample of middle-aged women with mixed menopausal status. This is a 2-year follow-up study of women previously enrolled in a 4-month randomized controlled exercise trial. The results of this trial were previously reported (Elavsky & McAuley, 2007a), including its effects on multidimensional self-esteem (Elavsky & McAuley, 2007b). Briefly, the findings from the original randomized trial ($N = 164$) demonstrated a mode-specific effect of two structured exercise programs, walking and yoga, on self-esteem. Following the intervention, walking enhanced subdomain self-perceptions relative to physical condition ($d = .61$) and strength ($d = .32$) as compared with the yoga and control participants ($d = .30$ and $.03$ for yoga and $.23$ and $-.06$ for control in condition and strength subdomains, respectively). Walking ($d = .34$) and yoga ($d = .23$) participants also derived benefits in the body attractiveness subdomain compared with the control group ($d = .05$). There were no significant group differences in physical self-worth and global self-esteem following the intervention, although there was an indication of varying magnitude of effects across groups. Compared with yoga and control, the walking group showed small improvement in global self-esteem ($d = .25, .09, -.04$ for walking, yoga, and control, respectively) and the walking and yoga participants also showed a trend toward increases in physical self-worth ($d = .39, .32, .17$ for walking, yoga, and control, respectively). As predicted by the EXSEM, the effects of physical activity, self-efficacy, and body fatness on physical and global self-esteem were mediated by subdomain self-perceptions.

The purpose of this study is to (1) examine long-term changes in self-esteem following the original intervention and (2) test whether the same relationships among multidimensional self-esteem, physical activity, and self-efficacy hold up across a 2-year period following the end of the structured programs. Specifically, a longitudinal panel analysis framework was used to examine the fit of the EXSEM and its utility for describing how long-term changes in physical activity outcomes (i.e., energy expenditure, body mass index, self-efficacy) are related to changes in self-esteem at the subdomain, domain-specific, and global levels as a function of previous participation in a 4-month exercise intervention.

Method

Participants

The sample was composed of middle-aged (42–58 years of age at enrollment) women who previously participated in a 4-month randomized controlled exercise trial. The results from this trial have been published previously (Elavsky & McAuley, 2007a, 2007b). At study entry, the participants ($N = 164$) were sedentary or low active (i.e., exercising fewer than two times per week for 30 min or more at moderate intensity), experiencing menopausal symptoms (i.e., having experienced vasomotor symptoms such hot flashes or night sweats in the last month). Additional inclusion criteria included no history of surgical menopause and no hormone therapy (HT) use in the last 6 months. The recruitment resulted in a sample of relatively healthy and primarily white women (83%), the majority of whom were married or in significant relationships (75%), had college education (64%), and above average income (67%). Based on self-reported menstrual bleeding patterns at baseline of the exercise trial 17% of women were categorized as premenopausal, 41% as perimenopausal, and 32% as postmenopausal. The majority of women in the sample were overweight or obese (70% of

the women had body mass index of 25 kg/m^2 with mean value of 29.67, $SD = 7.06$) and the overall retention rate in the trial was 90%. Out of the 164 women originally enrolled in the study, complete end-of-program data were available for 134 women. Although 102 women agreed to take part in the 2-year follow-up survey, only 99 women actually returned the survey for an overall response rate of approximately 74%. This study includes data from all women who returned either end-of-program or 2-year follow-up questionnaires ($n = 143$).

Measures

Background Information—Basic demographic and health history information was collected including menopausal status which was assessed based on self-reported bleeding patterns and categorized according to the Stages of Reproductive Aging Workshop (STRAW) criteria (Soules et al., 2001) into premenopausal (normal menses during the last 12 months), perimenopausal (irregular or infrequent menses in the last 12 months), and postmenopausal stages (no menses for the last 12 months or longer).

Physical Activity and Body Mass Index—Physical activity was assessed by self-report utilizing the Aerobics Center Longitudinal Study Physical Activity Survey (ACLS; Kohl, Blair, Paffenbarger, Macera, & Kronenfeld, 1988). The ACLS questionnaire assesses frequency, duration, and intensity of 14 different physical activities and allows for calculation of metabolic equivalents of energy expenditure in reported activities. Physical activity was entered into the model as weekly energy expenditure in leisure-time physical activity only (i.e., household and lawn work/gardening activities were excluded) and expressed in MET hours per week. In addition to physical activity, body mass index (BMI) was computed from weight and height measured in the laboratory at the end of the trial and from self-reported weight and height in the follow-up survey.

Self-Esteem Measures—Global self-esteem and self-perceptions relative to the subdomain level (physical domain) were assessed using two standard instruments: the Rosenberg Self-Esteem scale (RSE; Rosenberg, 1965) and the Physical Self-Perception Profile (PSPP; Fox & Corbin, 1989). The PSPP is a 30-item instrument used to assess self-esteem relative to several domains of physical functioning in a hierarchical, multidimensional fashion. The instrument is composed of a general physical self-worth subscale (PSW) representing physical self-esteem and four specific subdomain subscales of perceived sport competence, physical condition, attractive body, and strength. Participants indicated on a 4-point scale (1 = *not at all true*; 4 = *completely true*) the degree to which each item was characteristic or true of them. The possible range of scores is 6–24 for each subscale. Because no relationship between changes in sport competence subdomain self-perceptions and physical self-worth was observed during the original intervention (Elavsky & McAuley, 2007b) and other research has suggested that the sport competence subdomain is generally of little relevance in the populations of middle-aged and older adults (McAuley et al., 2000; McAuley, Mihalko, & Bane, 1997), only the physical condition, strength, and body attractiveness subdomain self-perceptions subscales were included in this analysis. Internal consistencies for all PSPP subscales in the current study were good (Cronbach's $\alpha = .82, .86$ for condition; $.88, .90$ for body; $.89, .89$ for strength; and $.87, .90$ for physical self-worth at the end of program and 2-year follow-up, respectively).

The RSE is a well-validated measure of general self-esteem (Rosenberg, 1965) and has been widely used in several domains of self-esteem research including physical activity (Fox, 1997). Participants respond on a 5-point Likert scale to 10 items ranging from 1 (*strongly agree*) to 5 (*strongly disagree*). The coding of negative items was reversed and responses were summed to yield a total score ranging from 10 to 50. Internal consistencies in the

current study were good (Cronbach's α = ranged from .92 to .87 for end-of-program and 2-year follow-up assessments, respectively).

Self-Efficacy—A modified version of the Exercise Self-Efficacy scale (EXSE; McAuley, 1993) was used to assess participants' beliefs in their ability to continue exercising at least 3 hr per week on a regular basis at moderate intensities over weekly incremental periods of time within the next 2 months (i.e., for the next week, for the next 2 weeks, etc.). For each item, participants indicate their confidence to execute the behavior on a 100-point percentage scale comprised of 10-point increments, ranging from 0% (*not at all confident*) to 100% (*highly confident*). A self-efficacy score is then calculated by summing the confidence ratings and dividing by the total number of items in the scale, resulting in a maximum possible efficacy score of 100. Internal consistencies were good (Cronbach's α = .99 across time points).

Background information was assessed at the baseline of the original 4-month exercise trial and again at 2-year follow-up. Self-esteem, self-efficacy, and physical activity measures were administered at the end of the trial and at 2-year follow-up.

Procedure

All 164 women originally enrolled in the randomized controlled exercise trial were contacted 2 years following the end of the trial. All participants received a letter announcing the follow-up study and were contacted by telephone within 2 weeks of receiving the letter. The women who agreed to take part in the research were mailed a packet of questionnaires with prepaid postage and self-addressed return envelope. An incentive to participate was offered in the form of a lottery for one of four \$250 cash prizes. Participants were contacted at least three times by telephone with a reminder to complete the questionnaire and return it. The data were collected between January and November 2007 to correspond with the timing of women completing the intervention, which took place in waves.

Statistical Analysis

Demographic characteristics were compared between respondents and nonrespondents using independent sample *t* tests or chi-square tests in the case of categorical variables using the SPSS 16.0 statistical software package. The data were subsequently analyzed using a longitudinal panel analysis within a covariance modeling framework with the full-information maximum likelihood (FIML) estimator in Mplus 5.1 (Muthén and Muthén, Los Angeles, CA). FIML was selected because there were missing data, and the full-information estimator is an optimal method for the treatment of missing data (Arbuckle, 1996; Enders, 2001; Enders & Bandalos, 2001). Nine women did not provide data at the end of the program but provided data at the 2-year follow-up. Overall, at the 2-year follow-up there was 31% of self-efficacy and self-esteem and 32% of BMI data missing.

Subsequently, we tested a longitudinal panel model based on the hypothesized EXSEM structure. A longitudinal panel analysis framework enables an examination of both cross-sectional and longitudinal relationships simultaneously. The longitudinal component of the analysis tests relationships among changes in variables over time while controlling for the initial values of study variables by way of estimating stability coefficients. To assess the long-term impact of the original intervention, all postintervention variables in the tested model (Time 1 in this study) were regressed on an intervention group assignment variable (dummy coded) and indirect effects of intervention group assignment (through Time 1 values) were estimated on 2-year follow-up variables (Time 2). The tested model further specified hypothesized paths between: (a) physical activity, self-efficacy, and BMI and subdomain self-perceptions relative to physical condition, body attractiveness, and strength;

(b) subdomain self-perceptions and physical self-worth; and (c) physical self-worth and changes in global self-esteem. The hierarchical relationships tested are depicted in Figure 1. The top panel of Figure 1 represents the effects of intervention group on variables at Time 1 (i.e., immediately postintervention) and associations among Time 1 variables as specified by the EXSEM model. The bottom panel of Figure 1 shows parameter estimates that represent effects across time (i.e., effects on Time 2 through Time 1) while controlling for the stability of measurement across time (correlations between same variables) and relationships at baseline. In addition, stability coefficients (Kessler & Greenberg, 1981) were calculated representing the associations among each variable across time controlling for all other variables in the model. These are also presented in Figure 1. For the sake of presentation clarity, all parameter estimates for the direct (at Time 1) and indirect (Time 2) effects of intervention group assignment are presented separately in Table 2.

Model-data fit was assessed using standard indices: the chi-square statistic (Kessler & Greenberg, 1981); the standardized root mean square residual (SRMR, which should approximate or be less than .08 for a good fitting model; Bollen, 1989; Hu & Bentler, 1999); the root mean square error of approximation (RMSEA, with values approximating .06 or less being indicative of a close fit; Browne & Cudeck, 1993); comparative fit index (CFI, which should approximate or be .95 or better for a good fitting model; Bentler, 1990; Hu & Bentler, 1999). All path coefficients and correlations are reported as standardized estimates.

Results

Sample Description

The demographic characteristics of the sample at study enrollment were previously reported (Elavsky & McAuley, 2007a, 2007b). There were no statistically significant differences in demographic characteristics between those who responded to the 2-year follow-up survey and follow-up nonresponders. As with the original sample, the women who completed the follow-up were mostly white (87.9%) and well educated (68.7% with college or university degree) and had an annual family income more than \$40,000 (79.8%). At the 2-year follow-up, the distribution of self-reported menopause status was as follows: 12% premenopausal, 34% perimenopausal, 54% postmenopausal.

Examination of Long-Term Intervention Effects Within the Panel Model

Means and standard deviations for all variables across both time points are presented in Table 1. Postintervention effects on all EXSEM variables were assessed by regressing all Time 1 EXSEM variables on a dummy coded intervention group variable. Indirect effects (through Times 1 variables) of the intervention on Time 2 EXSEM variables were also estimated. The results are presented in Table 2 by intervention group (dummy coded with the control group as the reference group). Immediately postintervention, walkers in the follow-up sample tended to have more positive self-perceptions relative to physical condition ($\beta = 0.16$, $p = .054$) and yoga participants had lower self-efficacy ($\beta = -0.27$, $p < .001$). The remaining effects were mostly small and nonsignificant. The only statistically significant long-term effect of the intervention was in the yoga group where participants continued to experience decreases in self-efficacy across the 2-year follow-up period ($\beta = -0.12$, $p < .05$).

Examination of EXSEM Relationships Within the Panel Model

Bivariate correlations among all variables are also presented in Table 1. The initial test of the model fit the data well ($\chi^2 = 135.191$, $df = 92$, $p = .0023$; SRMR = 0.085, RMSEA = .057; CFI = 0.963). Although the value of the chi-square was statistically significant, the SRMR, RMSEA, and CFI satisfied the combinatorial criteria for good model-data fit (Hu &

Bentler, 1999). As can be seen in Figure 1, at the end of the program there were statistically significant path coefficients ($p < .05$) for direct effects of physical activity (.14), exercise self-efficacy (.49) and BMI (−.27) on the physical condition self-perceptions; BMI on attractive body (−.61) variables. There was also a weak relationship between BMI and strength self-perceptions ($\beta = -.14, p = .092$) and physical activity and strength self-perceptions ($\beta = .15, p = .094$). In turn, physical condition (.40), attractive body (.43), and strength (.15) self-perceptions were all significantly associated with physical self-worth, which had a direct effect on global self-esteem (.40). Although not depicted in Figure 1, all subdomain-level self-perceptions were significantly correlated.

Relative to the relationships among model components over time (i.e., changes across the 2-year follow-up period), increases in physical activity (.29), self-efficacy (.34) and decreased BMI (−.19) were significantly associated with improvements in physical condition. Decreases in BMI were associated with increases in self-perceptions relative to attractive body (−.31) and weakly also with increases in strength self-perceptions ($\beta = -.12, p = .095$), whereas increases in physical activity (.12, $p = .151$) showed a weak and nonsignificant association with increases in strength self-perceptions. At the subdomain level, increases in self-perceptions relative to physical condition (.21) and attractive body (.48) were significantly associated with increases in physical self-worth. Finally, increased physical self-worth was associated with improvements in global self-esteem (.25). Overall the model accounted for 32.5% and 83.9% of the variation in physical self-worth and global self-esteem at baseline and for 24.9% and 49.2% of the variation in changes in physical self-worth and global self-esteem across the 2-year follow-up period, respectively. All path coefficients with p -level $< .10$ are shown in Figure 1.

As noted, stability coefficients (i.e., relationships between the same variables at baseline and four months) were also calculated for all variables within the panel model. These were all significant and are presented in Figure 1. For sake of clarity, Figure 1 does not depict correlations among residual change in variables at the subdomain level (i.e., among changes in physical condition, body attractiveness, and strength self-perceptions). These were all significant at $p < .001$ (.54 and .56 for condition esteem with body attractiveness and strength self-perceptions, respectively; and .41 for body attractiveness with strength self-perceptions). In addition, physical activity was significantly associated with self-efficacy both at baseline (.39, $p < .001$) as well as over time (.45, $p < .001$).

Discussion

The North American Menopause Society (NAMS) advocates lifestyle changes such as physical activity as the first line of defense against the adverse consequences of menopause, including the management of weight, mental health, and mild to moderate menopausal symptoms (NAMS, 2004). Healthy self-esteem is an essential component of mental health and women who report low self-esteem also report more menopause-related distress (Hunter & Liao, 1995; Schneider, Schultz-Zehden, Rosemeier, & Behre, 2000) and poorer quality of life (Elavsky, 2009; Elavsky & McAuley, 2005). Physical activity has a direct impact on many adverse consequences of menopause and has been shown to enhance self-esteem. In the current study, the long-term effects of physical activity on multidimensional self-esteem were evaluated using the exercise and self-esteem model (Sonstroem et al., 1994) in a sample of middle-aged women previously enrolled in a 4-month randomized controlled exercise trial. In the original exercise trial (Elavsky & McAuley, 2007b), walking and yoga enhanced aspects of subdomain self-perceptions related to body attractiveness, and physical condition and strength (for walking only). There were no significant intervention effects in physical and global self-esteem as a result of the RCT. In this longitudinal analysis of the follow-up sample, the only statistically significant effects of the intervention group

assignment were on enhanced physical condition self-perceptions for walkers postintervention and on reductions in self-efficacy for the yoga group both postintervention and at 2-year follow-up. Although not statistically significant, examination of the mean scores by group across the 2-year follow-up period indicated that gains obtained during the walking and yoga interventions tended to dissipate somewhat over time. Whereas, on average, the walkers in the follow-up sample maintained or slightly increased body ($d = 0.02$) and global self-esteem ($d = 0.23$), the yoga participants tended to experience decreases across all domains (d s ranging from -0.07 to -0.23). Decreases in self-esteem levels over time may be expected following the cessation of structured exercise programs, especially if physical activity levels are not maintained. As part of the original intervention, participants received a packet of information including tips for maintaining their physical activity and a listing of local physical activity resources; however, incorporating training in cognitive-behavioral strategies or a booster follow-up intervention may be needed to maintain intervention gains over the long-term. Interestingly, control participants in the follow-up sample reported increases in all self-esteem variables (d s ranging from 0.20 to 0.55). These participants also appeared to maintain or slightly increase their physical activity. It is possible that participating in the RCT, albeit as a control participant, served as an impetus for the women to make lifestyle changes. Alternatively, the high levels of physical activity may be the result of a reporting bias, or the group differences may have been magnified due to uneven numbers across groups in the follow-up sample. That is, the number of participants eligible for the follow-up study was uneven across the three intervention groups (walking = 56, yoga = 51, control = 36), which may have impacted the results and should thus be interpreted with caution.

With respect to the EXSEM structure, in the 2-year follow-up study indirect effects of physical activity outcomes on physical and global self-esteem were observed. That is, at the end of the trial, more physically active and efficacious women with lower BMI reported higher levels of physical condition self-perceptions and women with lower BMI also higher body attractiveness self-perceptions, both of which were associated with higher levels of physical self-worth which was related to global self-esteem. Across the 2-year follow-up period, increases in physical activity and self-efficacy and decreases in BMI led to increases in subdomain self-perceptions relative to physical condition and body attractiveness (for BMI only), changes which led to enhancements in physical self-worth and subsequently also global self-esteem.

Overall, these results appear to support the hierarchical structure postulated by the EXSEM but several differences between the original exercise trial findings and the long-term follow-up results should be noted. In the EXSEM analysis of the exercise trial data, body fatness was used as an indicator of body composition and was consistently related to physical condition, body, and strength self-perceptions at both baseline and across the intervention. In this follow-up study BMI was used as a body composition proxy and although it was associated with physical condition and body self-perceptions, its association with self-perceptions of strength failed to reach statistical significance both at the end of the trial and over time. Body fatness may be a more meaningful determinant of strength subdomain self-perceptions than weight status alone. Whereas BMI is useful for determining weight categories which have been associated with differential disease risk, it is a poor indicator of body fatness (Ode, Pivarnik, Reeves, & Knous, 2007) and this measurement issue may be compounded in menopausal women (Movsesyan, Tankó, Larsen, Christiansen, & Svendsen, 2003). Whenever possible, future studies should incorporate more direct measures of adiposity as these may be more strongly correlated with physical activity than weight status alone, especially in studies involving mixed samples of both men and women (Ball, Owen, Salmon, Bauman, & Gore, 2001).

Both during the original exercise trial and across the 2-year follow-up, self-efficacy operated on a parallel level with physical activity outcomes, supporting evidence from other studies involving older adults (McAuley et al., 2000, 2005). In addition, in the follow-up study, self-efficacy was associated with physical condition self-perceptions more strongly than physical activity or BMI, a finding that is in line with the specificity principle of the social cognitive theory (Bandura, 1986, 1997). That is, based on this principle self-efficacy should be more strongly associated with outcomes reflected by the specific efficacy measure used. Similarly to previous studies (Elavsky & McAuley, 2007b; McAuley et al., 2000, 2005), both self-efficacy and physical activity were more strongly associated with physical condition self-perceptions than with self-perceptions of attractive body (or strength) (i.e., outcomes related to exercise self-efficacy and physical activity but less so than the more conceptually related physical condition).

Interestingly, changes in strength self-perceptions were unrelated to changes in physical self-worth across the 2-year follow-up period. Although this is contrary to past studies involving older adults (McAuley et al., 2000, 2005), the same finding was observed during the exercise trial and it has been previously argued that such differences may be population specific (Elavsky & McAuley, 2007b). This study included mostly overweight but overall healthy middle-aged women. These were generally well functioning women for whom self-perceptions of strength may not be central to their judgments of self-worth. It is possible that self-perceptions of strength increase their influence on judgments of physical self-worth in older age when decrements in function become apparent. In younger women, body or weight-related motives are cited as common exercise adoption motives and perceptions of body attractiveness are thought to be of particular relevance to physical self-worth of women (Davis, 1997; Harter, 1990, 1996). In this study BMI was consistently correlated with subdomain level self-perceptions and body attractiveness self-perceptions had the most robust association with physical self-worth both at the end of the program and over time. Although it is important to tailor physical activity interventions to capitalize on those aspects of self-perceptions that are of greatest relevance and value to an individual's self-esteem (McAuley & Elavsky, 2006), some evidence suggests that in middle-aged women physical activity goals focused primarily on body or weight-related motives may actually decrease physical activity; instead, wellbeing or quality of life enhancing motivations should be emphasized to achieve long-term physical activity maintenance (Segar, Eccles, & Richardson, 2008; Segar, Spruijt-Metz, & Nolen-Hoeksema, 2006).

To our knowledge, this is the first examination of the EXSEM in middle-aged women across a long-term follow-up period. Unfortunately, BMI was the only physical parameter available and this study did not assess other physical components such as fitness, strength, or flexibility. Future studies should incorporate various physical indicators so that their impact on self-esteem can be determined. In addition to selecting direct measures of physical parameters, researchers should consider examining alternative pathways through which physical activity outcomes may impact self-esteem. For example, in a recent study involving a 9-month school-based physical activity intervention with adolescent females, Schneider et al. (2008) have shown that cardiorespiratory fitness may interact with physical activity such that increases in global physical self-worth are likely to occur in those participants who also increase their fitness. This finding is in line with the results of a meta-analysis of self-esteem studies in adults where Spence et al. (2005) demonstrated that fitness mediated the effects of exercise on global self-esteem. In the current study, physical activity and BMI appeared to exert independent influence on physical and global self-esteem that was mediated by physical subdomain specific self-perceptions; however, future studies should seek to examine the mediation/moderation effects by physical parameters more systematically. Perhaps there is yet a more important issue that deserves further consideration. As with any theoretical model, the EXSEM model proposes that physical activity influences self-esteem

in an explicitly defined causal order. It is conceivable, however, that global self-esteem also influences physical self-esteem, which in turn ultimately determines physical activity engagement. The objective of this study was to test the tenets of the EXSEM model in middle-aged women but the possibility of a misspecified (or bidirectional) causal ordering must be acknowledged. When the bottom-up versus top-down ordering of the EXSEM structure was compared in this study, both models fit the data well and the χ^2 difference test failed to reach statistical significance ($p = .07$). In the bottom-up model, Time 2 higher order constructs were regressed on Time 1 lower order constructs ($\chi^2 = 24.610$, $df = 23$, $p = .3707$; SRMR = 0.070, RMSEA = 0.022; CFI = 0.997). The alternative top-down model specified paths in the opposite direction with global self-esteem at Time 1 influencing physical self-worth at Time 2, physical self-worth at Time 1 impacting subdomain self-perceptions at Time 2, and subdomain self-perceptions at Time 1 influencing physical activity, self-efficacy, and body mass index at Time 2 ($\chi^2 = 45.769$, $df = 36$, $p = .1275$; SRMR = 0.048, RMSEA = 0.044; CFI = 0.985). In the bottom-up model, self-perceptions of physical condition at Time 2 were influenced by Time 1 physical activity (.15) and BMI (–.14); body attractiveness at Time 2 was influenced by Time 1 BMI (–.13) and marginally also physical activity (.10); and self-perceptions of strength at Time 2 were influenced by Time 1 physical activity (.16). Only self-perceptions of body attractiveness at Time 1 influenced physical self-worth at Time 2 (.21). In the top-down model, there were significant associations only between physical self-worth at Time 1 and subdomain self-perceptions at Time 2 (.24 for both physical condition and body attractiveness and .29 for strength). While top-down ordering or bidirectional effects cannot be discounted as alternative explanation based on these results, the pattern of associations also indicates the possibility that the directionality of effects may operate differently at different levels of the EXSEM hierarchy. That is, it is possible that the base of the EXSEM hierarchy operates in a bottom-up manner, with physical parameters influencing subdomain physical self-perceptions. At the subdomain level, both bottom-up and top-down influences are likely. No significant associations between physical self-worth and global self-esteem were observed in either of the tested time-lagged models, warranting the need for more longitudinal and experimental studies investigating causal sequencing of these effects.

At the 2-year follow-up physical activity and BMI were assessed by self-report which is prone to recall and response biases. It should be noted, however, that although self-reported BMI is considered an imprecise measure of weight status, the correlations between measured and self-reported BMI are relatively high in diverse samples ($r > .90$) and self-reported BMI correlates equally with disease biomarkers, making it an acceptable measure (McAdams, Van Dam, & Hu, 2007). The correlation between self-reported BMI at 2-year follow-up and objectively measured BMI at the end of the trial was reasonably high in this study ($r = .89$). In addition to the limitations inherent in self-report, physical activity assessment in this study included estimates for leisure-time activities only, without corroboration of other physical parameters such as fitness. A measure of fitness (peak oxygen uptake) was included in the exercise trial but it was not associated with subdomain self-esteem in the EXSEM analysis of the trial data. Although objective physical activity monitoring was included for a subsample of the follow-up respondents, the data were not available at both time points and could not be entered into the model. The correlation between self-reported energy expenditure and objectively measured physical activity in this study was moderate ($r = .40$ – $.54$ for activity of different intensities) but corresponds with values reported in the general physical activity literature.

The critical issue of the importance of valid measurement of physical activity outcomes extends to the assessment of self-efficacy and self-esteem. Self-efficacy and self-esteem represent conceptually and theoretically distinct constructs, yet in the physical activity literature their measurement often overlaps (Feltz & Chase, 1998). For example, concerns

have been voiced about the Physical Self-Efficacy Scale (Ryckman, Robbins, Thornton, & Cantrell, 1982) as a measure of self-efficacy, both along the lines of its psychometric properties (Motl & Conroy, 2000) as well as its item content which was shown to reflect self-esteem rather than self-efficacy (Hu, McAuley, & Elavsky, 2005). Researchers are urged to scrutinize their measures of choice closely, to ensure they are adequately capturing self-efficacy and self-esteem as distinct constructs.

It should also be noted that the study is based on a volunteer sample originally recruited to participate in a free exercise program involving either a walking, yoga, or control group. Only those who agreed to be randomized were admitted into the study, which along with other exclusionary criteria implemented in the exercise trial may have biased our sample. The majority of participants were white, well educated, of above-average socioeconomic status, and overall healthy, limiting the generalizability of results. The follow-up survey response rate, although in line with other survey research, was less than optimal and subsequently a significant portion of the data had to be estimated, which may have biased our results away from the null hypothesis. Nonetheless, this study represents the longest follow-up examination of the self-esteem and physical activity relationship in a well-characterized sample of middle-aged women with known menopausal status. Although further evaluations of the utility of the EXSEM are needed in larger and more diverse samples of menopausal women, this study demonstrated positive long-term effects of physical activity on self-esteem and provided additional support for the hierarchical and multidimensional nature of self-esteem.

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Figure 1.

Panel model depicting effects of intervention group assignment on Time 1 (postintervention) EXSEM variables (top panel) and relationships among EXSEM variables at Time 2 (2-year follow-up; bottom panel). *Note.* Solid lines represent relationships statistically significant at $p < .05$. Dashed lines represent relationships approaching statistical significance with $p < .10$.

Bivariate Correlations Among All Variables (Stability Coefficients) at the End-of-Trial and the 2-Year Follow-Up Assessments

Table 1

Variable	Descriptive		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	M	SD																		
End of Trial																				
1. Global self-esteem	40.61	6.96	1.00																	
2. Physical self-esteem	13.11	3.95	0.41**	1.00																
3. Condition esteem	12.79	3.75	0.21*	0.73**	1.00															
4. Body esteem	12.28	4.19	0.29**	0.73**	0.61**	1.00														
5. Strength esteem	12.58	4.12	0.07	0.52**	0.51**	0.40**	1.00													
6. Physical activity	7.28	8.87	0.08	0.19*	0.34**	0.06	0.18*	1.00												
7. Self-efficacy	51.94	34.97	0.16	0.27**	0.56**	0.14	0.16	0.39**	1.00											
8. Body mass index	28.40	6.16	0.00	-0.37**	-0.27**	-0.59**	-0.13	0.00	-0.06	1.00										
9. Walking ^a	—	—	0.02	0.08	0.20*	0.05	0.06	0.10	0.14	0.08	1.00									
10. Yoga ^a	—	—	-0.05	-0.12	-0.16	-0.09	-0.13	-0.03	-0.26**	-0.03	—	1.00								
2-Year Follow-Up																				
11. Global self-esteem (0.60)	41.54	6.34	0.67**	0.35**	0.19	0.30**	0.16	0.01	0.14	-0.07	0.02	-0.15	1.00							
12. Physical self-esteem (0.29)	12.70	4.14	0.33**	0.72**	0.53**	0.63**	0.43**	-0.03	0.12	-0.37**	-0.07	-0.20*	0.45**	1.00						
13. Condition esteem (0.35)	12.46	4.13	0.16	0.50**	0.60**	0.46**	0.42**	0.22*	0.36**	-0.33**	0.07	-0.24*	0.33**	0.70**	1.00					
14. Body esteem (0.53)	12.28	4.52	0.33**	0.60**	0.41**	0.75**	0.28**	0.04	0.08	-0.53**	-0.03	-0.21*	0.45**	0.81**	0.61**	1.00				
15. Strength esteem (0.66)	12.08	4.12	0.19	0.58**	0.52**	0.42**	0.74**	0.19	0.19	-0.17	-0.14	-0.15	0.27**	0.62**	0.66**	0.50**	1.00			
16. Physical activity (0.32)	11.03	10.78	0.12	0.11	0.16	0.11	0.12	0.35**	0.17	-0.14	0.07	-0.13	0.21*	0.27**	0.52**	0.21*	0.24*	1.00		
17. Self-efficacy (0.43)	50.97	35.70	0.07	0.93	0.32**	0.11	0.23*	0.19	0.44**	-0.15	0.11	-0.13	0.14	0.17	0.58**	0.13	0.26*	0.46**	1.00	
18. Body mass index (0.88)	27.79	6.34	-0.10	-0.40	-0.27*	-0.55**	-0.11	-0.04	-0.08	0.89**	0.10	0.04	-0.20	-0.47**	-0.37**	-0.58**	-0.19	-0.22*	-0.14	1.00

Note.

* $p < .05$;

** $p < .01$;

^a dummy coded with control as the reference group.

Table 2

Parameter estimates for intervention effects

Dependent Variable	Walking ^a				Yoga ^a					
	R ² Change	β	SE	Critical Value	p-Value	R ² Change	β	SE	Critical Value	p-Value
Direct Effects at T1										
Physical activity	0.018	0.133	0.105	1.269	0.205	0.002	0.047	0.106	0.439	0.660
Self-efficacy	0.000	0.000	0.102	-0.004	0.997	0.070	-0.265*	0.100	-2.642	0.008
BMI	0.011	0.103	0.106	0.972	0.331	0.001	0.036	0.106	0.343	0.732
Physical condition	0.026	0.160	0.083	1.930	0.054	0.002	0.044	0.085	0.517	0.605
Attractive body	0.003	0.055	0.086	0.639	0.523	0.004	-0.062	0.087	-0.706	0.480
Strength	0.003	-0.057	0.103	-0.550	0.582	0.012	-0.111	0.105	-1.056	0.291
Physical self-worth	0.001	-0.037	0.062	-0.601	0.548	0.000	-0.017	0.061	-0.279	0.780
Global self-esteem	0.000	-0.001	0.097	-0.013	0.990	0.000	0.004	0.097	0.042	0.967
Indirect Effects at T2 (Through T1)										
Physical activity	0.002	0.043	0.036	1.196	0.232	0.000	0.015	0.034	0.436	0.663
Self-efficacy	0.000	0.000	0.044	-0.004	0.997	0.013	-0.115*	0.049	-2.361	0.018
BMI	0.008	0.091	0.093	0.971	0.332	0.001	0.032	0.093	0.342	0.732
Physical condition	0.002	0.048	0.058	0.830	0.407	0.005	-0.072	0.058	-1.240	0.215
Attractive body	0.001	-0.027	0.077	-0.357	0.721	0.004	-0.062	0.077	-0.808	0.419
Strength	0.002	-0.039	0.073	-0.535	0.592	0.009	-0.094	0.073	-1.278	0.201
Physical self-worth	0.000	-0.003	0.075	-0.045	0.964	0.008	-0.088	0.075	-1.199	0.242
Global self-esteem	0.000	0.001	0.073	0.020	0.984	0.002	-0.048	0.073	-0.653	0.514

Note.

* statistically significant at $p < .05$;

^a dummy coded with control as the reference group.