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# Social Relations, Physical Activity, and Well-Being in Older Adults[1]

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***Background.*** **A randomized controlled trial was conducted to examine: (a) the effect of two physical activity modes on changes in subjective well-being (SWB) over the course of a 12-month period in older, formerly sedentary adults (*N* = 174, *M* age = 65.5 years) and (b) the role played by physical activity participation and social support in changes in SWB over time.**

***Method.*** **Participants were randomized into either an aerobic activity group or a stretching and toning group. Structural equation modeling was employed to conduct multiple sample latent growth curve analyses of individual growth in measures of SWB (happiness, satisfaction with life, and loneliness) over time.**

***Results.*** **A curvilinear growth pattern was revealed with well-being significantly improving over the course of the intervention followed by significant declines at the 6-month follow-up. Subsequent structural analyses were conducted showing that frequency of exercise participation was a significant predictor of improvement in satisfaction with life, whereas social relations were related to increases in satisfaction with life and reductions in loneliness. Improvements in social relations and exercise frequency also helped to buffer the declines in satisfaction with life at follow-up.**

***Conclusions.*** **It appears that social relations integral to the exercise environment are significant determinants of subjective well-being in older adults. Findings are discussed in terms of how physical activity environments might be structured to maximize improvements in more global well-being constructs such as satisfaction with life.** 

***Key Words:*** **exercise; aging; psychological well-being; controlled trial.**

## INTRODUCTION

A considerable literature exists that suggests physical activity participation to be associated with an improved sense of psychological well-being. Indeed, over 90 reviews have been published in this area [*1*]. Although the mechanisms underlying the association between well-being and physical activity are not well defined, there appears to be a fairly consistent association reported between these variables. In a recent review of 38 studies of physical activity effects on psychological well-being in older adults, McAuley and Rudolph [*2*] concluded that the relationship was consistent across age and gender, that it was unclear as to the effect that physical fitness had on this relationship, and that the measurement of psychological well-being was inconsistent.

Relative to this latter point, psychological health can be conceptualized as having both negative and positive affective poles, which can be characterized as psychological distress (e.g., depression, anxiety) and psychological well-being (e.g., positive affect) [*3,4*]. The majority of this literature with respect to older adults has focused on the reduction of negative symptomology and, very often, employed aerobic exercise as the mode of activity. We suggest that two elements be considered here. First, the understanding of psychological health necessitates a multidimensional approach that assesses the absence of negative affect, presence of positive affect, and satisfaction with one's life [*5*]. These affective and cognitive components of well-being are often collectively referred to by the umbrella term of subjective well-being (SWB; [*5*]). Although the SWB collective has been examined across a broad array of environments [*6*], typically only individual affective components (e.g., positive affect, well-being) are measured in physical activity research.

The second issue with respect to SWB and its relationship with physical activity concerns the role played by differential modes of activity. Although McAuley and Rudolph [*2*] have concluded that physical fitness per se

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is not implicated in physical activity effects on well-being in older adults, much of this literature employs only aerobic conditioning modes of activity (e.g., walking, jogging). Thus, it is concluded that aerobic activity has a beneficial effect on psychological or subjective well-being. Whether this effect is similar for nonaerobic forms of activity has not yet been determined. However, such a determination has obvious important implications for older adults who may be unable to engage in more intense types of activity. Moreover, if less intense modes of activity also result in similar improvements on measures of well-being, this would provide further evidence to suggest that vigorous aerobic activity is not necessary for important psychological benefits to occur. Certainly, others have suggested that psychological outcomes can be improved regardless of exercise format [*7*].

In addition to identifying how different modes of activity influence SWB, it is equally important for us to try to determine what factors underlie any change in SWB brought about by physical activity participation. The literature in this area has hypothesized a number of different mechanisms that may be at work including physiological (e.g., catecholamines, endorphins), psychological (e.g., distraction, mastery), and environmental factors (e.g., social interaction). The majority of empirical examinations of the factors underlying physical activity effects on psychological health have focused on individual difference variables (e.g., efficacy, self-motivation) rather than changes in perceptions that might be brought about by the exercise group, a potentially influential environmental factor. Indeed, most exercise interventions are conducted in group settings which maximize the opportunities for social interaction to take place and thereby the development of important social support networks. Certainly, there is evidence to indicate that social support plays an important role in adherence to physical activity. For example, the support of family members has been associated with adherence to activity regimens in clinical settings [*8*]. Duncan and his colleagues [*9,10*] have reported data from exercise trials involving older adults that have shown social support to be indirectly related to exercise behavior through its influence on self-efficacy [*9*] and self-efficacy and hardiness [*10*]. However, there is little empirical evidence to suggest a link between social support and SWB improvements that have resulted from extended exercise programs.

In many ways, this is quite surprising when one considers that there is increasing evidence to support the general link between social support and well-being. Indeed, social support, much like physical activity, has been demonstrated to have beneficial effects on an array of physical health outcomes including improvements in endocrine, immune, and cardiovascular function [*11*]. In addition, social support networks have been identified as important influences on a number of psychological outcomes [*12*]. For example, the existence of stronger levels of social support has been associated with both the affective [*13*] and cognitive [*14*] components of SWB. Social support has been consistently identified as an important determinant of both physical and emotional well-being in the elderly [*15,16*]. Indeed, a recent report has identified reduction in the numbers of social contacts over time as an important predictor of cognitive declines in the elderly [*17*]. Given such findings, it would be reasonable to assume that the interactive nature of group exercise environments serves to foster the development of social relations and support systems and that such influences might operate independently of any physical activity influence on SWB.

In an attempt to address some of these issues, we conducted a randomized controlled trial to examine the effects of differential modes of physical activity (light to moderate intensity walking and a stretching/toning condition) on several components of subjective well-being. Specifically, we contrasted the effects of the two exercise programs on measures of SWB over a 12-month period collecting measures at three time points: baseline; at the end of the 6-month exercise intervention; and at 6 months of follow-up beyond the intervention. It was expected that the influence of the physical activity interventions on well-being would exhibit a curvilinear pattern of growth over time. That is, a 6-month program of exercise would result in enhanced well-being with reductions in these gains over the 6-month follow-up period. Moreover, we were interested in determining whether this pattern would be consistent for both modes of activity. Given the nature of group physical activity interventions, a second purpose of this randomized controlled trial involved determining whether changes in social support, as a function of being part of an exercise group, contributed to changes in SWB parameters over and above any effects of physical activity participation.

## 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) age 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 [*18*], and (f) willingness to be randomly assigned to a 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. Six months after the completion of the trial 116 individuals (67%) returned for physiological assessment and 152 respondents (87%) 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 using a modification of the baseline-adaptive randomization scheme of Begg and Iglewicz [*19*]. Medication use was employed as the baseline binary variable distinguishing the use or nonuse of each of four major medication classes (cardiovascular, neuroleptic, anxiolytic, and antidepressant). This process was then implemented within each stratum of important baseline variables (e.g., gender and age), thus minimizing differences between groups. The procedure is further elaborated in McAuley et al. [*20*]. Details of medication use across groups can be found in Table 3.

### *Treatment Conditions*

*Aerobic exercise group.* The aerobic exercise intervention was designed to influence physical fitness as typified by cardiorespiratory endurance (see [*21*] for details of these effects). The exercise classes were conducted by trained exercise specialists and employed brisk walking as the aerobic component. The exercise program was conducted three times a week for 6 months. With respect to the exercise prescription, the intensity level began at light levels (50–55% $VO_{2max}$) and gradually increased to more moderate levels (65% $VO_{2max}$) by the midpoint of the program. Levels of intensity were prescribed based upon maximal responses during physiological testing and monitored via heart rate (Karvonnen method) and ratings of perceived exertion. Additionally, duration of exercise was also gradually increased beginning at 10–15 minutes per session and increasing by a minute per session until participants were exercising for 40 minutes per session.

*Stretching and toning control group.* This group met three times per week for 6 months under the supervision of an experienced exercise leader in a large gymnasium. 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 s. Each stretching/toning session lasted for approximately 40 minutes with 10-minute warm-up and cool-down periods [*22*].

### *Measures*

*Demographics and health and physical activity history.* Each subject completed an inventory providing demographic information and details of their medical history and lifestyle/exercise habits prior to participation in the physical fitness assessment. The health information obtained was used for four purposes: (1) to assess the individual's risk of cardiovascular disease; (2) to determine supervisory requirements for exercise testing and training; (3) to identify potential contraindications for participation in the study; and (4) to ascertain the physical activity histories of all subjects. Determination of the above was based on the criteria established by the American College of Sports Medicine Guidelines for Exercise Testing and Training [*22*].

### *Measures*

*Exercise frequency.* Frequency of exercise participation was assessed by having participants complete an exercise log at the end of every scheduled exercise session during the program. Participants indicated on the log the number of minutes they had been active plus their resting and exercise heart rates. For the purpose of analyses, frequency was defined as the number of times during the 6 months that they had exercised within the group setting.

*Subjective well being.* Deiner [*5*] has argued that assessments of subjective well-being should comprise affective and cognitive components. In the present study, we employed two affective measures assessing happiness and loneliness and a cognitive measure assessing satisfaction with life. *Happiness* was assessed by the Memorial University of Newfoundland Scale of Happiness (MUNSH) developed by Kozma and Stones [*25*]. The MUNSH is a 24-item measure comprised of four subscales, Positive Affect (PA), Negative Affect (NA), Positive Experiences (PE), and Negative Experiences (NE). A total happiness score is attained by the formula PA − NA + PE − NE. As this approach can result in negative numbers, we added a constant of (+20) to the score as recommended by McNeil [*24*], thus giving a scoring range of 0–44. The scale was developed as a measure of happiness in the elderly and has been validated in a variety of settings [*25,26*]. Internal consistency for the MUNSH in the present study ranged from $\alpha = 0.84$ to 0.90. Loneliness was measured with with UCLA Loneliness Scale [*27*]. This measure is considered the "gold standard" of loneliness measures and is a 20-item scale ranging from 20 to 80. Internal consistency for this scale in the present study ranged from $\alpha = 0.92$ to 0.94.

*Satisfaction with life.* Satisfaction with life was measured by the Satisfaction with Life Scale (SWLS) of Diener et al. [*28*]. This measure was designed to assess an individual's global judgment of life satisfaction by allowing the respondent to weight the importance of life domains in accordance with his or her own values and standards. The SWLS is a 5-item scale with values ranging from 1 to 35. Internal consistency for the SWLS in the present study ranged from $\alpha = 0.87$ to 0.92.

*Social support.* The Social Provisions Scale (SPS; [*29*]) was employed to assess social relations/support in the exercise groups. In a manner similar to that of Duncan and McAuley [*9*], we modified the wording of the items slightly to reflect social provisions that were supplied by the exercise group as opposed to more general assessments of support. The SPS is composed of 24 items with 4 items each reflecting the social provisions proposed by Weiss [*30*]: social integration, reassurance of worth, reliable alliance, opportunity for nurturance, and guidance. For the purpose of analyses in the present study, we combined the scores from these subscales to create an overall social support score ranging from 24 to 96. There is precedent for such action, as Cutrona and Russell [*29*] have shown the SPS to be adequately represented by a second-order single factor on which each of the provisions load. Cutrona and Russell [*29*] have concluded that the SPS assesses both specific components and overall levels of social support. Internal consistency for the total SPS in the present study ranged from $\alpha = 0.83$ to 0.90.

### *Procedures*

Baseline assessments of well-being, demographic information, physical activity, and general medical history were mailed to participants at entry into the trial and returned prior to initial physiological testing. Following this testing, participants embarked on a 6-month exercise program (either walking or stretching and toning). Two weeks into the program, participants completed the Social Provisions Scale. This 2-week time frame allowed participants an initial time period in order to get to know other group members and thereby to make an accurate assessment of initial levels of social support within the exercise group. Physical activity logs were completed on a daily basis by participants and verified by the exercise leaders, allowing us to accurately determine frequency of physical activity participation in the program. The measures of exercise social provisions and well-being were once again completed in the final week of the intervention. Finally, at 6 months beyond the termination of the intervention, participants completed the well-being measures and returned them 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 well-being data, there were 12.1 and 18.4% missing MUNSH data, 18.4 and 25.3% missing SWLS data, and 6.3 and 13.2% missing UCLA data at 6 and 12 months, respectively. In terms of social support, there were 17.2% missing data at the end of the intervention. Rather than discarding potentially useful data and increasing the likelihood of sampling bias if the missing data were not missing completely at random [*31*], we employed a raw maximum likelihood estimation procedure implemented in the structural equation modeling program AMOS [*32*]. In this procedure, the log-likelihood of the data is calculated providing reliable standard errors for the missing data case. 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 well-being over time and (b) to what extent changes in social relations as a function of the exercise intervention and frequency of exercise participation influenced growth in well-being.[5] Because we have repeated measures over time, we elected to

[5] Initial analyses included age, gender, and measures of physical fitness change (e.g., maximal aerobic capacity, time on treadmill) as covariates. However, none of these parameters was significant predictors and they were subsequently dropped from further analyses.

employ latent growth curve methodology within a multiple samples framework to examine developmental growth over the course of the trial and follow-up (see [*33–36*]). 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 data of interest as opposed to the original data [*33*]. 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 [*34*]. In addition, LGM allows one to examine, in a structural equation fashion, the extent to which predictor variables influence rate of growth in individual differences [*33*]. For a more thorough exposition of LGM approaches the reader is directed to Duncan, Duncan, et al. [*37*].

Initial attempts to fit an associative model with a common intercept and slope for each measure of well-being proved unsuccessful due to high levels of multicollinearity after correction for measurement error. Therefore, we employed a latent growth curve associative model that was analogous to a doubly multivariate repeated measures analysis of variance. In essence, this is a saturated three-factor growth model which is fit to each of the measures of well-being testing a quadratic function for each measure. As noted earlier, we conducted these analyses in a multiple sample framework. The initial model tests the growth curve of the measures but fixes the means of each measure to be equal across the two intervention conditions. Subsequent analyses systematically estimated the means for each measure across the two conditions and conducted a $\chi^2$ test to determine whether means were significantly different across the groups.

In the second stage of our analyses, we examined structural models which examined the influence of exercise frequency and changes in social relations over the course of the program on overall growth in the well-being measures. The fit of all models in our preceding analyses was tested by calculation of the $\chi^2$ goodness-of-fit test, the comparative fit index (CFI), and the root mean square error of approximation (RMSEA), which takes into consideration model complexity. A nonsignificant $\chi^2$ value, a CFI value $>0.90$, and a RMSEA value $<0.05$ are all considered indicative of a well-fitting model.

## RESULTS

Of the initial 174 participants entering the trial, 153 individuals completed the 6-month exercise program for an overall adherence rate of 88%. Attendance rates did not differ significantly between treatment conditions ($t = 0.88$, $P > 0.30$). 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. 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 $P > 0.10$). Physiological changes brought about by the exercise program are documented in Boileau et al. [*21*].

### *Estimating Growth in Subjective Well-Being*

Tests of the latent growth curve associative model fit were very good: $\chi^2$ (60, $N = 174$) = 74.06, $P$ = ns, CFI = 0.97, RMSEA = 0.037. Subsequent tests of group differences in growth of the well-being means were all nonsignificant, indicating that the estimation of equal means across treatment groups represented the most parsimonious model. The means and standard errors for each level of well-being at baseline and at 6 and 12 months are shown in Table 3. Specifically, these parameters demonstrate a significant increase in happiness and satisfaction with life at the end of the exercise intervention, followed by a significant decrease in these constructs at 12 months. Indeed, these values at 12 months have dropped marginally below baseline levels. With respect to loneliness, improvements are indicated by a significant decrease at the end of the intervention with a small but significant increase being apparent at 12 months. In essence, the latent growth curve estimates take on a curvilinear growth pattern with both exercise groups exhibiting significant linear improvements in SWB parameters following completion of the intervention followed by significant declines at the 6-month follow-up.

### *Effects of Physical Activity Participation and Social Support on Growth in Well-Being*

The associative model tested above gives us a good representation of the general shape of growth in well-being over the 12-month period comprising the exercise intervention and subsequent follow-up. In the structural model, we tested the relative contributions of the frequency of exercise participation and changes in social support over the 6-month exercise trial to changes in each of the measures of well-being. We employed the simple change score of the postintervention social support measure minus baseline support. This change in social support and frequency of exercise participation were then set to load on changes in well-being at 6 and 12 months. We also allowed baseline social support 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] | 0.42 | (0.08) | 0.42 | (0.08) | 0.41 | (0.07) |
| $VO_{2peak}$ (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 | (0.09) | 1.05 | (0.10) | 1.03 | (0.09) |
| 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 $N = 171$, aerobic $n = 86$.
[b] Total $N = 153$, aerobic $n = 73$, toning $n = 80$.

covary with baseline status of well-being and load on changes in well-being. The overall fit of the model was tenable: $\chi^2$ (93, $N = 174$) = 129.33, $P$ = ns, CFI = 0.92, RMSEA = 0.05. However, none of the predictor variables were significantly related to changes in happiness, as measured by the MUNSH. Therefore, we deleted the paths to happiness and reestimated the model with changes in satisfaction with life and loneliness as the dependent variables. This model was also tenable: $\chi^2$ (60, $N = 174$) = 53.61, $P$ = ns, CFI = 0.94, RMSEA = 0.01. Figure 1 provides a simplified path model of these analyses showing significant path coefficients between changes in social support and exercise frequency and changes in well-being.

As can be seen, individuals who exercised more often during the program also realized greater increases in satisfaction with life over the 6-month program ($\beta = 0.30$, $P < 0.05$) and significantly smaller declines in satisfaction with life over the follow-up period ($\beta = -0.24$, $P < 0.05$). However, frequency of physical activity was not significantly related to changes in loneliness at either time point. Increases in social support during the exercise program were related to improvements in satisfaction with life over this period ($\beta = 0.19$ $P < 0.05$) and to smaller declines at follow-up ($\beta = -0.22$, $P < 0.05$). Higher levels of initial social support ($\beta = -0.21$, $P < 0.05$) and changes in social support ($\beta = -0.10$, $P < 0.05$) were associated with reductions in loneliness over the intervention period. Additionally, participants with greater levels of social support at the program onset were less likely to experience increases in loneliness during follow-up. Overall, physical activity and social support accounted for 12.4 and 12.7% of the variation in satisfaction with life and 3.1 and 5% of the variation in loneliness at program end and follow-up, respectively.

### *Summary*

Our overall findings with respect to physical activity effects on SWB are suggestive of a curvilinear growth function in which exposure to physical activity programs leads to increased happiness and satisfaction with life and decreased loneliness over the 6-month intervention period. However, these improvements in SWB appear to be reversed at the 6-month follow-up post-intervention. This pattern was consistent for both exercise conditions. Structural models examining the effects of social support and exercise frequency on SWB suggested that neither variable played a role in improvements in happiness but that both were implicated in changes in satisfaction with life. However, only social support from the exercise group was a significant predictor of changes in loneliness.

## DISCUSSION

This study examined the differential effects of two modes of physical activity, a walking condition and a stretching and toning condition, on SWB responses of older adults over a 6-month randomized controlled exercise trial and at the 6-month follow-up. Our findings suggest that physical activity interventions (both aerobic and nonaerobic) can have positive effects on SWB in older adults and that these improvements are reversed following the program termination. In this study, satisfaction with life and happiness increased significantly whereas loneliness decreased significantly over the course of the 6-month intervention. Of perhaps the most interest was that these improvements in SWB did not differ by physical activity mode. Whereas changing physical fitness via aerobic activity has been implicated in improvements in cognitive elements of psychological function [*38*], the present findings suggest that aerobic

**TABLE 2**

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

| Variable | Total M ($n$ = 49) | Total F ($n$ = 125) | Aerobic M ($n$ = 26) | Aerobic F ($n$ = 59) | Toning M ($n$ = 23) | Toning 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 (%) | | | | | | |
| 10–11th 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 |
| Immunosuppresant (%) | 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 |

activity may not be necessary for psychosocial health gains. The research on such issues has been sparse, with few studies concentrating on nonaerobic forms of activity. A few contemporary studies have examined the effects of such activities as tai chi on elements of psychological health. These interventions have been shown to result in decreased anxiety, depression, and mood disturbance [*39*,*40*], as well as an enhanced generalized sense of well-being [*41*]. The results of the present study parallel such findings and add to the growing literature that suggests that vigorous physical activity is not necessary for health benefits [*42*].

An additional important implication of these findings concerns issues of adherence to physical activity regimens. The stretching and toning condition, as well as having positive effects on SWB, may also prove to be an exercise mode that is more easily adapted to fit within one's lifestyle of nonstructured exercise programs. Although walking and other aerobic activity programs for older adults typically have poor adherence approximating 50% [*43*], we were able to maintain adherence at approximately 88% in both groups. However, at follow-up, interviews with participants revealed that approximately 75% of the stretching/toning condition

**TABLE 3**

Mean Values (Standard Errors) for Measures of Subjective Well-Being at Baseline, 6, and 12 Months

| Measure | Baseline | 6 Months | 12 Months |
|---|---|---|---|
| Happiness | 39.14 (0.97) | 40.95 (0.81) | 38.42 (1.27) |
| Satisfaction with life | 25.32 (0.69) | 27.02 (0.68) | 24.41 (0.85) |
| Loneliness | 38.72 (0.87) | 37.78 (0.88) | 38.04 (1.01) |

had continued to exercise at program levels compared to 51.3% in the walking condition. The former 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 might well be more easily incorporated into home-based physical activity regimens than walking. Not being a central focus of the study, we do not have qualitative or quantitative data to support such an explanation. Clearly, if the gains in SWB that are 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 SWB.

It was of further interest in this study to determine the extent to which social relations developed within the exercise program contributed to any changes in SWB constructs over and above the influence of physical activity participation. First, it should be pointed out that preliminary analyses did not reveal any influence of changes in *physical fitness* on SWB, supporting our previous claim that vigorous activity programs may not be needed for psychological health improvements. Various hypotheses have been generated identifying physiological and psychological mechanisms as possible determinants of physical activity induced changes in psychological states. However, few efforts have been directed toward the role played by the exercise environment, more specifically the social interactions, relations, and support engendered by exercise groups. Exceptions to this are examinations of group processes such as cohesion among exercise groups and the influence of such processes on exercise behavior (e.g., [*44*]). As noted earlier, this lack of research in this area is surprising given the established link between these variables in other domains of functioning.

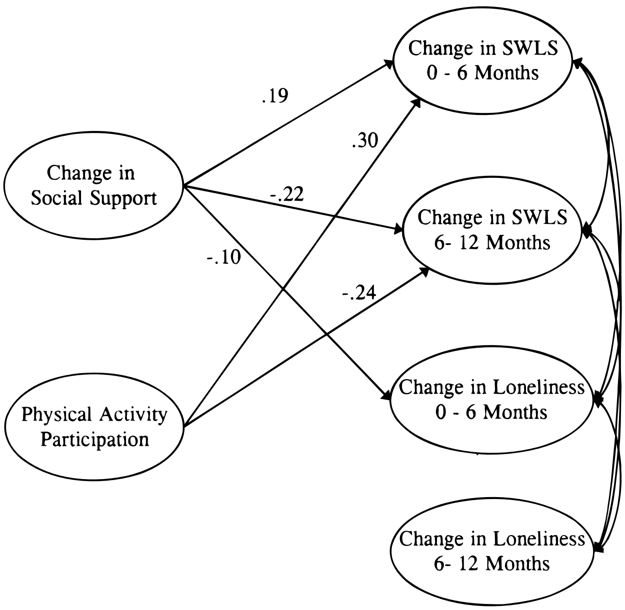


**FIG. 1.** Latent growth curve model depicting relations among physical activity participation, social support, and changes in satisfaction with life and loneliness at 6 and 12 months.

Our findings indicated that physical activity participation and social support are related to changes in elements of SWB but that these relationships are both complex- and construct-specific. For example, neither of our predictor variables was related to changes that resulted in happiness, as measured by the MUNSH [*23*]. It is conceivable that such a construct is simply too global a measure of well-being to be influenced by either group social interactions or physical activity frequency. In the case of satisfaction with life, we see that both frequency of physical activity and changes in social support play a role in changes over the 6-month intervention and the 6-month follow-up periods. That is, individuals who exercised more frequently during the exercise intervention, regardless of mode of activity, and who realized greater improvements in social support over the intervention period had significantly greater improvements in satisfaction with life. It is important to note that satisfaction with life remains relatively stable across age despite changes in physical and material resources [*45*]. That physical activity participation might enhance what is considered to be a relatively stable, but important element of overall health-related quality of life is underscored when we examine the pattern of relationships postintervention. As noted earlier, satisfaction with life declined at follow-up, as did the other elements of SWB. However, these declines appear to be attenuated by having been more active and having improved social support during the exercise program. What is interesting about these findings is that the shape and form of the SWB growth pattern are, as one would expect, curvilinear. That declines in SWB are attenuated by physical activity participation and social support in older adults has implications for exercise interventions. That is, emphasis should be placed on the provision of an exercise environment that maximizes the opportunities for frequent exercise participation (i.e., eradicates common barriers, increases availability of facilities) and in which social interactions are a salient target for enhancement.

Previous studies examining social support roles in physical activity-related behaviors have typically examined more global sources of support (e.g., size of social network). We adopted the approach that the exercise group constitutes its own social structure and that the interactions, friendships, and alliances that are formed therein are unique to the exercise group. Consequently, we assessed support specific to the exercise group to which the individuals belonged. As social support appears to be implicated in both the enhancement and the prevention of decline in satisfaction with life, subsequent work might be aimed at enhancing social support within the group via buddy groups, social activities outside exercise meetings, group identification (t-shirts, etc.), and so forth. Additionally, it will be of interest to determine whether any direct effects of exercise participation on change in satisfaction with life are mediated by exercise-related changes in health status or physical function.

The final element of SWB to be considered is loneliness. Although loneliness is no more pronounced in older adults than other measures of negative affect, the present findings suggest that reductions in loneliness can result from physical activity interventions. Interestingly, it appears that the physical activity environment provides the necessary social resources to combat loneliness. In the present study, greater levels of initial support from the exercise group in the first 2 weeks of the program and improvements in social support over the 6-month period were associated with significantly greater reductions in loneliness over the 6-month intervention. Although the exercise program (i.e., frequency of participation) does not appear to play a direct role in reductions in loneliness, it is apparent that the environment can provide the social resources to buffer feelings of loneliness. Further examination of this relationship in the context of exercising older adults is warranted.

Although we believe that the results of this trial have both theoretical and practical significance, there are of course several limitations to be considered when interpreting these data. First, as illustrated by the demographic data, our sample was composed predominantly of females. However, we would note that the distribution by gender is more reflective of the population at this age than would be an equal ratio of males and females. Moreover, there were no gender differences in any of the variables of interest. Additionally, despite best recruitment efforts, our sample was predominantly Caucasian. Little is known relative to physical activity effects on the psychosocial outcomes in minority older adults. There is, however, evidence to suggest that activity patterns among older African Americans are lower than older white Americans [*46*]. Given that African Americans are at higher risk for disease conditions known to be attenuated by physical activity, examination of the role played by social and psychological processes in this relationship in minority groups is warranted.

To our knowledge, few large-scale exercise trials exist that have focused on SWB, as theorized by Diener [*5*], in the elderly. The combination of a relatively large sample of older adults, a comprehensive longitudinal intervention, and contemporary methods for the analysis of longitudinal change in SWB have allowed us to explore patterns of relationships in older adults that have largely been ignored in the exercise gerontological literature. Future research efforts might explore methods to manipulate the social environment of exercise training trials in an effort to determine what specific elements of social support influence well-being and to what extent other psychological processes are involved in these improvements. As the typical human lifespan is extended and physical activity is acknowledged as an integral part of a healthy lifestyle, there is an increasing interest in health-related quality of life. How the social environment of the exercise experience influences this important public health outcome is deserving of continued attention.


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