Exercise Adherence or Maintenance Among Older Adults: 1-Year Follow-Up Study

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Follow-up evaluation was conducted of 101 older men and women (mean age = 67 ± 5 years) who had participated in a randomized study of physiological and psychological effects of aerobic exercise. Eighty-five subjects completed the follow-up evaluation, and almost all of them (94%) reported continuing with physical activity, as assessed by a self-report measure. Total energy expenditure was calculated as an indicator of exercise maintenance, and energy expenditure at follow-up was predicted from measures of physiological functioning, psychological well-being, and cognitive functioning obtained at the conclusion of the structured exercise program. Greater cardiorespiratory endurance, faster psychomotor speed, and lower anxiety predicted exercise behavior at follow-up, accounting for 13% of the variance in exercise behavior. Gender was not a significant predictor of exercise behavior.

Exercise adherence has been loosely defined in the research literature both as exercise behavior within a structured program and as exercise maintenance outside of a formal program (Martin & Dubbert, 1982). Studies of both types of exercise participation have revealed consistently poor adherence, with nearly 50% of subjects dropping out within 6 months of initiating an exercise routine (Dishman, 1982). Longer term adherence to exercise, especially outside of a formal exercise program, is often less than 50%. In fact, 19% of all North Americans report that they never exercise, and 36% of those over age 55 report not exercising (Wilmore, 1982). Furthermore, it has been suggested that patterns of exercise maintenance are generally poor in all age groups, including older individuals (Herbert & Teague, 1988-1989). Older adults may encounter more barriers to exercise maintenance, including health problems and social norms that have not encouraged exercise participation (Harris, 1977). Recent data suggest that there may be even greater barriers to exercise participation among older women due to poor exercise habits learned in adolescence (O'Brien & Vertinsky, 1991).

Although several randomized trials of exercise have been conducted among older adults (e.g., Blumenthal et al., 1989; Dustman et al., 1984; Emery & Gatze, 1990), levels of exercise maintenance after completing a structured program have not been examined. In younger samples, exercise maintenance has been associated with higher levels of physical fitness and low psychological distress (Dishman, 1990), but very few studies have examined predictors of exercise maintenance among older adults.

The present study examined long-term exercise maintenance in a cohort of 101 healthy older adults at least 1 year after completion of a supervised exercise program. The study was designed to determine the level of physical activity in this cohort at follow-up, as well as to determine predictors of exercise maintenance. Predictors included physiological measures, indicators of psychological well-being and cognitive functioning, age, gender, and amount of exercise training. It was hypothesized that both physiological functioning and psychological well-being would predict exercise activity and that gender would be predictive of exercise adherence, with men reporting higher levels of exercise activity.

**Method**

**Subjects**

The sample consisted of 50 men and 51 women who participated in the Duke Exercise and Aging Study. The mean age of the subjects was 67.0 (±4.9) years (range = 60–83 years). Most of the subjects were White (96%) and generally well-educated, with everyone having obtained at least a high school education. All subjects were sedentary prior to participating in the study protocol, having not engaged in any regular exercise for at least 4 months prior to initiating the study.

**Procedure**

At the outset of the Duke Exercise and Aging Study, subjects underwent a comprehensive assessment of physiological functioning, psychological well-being, and neuropsychological functioning. Physiological measures included weight, resting heart rate, resting blood pressure, and four indicators of cardiorespiratory fitness from bicycle ergometry testing: time on the bicycle, submaximal heart rate, maximum oxygen consumption ($\text{VO}_{2\text{max}}$), and anaerobic threshold. Measures of
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psychological well-being included the Center for Epidemiological Studies-Depression Inventory (CES-D; Radloff, 1977), State-Trait Anxiety Inventory (STAI; Spielberger, 1983), Affect-Balance Scale (Bradburn, 1969), and Rosenberg Self-Esteem Scale (Rosenberg, 1965). Cognitive measures included Digit Symbol and Digit Span subtests from the Wechsler Adult Intelligence Scale—Revised (WAIS-R; Wechsler, 1961), Trail Making Test (Reitan, 1958), and Finger Tapping (Halstead, 1947).

After completing the baseline assessment (Time 1), subjects were randomly assigned to one of three groups: an aerobic exercise group (n = 33), a yoga control group (n = 34), or a waiting list group (n = 34). Subjects in the aerobic group attended three supervised exercise sessions per week for 4 consecutive months. Aerobic exercise sessions began with 10 min of stretching exercise, followed by 30 min of continuous stationary bicycling and 15 min of walking at an intensity of at least 70% of VO2max determined by an initial maximal exercise test. Subjects in the yoga control group participated in 60 min of yoga exercise two to three times per week for 4 months. Subjects in the waiting list control group were instructed to maintain their usual activity patterns for 4 months but were not to engage in any exercise until the completion of their assessments. Subjects underwent a second comprehensive assessment at the end of the initial 4 months (Time 2).

Following the Time 2 assessment, all subjects participated in aerobic exercise for an additional 4 months and were assessed a third time (Time 3). Following the Time 3 assessment, all subjects were given the opportunity to participate in 6 more months of supervised aerobic exercise. At the end of the 6-month extension period, subjects were assessed a fourth time (Time 4), regardless of whether they had engaged in the extended, 6-month supervised exercise program.

Results of the serial assessments have been reported elsewhere (Blumenthal, Emery, Madden, Schniebolk, et al., 1991; Blumenthal, Emery, Madden, Coleman, et al., 1991; Emery & Blumenthal, 1990). During the first 14 months of the study, subjects achieved up to an 18% improvement in aerobic capacity (i.e., VO2max). However, there were relatively few improvements in cognitive functioning and psychological well-being, possibly because subjects were not significantly impaired or distressed at the study outset (Blumenthal, Emery, Madden, Schniebolk, et al., 1991).

Following the Time 4 assessment, no further supervised exercise program was offered to subjects. However, 1 year after completion of the Time 4 assessment, an attempt was made to contact all 101 subjects who initially entered the study. The follow-up evaluation included a retrospective self-report measure of physical activity during the prior 12 months, which listed a number of common physical activities including, but not limited to, activities in which subjects had been trained in the exercise program. Subjects recorded the number of months, days per month, and minutes per day that they were engaged in the physical activity.

To quantify activity level during the follow-up period, standard weight-adjusted values were assigned in kilocalories per minute for each physical activity (McArdle, Katch, & Katch, 1981). To calculate the energy expended for each activity, the kilocalories per minute standard values for each activity were then multiplied by the number of minutes per session, the number of sessions per month, and the number of months the subject reported participating in the activity during the preceding year.

Energy expended = kcal/min × # min/session

\[ × \# \text{ sessions/month} × \# \text{ of months} \]

Two summary scores were computed from these calculations for use as exercise maintenance outcome measures. First, overall activity was calculated by adding together the energy expenditure scores for all activities in which the subject participated. Second, an exercise behavior score was computed by adding together energy expenditure scores only for those activities in which subjects were trained during the exercise program. Thus, exercise behavior did not include activities such as golf, bowling, skating, yard work, and housework.

Data Analysis

All analyses were conducted predicting both overall activity and exercise behavior from measures of psychological well-being, cognitive functioning, and physiological functioning at Time 4. To build models for each activity score, separate regression equations were created for the three categories of predictors: physiological, cognitive, and psychological well-being. Age, gender, and amount of exercise training (i.e., number of sessions attended over the course of the 14 months) were included in each regression equation to examine their effects on physical activity and exercise maintenance and to determine the extent to which they interacted with other variables.

Results

Eighty-seven (88%) of the original 101 subjects completed the 1-year follow-up evaluation. At follow-up, 1 subject was deceased, 4 refused to participate, and 9 had moved from the area and could not be located. Two respondents refused to complete the activity questionnaire. Of the 85 subjects completing the activity questionnaire, 94% reported that they had continued in some form of physical exercise during the preceding year. More than half (54%) regularly continued stretching exercises, and 66% were regular walkers. Approximately one third of the group (34%) engaged in stationary bike riding, and 11% participated in strength training. Moreover, physical activities were not limited to those in which subjects had been trained. Other activities included swimming (11%), golf (14%), aerobic exercise classes (5%), jogging (5%), racquet sports (7%), yard work (53%), moderate physical labor (6%), housework (18%), and slow walking (7%). Several additional physical activities (e.g., ballroom dancing and horseback riding) were reported by only 1 or 2 subjects.

Predictors of Overall Activity

Stepwise regression was used to predict overall activity from physiological variables measured at Time 4. Predictor variables included weight, resting blood pressure and heart rate, VO2max and anaerobic threshold during exercise testing, age, gender, and exercise attendance. Only anaerobic threshold was a significant predictor. F(1, 63) = 4.75, p < .05, accounting for 7% of the variance in overall activity. Thus, greater submaximal performance was associated with higher levels of activity.

A second regression of cognitive variables (i.e., Trail Making, Digit Symbol, Digit Span, and Finger Tapping), age, gender, and exercise attendance revealed no significant predictors, although Finger Tapping (dominant hand) approached significance, F(1, 72) = 3.52, p < .07, R2 = .05.

A third regression predicting overall activity from measures of psychological well-being (i.e., CES-D, STAI, affect balance, self-esteem), age, gender, and exercise attendance revealed no significant predictors.
Predictors of Exercise Behavior

Stepwise regression was used to predict exercise behavior from physiological variables at Time 4, using the same predictor variables as the overall activity regression. Only $\text{VO}_2_{\text{max}}$ entered the equation, $F(1, 63) = 3.62, p < .07, R^2 = .05$. Greater cardiovascular endurance at Time 4 was associated with a higher level of exercise activity at follow-up.

The second stepwise regression of the cognitive variables with age, gender, and attendance revealed that faster finger-tapping speed (dominant hand) was associated with greater exercise behavior, $F(1, 72) = 4.26, p < .05, R^2 = .06$.

The third regression with age, gender, attendance, and the psychological well-being variables demonstrated that lower state anxiety predicted greater exercise behavior, $F(1, 72) = 8.54, p < .01, R^2 = .11$.

A final model was then tested including state anxiety, finger tapping (dominant hand), $\text{VO}_2_{\text{max}}$, and the interactions between these variables. The regression revealed a significant two-way interaction of $\text{VO}_2_{\text{max}}$ and finger tapping, $F(1, 66) = 9.42, p < .01, R^2 = .13$, as well as a significant three-way interaction of $\text{VO}_2_{\text{max}}$, finger tapping, and state anxiety, $F(1, 66) = 4.98, p < .05, R^2 = .13$. Figure 1 depicts the two-way interaction, with lower fitness and slower tapping associated with less exercise behavior. Figure 2 depicts the three-way interaction, with lower anxiety generally associated with greater exercise activity, although lower anxiety did not attenuate the effects of lower fitness and slower tapping.

Discussion

Almost all subjects in this study reported continuing in physical activity during the year following their exercise training. Exercise behavior was associated with greater cardiorespiratory endurance, faster psychomotor speed, and lower anxiety. Interestingly, the most common reason subjects gave for continuing with exercise was that it kept them in good shape and good health. The second most common reason was that it improved energy level and alertness. These results expand on past findings in younger samples, suggesting that low levels of distress and greater physical endurance are associated with long-term exercise adherence among older adults.

Gender was not a significant predictor of physical activity, which is contrary to past reports indicating that older women are particularly at risk for reduced exercise activity levels (O'Brien & Vertinsky, 1991). Thus, it is possible that the women in the study were unusually active or that the exercise intervention was particularly effective at increasing their level of motivation. It is also possible that gender differences in exercise adherence are not as pronounced in intervention studies as has been reported in previous epidemiological studies (O'Brien & Vertinsky, 1991).

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**Figure 1.** Exercise behavior as a function of tapping speed and fitness level. (Groupings determined by median value for each variable. Log = logarithmic; kcal = kilocalorie; $\text{VO}_2_{\text{max}}$ = maximum oxygen consumption.)
One limitation of the present study was the use of a self-report measure of exercise participation, because bias in self-reports of exercise may have confounded the data regarding exercise maintenance. However, there is no commonly used self-report measure of physical activity that is both reliable and valid (Brooks, 1987). The measure in this study was useful in that it provided a list of specific physical activities, while also providing space for subjects to add further activities, and it permitted quantification of activities in kilocalories.

There was apparently a high degree of commitment to exercise among subjects in the study, as noted in previous reports from the exercise intervention (e.g., Blumenthal, Emery, Madden, Coleman, et al., 1991). Hence, there was relatively little variability in exercise attendance and no significant relationship between exercise attendance and exercise behavior at follow-up. The data were more effective at predicting exercise behavior than overall activity, perhaps because exercise behavior is a more homogeneous construct with less variability than overall activity. However, overall activity, which included several common activities of daily living such as housework, was associated with anaerobic threshold, a measure of submaximal cardiovascular fitness. Thus, submaximal functioning may be an important and useful predictor of general activity level among older adults. Our best model predicted about 13% of the variance in exercise behavior and indicated the relevance of not only physiological factors for exercise adherence but also psychological and cognitive factors. Further research is warranted to examine additional factors associated with long-term exercise adherence among older adults.

References


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