Intervention-Related Cognitive Versus Social Mediators of Exercise Adherence in the Elderly
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Context: Participation in regular physical activity is recognized as one of the most important health behaviors associated with the prevention of chronic disease and the promotion of health and well-being among the elderly. Although a number of cross-sectional studies have reported predictors of physical activity participation, few studies have assessed changes in intervention-related mediators associated with physical activity adherence in the elderly.

Objective: The purpose of this study was to compare the relative abilities of cognitive mediating variables (i.e., self-efficacy beliefs and outcome expectancies/realizations) versus a social mediating variable (i.e., exercise-related social support) to examine mediators of a telephone-based, exercise-counseling intervention on exercise adherence during months 7 to 12 of an exercise intervention.

Method: Participants were 103 community-dwelling, healthy, sedentary, older adults (67 women and 36 men). Self-efficacy for exercise, outcome expectancies/realizations, and social support for exercise were assessed at baseline, 6 months, and 12 months. Participants received telephone-based exercise counseling to promote exercise adherence during the course of two 12-month exercise programs (i.e., aerobic/strength or flexibility exercises).

Results: Changes in cognitive mediators (i.e., self-efficacy and fitness outcome realizations) were associated with 7- to 12-month exercise adherence while exercise-related social support was not.

Conclusion: Attention should be given to increasing confidence in the elderly to overcome barriers to exercise and achieve relevant fitness outcomes in exercise programs.

Medical Subject Headings (MeSH): aging, behavioral research, exercise, physical fitness

Introduction

Adults aged >65 years are one of the fastest-growing segments of the population in the United States and worldwide. Participation in regular physical activity is recognized as one of the most important health behaviors associated with the prevention of chronic disease and the promotion of health and well-being among the elderly. However, a substantial proportion of the elderly community remain underactive.

Although a great deal of research has been conducted to explore factors related to the adoption and maintenance of exercise in middle-aged and younger adults, relatively fewer studies have focused on mediators of exercise among adults aged >65 years. Further, the vast majority of studies conducted to date have identified variables associated with physical activity participation using cross-sectional study designs. These study designs are a good way to identify correlates of physical activity participation and set the stage for the design of interventions to increase exercise adherence, but do little to further our knowledge about the mechanisms by which our interventions are achieving their effects.

For this reason, numerous researchers have called for the increased study of mediators of interventions designed to increase exercise adherence. It has been cogently argued that the investigation of intervention mediators will advance theory and provide critical information that can be used to tailor and improve the effectiveness of subsequent interventions.

The study of mediators and moderators was greatly
stimulated by the work of Baron and Kenny. These researchers conceptualized mediators as possible mechanisms through which one variable may be related to another variable or through which an intervention might achieve its effects (i.e., a causal link between an intervention and an outcome). In contrast, these researchers conceptualized moderators as variables that explain for whom and under what conditions a treatment is effective. Although the conceptual definitions proposed by Baron and Kenny remain widely acceptable to researchers across a number of disciplines, the analytic and methodologic strategies used to test mediator and moderator effects have recently been called into question. Kraemer et al. have proposed operational definitions and analytic strategies consistent with Baron and Kenny’s conceptual definitions that resolve many of the ambiguities. Most relevant to this study is Kraemer et al.’s recommendation to demonstrate temporal precedence in defining mediators (i.e., changes or events occurring during an intervention vs moderators measured at baseline, prior to intervention initiation).

Social cognitive theory—in which cognitive and social variables are viewed as determinants of initiation and maintenance of health behavior change—has received a great deal of attention in the health behavior literature. According to this theory, exercise adherence is determined, in part, by a person’s self-confidence that he or she can successfully take action (i.e., self-efficacy expectations) and as a result achieve desirable results (i.e., outcome expectations/realizations). These expectations are thought to be influenced by past performance, social modeling, verbal persuasion, and physiologic arousal. Results of several studies with middle-aged and younger adults suggest that cognitive and social variables may mediate the relationship between interventions and exercise adherence. McAuley et al. reported that an efficacy-based intervention successfully increased physical activity in previously sedentary adults. However, the effect of self-efficacy was evident only in the early and middle stages of the exercise program, but not in the last month. In a study of sedentary adults aged 50 to 65 years, Neff and King reported that realizing one’s fitness and psychological benefits initially expected from exercise was positively related to subsequent exercise adherence, while initial expectations alone were not significantly related to adherence. This finding is consistent with Rothman’s suggestion that satisfaction with one’s accomplishments is important for longer-term maintenance of health behaviors. In terms of social support, Oka et al. reported that exercise-related social support received from family and friends at 6 months of an exercise study was positively associated with exercise adherence during months 7 through 12 of the study in adults aged 50 to 65 years. Further, some studies have explored the temporal relationship among cognitive and social variables. For example, Duncan and McAuley using latent growth-curve analyses, reported that social support affects exercise adherence through its association with self-efficacy. However, relatively little is known about the temporal relationship among mediators that are associated with interventions designed to promote adherence to exercise programs.

The primary objectives of this study were to: (1) employ the analytic strategies recommended by Kraemer et al. to examine components of social cognitive theory by comparing early changes in cognitive (i.e., self-efficacy and outcome expectancies/realizations) and social (i.e., social support for exercise) mediators of a telephone exercise-counseling intervention on subsequent 7- to 12-month exercise adherence in the elderly; and (2) explore the associations and temporal relationships between significant cognitive and social mediators of the telephone exercise-counseling intervention.

Methods

Participants

Participants were 103 elderly adults (67 women and 36 men) who agreed to participate in a randomized clinical trial evaluating the effect of different types of physical activity on physical functioning and health-related quality of life, the major results of which are described elsewhere. The mean age of participants was 70.18 years (standard deviation [SD] = 4.1). Participants were healthy, sedentary, predominantly white (95%) and well-educated (mean years of education = 15.2, SD = 2.9). Participants were recruited using a random-digit-dial telephone survey of the community of Sunnyvale, California (population, 117,229) and a citywide media promotion.

Procedures

Following baseline assessments, participants were randomly assigned to one of two exercise programs: (1) moderate-intensity endurance and strengthening exercises (Fit & Firm); or (2) stretching and flexibility exercises (Stretch & Flex). Following randomization to condition, participants received an exercise prescription, telephone exercise counseling to promote exercise adherence for 12 months, and attended 6- and 12-month assessment visits. A brief description of the study interventions is presented below. A more complete description is available elsewhere.

Exercise prescription. Exercise prescriptions were developed based on quantities of exercise recommended by the American College of Sports Medicine and previous research of the elderly. Participants in each condition were instructed to participate in two exercise sessions in a class and two or more exercise sessions at home each week. Exercise classes
(conducted at a local YMCA and led by five paid community instructors) lasted approximately 1 hour and home-based sessions lasted 40 minutes.

**Fit & Firm regimen.** The purpose of the Fit & Firm class was to improve cardiovascular fitness using low-impact aerobic exercise and to improve muscular strength using resistance training. Each class consisted of a 5- to 10-minute warm-up, 40 to 50 minutes of aerobic exercise and strength training, and 5 to 10 minutes of cool-down exercises. Target heart rates were set at 40% to 60% of participants’ heart rate reserve based on their most recent treadmill test. In addition, participants were asked to exercise for ≥40 minutes at their target heart rate two or more times each week at home.

**Stretch & Flex regimen.** The purpose of the Stretch & Flex class was to improve flexibility without undue elevation of participants’ heart rates. Each class consisted of a 5- to 10-minute warm-up, 40 minutes of stretching exercises, and 5 to 10 minutes of relaxation exercises. Participants were asked to assess their heart rate once during each exercise class to ensure that they were not significantly elevating their heart rate. In addition, participants were asked to engage in stretching exercises for ≥40 minutes two or more times each week at home.

**Telephone exercise-counseling intervention.** Participants in both groups were contacted by trained health educators weekly for the first month, every other week for the next 2 months, and once per month for the remainder of the year. The purpose of these structured interviews was to answer questions, problem solve ways to overcome barriers to ongoing exercise participation, and remind participants to return their exercise logs. The content of these exercise counseling calls was derived from social cognitive theory, the trans-theoretical model, and previous studies. The telephone calls lasted from 10 to 20 minutes with an average duration of 15 minutes.

**Measures**

**Self-efficacy for exercise.** The Self-Efficacy for Exercise Questionnaire was developed at Stanford University in collaboration with A. Bandura, and validated in a previous study. The14-item scale assesses participants’ confidence (rated from 0% to 100% confident) that they can exercise in spite of various potential barriers (e.g., when tired or on vacation).

**Outcome expectancies/realizations.** At baseline (outcome expectancies), participants rated 16 potential physical and psychological/behavioral outcomes from exercise (1 = “no change expected” to 10 = “extreme improvement expected”), and indicated the most important outcome for them. At 6 months, participants rated how the 16 outcomes had changed during the 6-month period (outcome realization) on a scale of from 1 (“no change”) to 10 (“extreme improvement”). This scale has been shown to predict subsequent exercise adherence in previous studies of the elderly.

**Social support for exercise.** The Social Support for Exercise Behavior Questionnaire by Sallis et al. was used to assess participants’ perceived exercise-related social support from family, friends, and exercise classmates. This scale was designed to measure perceived social support specific to exercise behavior. Participants were asked to rate (1 = never, 2 = rarely, 3 = a few times, 4 = often, and 5 = very often) how often their family, friends, and exercise classmates encouraged their participation and involvement in exercise. Hence, each person received a separate social-support-for-exercise score for family, friends, and exercise classmates, which was combined to yield a total support score (possible score range of 11 to 55). Because the results of the analyses were similar regardless of whether the subscale scores or the total score were used, we report results for the total social support score. This scale has been shown to have good test-retest reliability and concurrent criterion-related validity with exercise habits.

**Exercise adherence.** Participants completed weekly exercise logs for the purpose of quantifying exercise participation. Average monthly adherence rates were calculated as follows: (number of exercise sessions reported/number of sessions prescribed) × 100. If data for a particular month were unavailable for a particular participant, a conservative approach was taken, and the participant was assigned a zero for that month. Validation for intensity and duration of exercise recorded on the self-report exercise logs was obtained from approximately 20% of the participants in the study who were randomly assigned to wear a solid-state, two-channel portable microprocessor (Vitalog) that recorded their heart rate and body movement continuously for 3 days. The Vitalog microprocessor has been shown to provide a valid and reliable assessment of adherence to home-based exercise prescriptions. Further, class instructors recorded class attendance to verify that the participants were accurately entering their class exercise session in their exercise logs.

**Statistical Analyses**

In order to examine the mediating effects of the social cognitive variables in this study on adherence, we followed the analytic and methodologic recommendations made by Kraemer et al. We examined the relationship between changes in the social cognitive variables during the first 6 months of the study and 7- to 12-month adherence. This analytic strategy satisfies Kraemer et al.’s requirement that a mediator be assessed after the beginning of a telephone exercise-counseling intervention (i.e., change in social cognitive variables from 0 to 6 months) and be correlated with a subsequent outcome (i.e., 7- to 12-month exercise adherence).

**Results**

**Exercise Adherence**

As previously reported, the accuracy of participants’ self-reported adherence was supported by Vitalog recordings and class attendance records. As reported previously, exercise adherence across the 12-month intervention period was high (80%) and comparable for the two programs. Similarly, 7- to 12-month adherence rates in the Fit & Firm and Stretch & Flex groups were comparable (i.e., 78.6% and 76.9%, respectively) (Table 1). The pattern of the results presented below was the same for both the Fit & Firm and Stretch & Flex
groups. Thus, results for the sample as a whole will be reported throughout the remainder of this report.

**Self-Efficacy for Exercise**

Pearson product-moment correlation coefficients were computed to assess the bivariate relationships between baseline self-efficacy for exercise and changes in self-efficacy from baseline to 6 months (i.e., proposed intervention mediator) and 7- to 12-month exercise adherence. As seen in Table 2, only change in self-efficacy was significantly related to 7- to 12-month exercise adherence ($r = 0.46, p < 0.01$).

**Outcome Expectancies/Realizations**

Expected outcome importance was ranked using descriptive analyses. The most frequently endorsed expected outcomes were fitness (35%), weight change (15%), and confidence (14%). Factor analyses were conducted on the 16 outcome expectancy and realization items, revealing the same two factors for both the outcome expectancies and outcome realization items. Five items (i.e., fitness, weight, appearance, energy, and eating habits) loaded most strongly on a factor that we labeled “fitness outcome expectancies/realizations,” and ten items (i.e., confidence, sleep, depression, tension, coping with stress, concentration, mood, alertness, appetite, and stress) loaded most strongly on a factor we labeled “psychological outcome expectancies/realizations.” Mean (SD) fitness outcome expectancies and outcome realizations across the five items on each scale were 4.3 (2.3) and 2.9 (2.0), respectively. Pearson product-moment correlation coefficients were computed to assess the bivariate relationships between outcome expectancies, outcome realizations from baseline to 6 months (i.e., proposed intervention mediator), and 7- to 12-month exercise adherence. As seen in Table 2, only fitness outcome realizations were significantly related to 7- to 12-month exercise adherence ($r = 0.22, p < 0.05$).

**Social Support for Exercise**

Pearson product-moment correlation coefficients were computed to assess the bivariate relationships between baseline social support for exercise and changes in social support for exercise from baseline to 6 months (i.e., proposed intervention mediator) and 7- to 12-month exercise adherence. As shown in Table 2, neither baseline nor change in social support for exercise was significantly related to 7- to 12-month exercise adherence ($r's = 0.13, p's > 0.05$).

**Comparative Model**

To explore the relative explanatory power of the proposed mediators (i.e., 0- to 6-month change in self-efficacy, 0- to 6-month fitness outcome realizations, and 0- to 6-month change in social support) and because these three mediators were only modestly correlated with one another ($r's < 0.18$), a multiple regression analysis was conducted with 7- to 12-month adherence as the dependent variable and group assignment, change in self-efficacy (0 to 6 months), fitness outcome realizations (0 to 6 months), and change in social support (0 to 6 months) as independent variables.

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**Table 1. Exercise adherence data for the Fit & Firm and Stretch & Flex groups**

<table>
<thead>
<tr>
<th>Adherence</th>
<th>Fit &amp; Firm (n=53)</th>
<th>Stretch &amp; Flex (n=50)</th>
<th>Total sample (N=103)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
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<tr>
<td>1-6 months (%)</td>
<td>78.4</td>
<td>27.7</td>
<td>83.7</td>
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<tr>
<td>7-12 months (%)</td>
<td>78.6</td>
<td>39.6</td>
<td>76.9</td>
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</table>

M, mean; SD, standard deviation.

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**Table 2. Correlation between cognitive and social variables at baseline, change in variables from 0–6 months and 7–12 months exercise adherence**

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1. Baseline self-efficacy for exercise</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>2. Change in self-efficacy (0–6 months)</td>
<td>-0.38**</td>
<td>-0.15</td>
<td>-0.18</td>
<td>-0.18</td>
<td>-0.15</td>
<td>-0.18</td>
<td>-0.18</td>
<td>-0.15</td>
<td>-0.18</td>
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<tr>
<td>3. Baseline fitness outcome expectancies</td>
<td>0.12</td>
<td>0.15</td>
<td>0.18</td>
<td>0.18</td>
<td>0.15</td>
<td>0.18</td>
<td>0.18</td>
<td>0.15</td>
<td>0.18</td>
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<tr>
<td>4. Fitness outcome realizations (0–6 months)</td>
<td>0.05</td>
<td>-0.04</td>
<td>0.63**</td>
<td>0.29**</td>
<td>0.05</td>
<td>-0.04</td>
<td>0.63**</td>
<td>0.29**</td>
<td>0.05</td>
</tr>
<tr>
<td>5. Baseline psychological outcome expectancies</td>
<td>0.06</td>
<td>0.13</td>
<td>0.22**</td>
<td>0.70**</td>
<td>0.06</td>
<td>0.13</td>
<td>0.22**</td>
<td>0.70**</td>
<td>0.06</td>
</tr>
<tr>
<td>6. Psychological outcome realizations (0–6 months)</td>
<td>0.07</td>
<td>0.06</td>
<td>0.25*</td>
<td>0.32**</td>
<td>0.07</td>
<td>0.06</td>
<td>0.25*</td>
<td>0.32**</td>
<td>0.07</td>
</tr>
<tr>
<td>7. Baseline social support for exercise</td>
<td>0.01</td>
<td>0.13</td>
<td>-0.03</td>
<td>0.16</td>
<td>0.11</td>
<td>0.09</td>
<td>-0.30**</td>
<td>-0.30**</td>
<td>0.01</td>
</tr>
<tr>
<td>8. Change in social support for exercise (0–6 months)</td>
<td>0.08</td>
<td>0.46**</td>
<td>-0.01</td>
<td>0.22*</td>
<td>-0.06</td>
<td>0.09</td>
<td>0.13</td>
<td>0.13</td>
<td>0.08</td>
</tr>
</tbody>
</table>

*p < 0.05; **p < 0.01, two-tailed tests of significance.
entered simultaneously. The following standardized coefficients were computed: group assignment ($\beta = 0.00, \ p = 0.99$); changes in self-efficacy for exercise ($\beta = 0.37, \ p < 0.001$); fitness outcome realizations ($\beta = 0.17, \ p = 0.12$); and changes in social support for exercise ($\beta = 0.03, \ p = 0.77$). The results suggest that the cognitive mediators of the intervention were more strongly associated with 7- to 12-month exercise adherence than was the social mediator.

To explore the relative importance of amount of 6-month change in the strongest mediator—self-efficacy—with absolute levels of self-efficacy at 6 months, an additional simultaneous regression analysis was conducted with both of these self-efficacy measures as predictors. Both change in self-efficacy ($\beta = 0.28, \ p < 0.01$) and absolute levels of self-efficacy at 6 months ($\beta = 0.24, \ p < 0.05$) were found to make significant, independent contributions to 7- to 12-month exercise adherence.

**Temporal Relationship Among Mediator Variables**

Several Pearson product-moment correlation coefficients were computed to explore the temporal relationships among the mediator variables. As seen in Figure 1, the only significant relationship between mediators was the correlation between fitness outcome realizations from 0 to 6 months and changes in self-efficacy from 7 to 12 months ($r = 0.27, \ p < 0.01$). These data suggest that perceived positive fitness outcome realization is associated with subsequent increases in self-efficacy for exercise (i.e., fitness outcome realization may be one of the mechanisms driving changes in self-efficacy).

**Discussion**

The results of this study extend the current literature on intervention mediators of physical activity adherence in the elderly in several ways. When the mediators assessed in this study were considered together as proposed in social cognitive theory, changes in cognitive variables (i.e., self-efficacy for exercise and fitness outcome realizations) mediated the relationship between the telephone exercise-counseling intervention and 7- to 12-month exercise adherence. Although change in self-efficacy was a significant mediator of the...
intervention when considered alone and in the comparative model, fitness-related outcome realizations was a less strong mediator in the presence of self-efficacy and social support than when it was considered alone. These results are in contrast to the baseline assessments of these variables, which did not predict 7- to 12-month exercise adherence. These data are consistent with previous research involving middle-aged adults in which self-efficacy and outcome realizations were shown to be directly related to exercise adherence.22,24 Further, the greater association of exercise adherence with change scores as compared to baseline scores indicates that perceptions by the elderly related to their experience in an exercise programs determine future adherence rather than preparticipation perceptions (baseline scores). In contrast, absolute levels of exercise self-efficacy at 6 months did appear to make an independent contribution to 7- to 12-month exercise adherence levels, over and above the changes in self-efficacy observed during the first 6 months. The relative importance of these two dimensions of self-efficacy (i.e., absolute levels vs amount of change) deserves further attention.14

The results concerning the temporal relationship among the cognitive predictors (Figure 1) suggest that perceived fitness–outcome realizations from baseline to 6 months are associated with subsequent increases in self-efficacy (7 to 12 months), while the converse is not supported by these data. This indicates the importance of helping the elderly achieve fitness-related outcomes in order to elevate subsequent levels of self-efficacy. It is possible that perceiving benefits in fitness outcomes, such as appearance and weight, communicates to participants that they have been successful in their exercise program. This perception may build their confidence that they can be successful in the future (i.e., increase self-efficacy). Hence, changes in self-efficacy may not only be seen as a target for interventions, but also as the result of interventions in which participants have achieved perceived fitness-related outcomes. This is consistent with Bandura’s18 notion that past mastery experiences lead to future increases in self-efficacy, which further increases the likelihood of future adherence and subsequent mastery experiences.

Exercise-specific social support was not related to longer-term adherence in this study. This is in contrast to a previous study24 that reported social support from family and friends, assessed using a Likert-type scale, was related to 7- to 12-month adherence in middle-aged adults. One possible explanation for this finding is that healthy, reasonably well-educated, white older adults may not require the types of support assessed via the questionnaire used in the current study (e.g., exercised with me, or helped plan activities around exercise) to facilitate adherence. Nonetheless, future studies should examine different types of social support to determine if types of support not measured in this study (e.g., emotional support) may be related to adherence.

A central conclusion that can be drawn from this study is that interventions targeting older adults should focus on promoting improvement in fitness-related variables, such as perceived fitness, weight, appearance, energy, and eating habits. This may, in turn, increase self-efficacy and, subsequently, enhance long-term exercise adherence.

In terms of designing programs to promote exercise adherence in older adults, the results of this study indicate that it is important to monitor self-efficacy and provide feedback to participants on fitness-related benefits of exercise. Further, more frequent monitoring and feedback would give intervention staff more opportunities to provide support for participants, and also allow researchers an opportunity to determine more precisely when fitness-related outcome realizations and changes in self-efficacy are most salient with respect to exercise adherence.36

Several limitations should be considered in reviewing the results of this study. First, the sample is predominantly non–Hispanic white, well-educated, and healthy, which precludes generalizing these results to individuals who differ in these characteristics. Future research should be conducted to determine the relevance of these mediators to other populations. Second, there was no assessment-only control group in this study. The inclusion of such a control group could have helped rule out the possibility of a third variable being responsible for the findings reported.

A useful next step in this area of research is conducting a randomized controlled trial in which an intervention designed to maximally enhance self-efficacy and perceived fitness realizations is compared to the standard cognitive behavioral/transtheoretical-based, telephone-counseling intervention used in this study. This may require more frequent assessment of self-efficacy and fitness-related outcomes as well as a greater percentage of intervention time being spent by staff and elderly participants on positively changing these cognitive mediators. The greater success of such an intervention would indicate that the mediators identified in this study are really causal mechanisms through which such interventions achieve their results.

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