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Exercise Self-Efficacy and Control Beliefs Predict Exercise Behavior After an Exercise Intervention for Older Adults

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Abstract

The present study examined exercise self-efficacy and exercise behavior during and after a strength training intervention program with older adults. A model with cross-lagged and contemporaneous paths was tested with structural equations. Within testing occasions, higher physical resistance was related to greater beliefs in efficacy and control over exercise. At 3 months into the intervention, those who had higher physical resistance were less likely to show subsequent changes in beliefs. Those who had higher self-efficacy and control beliefs at 6 months were more likely to report that they were still exercising at 9 and 12 months after the intervention. Findings indicate that exercise self-efficacy and exercise behavior are associated with one another, and that beliefs developed during an intervention are important for maintenance of an exercise regimen.

Regular exercise produces benefits that can help alleviate some of the illnesses and discomforts that often accompany old age. Despite the decline seen in muscular strength in aging, physical activity can help improve strength and certain functional measures such as climbing stairs or lifting objects (Skelton, Young, Greig, & Malbut, 1995). Although many reports tout the benefits afforded by being physically active, a large majority of the adult population do not engage in the recommended levels of regular physical activity (King, 2001). National data from the Center for Disease Control and Prevention (CDC; 2000) suggest that 31% of adults between the ages of 65–74 report engaging in 20 minutes of moderate physical activity for three or more days per week, while only 16% of adults in this age range report moderate physical activity for five or more days per week, which is the current recommendation for older adults. The relatively low number of active adults presents increasing alarm not only because of the rising cost of health care, but also in response to the growing segment of the population over the age of 65 (Orsega-Smith, Payne, & Godbey, 2003) which is expected to increase from 12% of the population in 2000 to 20% of the population by the year 2030 (DHHS, 2002).

Physical activity recommendations from the CDC and American College of Sports Medicine (ACSM) for the older adult population suggest the importance of incorporating cardiorespiratory, flexibility, and strength training activities into an exercise program. Research from the 2001 National Health Interview Survey suggests that 12% of adults age 65 to 74 and 10% of adults age 75 and older meet the national strength training objective, to enhance and maintain muscular strength and endurance two or more days per week (CDC,

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2004). Muscle strength is an important concern for older adults, given that 45% of women ages 65–74 years and 65% of women ages 75–84 are unable to lift 10 pounds (Jette & Branch, 1981). Research suggests that these effects can be reversed or at least prevented, with one study finding that older adults who participated in a 12-week strength program increased their overall muscle strength by 40% (Tsutsumi, Don, Zaichowsky, & Delizonna, 1997). In addition, evidence suggests that exercise, specifically strength training, can help reduce disability and preserve the ability to maintain independent living status (Jette et al., 1999) and reduce the risk of falling among older adults (Connell, 1996), as well as improve working memory scores over time (Lachman, Neupert, Bertrand, & Jette, 2006).

When conducting research on exercise in older adults, it is especially important to consider the barriers to physical activity among this population. The exercise barriers most commonly listed by older adults consist of personal and environmental obstacles as well as limited time and no exercise partner (Ebrahim & Rowland, 1996). Cohen-Mansfield, Marx and Guralnik (2003) reported that more than half of their participants cited health problems and pain as perceived barriers to fitness. Other personal barriers include chronic disease, fear of injury and falls, and beliefs that exercise will not make a difference (Clark, 1995; Lachman et al., 1997; Lees, Clark, Nigg, & Newman, 2005). Environmental barriers involve an array of reasons, ranging from inclement weather to lack of transportation and monetary funds (Myers & Roth, 1997). The issue of environmental barriers was minimized in the current study because we utilized a home-based exercise program, thereby reducing issues of cost (e.g., not having to pay for a health club), transportation, and poor weather conditions.

Another important class of exercise-related barriers is beliefs about self-efficacy and control. The attitudes and assumptions adults hold about exercise are often negative and erroneous (Lachman et al., 1997). The current study implemented an intervention targeting exercise self-efficacy over time because older adults often display low efficacy and control regarding their ability to exercise (Bandura, 1992; 1997). The sense of control has been defined as the feeling that one has an influence over his or her actions. Control over the aging process is often identified as an important component for healthy aging (Abeles, 1991; Baltes & Baltes, 1986; Brandtstädter & Renner, 1990; Brim, 1992; Lachman, 1986; Rodin, 1986; Schultz, Heckhausen, & Locher, 1991). Past research suggests that there are declines in the sense of efficacy (the belief in one’s capabilities; Bandura, 1986) and control over physical functioning among older adults (Lachman, 1986; 1999). In addition, the literature concerning research on the relationship between control and health-facilitating behavior as a whole points toward internal locus of control (the perception of one’s own personal control) as a motivating factor for actions taken to prevent health problems (Carlisle-Frank, 1991; Lefcourt & Davidson-Katz, 1991).

Age differences in control beliefs suggest that perceived constraints (the perception that there are obstacles to achieving goals) increase, while mastery and self-efficacy remain stable or slightly decrease with age (e.g., Lachman & Weaver, 1998). In addition, greater changes have been found when control beliefs were studied for specific areas such as health rather than as a generalized belief system (Lachman & Leff, 1989). For instance, older adults increasingly believe that health outcomes are determined by following the advice of powerful others such as physicians (Lachman & Leff, 1989).

Self-efficacy beliefs are important because the belief that one can exercise, even given constraints and impediments such as feeling tired or being busy, is associated with a greater likelihood of doing it (Bandura, 1997). According to Bandura (1977; 1986; 1997) and the social-cognitive model of physical activity, self-efficacy is the primary determinant of consistent, health-promoting levels of physical activity. It is important to note, however, that the relationship between exercise beliefs and exercise behaviors is reciprocal. Behavior

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change is also determined by outcome expectations or sense of controllability; that is, whether one expects one's actions to lead to desirable outcomes. One may have high self-efficacy for exercise, but if one believes that exercise does not do anything to prevent or remediate aging-related losses, there would be little motivation to continue exercising (Lachman et al., 1997; Lachman, 2006). The benefits of exercise are often not immediate and one needs to stick with it for some time in order to feel the rewards. This requires a high degree of motivation. The belief that exercise would help to improve one's physical well-being and that there is some control over the physical aging process is an important source of motivation (Lachman et al., 1997; Lachman, 2006). Both self-efficacy and outcome expectations (sense of control) play an influential role in the adoption and maintenance of exercise behavior (e.g., Anderson, Wojcik, Winett, & Williams, 2006; Conn, 1998; Resnick & Spellbring, 2000). People who have higher levels of self-efficacy regarding exercise are both more likely to get involved with a program, and to realize that they are benefiting from its effects than are people low in self-efficacy (Taylor, 1999). Dishman (1982) also found that adherence to an exercise program is facilitated by a routine that is both conveniently located and accessible. An individual may have high self-efficacy expectations for exercise, but if he or she does not believe the exercise will improve health, strength, or function, then it is unlikely that there will be adherence to a regular exercise program.

While self-efficacy is believed to be an important component of physical activity initiation and maintenance, only a handful of interventions have sought to change efficacy beliefs among older adults (McAuley, Courneya, & Lettunich, 1991; McAuley, Jerome, Marquez, Elavsky, & Blissmer, 2003; Taylor, Bandura, Ewart, Miller, & DeBusk, 1985). McAuley and colleagues (2003) reported that over the course of a 6-month exercise program, self-efficacy fluctuated throughout the intervention, and at program end, had declined. The authors suggested that this decline in self-efficacy may have been a result of the realization of the older adults that the program was coming to an end, and that they would have to exercise on their own. It is also possible that initial estimates of exercise efficacy were overly optimistic (McAuley et al., 2003) and may have suffered from ceiling effects of measurement (e.g., Litt, Kleppinger, & Judge, 2002). Indeed, long-term maintenance of physical activity is a primary goal of research within the field of exercise behavior and self-efficacy. Another study conducted by McAuley and colleagues found that self-efficacy was a reliable predictor of exercise behavior at a 6- and 18-month follow-up (McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003), suggesting the importance of enhancing efficacy beliefs to promote long-term behavior.

The present study had two main goals. First we examined whether successful experience with a resistance exercise program would have an impact on exercise self-efficacy and control beliefs for older adults. We examined the longitudinal relationships between exercise beliefs (both self-efficacy and control) and exercise behavior, in this case the frequency and intensity of resistance training. We expected that increased beliefs would be associated with increased resistance levels, based on the theory of self-efficacy and previous work showing that beliefs are a reliable predictor of exercise behavior (e.g., Anderson et al., 2006; Bandura, 1986; 1997; Lachman et al., 1997; McAuley, Jerome, Elavsky, et al., 2003). As previous research has found that the frequency (McAuley Jerome, Elavsky, et al., 2003) and intensity (McAuley, Lox, & Duncan., 1993) of exercise activity predicts exercise self-efficacy, we also examined the possibility that resistance level would predict beliefs based on the notion that realization of and satisfaction with progress with the exercise intervention could boost beliefs (e.g., McAuley, Jerome, Marquez, et al., 2003).

Second we investigated whether exercise beliefs would be tied to maintenance of an exercise intervention after 9 to 12 months. Research suggests that interventions designed with a focus on exercise self-efficacy can lower dropout rates from exercise programs and increase maintenance of exercise participation (McAuley, Courneya, Rudolph, & Lox, 1994; McAuley, Kramer, & Colcombe, 2004; McAuley et al., 1993). Therefore, it was expected that higher levels of exercise beliefs would be associated with maintenance of exercise behaviors after the intervention.

Method

Participants

Participants were recruited from 826 older persons contacted through mailings, referrals from community agencies, and self-referrals between November 1994 and June 1996. Participants, who were initially screened by telephone, had to be 60 years of age or older and had to report limitations in at least one of nine functional areas (excluding vigorous activity) listed in the Short-Form Health Survey physical function scale (Ware & Sherbourne, 1992). They were also excluded if their physician identified contraindications for exercise. Further information about the sampling procedure can be found in Jette et al. (1999). Participants were randomly assigned to a treatment (N= 102) or wait list control (N=108) condition by a staff member who was blind to the baseline data. Because we were interested in exercise behaviors in the current study, we examined participants in the treatment group (74 women, 28 men), who were on average 75.32 years old (SD = 7.37), had an average of 14.25 years of education (SD = 2.67), and an average number of 2.73 diseases (SD = 1.56).

Design and Procedures

The Strong for Life (SFL) treatment program (Jette et al., 1999) consisted of a 35-minute videotaped program of 10 exercise routines performed on tape by a trained leader. Elastic bands (Therabands) of varying thickness were used for individualized resistance training. The exercises included movement patterns that incorporated diagonal and rotational motions associated with functional activities. All routines were performed in a seated or standing position. Participants were instructed to exercise three times a week and to increase resistance by using a thicker band when they could perform 10 repetitions of each movement pattern without significant fatigue or loss of proper execution. The program contained five minutes of warm-up, 25 minutes of strengthening, and five minutes of cool-down exercises. Intervention participants received two home visits (in addition to the first baseline visit) from a physical therapist/trainer. The program was individualized so that people could progress at their own rate with guidance from the trainer. The first visit consisted of exercise instruction including guidelines for how to increase resistance levels and instructions on how to complete bimonthly exercise calendars with information on the frequency and level of resistance. During the first session the therapist used cognitive strategies to enhance each subject’s positive attitudes and beliefs related to exercise (Lachman et al., 1997). This aspect of the training was delivered through the viewing of a motivational videotape, a discussion of potential obstacles to long-term exercise participation, using cognitive restructuring techniques, and a review of the benefits of exercise (see Jette et al., 1998). The second visit, two to three weeks after the first visit, gave the trainer the opportunity to review with the participant the materials covered during the first session including exercise performance. The therapist reviewed the exercises the participant had difficulty with, and explained the criteria for progression of exercise resistance as well as the instruction on proper use of the exercise calendars. The wait list control participants were instructed to continue with their normal everyday routine, and received the exercise program at the conclusion of the study. The intervention lasted six months, with assessments taken during the program at three months and at the end of the program at six months after baseline. More details about the program can be found in Jette et al. (1999).

Simple behavioral incentives (Lachman et al., 1997) were implemented to promote subject adherence to the intervention protocol. Subjects received a crisp, new dollar bill for returning each calendar; a sticker was sent if the subject achieved the exercise goal during each calendar period; and a colored magnet corresponding to the resistance band color was sent when a subject progressed to the next level of resistance. Subject monitoring was accomplished by periodic telephone contact by the therapist. Participants were called bimonthly during the first three months of the program. Additional calls were made if the subject was encountering difficulty. Participants were also instructed to identify obstacles detrimental to exercise program adherence and strategies to overcome the obstacles. They were encouraged to call the monitoring therapist if they needed assistance in resolving the obstacle, but calls from participants were rare. Because we were interested in the relationship between exercise beliefs and resistance, data from the control group were not used for the present study. Therefore, data from 74 women and 28 men who participated in the experimental group were used. Descriptive characteristics of this sample can be found in Table 1.

Measures

Background information included age in years and gender (0=female, 1=male). Physical disability level was assessed at baseline using the Physical Disability scale from the short form of the Sickness Impact Profile (SIP-SF; de Bruin, Buys, de Witte, & Diederiks, 1994). The Physical Disability subscale reflected an individual’s basic and instrumental functional activities and mobility (e.g., walking, climbing stairs, self-care, shopping, house cleaning), with higher scores indicating greater disability. The possible range in scores was from 0 (*no disability*) to 100 (*total disability*). A log transformation of this variable was used in the analyses.

Resistance levels were assessed at baseline, three months, and six months. The color of the band corresponded to different thickness and resistance levels. At baseline the level was assigned by the exercise trainer. Most participants started at level 1 or 2. The full range was from 1 to 10, with higher numbers indicating greater resistance. The highest color level used by three months and six months after baseline was recorded as the maximum level of resistance and was used in the present analyses.

Exercise beliefs were indicated by measures of *exercise self-efficacy* and *exercise control*, which were assessed at baseline, three months into the intervention, and six months into the intervention (Jette et al., 1998).

Exercise control beliefs—A six-item scale was developed to assess beliefs about control over exercise behavior. These items were based on similar items use to assess control over memory changes (Lachman, Bandura, Weaver, & Elliott, 1995). Items were rated on a 5-point scale from “strongly agree” (1) to “strongly disagree” (5). Example items are “I have control over whether I exercise regularly” and “I am confident in my ability to do an exercise routine”. The mean score across the items was computed with a higher score indicating greater perceived control. The coefficient alpha for the scale was .59 and it has been used effectively in previous studies (Jette et al., 1998).

Exercise self-efficacy—We modified Bandura’s exercise self-efficacy scale (Bandura, 1997) for use with older adults. The scale included nine items, which assessed how sure subjects were that they would perform exercise under different conditions or constraints, including when they were tired and when they were feeling under pressure to get things done. Based on pilot testing with older adults over the telephone, the response format was modified to a 4-point scale, ranging from “very sure” (1) to “not at all sure” (4). The mean score across the nine items was computed with a coefficient alpha of .88. After recoding, a higher score indicated greater exercise-related self-efficacy. For a complete list of the exercise control belief and self-efficacy items, see http://www.brandeis.edu/projects/lifespan/exercise-measures.pdf.

Exercise activity at 9 and 12 months was assessed by asking participants whether they continued to follow the SFL program during the past two weeks either at 9 or 12 months after baseline. Of those who responded (n = 90), 43% did not exercise for at least two weeks after the intervention ended and 57% continued regular exercise.

Statistical Analyses

A structural equation modeling (SEM) procedure with the AMOS statistical program was used to test the model of best fit among exercise beliefs and resistance levels over time. Because the data were longitudinal and we were interested in changes in beliefs over time as well as the impact of beliefs on resistance, we tested a cross-lagged panel design. Resistance level and exercise activity at 9 or 12 months were observed variables. Exercise beliefs were treated as latent variables. The observed variables marking exercise beliefs were the exercise control and exercise efficacy scales. To enhance the fit of the model, the error terms for exercise efficacy, exercise control, and resistance were allowed to correlate with their counterparts over time.

Results

Intercorrelations among observed variables are presented in Table 2. As would be expected, older adults, women, and those with more disabilities started the program with lower levels of resistance, so gender, age, and physical disability level were used as covariates in the model. The model was conducted with the experimental group only, as resistance level was only recorded for the treatment group.

To test the directional nature of the relationship between exercise beliefs and resistance, we started the SEM procedure with a saturated model in which the two cross-lagged effects of beliefs on resistance and resistance on beliefs were both released (i.e., freely estimated), similar to the procedure demonstrated by Fukukawa et al. (2004). We also tested contemporaneous relationships by including paths from resistance at 3 months to beliefs at 3 months and from resistance at 6 months to beliefs at 6 months. We did not include a contemporaneous path from beliefs at baseline to resistance at baseline because the trainer assigned the initial resistance level. The overall fit of the models were evaluated using the Comparative Fit Index (CFI), CMIN/df, and root mean square error of approximation (RMSEA). The original full-model provided an adequate fit to the data (CFI = .957, CMIN/df = 1.37, p = .053, RMSEA = .061), but not all paths of interest were significant. In subsequent models we examined whether more parsimonious models (based on predicted directional influences as well as modification indices from AMOS) would provide a better fit to the data. The second model constrained the nonsignificant path from resistance at 6 months to exercise participation at 9 or 12 months to be zero. This model also provided an adequate fit to the data (CFI = .957, CMIN/df = 1.37, p = .054, RMSEA = .060), but it was not a significantly better fit than the original model (p = .291). The third model kept the constraint of the second model and also constrained the nonsignificant path from exercise beliefs at 3 months to resistance at 6 months to be zero. This model also provided an adequate fit to the data (CFI = .958, CMIN/df = 1.34, p = .061, RMSEA = .058), but it was not a significantly better fit than the original model (p = .461). The final model kept the two constraints of the previous model and also constrained the nonsignificant path from beliefs at baseline to resistance at 3 months to be zero. This model also provided an adequate fit to the data (CFI = .959, CMIN/df = 1.33, p = .065, RMSEA = .057), but it was not a significantly better fit than the saturated model ($p = .495$). We determined the final model to be the best representation of the data because the fit indices were adequate, it was the most parsimonious, and all paths between variables of interest were significant. The final model is presented in Figure 1.

Interpretation of the Paths

Younger-old adults, women, and those with lower levels of physical disability reported higher exercise beliefs at baseline, while men, younger-old adults, and those with lower levels of physical disability used higher resistance levels at baseline. Resistance and beliefs were relatively stable over the course of the intervention (i.e., the cross-time stability paths were significant), but the prediction was not perfect indicating that there were some individual differences in change over time. Indeed, follow-up repeated measures ANOVAs revealed that resistance increased over the 6 months (Wilks' $\lambda = .15$, $F[2,94] = 259.91$, $p < .001$), while efficacy (Wilks' $\lambda = .95$, $F[2,91] = 2.43$, $p = .09$) and control (Wilks' $\lambda = .98$, $F[2,91] = .72$, $p = .489$) did not change significantly on average (see Table 1). Higher resistance at 3 and 6 months was related to higher exercise efficacy and control beliefs within occasions. At 3 months those who had higher resistance were less likely to increase their exercise beliefs from the 3 to 6-month assessment. Finally, those with higher beliefs at 6 months were more likely to be involved in exercise activity at 9 and 12 months.

Post hoc analyses examined the possibility that there may have been a decline in self-efficacy as a result of the realization that the program was coming to an end, and that participants would have to exercise on their own (as found by McAuley, Jerome, Marquez, et al., 2003). It is also possible that initial estimates of exercise efficacy were overly optimistic (McAuley et al., 2003) and may have suffered from ceiling effects of measurement (e.g., Litt et al., 2002). Indeed, it is possible that those who agreed to participate in the intervention had elevated self-efficacy at the outset. However, paired t-tests did not reveal any significant differences in the change scores from baseline to 3 months and from 3 months to 6 months in either exercise control ($t[92] = 1.21$, $p = .23$) or exercise efficacy ($t[92] = 0.67$, $p = .50$). We also examined the possibility that the initial gains in resistance from baseline to 3 months were higher than the gains from 3 months to 6 months. Indeed, paired samples t-tests comparing the two change scores demonstrated that this was the case ($t[95] = 9.43$, $p < .001$).

Discussion

We investigated factors leading to change and maintenance in exercise behavior during and after an intervention, in a sample of older, sedentary participants who had some disability. Longitudinal relationships between exercise beliefs and exercise resistance training behavior were also examined. In line with our hypothesis, beliefs developed during the intervention in response to exercise experiences predicted the maintenance of the exercise regimen 3–6 months after completion of the intervention. We also tested the relationship between beliefs and resistance, and found that changes in resistance were predictive of changes in beliefs, consistent with self-efficacy theory. Although there was no average change in exercise beliefs for the intervention group, there were individual differences in change. Ultimately, beliefs that were developed during the intervention predicted exercise participation after the formal program was terminated.

Our findings fit with previous research which has documented that the realization of and satisfaction with progress with the exercise intervention can boost beliefs (e.g., McAuley, Jerome, Marquez, et al., 2003). We extend previous findings by showing that this longitudinal pattern holds for resistance training with older adults who were previously sedentary and had some disability. While McAuley (1991) examined sedentary adults, people with disabilities were also included in our research to see if strength training is effective in curtailing the cycle of disablement (Verbrugge & Jette, 1994). Further, we also included both control and efficacy as indicators of exercise beliefs. As participants increased their exercise intensity and strength, their perceptions of their efficacy and control regarding exercise also increased. It is important to note, however, that the association between increased exercise intensity and increased beliefs was not constant across the study period. Specifically, people at 3 months who had higher resistance were less likely to increase their exercise beliefs from the 3 to 6-month assessment. There could be interindividual (between-person) differences in this within-person process, and future studies should be aimed at examining the differences between people (e.g., personality) that may be associated with this differential relationship between resistance and beliefs over time. Additionally, future work which is able to incorporate a task-specific self-efficacy measure regarding competence of a resistance program will be able to add to our understanding of the specific relationship between efficacy and resistance over time. Although variations in resistance level were important for changes in beliefs during the intervention, it is important to note that changes in beliefs predicted continued participation in exercise behavior after the intervention ended. This suggests a reciprocal relationship is involved in linking exercise behavior and beliefs, and fits with the social-cognitive model of physical activity where self-efficacy is the primary determinant of consistent, health-promoting levels of physical activity but is also determined by outcome expectations or control beliefs (e.g., Bandura, 1977; 1986; 1997).

The finding that exercise beliefs are important for future behaviors is especially important for older adults. Age differences in control beliefs suggest that perceived constraints (the perception that there are obstacles to achieving goals) increase, while mastery and self-efficacy remain stable or slightly decrease with age (e.g., Lachman & Weaver, 1998). For instance, older adults increasingly believe that health outcomes are determined by following the advice of powerful others such as physicians (Lachman & Leff, 1989). Our results suggest that efforts aimed at increasing exercise efficacy and control in a sample of older adults is beneficial for future participation in resistance training, which is in turn associated with improved strength (e.g., Cavani, Mier, Musto, & Tummers, 2002; Fiatarone et al., 1990; Jette et al., 1999; Tsutsumi et al., 1997), reduced risk of falling, (Connell, 1996) and improved cognition (Lachman et al., 2006).

Limitations and Future Directions

While the current study sheds light on the longitudinal associations between resistance and exercise beliefs, there are some limitations that should be considered. Although the participants varied in resistance level, on average the program used relatively low-intensity resistance exercises with Therabands. This approach was implemented in order to include older participants who had some disabilities and because it was a feasible method for a home-based program (Jette et al., 1999). Nevertheless, more systematic variation of resistance intensity would be useful in future work. It is also important to note that although the structural equation model does take measurement error into account, the internal consistency of the exercise control beliefs scale was somewhat low.

Additionally, while the intercorrelations between measures at 3- and 6-months for resistance, exercise efficacy, and exercise control were significant, they were not large in magnitude. This could lead to a weaker path model. Therefore, the fact that we found associations in the structural model with only moderate correlations among the measures suggests that the effects are present, but further work will be needed to verify these associations when stronger correlations are observed.

In this study we relied on self-reports of resistance level, which could lead to some reporting errors or inaccuracies. In future research, direct observations or use of other methods that can be directly verified should be considered. For example, it might be of interest to compare groups where one group is given instructions about when to change the resistance while individuals in the other group initiate the change themselves. Another important consideration is that the conclusions about resistance change in relation to change in beliefs are made based on individual differences in change within the experimental group, rather than differences resulting from the experimental manipulation. Thus, the directionality of findings is not conclusive. The present study does suggest potential benefits of interventions targeted at both exercise beliefs and resistance training for disabled older adults, and it sets the stage for further work to clarify the directionality and other important mechanisms.

Conclusion

The study results are promising in that there was some evidence of linkages between changes in resistance and changes in exercise beliefs, and that changes in beliefs predicted continued participation in resistance training. Identifying and overcoming barriers to exercise participation is an important way to improve quality of life, especially for older adults. The present study showed that interventions with older adults that target resistance and exercise beliefs may be a fruitful avenue to boost exercise participation and maximize maintenance.

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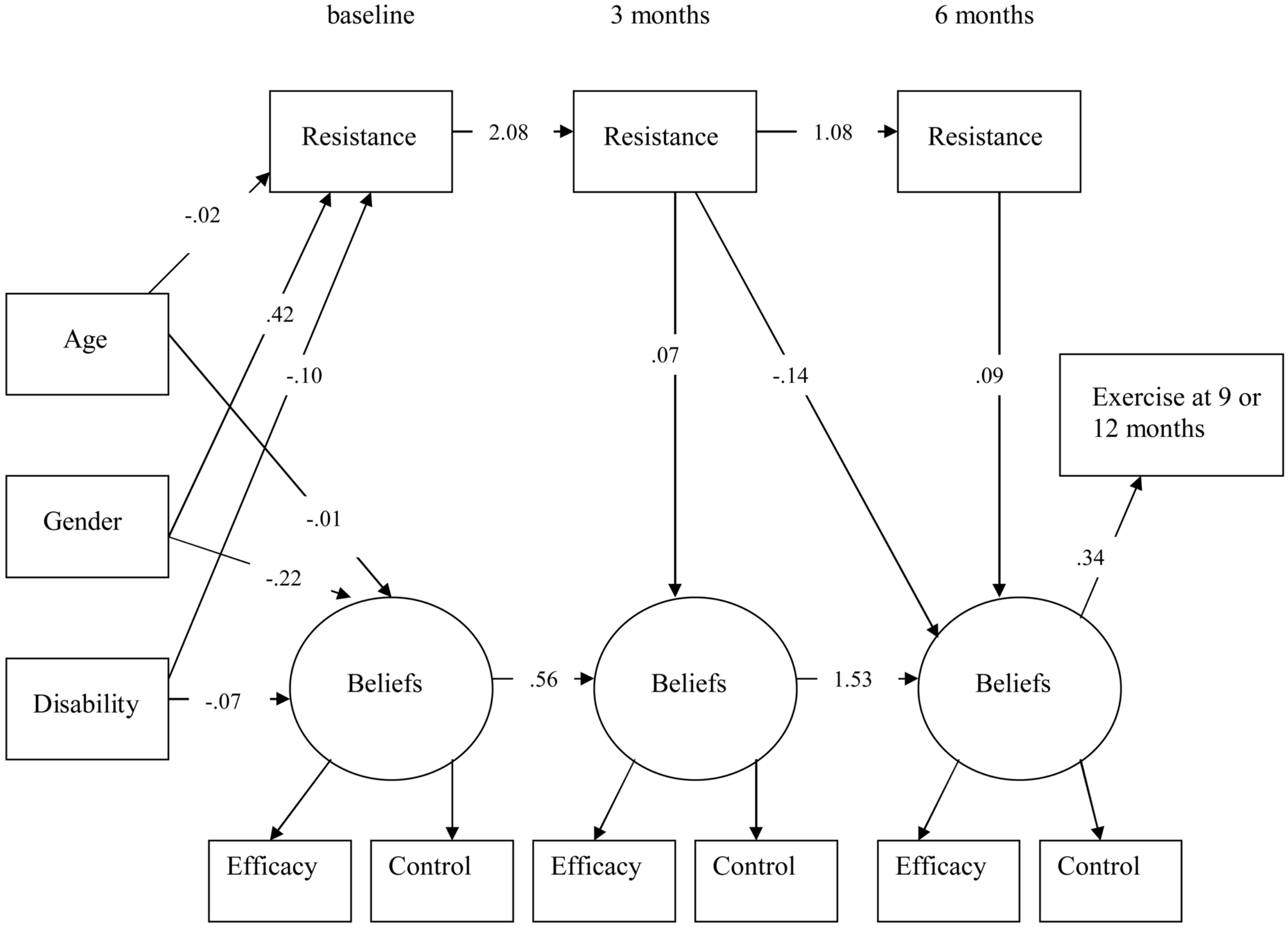

Figure 1.
Final model of beliefs and resistance over time (baseline, 3 months, 6 months, and follow-up at 9 and 12 months). Path values are unstandardized estimates and are statistically significant at an alpha level of .05.

Table 1

Descriptive Information for Participant Characteristics and Observed Variables

Variable	***M***	***SD***
Age	75.32	7.37
Log transformation of disability level	1.48	1.36
Exercise efficacy		
Baseline	3.25	.59
3 months	3.20	.67
6 months	3.08	.70
Exercise control		
Baseline	4.63	.45
3 months	4.69	.47
6 months	4.64	.52
Resistance		
Baseline	1.89	.79
3 months	4.27	1.25
6 months	5.33	1.57
Exercise at 9 or 12 months	57%	

n = 90–102

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Table 2

Intercorrelations among Observed Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Age	--											
2. Gender	−.06	--										
3. Physical Disability	−.18	−.08	--									
4. Exercise Efficacy (b)	−.5	−.11	−.15	--								
5. Exercise Control (b)	−.17	−.25*	−.19	.49***	--							
6. Exercise Efficacy (3)	−.02	.07	−.02	.46***	.19	--						
7. Exercise Control (3)	−.26*	−.08	−.28**	.33**	.59***	.29**	--					
8. Exercise Efficacy (6)	−.16	−.05	.00	.37***	.29**	.56***	.38***	--				
9. Exercise Control (6)	−.25*	−.05	−.31**	.44***	.54***	.30**	.57***	.53***	--			
10. Resistance (b)	−.25*	.27**	−.32**	.10	.05	.29**	.32**	.31**	.28**	--		
11. Resistance (3)	−.23*	.35***	−.30**	.20*	.16	.33***	.35***	.33***	.24*	.45***	--	
12. Resistance (6)	−.18	.27***	−.32**	.10	.05	.29**	.32**	.31**	.28**	.34***	.83***	--
13. Exercise at 9 & 12 mos.	−.08	−.06	.05	.17	.18	.23*	.21*	.21*	.23*	−.10	.15	.19

* $p < .05$,

** $p < .01$,

*** $p < .001$;

Note: b = baseline, 3 = 3 months, 6 = 6 months; n = 89–102