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Long-term Maintenance of Exercise, Self-Efficacy, and Physiological Change in Older Adults

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The present study documents the maintenance of exercise participation, self-efficacy, and physiological change in older adults at 9-month follow-up to a 5-month structured exercise program. Males and females (mean age = 54 years) completed graded exercise testing, body composition, and physical performance testing at the end of and 9 months after cessation of an exercise program. Self-efficacy assessments were also conducted prior to and following each graded exercise test and in the last week of the program. Results indicated that whereas some general reductions in physiological conditioning occurred, significant declines in physical performance and self-efficacy measures were evidenced at follow-up. However, exposure to the acute bout of physical testing increased the efficacy expectations to the point were they were no longer significantly different from postexercise program levels. Moreover, exercise self-efficacy was the only variable to significantly predict adherence to exercise during follow-up. However, previous attendance in the program, aerobic capacity, and self-efficacy all significantly discriminated between compliers and noncompliers to exercise prescription. Results are discussed with respect to the role played by acute exercise bouts in enhancing perceptions of personal efficacy in older adults and the utility of self-efficacy as a predictor of exercise behavior at various stages of the exercise process.

EXERCISE and physical activity have been demonstrated to have wide-ranging effects on a host of physical conditions including coronary artery disease, obesity, cancers, and all-cause mortality (Blair et al., 1989; Bouchard, Shepherd, Stephens, Sutton, & McPherson, 1990). Moreover, it appears that these effects are not unique to the young but are also reliably demonstrated in older adults (Blumenthal et al., 1989; Cunningham, Rechnitzer, Howard, & Donner, 1987; King, Taylor, Haskell, & DeBusk, 1989). In addition to the physiological effects of exercise, a considerable literature suggests that a number of psychological conditions are also influenced, including cognitive functioning (Dustman et al., 1984), anxiety (Petruzzello, Landers, Hatfield, Kubitz, & Salazar, 1990, for a review), and perceptions of personal efficacy (McAuley, Courneya, & Lettunich, 1991).

Self-efficacy expectations are the individual's beliefs in his/her capabilities to execute necessary courses of action to satisfy situational demands and are theorized to influence the activities that individuals choose to approach, the effort expended on such activities, and the degree of persistence demonstrated in the face of failure or aversive stimuli (Bandura, 1986). Perceptions of personal efficacy have typically been identified as important predictors of exercise and other health outcomes (see McAuley, 1992a and O'Leary, 1985 for reviews), but have largely been ignored as psychosocial outcomes in and of themselves. With respect to exercise and physical activity, even relatively short, acute bouts of physical activity have been shown to enhance self-efficacy. For example, McAuley et al. (1991) examined the effects of both acute (pre- and postprogram graded exercise test) and long-term (5-month exercise program) exercise bouts on self-efficacy perceptions for physical activity in a sample of previously sedentary middle-aged adults. Both males and females demonstrated significant gains in perceived capabilities in response to both acute and long-term exposure to exercise. Prior to program onset, males were significantly more efficacious than females; however, females became as efficacious, and in some activities more so than males by the end of the program. Moreover, both groups demonstrated the expected cardiorespiratory, body compositional, and vascular changes associated with prolonged exercise involvement. The McAuley et al. (1991) study is one of the few to examine such efficacy changes over time and is extended in the present study by determining whether these changes in efficacy and physiological function are maintained in the absence of a formal program at 9-month follow-up.

A perennial problem associated with any behavior designed to result in positive health benefits is that of regimen adherence (Meichenbaum & Turk, 1987). In this respect, exercise is no exception, and a substantial literature exists documenting the nature of the problem and its possible solutions (Dishman, 1988). Although a number of recent studies have demonstrated self-efficacy cognitions to be consistent predictors of exercise behavior (Garcia & King, 1991; McAuley, 1992b; Sallis et al., 1986), few studies have gone beyond the static, one-time assessment designs and examined such predictors at multiple stages of the exercise process. McAuley (1992b, 1993) adopted the contemporary perspective (Dishman, 1988; Sallis & Hovell, 1990) that exercise is a complex and dynamic process in which individuals move through various stages of participation and in which diverse factors play different roles at different stages. In this study, self-efficacy was shown to be predictive of adherence in the early stages of an organized exercise program for older adults, but that previous participation in the program best predicted later adherence to the program (McAuley, 1992b). Further, once the program was terminated, self-efficacy again became the most potent predictor of exercise behavior at 4-month follow-up (McAuley, 1993). Such findings suggest that efficacy cognitions play their most important role in the acquisition of behavioral proficiencies (Bandura, 1989) and when behaviors become routine, such cognitive control systems give way to lower control systems. However, the interruption of such routine behaviors places an increased demand on the individual, necessitating that higher cognitive control systems (self-efficacy), once again be brought into effect. As a further extension, the second purpose of the present study was therefore to determine whether the roles played by efficacy cognitions, past experience, and physiological parameters remained similar in the maintenance of physical activity 9 months beyond program termination.

To summarize, this study represents a 9-month follow-up of initially sedentary middle-aged males and females previously engaged in a 5-month structured walking program. The primary objective concerned whether increases in physical efficacy and physiological change brought about by the program had been maintained at follow-up. The second objective examined the role of self-efficacy in the maintenance of exercise behavior over the 9 months.

METHODS

Subjects

Previous participants in a 20-week exercise program designed for middle-aged, sedentary adults comprised the sample population for this study. Subjects ranged in age from 45 to 65 years of age, were randomly stratified by gender and 5-year age cohorts, and predominantly Caucasian. The details concerning their initial recruitment, demographics, physiological status, etc., are reported elsewhere (McAuley, 1992b; McAuley et al., 1991). Of the 82 subjects who completed postexercise program physiological and efficacy assessments, 44 (53.5%) individuals (26 females, 18 males) were available for testing at 9-month follow-up. Primary reasons for nonparticipation at follow-up were failure to secure contact with the participant or lack of time, scheduling conflicts, and lack of interest on the part of the participant. Preliminary analyses of the postprogram variables of interest comparing those subjects who were assessed at follow-up with those who declined to participate did not reveal any significant differences between the two groups. Therefore, the current sample appears to be representative of the larger group initially sampled.

Measures

Physiological measures. — A battery of physiological tests designed to determine cardiorespiratory (resting heart rate, time to reach 70% of predicted maximum heart rate, estimated $\dot{V}O_2max$), vascular functioning (maximum diastolic and systolic blood pressure), body composition (weight, body mass index, and percentage of body fat), and physical performance (abdominal curls, push-ups, and flexibility) was administered at the end of the 20-week program and 9 months later at follow-up. Cardiorespiratory and vascular function were assessed via submaximal bicycle ergometer graded exercise testing using a modified Astrand–Ryhming protocol (Siconolfi, Cullinane, Carleton, & Thompson, 1982) with continuous electrocardiographic and blood pressure monitoring. Body weight was obtained via a calibrated scale and percentage of body fat was measured using the 7-site technique and generalized equation developed by Jackson and Pollock (1978). Body mass index was estimated based on the ratio of body weight (in kg) to height (in m^2). For the physical performance measures subjects were required to complete as many sit-ups and push-ups at a maximum rate of 35 repetitions/minute (subjects could perform the task at a slower rate but not faster) until fatigue or until a 90-second time limit expired. Finally, flexibility was assessed via a standard sit and reach test. For this latter test, subjects were allowed three attempts that were then averaged.

Efficacy measures. — Two sets of efficacy measures were assessed, *physical activity efficacy,* and *adherence efficacy.* The former comprised three measures designed to determine subjects' beliefs in their physical capabilities with respect to sit-ups, bicycling, and walking/jogging and were assessed prior to and following each physiological testing session (i.e., twice at the end of the program and twice at follow-up). These measures were composed of items reflecting the subjects' confidence in being able to complete increasing numbers of sit-up repetitions successfully; cycle for progressively longer time periods at increasing workloads; and walk/jog successive quarter-mile distances within 4-minute intervals. The structure of the scales and their scoring were in accord with the recommendations of Bandura (1977, 1986) and internal consistencies were acceptable (all α's > .85).

The adherence efficacy scale was assessed only at the end of the exercise program and was composed of items reflecting subjects' beliefs in their capability to continue to exercise on a regular basis (i.e., following prescribed frequency, intensity, and duration of activity) for successive monthly periods beyond program termination. This latter measure was used to predict exercise maintenance at follow-up and also demonstrated good internal consistency (α = .92).

Exercise behavior. — Exercise behavior was assessed at both the end of the program and at follow-up. *Previous exercise behavior* was assessed via aggregated daily attendance to the 5-month exercise program. This measure was determined from daily attendance logs kept by the exercise leaders. As subjects' duration and intensity levels of exercise participation were carefully monitored on a daily basis by the exercise leaders, and as frequency was deemed an important aspect of exercise behavior for previously sedentary individuals (Martin & Dubbert, 1985), this measure avoids some of the more typical problems associated with the assessment of attendance as exercise behavior. Exercise behavior at follow-up was assessed via self-report and consisted of subjects completing a short inventory detailing their exercise participation patterns over the past 9 months. As such, we were able to tap two aspects of exercise participation: *exercise maintenance* (i.e., degree of exercise participation postprogram) and *exercise compliance* (i.e., whether participants had complied with exercise prescription beyond the program). Exercise maintenance was based on: (a) the average number of times/week that they reported exercising (frequency); (b) the number of minutes/session they had exercised (duration); and (c) the degree they considered themselves to have exercised regularly in the past 9 months [scores ranging from 1 (not at all) to 7 (very regularly)]. These three aspects of maintenance were all quite strongly correlated ($r > .60$) and were therefore standardized and aggregated to form a summary score representing exercise maintenance. Exercise compliance was treated as a dichotomous variable and assessed by asking subjects whether they had/had not continued to exercise at the frequency, intensity, and duration prescribed at the end of the program.

Procedures

All subjects were scheduled for individual appointments at the end of the exercise program and at 9-month follow-up for graded exercise testing (GXT), body composition assessment, and physical performance testing. All Institutional Review Board and human subjects information, orientation to the GXT protocol, physician's approval, and subjects' informed consent were administered and collected prior to the start of the exercise program. Upon arriving at the laboratory for their GXTs, subjects completed each of the three physical activity efficacy scales pertinent to testing that day (walking, biking, and sit-ups) before completing the physical performance tests and prior to preparation for the GXTs. Details regarding the GXT protocols (modified Astrand–Ryhming protocol) are published elsewhere (McAuley et al., 1991). Upon completion of the physiological testing, subjects once again completed the three efficacy scales. In the last week of the exercise program, subjects also completed the adherence efficacy scale, reflecting their beliefs in their capabilities to continue exercising at their prescribed intensity, frequency, and duration for successive months following the program. Finally, at follow-up, subjects completed a short inventory detailing their exercise behavior over the past 9 months.

In summary, physiological parameters were assessed at program end and at 9-month follow-up. Previous exercise behavior and exercise efficacy specific to adherence were measured at the end of the exercise program. Physical activity efficacy measures were taken prior to and following graded exercise testing at the end of the program and at 9-month follow-up. Finally, exercise maintenance and compliance were assessed at 9-month follow-up.

RESULTS

The results are reported in two sections. The first details the degree of maintenance in the self-efficacy and physiological variables over the 9-month period between program end and follow-up assessment. Repeated measures multivariate analyses of variance (MANOVA) with time as the within-subjects factor and gender as a between-subjects factor were conducted on the following groups of variables: *Cardiorespiratory Fitness* (time to reach 70% heart rate maximum, resting heart rate, and $\dot{V}O_2max$); *Vascular Responses* (maximum systolic and diastolic blood pressure during exercise); *Body Composition* (body mass index, percentage of body fat, and total weight); *Physical Performance* (sit-up and push-up repetitions and flexibility); and *Physical Activity Self-Efficacy* (biking, walking, and sit-ups). (Although we chose to group conceptually similar variables together in the multivariate analyses, we also indicate in Table 1 any statistically significant univariate effects that may be masked within multivariate analyses.) In the interests of clarity and space, we report only significant multivariate effects, and these are followed-up with repeated measures univariate analyses and the calculation of effect sizes (ES). The second section examines the relative role of physiological, behavioral, and cognitive variables in the maintenance and compliance of self-reported physical activity at follow-up. Correlational and multiple regression techniques were used to determine these relationships. Descriptive statistics are presented in Table 1.

Maintenance of self-efficacy. — As noted previously, efficacy perceptions with respect to biking, walking, and sit-up performance were assessed immediately before and after the end-of-program GXT and prior to and following the GXT conducted 9 months later. A significant overall multivariate effect for time was revealed, $F(9,29) = 9.91$, $p < .0001$. Follow-up analyses indicated that the main effects for bicycle efficacy, $F(3,38) = 11.51$, $p < .0001$, and sit-up efficacy, $F(3,38) = 11.97$, $p < .0001$, were both significant. Bicycle efficacy increased a small but statistically significant amount from pre- to post-GXT at the end of the program ($p < .01$, $ES = .21$) and then decreased significantly over the 9-month postprogram period ($p < .005$, *ES*

Table 1. Descriptive Statistics for Physiological, Behavioral, and Cognitive Responses at End of Program and 9-Month Follow-up

Variable	End of Program *M(SD)*	Follow-up *M(SD)*
Age	56.07(5.89)	56.93(6.00)
Weight (lbs)	171.41(32.44)	171.71(29.88)
% body fat	27.00(7.07)	25.07(6.59)*
Body mass index	26.29(4.41)	26.40(3.95)
Systolic blood pressure	162.25(19.70)	171.27(19.94)*
Diastolic blood pressure	82.37(10.89)	86.91(9.23)*
$\dot{V}O_2max$ (ml/kg/min)	31.64(7.90)	28.34(6.92)*
Time to reach 70% MHR	6.37(1.58)	6.93(1.26)
Resting heart rate	72.75(13.88)	76.03(10.70)
Abdominal curls	50.98(18.37)	43.36(21.05)*
Push-ups	26.70(10.15)	20.52(11.89)*
Flexibility	16.08(2.83)	14.03(2.72)*
Walk efficacy pre-GXT	81.15(28.15)	70.78(31.32)
Walk efficacy post-GXT	81.72(27.70)	72.98(29.10)
Bike efficacy pre-GXT	81.92(25.81)	67.57(32.27)*
Bike efficacy post-GXT	86.75(22.18)	79.97(25.14)
Sit-up efficacy pre-GXT	77.86(20.94)	65.51(30.17)*
Sit-up efficacy post-GXT	86.54(19.76)	80.66(25.04)
Exercise efficacy	77.13(21.42)	NA
Program attendance	46.14(10.62)	NA
Exercise frequency	NA	2.43(1.40)
Exercise regularity	NA	4.47(1.83)

*Follow-up values significantly different from end of program values.

Note. MHR, maximum heart rate; GXT, graded exercise testing; NA, not applicable.

= −.67). However, information provided as a function of the follow-up GXT resulted in a significant increase from pre- to postfollow-up GXT ($p < .001$, $ES = .43$), raising self-efficacy to levels that were not significantly different from those reported 9 months previously. A similar pattern emerged for the sit-up efficacy with a significant increase ($p < .001$, $ES = .37$) evidenced from pre- to post-GXT at the end of the program and a significant decrease ($p < .001$, $ES = -.76$) in efficacy over the 9-month period between program end and follow-up. Once again, participation in the follow-up physiological assessment resulted in a significant pre–post increase in efficacy ($p < .001$, $ES = .43$) to levels that were not significantly different from those at the end of the program. These changes over time are graphically depicted in Figure 1.

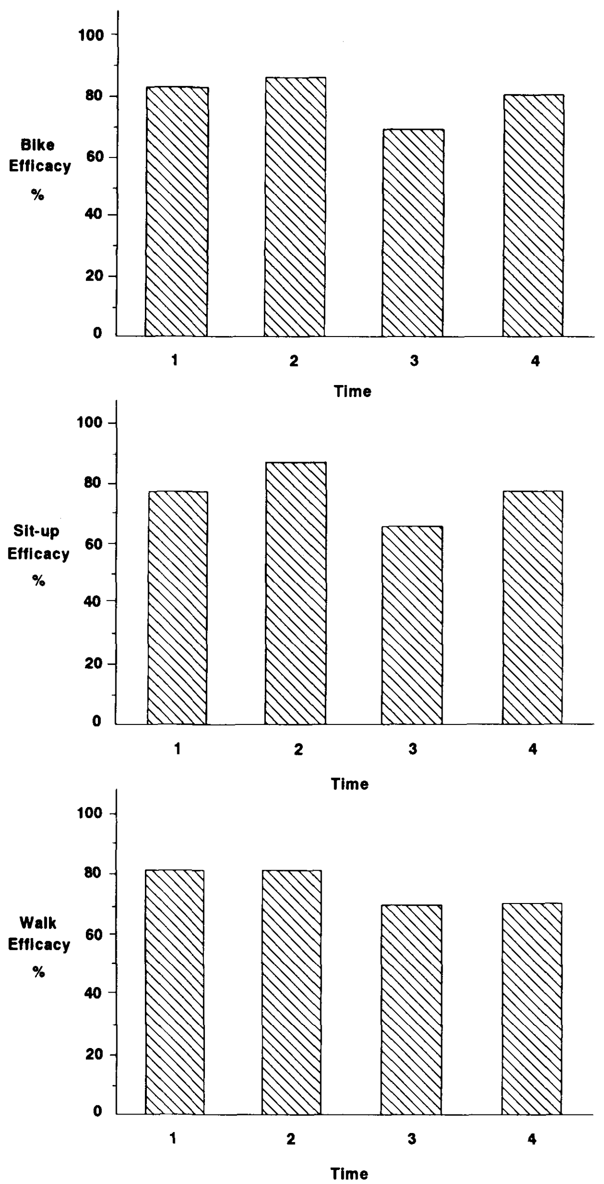

Figure 1. Changes in efficacy perceptions for all subjects pre- to post-GXT at the end of the exercise program (Time 1 to Time 2) and at 9-month follow-up (Time 3 to Time 4). Time 1: pre-GXT (postexercise program); Time 2: post-GXT (postexercise program); Time 3: pre-GXT (at follow-up); Time 4: post-GXT (at follow-up).

Maintenance of physical condition. — The repeated measures MANOVA for the measures of *Cardiorespiratory Fitness* (resting heart rate, $\dot{V}O_2$max, and time taken to reach 70% predicted maximum heart rate) revealed a significant main effect only for gender ($F(3,32) = 2.95$, $p < .05$). Follow-up analyses indicated that this effect was due to males taking significantly longer to reach 70% predicted heart rate maximum ($p < .05$, $ES = .70$) at the end of the program and at follow-up ($p < .05$, $ES = .68$). However, as can be seen in Table 1, subjects had significantly lower aerobic capacity at follow-up. A significant time effect for *Vascular Responses* was revealed, ($F(2,41) = 3.20$, $p < .05$). As can be seen in Table 1, both maximum systolic ($p < .01$, $ES = .46$) and diastolic ($p < .01$, $ES = .45$) blood pressure during exercise were significantly higher at follow-up than at the end of the program. With respect to *Body Composition,* there was a significant gender by time interaction ($F(3,39) = 3.77$, $p < .05$). Follow-up tests indicated that males had significantly less body fat than females at the end of the program ($p < .005$, $ES = .94$) but over the course of the 9-month period males increased their body fat whereas females decreased their percentage of fat. Finally, there was a significant multivariate effect for time on *Physical Performance*, $F(3,33) = 4.55$, $p < .01$. Subsequent analyses indicated that subjects were significantly weaker in the upper body ($p < .01$, $ES = -.51$) and abdominal regions ($p < .06$, $ES = -.50$), as well as being less flexible ($p < .01$, $ES = -.61$) at follow-up. Means and standard deviations are shown in Table 1.

Maintenance of physical activity at follow-up. — In order to examine the patterns of relationships among the physiological ($\dot{V}O_2$max, percentage of body fat), behavioral (attendance during the program), and cognitive (self-efficacy) variables at program end and maintenance of exercise behavior, correlational analyses were initially conducted. As shown in Table 2, all four predictor variables are related but only self-efficacy ($r = .43$) and $\dot{V}O_2$max ($r = .32$) were significantly related to exercise maintenance. To examine this relationship further, hierarchical multiple regression analyses were conducted to determine which of the predictors contributed significant unique variance to self-reported maintenance. In total, the predictors accounted for 24% of the variation ($p < .05$). However, only self-efficacy ($R^2 = .112$, $p < .05$) was a significant unique predictor of exercise maintenance.

Fifty percent of subjects at follow-up indicated that they had complied with the exercise prescription given to them at program end, whereas 50% reported noncompliance. To determine whether the physiological, behavioral, and cognitive variables were able to discriminate between these two groups, a discriminant function analysis was conducted. From this analysis, one significant function emerged [Wilks' lambda = .742, $F(3,30) = 3.47$, $p < .05$]. Self-efficacy, previous attendance, and $\dot{V}O_2$max entered the equation, whereas body fat did not. The structure matrix of the relations between the discriminating variables and the canonical function indicated that higher attendance during the formal program (.749), greater aerobic capacity (.626), and

Table 2. Correlations Among Physiological, Behavioral, and Cognitive Responses at End of Program and 9-Month Follow-up

	Resting Heart Rate	$\dot{V}O_2max$	% Fat	Program Attendance	Adherence Efficacy
$\dot{V}O_2max$	−.22				
% fat	−.02	−.46***			
Program attendance	−.20	.22	−.47***		
Efficacy	−.06	.30*	−.25	.42**	
Exercise maintenance	−.19	.32*	−.01	.18	.43***

*$p < .05$; **$p < .01$; ***$p < .001$.

stronger beliefs in exercise capabilities at the end of the program (.693) resulted in greater likelihood of compliance to prescribed exercise behavior. All of these loadings, while moderate in size, are statistically significant.

Discussion

The present study represents a follow-up investigation of the maintenance of self-efficacy, physiological condition, and exercise behavior in older adults 9 months after the cessation of a 5-month exercise program. Although the physiological and psychological benefits of physical activity are well-documented (Bouchard et al., 1990), the problems of long-term maintenance of such change and adherence to exercise regimens make the accrual of health benefits less than reliable. As noted earlier, efficacy cognitions or beliefs in personal capabilities have been demonstrated to be important mediators of a broad array of health behaviors (Bandura, 1986; McAuley, 1992a; O'Leary, 1985). However, very little research has been forthcoming that examines the reciprocally determining nature of the self-efficacy and exercise behavior relationship. That is, the roles played by physical activity in facilitating efficacy cognitions over time and the reciprocal effect of self-efficacy in the dynamic process of exercise behavior have received little attention in this literature.

With respect to maintenance of efficacy, subjects in the present study evidenced declines in walking efficacy over the 9-month period following the program, and these declines failed to be significantly altered following graded exercise testing. This is perhaps unsurprising given that self-efficacy predictions are specific to the domain of functioning (Bandura, 1986). In this case, although cycle ergometry is a form of physical activity, it does not offer precisely the same information that walking outdoors or on a treadmill might provide. However, in the case of biking and sit-up efficacy, we see an interesting pattern of results. Between program end and follow-up, subjects declined significantly in both aspects of self-efficacy. However, engaging in physiological testing comprised of physical performance tests (sit-ups, push-ups, and flexibility) and a graded bicycle ergometer exercise test served to significantly enhance efficacy cognitions to the point where they were no longer significantly different from the end of program levels. That a single bout of activity can have such marked effects is strong testimony to the role that mastery experiences or past performance accomplishments play in shaping convictions of personal capabilities. Moreover, they underscore that efficacy cognitions, not unlike the exercise process itself, are dynamic and constantly changing as new information serves to enhance and maintain one's convictions of capabilities.

Such theoretical support also has important practical implications. When individuals are engaged in organized exercise programs that are conducted by trained and knowledgeable personnel, feedback regarding performance accomplishments is readily and frequently dispersed. However, when the onus is on the participant to exercise on his/her own outside the bounds of a formal program, such information may be more difficult to come by. Indeed, it is quite possible that individuals, particularly when they are older and/or have preconceived notions regarding deteriorating physical condition, might believe they are no longer benefiting from exercise, even if they continue to participate outside the program. Self-monitoring physical progress and conditioning can quite easily provide such information. For example, keeping a daily log of distance covered, repetitions completed, time spent exercising, resting and exercise heart rates, ratings of perceived exertion, etc., can provide sufficient evidence with respect to physical accomplishments. This information can, in turn, enhance, or at least maintain, self-efficacy with respect to the physical activity domain.

In an earlier report (McAuley et al., 1991), we detailed some intriguing gender differences in efficacy responses. In those findings, males were significantly more efficacious than females prior to the onset of the exercise program; however, these differences were eradicated by the end of the program. This latter pattern of relationships appears to have been maintained at follow-up. No significant gender effects for efficacy were revealed, suggesting that even though efficacy declined over the course of follow-up, it did not do so differentially for males and females. It appears that the increased efficacy brought about by the exercise program served to provide the female subjects with a robust sense of efficacy that, although having declined at follow-up, was not any more adversely affected than that of the male subjects. Attention to gender differences with respect to exercise and health self-efficacy has largely gone ignored in the literature, and further examination is warranted.

Maintenance of physical condition at follow-up was also of interest in the present study. General cardiorespiratory fitness declined somewhat, whereas little overall change in body composition occurred. There were significant differences in blood pressure responses, with subjects demonstrating higher maximum diastolic and systolic responses during exercise at follow-up. As noted in Table 1, subjects were exercising at slightly below (mean = 2.43 times/week) the frequency prescribed and used during the program (3 times/week), and whereas one would expect a degree of maintenance of condition, marked improvements would be unlikely. There were also significant declines in muscular strength and flexibility at follow-up. For many individuals, the warm-up and cool-down phases of physical activity in which stretching and strengthening activities are usually engaged are typically the least enjoyed aspect of physical activity. This is likely to be particularly true for those individuals who are older, overweight, and have a history of sedentariness. Given the obvious importance of flexibility, muscle tone, and strength for not only injury prevention but for all aspects of physical functioning and activities of daily living, the importance of continuing to include such activities in older individuals' exercise regimens must be underscored.

As previously noted, the health benefits associated with physical activity can only be accrued if participants adhere over time. A number of behavioral, physiological, and cognitive parameters have been identified in the literature (Dishman, 1988) as predictive of initial adherence, but few attempts have been made to examine the differential contributions of such variables at different stages of the exercise process. That self-efficacy was a consistent predictor of physical activity maintenance over time in the present study is interesting from the perspective of distinguishing between predictors of *compliance* and *adherence*. Compliance is generally regarded as the degree to which individuals are obedient in following the instructions and prescriptions of a health care practitioner such as a physician, therapist, or exercise leader (Meichenbaum & Turk, 1987). Adherence, on the other hand, describes more of a voluntary, free-choice process of continuing a course of actions that is mutually acceptable to the individual and health care practitioner and that will bring about some positive health outcome (Meichenbaum & Turk, 1987). These two terms have, however, been largely used interchangeably in the exercise literature. Assessing subjects' self-reported frequency, regularity, and duration of exercise behavior afforded us a measure of *adherence*, whereas measuring whether subjects had continued to exercise at the dosage prescribed by the exercise personnel at the end of program tapped *compliance*. Slightly different patterns of relationships evolved for each aspect of continued exercise behavior. For example, discriminant analysis of the compliance variable revealed that aerobic capacity (estimated $\dot{V}O_2max$), past exercise behavior (program attendance), and self-efficacy all contributed to the discrimination between compliers and noncompliers. However, hierarchical regression analyses of the adherence data using the same variables revealed self-efficacy to be the only significant predictor of exercise behavior at follow-up. Such findings may have important implications for how programs are structured. For example, if one is concerned with having participants continue to maintain activity without necessarily mirroring the content of the structured exercise program, then establishing conditions that maximize perceived capabilities appears crucial. Whatever the compliance/adherence goal with respect to exercise, it is clear that self-efficacy plays an important role in the maintenance of physical activity beyond program involvement, as well as in the early stages of exercise adoption (Garcia & King, 1991; McAuley, 1992b; Sallis et al., 1986).

Findings from the present study provide us with indication of the reciprocal relationships between self-efficacy cognitions and exercise participation. However, some caution must be exercised in the interpretation of the present results given the relatively small sample. In spite of our efforts to include as many subjects as possible at follow-up, a considerable number were lost to attrition. However, those subjects whose data are reported herein did not differ significantly on any of the physiological or psychological measures at program end from those who did not participate at follow-up. Therefore, the findings reported must be reproduced with larger samples. Moreover, the difficulty in successfully getting subjects to participate many months after program end is clearly a pragmatic concern for future research efforts and every effort must be made to ensure full compliance at follow-up. A further concern, it might be argued, is the status of those subjects who were willing to come back for follow-up. It might be argued that those who did participate at follow-up were those who had continued to exercise. Examination of subjects' activity levels indicates that 50% of the subjects reported being noncompliers to their exercise prescription and 40% reported being nonregular exercisers. Therefore, it appears that we were tapping a cross-section of exercise participation levels.

In conclusion, this study of the maintenance of self-efficacy, physiological condition, and physical activity in older adults reaffirms (a) the tenets of self-efficacy theory (Bandura, 1977, 1986) and (b) the role played by self-efficacy in compliance and adherence to physical activity. With respect to the former, we have demonstrated that after significant declines of efficacy brought about by a 9-month absence of a formal exercise program, acute bouts of activity that provide salient and accurate information can once again elevate strength of self-efficacy beliefs to the levels they had reached after 5 months of exercise. Once again, efficacy has been shown to be a reliable predictor of exercise maintenance, even at 9-month follow-up, suggesting that efficacy plays a role at multiple stages of the exercise process. The challenge now is to conduct intervention studies in an effort to experimentally manipulate efficacy cognitions and demonstrate that enhanced efficacy leads to further increments in adherence. Aging individuals with a history of sedentariness would appear to be exemplary candidates for such an intervention.

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