Exercise Behavior in Older Adults: A Test of the Transtheoretical Model

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The transtheoretical model (TTM) was developed as a guide for understanding behavior change. Little attention has been given, however, to the appropriateness of the TTM for explaining the adoption of exercise behavior in older adults. The purposes of this study were to determine the reliability of the TTM instruments and validate TTM predictions in 86 community-dwelling older adults (mean age 75.1 ± 7.0 years, 87% women) who were participants in a 16-week walking program. TTM construct scales—self-efficacy, decisional balance (pros and cons), and processes of change (behavioral and cognitive)—were generally reliable (all $\alpha > .78$). Behavioral processes of change increased from baseline to follow-up, but pros, cons, and cognitive processes did not change among participants who became regular exercisers. Stage of change did not predict exercise adoption, but baseline self-efficacy predicted walking behavior. These results lend partial support to the TTM in predicting exercise behavior.

Key Words: exercise adoption, exercise adherence, walking program, behavior change

National guidelines recommend that adults engage in moderate-intensity physical activities for at least 30 min on 5 or more days of the week (Centers for Disease Control and Prevention [CDC], 2006b). Regular exercise has repeatedly been noted to have substantial benefits on both physical and mental health. Studies have shown that exercise can not only prevent diseases such as coronary artery disease and non-insulin-dependent diabetes mellitus (Goodpaster & Brown, 2005; Laughlin & Wolfe, 2004) but also improve sleep (Tworoger et al., 2003), enhance mood and general well-being (McAuley, Elavsky, Jerome, Konopack, & Marquez, 2005), improve blood pressure (Roberts, Vaziri, & Bernard, 2002), and decrease mortality (Hirvensalo, Rantanen, & Heikkinen, 2000).

In the older population, moderate physical activity such as walking is associated with improved health outcomes (Perkins & Clark, 2001). Specifically, participation in regular exercise can improve muscle strength, endurance, and functional

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performance and decrease the risk of falling (Knap, Buturovic-Ponikvar, Ponikvar, & Bren, 2005; Means, Rodell, & O’Sullivan, 2005). Despite the known benefits of exercise, over 60% of older adults do not engage in it (CDC, 2006a). Unfortunately, a significant number of the older population, particularly those age 85 years and over, have chronic disorders and functional impairments that could be alleviated by regular exercise such as walking.

Research on the correlates of physical activity has identified demographic, biological, cognitive, behavioral, social, and cultural factors associated with the adoption and maintenance of exercise behavior (Ploeg, Beek, Woude, & Mchelen, 2004). Several theories have been used to explain and predict a variety of health-related behaviors including exercise. A model that has received widespread attention from researchers and practitioners, the transtheoretical model (TTM) of behavioral change, was proposed by Prochaska and DiClemente (1982, 1983). It is an integrative framework for understanding how people progress in adopting and maintaining a health-behavior change for optimal health. Originally developed in the context of smoking cessation, weight control, and psychotherapy, it has also been applied to the adoption and maintenance of exercise (Cardinal, Tuominen, & Rintala, 2004; Garner & Page, 2005).

A search of MEDLINE and CINAHL from 1996 to 2006 revealed 16 studies using the TTM to explain exercise behavior in older adults. Among these 16 studies, however, only one reported the reliabilities of the TTM constructs: decisional balance (Cronbach’s $\alpha$: pros = .90 and cons = .67), self-efficacy (Cronbach’s $\alpha$ = .74), and processes of change (Cronbach’s $\alpha$: behavioral = .86 and cognitive = .87; Pinto, Lynn, Marcus, DePue, & Goldstein, 2001). One study reported the reliabilities of self-efficacy ($\alpha$ coefficient = .95) and processes-of-change scales ($\alpha$ coefficient: behavioral = .70 and cognitive = .92; Hellman, 1997). Two studies reported internal consistency ($r = .72, p < .05$, $\alpha$ coefficient = .95) and findings to support validity, but only for self-efficacy (Resnick, 2001; Resnick & Nigg, 2003). Most of the studies conducted to date have been cross-sectional in nature; there is little empirical evidence from longitudinal studies documenting the validity of the TTM in explaining and predicting older adults’ exercise behavior. Thus, there are limited data available on the reliability of the TTM instruments and the validity of TTM constructs in explaining and predicting older adults’ exercise behavior. The purposes of this study were to examine the reliability of the TTM instruments and the validity of the TTM in predicting change in exercise behavior in community-dwelling older adults who were participants in a 16-week walking program.

### Transtheoretical Model

The core constructs of TTM include the stages of change, self-efficacy, decisional balance, and processes of change (Prochaska & Velicer, 1997). General descriptions of the constructs follow.

### Stages of Change

The stage construct referred to as motivational readiness to change was developed to reflect the temporal dimension of health-behavior change (Prochaska, Redding,
Five stages of change have been proposed. In the first stage, pre-contemplation, the person is not engaged in the appropriate health behavior and has no intention to change within the next 6 months. In the contemplation stage, the person has the intention to change within the next 6 months. In the preparation stage, the person has the intention to change within the next 30 days and has taken some behavioral steps in this direction. The action stage is achieved when behavior has been changed to the target level recommended for that behavior. Once this level of behavior has been maintained for 6 months, the person enters the maintenance stage, which might last as long as 5 years.

Movement through these five stages can be in a linear or a cyclical manner. The amount of progress people make as a result of intervention tends to be a function of the stage they are in at the beginning of treatment or program (Marcus & Simkin, 1993). Participants in the preparation stage are more likely to adopt the new behavior than those in the precontemplation or contemplation stages (Prochaska, DiClemente, & Norcross, 1992).

Self-Efficacy

Adapted from social-cognitive theory developed by Bandura (1977), self-efficacy describes a person’s confidence to perform a behavior in challenging or tempting situations; it is defined as one’s situation-specific self-confidence (Bandura, 1986; Prochaska & Velicer, 1997). Self-efficacy increases as progress is made through the stages of change (Marcus, Eaton, Rossi, & Harlow, 1994) and predicts exercise-program adherence (Marcus, Selby, Niaura, & Rossi, 1992).

Decisional Balance

Decisional balance reflects an individual’s relative weighing of the perceived positive aspects (pros) and negative aspects (cons) of changing behavior. Pros of change generally increase across the stages and often peak in the action stage. Conversely, cons usually decrease with advancing stages. Preparation appears to be the stage at which potential gains are in balance with perceived losses (Reed, 1999). Before an individual progresses to action, the pros and cons should cross over, with the pros becoming greater than the cons, as a sign that the person is well prepared for action (Prochaska, Redding, & Evers, 1997).

Processes of Change

The processes of change are defined as the covert and overt activities that people use to progress through the five stages. There are 10 processes of change. Five of these are cognitive processes: social liberation, consciousness raising, dramatic relief, self-reevaluation, and environment reevaluation. The other five are behavioral processes: self-liberation, counterconditioning, stimulus control, contingency management, and helping relationships (Reed, 1999). The TTM proposes that use of specific processes of change depends strongly on the individual’s stage of change; for example, use of the cognitive processes tends to peak in the preparation stage, whereas use of the behavioral processes tends to peak in the action stage (Marcus, Rossi, Selby, Niaura, & Abrams, 1992).
Methods

Design
This was a secondary data analysis using data from Project Telewalk, a pilot study designed to test whether the type of exercise reminders would affect walking behavior and adherence in older adults who were participants in a 16-week walking program. Participants were randomized into one of three groups: self-monitoring only (control; \( n = 27 \)), live-person telephone calls for exercise monitoring and prompting (\( n = 33 \)), and computerized telephone calls for exercise monitoring and prompting (\( n = 26 \)). After randomization, all participants were instructed on a graded exercise prescription with the goal of walking 30 min/day at least 5 days/week, which conforms to the CDC’s exercise guidelines (CDC, 2006b). Data were collected at baseline and the end of the 16-week walking program. No differences in walking behavior were found between intervention groups (Wyman et al., 2002). Therefore, in this analysis, all groups were combined to examine the reliability of the instruments and the validity of the TTM constructs in predicting behavior change. Research procedures were approved by the institutional review board of the University of Minnesota.

Sample
The sample consisted of 86 community-dwelling older adults (126 were screened, 86 were enrolled). Recruitment procedures included presentations to older adults at senior centers and senior apartment complexes, posters and brochures, a letter mailed to insurance-plan enrollees, and word of mouth. Participants had to be age 55 years or older; community-dwelling; mentally intact (Mini Mental State Examination score >23; Folstein, Folstein, & McHugh, 1975); able to walk 30 ft without stopping; free from severe acute or chronic health conditions that would prohibit safe, independent, low- to moderate-intensity-exercise participation; not currently involved in regular exercise (at least 20 min/session, 3 times a week); free from terminal illness; and able to understand and read English. Participants also had to meet the following criteria to be included in the walking program: distance visual acuity >20/70, no artificial leg brace or prosthesis, touch-tone telephone service, and physician clearance for exercise participation. Participants received a modest honorarium for completing the baseline and follow-up evaluations ($25 per evaluation).

Measures
Sociodemographic characteristics were measured by a self-administered questionnaire with items on age, gender, education, and income level. Stage of change was measured by an adaptation of the Exercise Stage of Change Questionnaire (Marcus, Rakowski, & Rossi, 1992). The original questionnaire consists of five true-or-false questions assessing current and past involvement in regular exercise and intent to exercise in the next 6 months. The Kappa index of test–retest reliability of this instrument used in middle-aged adults (\( N = 20 \)) over a 2-week period was .78. Concurrent validity for this measure was demonstrated by its significant association with the Seven Day Recall Physical Activity Questionnaire (Marcus
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& Simkin, 1993). For this study, the questions were reworded in a yes/no format, and regular exercise was specified as 20 min/day at least 3 days/week.

Self-efficacy was measured by a modified Exercise Self-Efficacy Scale (McAuley, Lox, & Duncan, 1993). In order to be consistent with the study’s exercise prescription, the original questions that used 3 days/week were modified to read 5 days/week. Because most of the participants were at retirement age, the word work in one of the items was replaced with other commitments. The instrument consisted of 13 items in which participants rate their confidence in their ability to exercise 5 days/week under different conditions such as boredom with exercise, personal stress, or pain or discomfort, using a 5-point Likert like scale ranging from not at all confident (1) to extremely confident (5). The mean score of the 13 items was calculated to determine whether participants had high or low self-efficacy (higher scores reflect higher self-efficacy). Scores were calculated with mean imputation if at least 10 of the 13 items were completed. In this study, the modified Exercise Self-Efficacy Scale had a high internal-consistency reliability, with a Cronbach’s alpha of .94 at both baseline and follow-up.

Decisional balance was measured by the Exercise Decisional Balance Scale (Marcus et al., 1994), which included a 10-item “pro” scale that measures benefits of exercise and a 6-item “con” scale that measures the cost of exercising. Each item was rated using a 5-point Likert scale ranging from not at all important (1) to extremely important (5), with summary scores determined for the pro and con scales by computing a mean score across scale items. Scores were calculated with mean imputation if at least 8 out of 10 (pros) and 4 out of 6 (cons) items were completed. In this study, the Cronbach’s-alpha reliability coefficients of the exercise decisional-balance measures were good: .92 for pros and .84 for cons at baseline, .93 for pros and .78 for cons at follow-up. Because of the difference in the number of items, T scores were created for the pro and con scales in order to provide a standard metric for graphing.

Processes of change were assessed by a modified Exercise Processes of Change Questionnaire (Marcus, 1995). One question was changed from “I am aware that many health clubs now provide free babysitting services to their members” to “I am aware that many malls allow indoor walking for members of the community” to be more age appropriate. The questionnaire consists of 40 items (4 items per process) in which the individual rates the frequency that a particular item is used according to a 5-point Likert-like scale ranging from never (1) to repeatedly (5). The first 20 items measure the cognitive processes, and the last 20 items measure the behavioral processes. The mean scores were calculated to create cognitive- and behavioral-process scales with mean imputation if at least 15 of the 20 items were completed. The reliability coefficients of the behavioral and cognitive processes-of-change subscales on the Exercise Processes of Change Questionnaire in this study were high, as measured by Cronbach’s alphas of .89 and .91, respectively, at baseline, and .89 and .92, respectively, at follow-up.

Walking behavior and adherence were measured by participants’ self-recorded exercise logs, which they completed daily and mailed in weekly. The exercise log included space to record daily number of minutes walked, number of miles walked (based on the number retrieved from an electronic pedometer worn while walking), and perceived exertion level associated with walking. For this study, walking behavior was defined as the total number of minutes walked from Weeks 4–16, and
walking adherence was defined as the number of weeks a participant exercised at or above the prescription of 30 min/day, 5 days/week from Week 4 through 16.

**Procedures**

All prospective participants were initially screened over the telephone by the project coordinator or research nurses, using basic eligibility criteria, which included the Modified Physical Activity Readiness Questionnaire (PAR-Q; Cardinal, Esters, & Cardinal, 1996). For individuals who were eligible initially and wished to enroll, a letter was faxed to their primary-care provider explaining the study and requesting written medical clearance using a simple check-off form that could be faxed back.

There were three home visits for each participant. The first visit involved obtaining written consent and completing a comprehensive evaluation consisting of a history, brief physical examination, and self-administered questionnaires on health-related quality of life (Ware, Snow, Kosinski, & Gandek, 1993), exercise goals and preferences, TTM instruments, and demographic characteristics.

The second home visit involved randomizing each participant into one of the three treatment groups: self-monitoring (control), weekly live nurse telephone prompting, or weekly computerized, telephone-system prompting. Verbal and written instructions on the graded, low- to moderate-intensity walking program and how to complete the daily exercise log were provided by a registered nurse. Instructions were given on walking pace, exertion level, warm-up and cool-down exercises, and the walking prescription, which progressed from walking 15 min/day, 5 days/week initially to 30 min/day, 5 days/week by the fourth week of the program. All participants were asked to complete a daily exercise log. A final home visit was conducted at the end of the 16-week intervention period to collect data on TTM constructs and selected clinical variables.

**Data Analysis**

Descriptive statistics were used to summarize demographics, scales, subscales, and exercise-log variables. Reliability of the TTM instruments was assessed using Cronbach’s alpha (internal consistency). Concurrent validity between TTM scales at each visit was assessed with Spearman’s correlations, and between stages of change and TTM scales, by analysis of variance (ANOVA) and graphs. Validity of the TTM constructs in predicting exercise adoption was assessed by the outcomes of series of statistical tests and graphs derived from the following hypotheses:

- **H₁.** Pros increase with exercise adoption (Prochaska et al., 1992). Hypothesis 1 was examined by comparing baseline values of decisional balance pros with follow-up values, using a paired t test within the group that adopted exercise behavior (adopters).

- **H₂.** Cons decrease with exercise adoption (Prochaska et al., 1992). Hypothesis 2 was examined by comparing baseline values of decisional balance cons with follow-up values for adopters using a paired t test.

- **H₃.** Cognitive processes of change decrease with exercise adoption (Prochaska & DiClemente, 1983). Hypothesis 3 was examined by comparing baseline values of cognitive processes with follow-up values for adopters using a paired t test.
H₄. Behavioral processes of change increase with exercise adoption (Prochaska & DiClemente, 1983). Hypothesis 4 was examined by comparing baseline values of behavioral processes with follow-up values for adopters using a paired t test.

H₅. Participants in the preparation stage at baseline are more likely to become exercise adopters than those in precontemplation or contemplation (Prochaska et al., 1992). Hypothesis 5 was tested by comparing rates of adopters across groups formed by stage of change at baseline using a chi-square test.

H₆. Higher self-efficacy predicts walking behavior and adherence (Marcus, Selby, et al., 1992). Hypothesis 6 was examined using Spearman’s correlations between self-efficacy at baseline and walking behavior and adherence.

We used t tests to compare TTM constructs at follow-up between exercise adopters and nonadopters to assess differences between these groups. A p < .05 level of significance, two-tailed, was used for all analyses. No other adjustment was made for multiple comparisons because the hypotheses derived a priori from the TTM. There were few missing data points, and after the imputation rules described above were applied, the number of missing values was 2 or fewer on all scales.

Results

Demographic characteristics of the 86 participants are shown in Table 1. The sample ranged in age from 55.8 to 87.4 years, with 0–10 chronic health problems. Four participants did not complete a follow-up visit, and another 2 completed the stage-of-change questions in an inconsistent manner that prevented classification at follow-up. Among remaining participants (n = 80), 64 (80%) reported regularly exercising (at least 30 min/day, 3 days/week) at follow-up. The average number of minutes walked per week was 159 (SD 63.4), with a range of 0–414 min. The average number of weeks that participants were able to walk at or above the exercise prescription (i.e., adherence) during follow-up was 8.7 out of 13 weeks (SD 4.5), with a range of 0–13 weeks.

Associations Among TTM Measures at Baseline and at Follow-Up

Table 2 displays the correlations among summative TTM scales at baseline and follow-up. All correlations are based on observations from 79–85 participants. The patterns of association were similar at both time points: Decisional-balance cons were significantly negatively correlated with self-efficacy, and all other associations were positive. The strongest correlations were between use of cognitive processes and behavioral processes and between use of cognitive processes and decisional-balance pros.

The relationship between stage of change and decisional balance was examined graphically using t scores and tested by ANOVA using mean scores (Figure 1). Figure 2 depicts the cognitive and behavioral processes-of-change mean scores. At baseline, all participants were in precontemplation, contemplation, or preparation. None of the TTM variables differed significantly across these groups (Figures 1 and
At follow-up, participants were assigned into three groups: precontemplation/contemplation (only 1 participant reported being in precontemplation), preparation, and action/maintenance, because the program was not long enough for participants to meet the 6-month criterion for maintenance. At follow-up, significant differences between these groups were found for decisional-balance pros ($F = 5.300, df = 2,$...
 Means for pros and behavioral processes rose as anticipated by the TTM’s being lowest in the contemplation group and highest in the regular exercisers. To evaluate possible differences by gender in TTM constructs at baseline and follow-up, t tests were performed. There were no significant differences between men and women (p > .17, all); therefore, no separate analyses were conducted by gender.

Figure 1 — Decisional balance at baseline. (a) Results of ANOVA comparing baseline means showed no difference in pros or cons between groups (pros: $F = 2.413$, df = 2, 82, $p = .096$; cons: $F = 2.307$, df = 2, 81, $p = .106$). (b) Results of ANOVA comparing follow-up means (using three groups: PC/C, P, and A) showed differences in pros but not cons (pros: $F = 5.300$, df = 2, 76, $p = .007$; cons: $F = 0.892$, df = 2, 76, $p = .414$). Note. PC = precontemplation; C = contemplation; P = preparation; A = action; M = maintenance.
Exercise Adoption

At the final visit, 64 participants reported regularly exercising (adopters). Of these, 30 correctly classified themselves as in the action stage of change, and 34 responded positively to the item “I have exercised regularly for the past 6 months.”
which classified them as being in maintenance. Because all participants reported not regularly exercising at baseline (approximately 18 weeks earlier), it appears that some participants misjudged or ignored the time frame posed by the question. Exercise logs did, in general, confirm adopters’ reports, in that only 1 of the 64 adopters logged less than 1 hr of walking in the last week of the intervention, and 90% of adopters reported 2 or more hr of walking in the last week. Of those who described themselves as not in action (n = 16), however, all but 2 had also stated that they exercised more than 1 hr/week in the last week, which was the guideline for regular exercise in the stage-of-change questions, with 9 participants reporting 2 or more hr of exercise that last week.

Table 3 displays the baseline and follow-up values of the TTM scales (M ± SD) for adopters and summarizes the results of the tests for Hypotheses 1–4. Only Hypothesis 4 was supported in this longitudinal analysis. Self-efficacy scores did not change between baseline and follow-up (3.4 vs. 3.3, t test = .715, df = 60, p = .477), and effect sizes (ES [mean change divided by baseline SD]) for the nonsignificant results were quite small (ES = 0–.13), suggesting that these results were not Type 2 errors. The statistical power for a paired t test with n = 64 has 80% power to detect effect sizes of .36 or larger.

**Stage of Change at Baseline and Success in Behavior Change**

Hypothesis 5 posits that participants in the preparation stage at baseline would be more likely to become exercise adopters after the intervention than would those in precontemplation or contemplation. This hypothesis was also not supported in the longitudinal analysis; 78% (35 of 45) of participants in preparation at baseline became adopters, and 82.8% (29 of 35) of participants in precontemplation or contemplation became adopters (χ² = .097, p = .75). Although there was low power to detect this result, the difference was not large or meaningful; it would have taken a study of over 2,000 participants to find this effect with 80% power.

**Table 3** Evaluation of Change in Transtheoretical-Model Measures of Decisional Balance and Processes of Change Between Baseline and Follow-Up for Exercise Adopters

<table>
<thead>
<tr>
<th>Measure</th>
<th>Baseline, M (SD)</th>
<th>Follow-up, M (SD)</th>
<th>Hypothesis, paired t test, df, p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decisional balance pros</td>
<td>3.7 (.77)</td>
<td>3.7 (.70)</td>
<td>Hypothesis 1 not supported, t = 0.160, df = 62, p = .87</td>
</tr>
<tr>
<td>Decisional balance cons</td>
<td>2.1 (.85)</td>
<td>2.2 (.77)</td>
<td>Hypothesis 2 not supported, t = –1.017, df = 61, p = .31</td>
</tr>
<tr>
<td>Cognitive processes</td>
<td>3.1 (.66)</td>
<td>3.1 (.56)</td>
<td>Hypothesis 3 not supported, t = 0.606, df = 61 p = .55</td>
</tr>
<tr>
<td>Behavioral processes</td>
<td>3.0 (.56)</td>
<td>3.1 (.66)</td>
<td>Hypothesis 4 supported, t = –2.35, df = 62, p = .02</td>
</tr>
</tbody>
</table>

*Note.* Adopters were those in the action or maintenance stage based on their responses to the Stage of Change Questionnaire at follow-up.
Associations Between Baseline Self-Efficacy and Walking Adherence

Hypothesis 6 states that self-efficacy is related to walking behavior and adherence. Spearman’s correlations showed that baseline self-efficacy was significantly related to walking behavior, that is, total number of minutes walked from Weeks 4 to 16 (Rho = .298, p = .006), and approached significance for walking adherence, that is, number of weeks exercised at or above exercise prescription from Weeks 4 to 16 (Rho = .203, p = .062). The sample size had 80% power to detect correlations of .3 or larger.

The t tests conducted to compare the adopters with the nonadopters at follow-up revealed that mean self-efficacy was significantly higher in the adopter group (p = .020), as were the pros of exercise (p = .002), behavioral processes (p = .005), and total minutes walked (p = .005), whereas walking adherence approached significance (p = .058).

Discussion

This is one of the first longitudinal studies to examine the validity of the TTM constructs in predicting change in exercise behavior in older adults. These results raise questions related to the ability of the TTM to predict exercise behavior. Although comparisons between adopters and nonadopters at follow-up of the 16-week walking program showed large differences consistent with TTM tenets, it does not appear that changes in the attitudes of adopters were primarily responsible. Use of behavioral processes was the only construct that increased in adopters; their self-efficacy, cognitive processes, pros, and cons did not change significantly. Thus, it would appear that it is changes in the attitudes of the nonadopters that drive the differences at follow-up.

The relationship between stage of change and exercise adoption predicted by the TTM was not supported; the percentage of participants in the precontemplation and contemplation stages (82.8%) who adopted exercise behavior at the end of the 16 weeks was not statistically different from the percentage of those in the preparation stage (78%) at baseline. The sample consisted of participants who volunteered for an exercise study, so the reports of precontemplation are suspect. Simply by volunteering to be in an exercise study, one could argue that all of the participants were at the preparation stage before the program began but misclassified themselves as precontemplation or contemplation. This might be a shortcoming of the stage-of-change instrument, not a problem with the model.

The time frame used in the stage-of-change instrument was also problematic. Some of the participants in this study ignored or misjudged the time frame when answering the stage-of-change questions; for example, some participants classified themselves in the maintenance stage (6 months of walking) at the end of the walking program when the program was only 16 weeks long. Moreover, several of the nonadopters completed exercise logs that contradicted their answers on the stage-of-change instrument.

Findings on the relationships between TTM constructs showed that pros in decisional balance and behavioral processes of change were significantly higher among those in action and maintenance stages at follow-up, which is consistent
with model predictions and with findings from other studies (Marcus et al., 1994; Marcus & Owen, 1992; Marcus, Selby, et al., 1992). The TTM also predicts that before an individual progresses to action, the cons should become lower than the pros as a sign that the person is well prepared for action (Prochaska et al., 1997). This effect was not evident in this sample. Pros increased steadily as stages of change progressed from contemplation to maintenance at follow-up, but, contrary to the model prediction, cons did not decrease from preparation stage to action stage. This finding indicated that the cons of walking still played an important role in regular walking among the older participants, which implies that in general they had a tendency to remain concerned about the negative aspects of walking throughout the different stages. A similar finding was noted from an obesity study in which decisional balance for exercise did not change until individuals entered the maintenance stage (Pinto, Clark, Cruess, Szymanski, & Pera, 1999).

When promoting any type of exercise or walking program to older adults or to populations who are not physically fit, it is important to acknowledge their concerns and any unpleasant experience such as fear of falling or getting hurt that might be associated with their exercise participation. Dishman (1993) echoes this statement by suggesting that knowledge of participants’ pro and con beliefs in addition to their sociodemographic, biologic, and environmental influences will enhance researchers’ and clinicians’ ability to design effective exercise-promotion interventions.

Participants used behavioral processes more often as they progressed to higher stages of change from baseline to follow-up, which is consistent with the model prediction and other recent health-behavior studies (Cardinal & Kosma, 2004; Schnoll et al., 2002). Cognitive processes of change did not decline after baseline among adopters, however, and did not differ across stage-of-change groups at follow-up. Researchers suggest that measuring and understanding individuals’ use of processes of exercise-behavior change might help in designing and testing specific interventions to help individuals advance quickly from one stage of exercise adoption to another. Based on this study’s findings, interventions to promote continued use of behavioral processes might be a promising strategy to enable more participants to remain in maintenance.

Although self-efficacy was significantly related to walking behavior, it was only marginally associated with walking adherence. This could in part result from our criteria for adherence that did not distinguish between those who achieved the target walking prescription and those who “overadhered.” In this study there were many participants who consistently walked far beyond the recommended exercise prescription. The number of minutes walked captured their exercise behavior, but the adherence variable did not.

In general, the TTM measures had relatively high internal-consistency reliability when used in this older population. As noted earlier, the stage-of-change instrument might be problematic. It did not appear to accurately classify participants’ stage of readiness when they had already shown interest in participating in an exercise program. It is noteworthy that the time frames used in the stage-of-change questionnaire are adapted from studies on smoking cessation, which might differ from exercise-behavior adoption. Adopting a new behavior certainly is different from giving up a bad one. The time frames might not make sense to some people and therefore are easily ignored. This might be a recall issue and too difficult a judgment for respondents; it is also possible that the wording of the questionnaire items could be improved.
There are several limitations to this study. Because the data are from a pilot study with a small sample size, power is limited. This study modified some items from the Decisional Balance Questionnaire to better reflect the older population. This might not have captured all the pros and cons of exercise for this age group, however. For example, it does not capture the possible con of pain or injury, which is a risk in those with chronic conditions such as osteoporosis or osteoarthritis (Plotsnikoff, Blanchard, Hotz, & Rhodes, 2001). Further development of this instrument for use in an older population might be warranted. The sample was predominantly female, White, and well educated, so results might not be generalizable to other older populations. Moreover, although there were no gender differences found on any of the TTM constructs in this population, they have been found in younger populations (O’Hea, Wood, & Brantley, 2003), suggesting the need for further studies in this area. The sample consisted of participants who volunteered for an exercise study. Generally, volunteer samples are more motivated and positive toward a behavioral intervention than nonvolunteer samples are (Godin, Desharnais, Valois, & Bradet, 1995). Although the ascertainment of exercise behavior was based on self-report data that were subject to recall bias and social desirability, we did not believe this be a major concern, because the TTM measures and exercise logs were completed prospectively. Finally, the $50 honorarium and the attention of research nurses might have had a positive impact on exercise adherence.

**Conclusion**

In summary, the results of this study lend partial support to several of the TTM constructs related to exercise behavior in older adults. The summative TTM instruments were reliable. Self-efficacy at baseline predicted walking behavior but was marginally associated with walking adherence. The cons of exercising were viewed as being as important as the pros to this group of older adults when making the decision to exercise. As individuals progressed to a higher stage of change, behavioral processes increased and the cognitive processes of change remained a strong influence on regular walking. The time frame used in the stage-of-change instrument could be problematic for older adults. Further research with longitudinal data is needed to further explore the application of the TTM in predicting exercise behavior in older adults.

**References**


