

# Validation of the Measures of the Transtheoretical Model for Exercise in an Adult African-American Sample

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## Abstract

**Purpose.** African-Americans have high rates of physical inactivity-related morbidity and mortality, thus effective interventions to increase exercise are necessary. Tailored interventions show promise, but measures need validation in this population. This study validated transtheoretical model measures for exercise in an African-American sample.

**Design.** Cross-sectional measure development.

**Setting.** Telephone survey of individuals in North Carolina.

**Subjects.** 521 African-American adults.

**Measures.** Stages of change, decisional balance (pros and cons), self-efficacy and processes of change (POC) for regular exercise.

**Analysis.** Confirmatory factor analyses tested measurement models. Multivariate analyses examined relationships between each construct and stages of change.

**Results.** For decisional balance, the two-factor uncorrelated model was the most parsimonious good-fitting model ( $\chi^2_{235} = 158.76$ ; comparative fit index [CFI], .92; average absolute standardized residual [AASR], .04), and alphas were good (pros  $\alpha = .85$  and cons  $\alpha = .74$ ). The one-factor model for self-efficacy ( $\alpha = .80$ ) revealed an excellent fit ( $\chi^2_{29} = 45.51$ ; CFI, .96; AASR, .03). For the POC subscales with good alphas ( $\alpha = .62-.91$ ), a 10-factor fully correlated model fit best ( $\chi^2_{360} = 786.75$ ; CFI, .91; AASR, .04). Multivariate analyses by stage of change replicated expected patterns for the pros, self-efficacy, and POC measures with medium-sized effects ( $\eta^2 = .05-.13$ ). Results by stage of change did not replicate for the cons scale.

**Conclusions.** The structures of these measures replicated with good internal and external validity, except for the cons scale, which requires additional development. Results support the use of these measures in tailored interventions to increase exercise among African-Americans. (*Am J Health Promot* 2012;26[5]:317-326.)

**Key Words:** Transtheoretical Model, Exercise, African-American, Validation, TTM, Adults, Prevention Research. Manuscript format: research; Research purpose: instrument development/validation; Study design: cross-sectional; Outcome measure: behavioral; Setting: local community and state; Health focus: fitness/physical activity; Strategy: skill building/behavior change; Target population: adults; Target population circumstances: North Carolina, African-American

## PURPOSE

The promotion of regular exercise is crucial to the prevention and management of obesity and many chronic diseases.<sup>1-3</sup> However, despite clear health benefits of exercise, physical inactivity remains a major public health problem in the United States and is particularly common among African-Americans.<sup>4</sup> National data suggest that in 2006, only 31.2% of people in the United States reported that they engaged in the recommended amount of regular exercise, whereas 39.5% reported that they did not engage in any leisure time physical activity.<sup>5</sup> Comparisons by race during the same period found that 48.9% of African-Americans reported no leisure time physical activity as compared with 38.2% of whites.<sup>5</sup> Additionally, for those who reported engaging in regular physical activity, only 24.9% of African-Americans reported regular physical activity as compared with 31.9% of whites.<sup>5</sup> Moreover, African-Americans bear a disproportionate burden of chronic disease in the United States.<sup>6</sup> The reported lower levels of exercise and higher physical inactivity could be both causally related as well as a complication of the higher rates of chronic disease in this population.<sup>6</sup>

Given this higher disease burden combined with lower rates of physical activity, there is a need for effective interventions to help increase exercise participation among African-Americans. Numerous theoretical frameworks have been applied to physical activity and exercise interventions to

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better understand how people adopt and maintain regular exercise.<sup>7</sup> One important theoretical framework is the transtheoretical model (TTM) of behavior change, an integrative model of intentional behavior change demonstrating when, why, and how people change behavior.<sup>8-10</sup> The key TTM constructs include stage of change (addressing the temporal dimension of change), decisional balance, and situational self-efficacy (reflecting key mediational decision-making components) and the processes of change (reflecting the experiential [i.e., cognitive and emotional] and behavioral strategies for changing one's behavior). These TTM constructs and their relationships have been well described in detail elsewhere.<sup>10,11</sup>

TTM measures for regular exercise have been previously developed and evaluated by a number of investigators.<sup>12-15</sup> In addition, stage-matched exercise interventions that have used TTM exercise measures have been shown to be effective.<sup>16-18</sup> As part of these exercise interventions, measures have been developed and validated in many samples for the constructs of stage of change,<sup>19-24</sup> decisional balance,<sup>12,25-28</sup> self-efficacy,<sup>26,27,29,30</sup> and processes of change.<sup>13,31</sup>

Despite the abundance of research applying the TTM to regular exercise, the participant samples in most validation and intervention studies have been predominantly middle-class, white, and female.<sup>12,18,32</sup> TTM measures for regular exercise have minimal validation in African-American samples.<sup>12,18</sup> Many researchers have commented on the lack of validation of the TTM exercise measures in minority and underserved populations.<sup>12,18,32</sup> This lack of validation leaves potential cultural factors influencing physical activity rates among African-Americans unexamined. Some studies have suggested that perceived barriers to exercise, including greater care-giving duties, lack of safe places to exercise, presence of dogs in neighborhoods, lack of exercise role models, no side-walks in community, and low energy levels, may affect rates of activity among African-Americans.<sup>33,34</sup> Additionally, cultural differences such as less perceived pressure to be thin, higher body satisfaction, and the belief

that body size is not central to attractiveness may also contribute to lower rates of physical activity in African-Americans.<sup>33,34</sup> These cultural factors underscore the importance of validating existing TTM exercise measures in African-American samples.

This study addressed this gap by validating several TTM construct measures for regular exercise in an African-American sample. It was not anticipated that the structure or the relationships between TTM constructs would be different for this population. However, it remains essential to examine the validity of these measures, especially when data from these measures are used for empirical decision making and tailored intervention recommendations (i.e., based upon an individual's scale scores). Investigating the hypothesized measurement model fit and the functional relationships of the constructs by stage of change is necessary for developing and tailoring interventions. If the structure or relationships differ in this sample, it might be necessary to culturally tailor the measures and/or change decision-making rules.<sup>33,34</sup> It was hypothesized, based on expected factor structure and direction of relationships from previous studies of the TTM, that in an African-American sample: (1) the TTM exercise variables would reveal adequate fit to the theorized measurement models for decisional balance, self-efficacy, and processes of change (two-factor uncorrelated model for the pros and cons of exercise behavior; one-factor model of self-efficacy; and 10-factor, fully correlated model representing the 10 experiential and behavioral processes of change, respectively); (2) a characteristic crossover pattern of pros and cons would be found, with an increase in pros (approximately 1 SD) and a decrease in cons (approximately .5 SD) across the stages from the precontemplation to action stages; (3) the relationship between self-efficacy and stage of change would show an increase in self-efficacy across the stages; (4) experiential and behavioral process use would be lower in the earlier stages and increase in the higher stages; and (5) there would be an increase in self-reported exercise, as measured by the Godin Leisure Time Exercise Ques-

tionnaire (GLTEQ), across the stages of change.

## METHODS

### Design

This cross-sectional study procedure was approved by the University of Rhode Island Institutional Review Board. This investigation used the baseline sample of a larger intervention study that assessed and intervened on two behaviors: organ donation intentions and exercise in an African-American community sample.<sup>35</sup> The study design, recruitment methods, and inclusion and exclusion criteria were determined by the investigators for the primary data collection. Eligible participants were African-American, at least 18 years old, and selected to be in preaction stages for organ donation intention. Regarding exercise behavior, potential participants were excluded if they answered affirmatively to any of eight medical screening questions (e.g., recent myocardial infarction) that might be incompatible with efforts to increase regular exercise.

### Sample

Participants were adult community members in and around Guilford County, North Carolina. Data for these analyses were collected from February 2006 to January 2007. Individuals attending predominantly African-American churches, community health fairs, and historically black colleges and universities were asked to provide contact information to be considered for participation in health research. Individuals who provided contact information were then screened by phone, and if eligible, were enrolled in the study. Participants were randomized into one of two groups: an organ donation intervention (organ donation group) or an exercise intervention (exercise group). Participants in both groups were assessed on exercise stage of change, decisional balance, and self-efficacy. The processes of change for exercise were assessed only in the exercise group. Participants completed baseline survey assessment questions over the phone, and responses were entered into a computer database. A total of 1458 adults in North Carolina

were invited to participate, and 898 (61.6%) agreed to be a part of the study. Of those, 363 were screened out because of being in action or maintenance for organ donation, they could not be placed in a stage category for organ donation, or they were ineligible for an exercise intervention. The remaining baseline sample included 535 participants (97.4% African-American). For this project, only those who reported that they were African-American (N = 521) were included in analyses. The sample was primarily female (79.8%) with a mean age of 37.5 years (range, 18–70 years). In addition, 5% of participants also self-classified as American Indian or Alaskan Native, and fewer than 1% self-classified as Asian, Hispanic, or Native Hawaiian/other Pacific Islander. Approximately 37% reported being married or living with a partner. Sixty-two percent of the sample was employed or self-employed, 44% reported having children under 18 years living in their household, and more than 80% reported some college/associate's degree or technical training (20.8% reported a college degree). The mean body mass index was 29.1 kg/m<sup>2</sup> (SD, 7.1).

## Measures

**Demographics.** Single items were used to assess age, gender, ethnicity, education, income, marital status, employment status, and body mass index.

**Stage of Change.** All participants were given the definition of regular exercise, which for this study was described as “any planned moderate or intense exercise (e.g., brisk walking, aerobics, jogging, bicycling, swimming, rowing, basketball) performed to increase physical fitness. Such activity should be performed most days of the week ( $\geq 4$  days) for 30 minutes per session.”<sup>36,37</sup> Stage of change was measured by a staging algorithm that assessed readiness to engage in regular exercise, with response options of precontemplation (not intending to exercise regularly in the next 6 months), contemplation (intending to begin exercising regularly in the next 6 months), preparation (intending to begin exercising regularly in the

next 30 days), action (exercising regularly for  $<6$  months), and maintenance (exercising regularly for  $\geq 6$  months). The reliability and stability of the algorithm have been demonstrated in several studies.<sup>21,38</sup>

**Decisional Balance.** A 10-item decisional balance measure assessed the relative importance of various advantages (pros) and disadvantages (cons) in an individual's decision to engage in regular exercise (Table 1). This measure was composed of two separate scales: a five-item pros scale ( $\alpha = .90$ ) and a five-item cons scale ( $\alpha = .67$ ), which have been demonstrated to be internally consistent and significantly related to stage.<sup>26</sup> Participants were asked to rate the importance of each item in their decision to be physically active on a five-point scale, ranging from 1 (not at all important) to 5 (extremely important)<sup>26</sup> (Table 1).

**Self-Efficacy.** A six item self-efficacy measure ( $\alpha = .82$ ) was used to assess an individual's confidence to be physically active in the presence of various challenges,<sup>29</sup> including negative affect, excuse making, exercising alone, lack of equipment access, resistance from others, and bad weather conditions. Participants rated their confidence to be physically active on a five-point scale ranging from 1 (not at all confident) to 5 (completely confident) (Table 1).

**Processes of Change.** A 30-item measure assessed the 10 common cognitive, evaluative, affective, experiential, and behavioral strategies used by individuals to facilitate progress through the stages of change. Individuals in the exercise intervention group only (n = 255) were asked to recall the past month and rate the frequency of use of each of the items. Participants rated their frequency of use in the past 30 days on a 5-point scale ranging from 1 (never) to 5 (repeatedly). Examples of processes of change items are “My friends encourage me to exercise” and “I keep a set of exercise clothes conveniently located so I can exercise whenever I get the time” (Table 1). Previously this measure demonstrated internal consistency with coefficient alphas for the 10 subscales ranging from .64 to .86.<sup>31,39</sup>

**GLTEQ.** The behavioral outcome measure for exercise was the GLTEQ.<sup>40</sup> The Godin is a self-report measure of exercise that assesses the frequency of strenuous, moderate, and mild activity lasting at least 20 minutes per occasion over an average week.<sup>40</sup> For this study, the duration of physical activity was specified as at least 30 minutes 4 or more days per week to meet the recommendations of regular physical activity at the time of data collection. The GLTEQ has been validated against other frequently used physical activity questionnaires.<sup>41</sup> Of particular importance for this study is that the GLTEQ has been validated against the stages of change and other physical activity measures in minority samples including African-Americans.<sup>19,20,42–45</sup>

## Analysis

The analysis of the measures of the TTM for readiness to engage in regular exercise was two-fold. The first step tested and confirmed the best-fitting structural model for the decisional balance, self-efficacy, and processes of change measures using EQS (version 6.1 Multivariate Software, Inc., Encino, California).<sup>46</sup> The second step determined if the hypothesized relationships between each measure and stages of change could be replicated.

**Confirmatory Factor Analyses.** To establish the best-fitting model for each of the confirmatory factor analyses (CFA) procedures, several different macro fit indices were compared. These included the (1) comparative fit index (CFI), (2) average absolute standardized residual (AASR), (3) root mean squared error of approximation (RMSEA), and (4) likelihood ratio  $\chi^2$  test statistic.<sup>47</sup> For CFI, values of .80 to .89 indicate adequate fit, whereas values of .90 and greater indicate good or excellent fit.<sup>48</sup> For the AASR and RMSEA, values below .06 indicate excellent fit.<sup>49</sup> In addition, the individual items factor loadings were examined, with adequate factor loadings expected to be above .40.

For the decisional balance measure, four confirmatory structural models were compared, including the null model, a two-factor uncorrelated model, a two-factor correlated model, and a general one-factor decisional balance model. Two models were

**Table 1**  
**Decisional Balance, Self-Efficacy, and Processes of Change Items and Raw Score Means  $\pm$  SD**

|                                                                                                            | Mean $\pm$ SD   |
|------------------------------------------------------------------------------------------------------------|-----------------|
| Pros of regular exercise                                                                                   |                 |
| I would have more energy for my family and friends if I exercised regularly. (Pros 1)                      | 3.93 $\pm$ 1.15 |
| I would feel less stressed if I exercised regularly. (Pros 2)                                              | 4.12 $\pm$ 1.04 |
| Exercising puts me in a better mood for the rest of the day. (Pros 3)                                      | 3.98 $\pm$ 1.12 |
| I would feel more comfortable with my body. (Pros 4)                                                       | 4.20 $\pm$ 1.01 |
| Regular exercise would help me have a more positive outlook on life. (Pros 5)                              | 4.01 $\pm$ 1.07 |
| Cons of regular exercise                                                                                   |                 |
| I would feel embarrassed if people saw me exercising. (Cons 1)                                             | 1.44 $\pm$ .96  |
| Exercise prevents me from spending time with my friends. (Cons 2)                                          | 1.42 $\pm$ .83  |
| I feel uncomfortable or embarrassed in exercise clothes. (Cons 3)                                          | 1.38 $\pm$ .89  |
| There is too much I would have to learn to exercise. (Cons 4)                                              | 1.24 $\pm$ .69  |
| Exercise puts an extra burden on my significant other. (Cons 5)                                            | 1.23 $\pm$ .68  |
| Self-efficacy                                                                                              |                 |
| I am under a lot of stress. (SE 1)                                                                         | 3.38 $\pm$ 1.33 |
| I feel I don't have the time. (SE 2)                                                                       | 2.68 $\pm$ 1.32 |
| I have to exercise alone. (SE 3)                                                                           | 3.02 $\pm$ 1.48 |
| I don't have access to exercise equipment. (SE 4)                                                          | 2.77 $\pm$ 1.42 |
| I am spending time with friends or family who do not exercise. (SE 5)                                      | 2.84 $\pm$ 1.38 |
| If the weather is bad (such as when it's raining or too hot). (SE 6)                                       | 2.73 $\pm$ 1.44 |
| Experiential processes of change                                                                           |                 |
| Consciousness raising                                                                                      |                 |
| I read articles about exercise in an attempt to learn more about it. (CR 1)                                | 2.94 $\pm$ 1.31 |
| I look for information related to exercise. (CR 2)                                                         | 2.80 $\pm$ 1.36 |
| I find out about new methods of exercising. (CR 3)                                                         | 2.79 $\pm$ 1.29 |
| Dramatic relief                                                                                            |                 |
| I get upset when I see people who would benefit from exercise but choose not to exercise. (DR 1)           | 2.32 $\pm$ 1.38 |
| I am afraid of the consequences to my health if I do not exercise. (DR 2)                                  | 3.55 $\pm$ 1.37 |
| I get upset when I realize that people I love would have better health if they exercised. (DR 3)           | 3.16 $\pm$ 1.26 |
| Environmental reevaluation                                                                                 |                 |
| I realize that if I don't exercise regularly, I may get ill and be a burden to others. (ER 1)              | 3.03 $\pm$ 1.44 |
| I think that my exercising regularly will prevent me from being a burden to the health care system. (ER 2) | 3.35 $\pm$ 1.41 |
| I think that regular exercise plays a role in reducing health care costs. (ER 3)                           | 3.87 $\pm$ 1.14 |
| Self-reevaluation                                                                                          |                 |
| I feel more confident when I exercise regularly. (SR 1)                                                    | 3.87 $\pm$ 1.20 |
| I believe that regular exercise will make me a healthier, happier person. (SR 2)                           | 4.14 $\pm$ 1.07 |
| I feel better about myself when I exercise. (SR 3)                                                         | 3.99 $\pm$ 1.15 |
| Social liberation                                                                                          |                 |
| I have noticed that many people know that exercise is good for them. (SO 1)                                | 4.07 $\pm$ 1.00 |
| I am aware of more and more people who are making exercise a part of their lives. (SO 2)                   | 3.77 $\pm$ 1.11 |
| I have noticed that famous people often advertise the fact that they exercise regularly. (SO 3)            | 3.90 $\pm$ 1.17 |
| Behavioral processes of change                                                                             |                 |
| Counter conditioning                                                                                       |                 |
| When I feel tired, I make myself exercise anyway because I know I will feel better afterwards. (CC 1)      | 2.46 $\pm$ 1.32 |
| Instead of taking a nap after work, I exercise. (CC 2)                                                     | 2.21 $\pm$ 1.27 |
| Instead of relaxing by watching TV or eating, I take a walk or exercise. (CC 3)                            | 2.52 $\pm$ 1.17 |
| Stimulus control                                                                                           |                 |
| I keep a set of exercise clothes conveniently located so I can exercise whenever I get the time. (SC 1)    | 2.79 $\pm$ 1.51 |
| I use my calendar to schedule my exercise time. (SC 2)                                                     | 2.04 $\pm$ 1.27 |
| I make sure I always have a clean set of exercise clothes. (SC 3)                                          | 3.09 $\pm$ 1.54 |
| Helping relationships                                                                                      |                 |
| I have a friend who encourages me to exercise when I don't feel up to it. (HR 1)                           | 2.62 $\pm$ 1.48 |
| I have someone who encourages me to exercise. (HR 2)                                                       | 3.00 $\pm$ 1.46 |
| My friends encourage me to exercise. (HR 3)                                                                | 2.77 $\pm$ 1.39 |

Table 1, Continued

|                                                                                                | Mean $\pm$ SD   |
|------------------------------------------------------------------------------------------------|-----------------|
| Reinforcement management                                                                       |                 |
| One of the rewards of regular exercise is that it improves my mood. (RM 1)                     | 3.53 $\pm$ 1.27 |
| I try to think of exercise as a time to clear my mind as well as a workout for my body. (RM 2) | 3.69 $\pm$ 1.30 |
| If I engage in regular exercise, I find that I get the benefit of having more energy. (RM 3)   | 3.89 $\pm$ 1.14 |
| Self-liberation                                                                                |                 |
| I tell myself that I can keep exercising if I try hard enough. (SL 1)                          | 3.59 $\pm$ 1.21 |
| I make commitments to exercise. (SL 2)                                                         | 3.09 $\pm$ 1.32 |
| I believe that I can exercise regularly. (SL 3)                                                | 3.99 $\pm$ 1.06 |

compared for the self-efficacy measure, which included the null model and a single-factor model. Lastly, for the processes of change measure, three models were compared using CFA. These included the null model, a two-factor correlated model representing only the combined experiential and behavioral processes, and a 10-factor fully correlated model.

**External Validation.** To assess the external validation of the decisional balance, self-efficacy, processes of change, and GLTEQ measures, each were examined across stage of change to examine the functional relationships. Decisional balance, self-efficacy, and the GLTEQ were compared across the entire sample. Only one-half of the sample ( $n = 255$ ) was available for the comparison of the processes of change scales by stage of change.

Specifically, to assess this relationship for decisional balance and processes of change, two multivariate analyses of variance (MANOVA) were conducted, examining mean differences across the stages of change. Similarly, two analyses of variance (ANOVA) were conducted on the self-efficacy measure and GLTEQ measure by stage of change.

## RESULTS

### CFA

CFAs were conducted on the decisional balance ( $n = 511$ ), self-efficacy ( $n = 508$ ), and processes of change ( $n = 247$ ) measures. Four measurement models were compared for the 10-item decisional balance measure: (1) the null model, (2) a one-factor model, (3) a two-factor uncorrelated model, and (4) a two-factor correlated model. As

expected, the one-factor model was a poor fit to the data ( $\chi^2[35] = 626.12$ ;  $p < .001$ ; CFI, .63; AASR, .09; RMSEA, .18). The best-fitting models proved to be both the two-factor correlated model ( $\chi^2[34] = 156.94$ ;  $p < .001$ ; CFI, .92; AASR, .04; RMSEA, .08), and the two-factor uncorrelated model ( $\chi^2[35] = 158.76$ ;  $p < .001$ ; CFI, .92; AASR, .04; RMSEA, .08). A  $\chi^2$  difference test comparing the correlated and uncorrelated models was not significant ( $\chi^2[1] = 1.82$ ;  $p > .05$ ). The fit indices of the correlated and uncorrelated models were almost identical; however, the uncorrelated model uses fewer degrees of freedom. Thus, in the interests of parsimony, the uncorrelated model was selected as the best fit for the data. Coefficient alphas for the pros and cons scales were  $\alpha = .85$  and  $\alpha = .74$ ,

respectively, and the correlation between the pros and cons scales was .07. All factor loadings were adequate and ranged from .57 to .85. The two-factor uncorrelated model including items and factor loadings is shown in Figure 1.

Two measurement models were tested for the self-efficacy measure: (1) the null model and (2) a one-factor model. As anticipated, the one-factor model showed the best fit to the data ( $\chi^2[9] = 45.51$ ;  $p < .001$ ; CFI, .96; GFI, .97; AASR, .03; RMSEA, .09). Coefficient  $\alpha$  was .80, and factor loadings ranged from .49 to .70. The one-factor model, including items and factor loadings, is shown in Figure 2.

Three measurement models were tested for the processes of change measure: (1) the null model, (2) the correlated two-factor (combined expe-

Figure 1  
Two-Factor Uncorrelated Decisional Balance Model

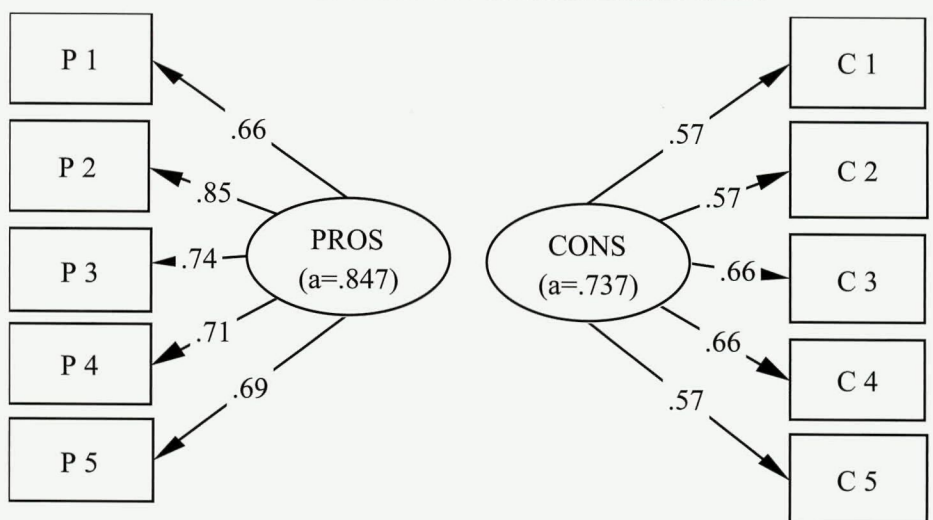
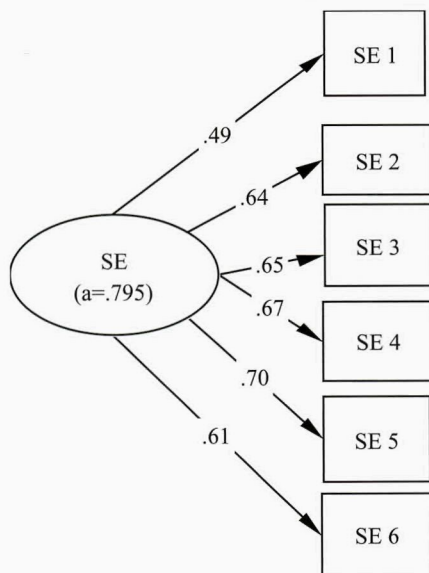


**Figure 2**  
**One-Factor Self-Efficacy Model**

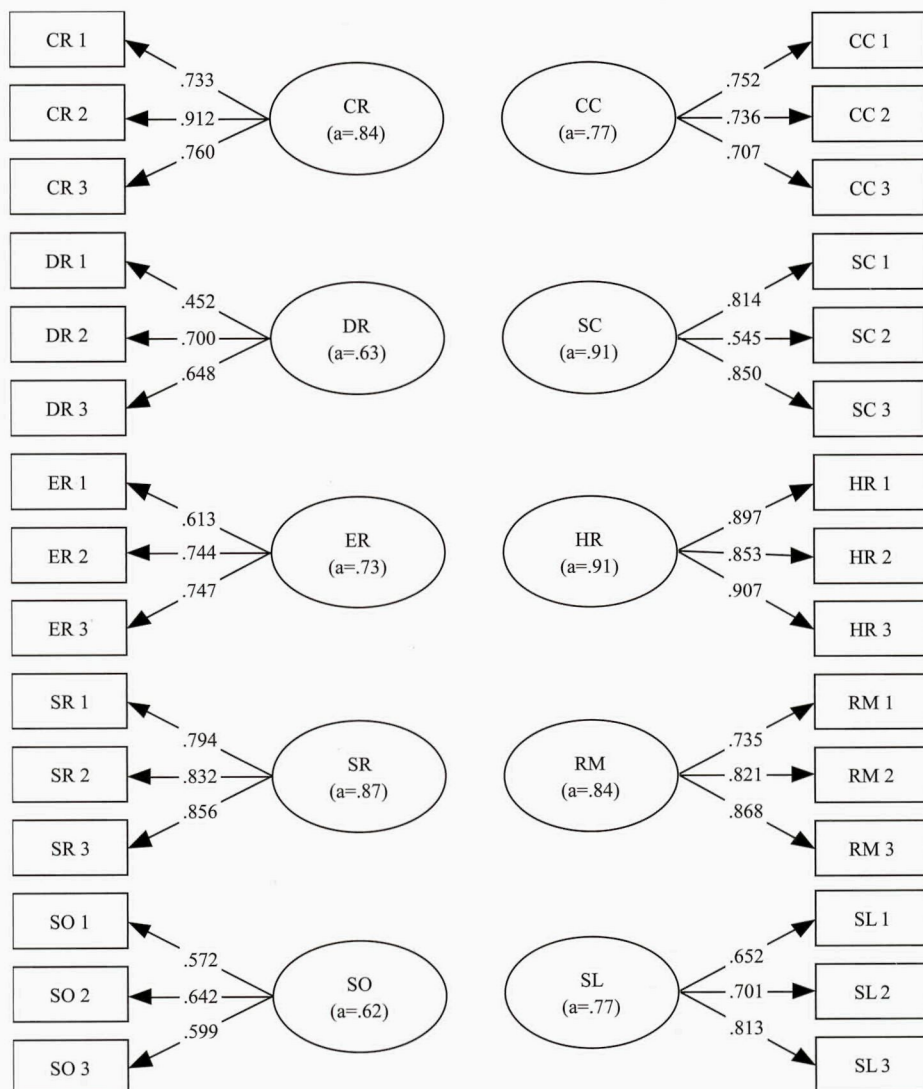


ritional and behavioral) model, and (3) a ten-factor fully correlated model. As expected, the two-factor model did not fit the data well ( $\chi^2[404] = 1752.32$ ;  $p < .001$ ; CFI, .70; AASR, .06; RMSEA, .12). The 10-factor fully correlated model revealed the best fit to the data ( $\chi^2[360] = 786.75$ ;  $p < .001$ ; CFI, .91; AASR, .04; RMSEA, .07). Factor loadings ranged from .45 to .91, and coefficient alphas ranged from .62 to .91. Figure 3 displays all items, factor loadings, and coefficient alphas.

### Descriptives

A series of descriptive analyses examined possible demographic differences across all TTM variables. These analyses indicated that the stage of change distribution differed significantly by gender ( $\chi^2[4, N = 513] = 24.06$ ;  $p < .001$ ), with more men reporting being in the action/maintenance stages. In addition, the pros and cons scales differed significantly by education level ( $F[4, 511] = 2.45$ ;  $p < .05$ ;  $\eta^2 = .02$  and  $F[4, 510] = 3.06$ ;  $p < .05$ ;  $\eta^2 = .02$ , respectively). Follow-up Tukey tests revealed that individuals with a high school degree (or general equivalency diploma) reported significantly lower pros than those with graduate training. No other significant demographic differences were found.

**Figure 3**  
**Ten-Factor Correlated Processes of Change Model**



Participants were categorized according to their readiness to engage in regular exercise using the staging algorithm. The distribution by stage for the entire sample ( $N = 521$ ) was precontemplation, 6.1% ( $n = 32$ ); contemplation, 8.3% ( $n = 43$ ); preparation, 38.2% ( $n = 199$ ); action, 13.4% ( $n = 70$ ); maintenance, 32.4% ( $n = 169$ ); and unstageable 1.5% ( $n = 8$ ). Processes of change were only assessed on one-half of the sample ( $n = 255$ ), and the stage distribution for this was precontemplation, 7.8% ( $n = 20$ ); contemplation, 9.0% ( $n = 23$ ); preparation, 37.6% ( $n = 96$ ); action, 15.7%

( $n = 40$ ); and maintenance, 29.8% ( $n = 76$ ). The stage distribution for the two sample halves did not differ ( $\chi^2[4] = 5.58$ ;  $p > .05$ ).

### External Validation

A MANOVA was conducted to determine if the pros and cons of regular exercise differed by stage of change. As predicted, there was a significant main effect for stage of change (Wilk's  $\Lambda = .91$ ;  $F[8, 1006] = 6.08$ ;  $p < .001$ ; multivariate  $\eta^2 = .05$ ). The follow-up ANOVA and Tukey test found that the pros significantly differed by stage ( $F[4, 504] = 12.13$ ;  $p < .001$ ;  $\eta^2 = .09$ ).

**Table 2**  
Standardized T-Scores  $\pm$  SD for Decisional Balance, Self-Efficacy,  
and the Godin by Stage of Change\*

|               | Precontemplation<br>(n = 32) | Contemplation<br>(n = 43) | Preparation<br>(n = 199) | Action<br>(n = 70) | Maintenance<br>(n = 169) |
|---------------|------------------------------|---------------------------|--------------------------|--------------------|--------------------------|
| Pros          | 40.75 (11.76)                | 45.52 (10.87)             | 51.48 (8.71)             | 49.15 (8.84)       | 51.53 (10.11)            |
| Cons          | 49.50 (7.01)                 | 50.87 (10.43)             | 50.36 (10.21)            | 49.28 (8.33)       | 49.83 (10.84)            |
| Self-efficacy | 45.84 (11.42)                | 45.58 (8.36)              | 48.71 (8.48)             | 49.14 (8.85)       | 53.71 (10.95)            |
| GLTEQ         | 48.14 (14.6)                 | 43.56 (6.1)               | 45.85 (6.9)              | 52.55 (11.5)       | 55.99 (8.7)              |

\* GLTEQ indicates Godin Leisure Time Exercise Questionnaire.

Precontemplators reported significantly lower pros than those in preparation, action, and maintenance. In addition, contemplators reported significantly lower pros than participants in preparation and maintenance. Overall, the pros increased from precontemplation through the preparation stage. The ANOVA for the cons was not significant ( $F[4, 504] = .26$ ). Scale means  $\pm$  SD for the pros and cons are given in Table 2.

The results for the pros and cons were also compared with the predictions of the strong and weak principles of change described by Prochaska.<sup>50</sup> The strong principle states that the

maximum increase in the pros of a healthy behavior change between the precontemplation and action stages will be approximately 1 SD. The expected decrease in the cons (the weak principle) is approximately .5 SD. Hall and Rossi<sup>51</sup> have verified these principles in a meta-analysis of 120 studies across 48 health behaviors. The maximum increase in the pros occurred between the precontemplation and preparation stages, and the maximum decrease in the cons was between contemplation and action. Results indicated the expected large effect size for the strong (pros) principle ( $d = 1.12$  [95% CI, .73, 1.50]) but almost

no effect for the weak (cons) principle ( $d = .16$  [95% CI,  $-.22, .54$ ]).

ANOVA and Tukey test results for self-efficacy found significant differences by stage ( $F[4, 501] = 11.03$ ;  $p < .001$ ;  $\eta^2 = .08$ ), with participants in maintenance reporting significantly higher self-efficacy than those in all other stages of change (Table 2). Overall, self-efficacy showed an increase through the stages from contemplation to maintenance.

MANOVA conducted on the processes of change subscales indicated a significant main effect for stage of change (Wilk's  $\Lambda = .57$ ;  $F[40, 885.36] = 6.08$ ;  $p < .001$ ; multivariate  $\eta^2 = .13$ ), with participants in the later stages reporting more process use than those in the earlier stages of change. In addition, participants who were further along in the stages reported using more behavioral processes. Scale means, SD, and follow-up ANOVA and Tukey results are presented in Table 3.

ANOVA conducted on the GLTEQ also indicated significant differences by stage of change ( $F[4, 502] = 37.99$ ;  $p < .001$ ;  $\eta^2 = .23$ ). Follow-up Tukey tests revealed that participants in precontemplation reported significantly less physical activity compared with

**Table 3**  
Processes of Change by Exercise Stage of Change

|                            | PC† (n = 20)      | C (n = 23)        | Prep (n = 96)    | A (n = 40)       | M (n = 76)        |             |          |                                  |
|----------------------------|-------------------|-------------------|------------------|------------------|-------------------|-------------|----------|----------------------------------|
|                            | Mean $\pm$ SD     |                   |                  |                  |                   | F           | $\eta^2$ | Tukey Tests                      |
| Processes of change        |                   |                   |                  |                  |                   | DF (4, 242) |          |                                  |
| Counter conditioning       | 42.97 $\pm$ 7.40  | 42.10 $\pm$ 5.43  | 48.10 $\pm$ 8.41 | 50.12 $\pm$ 7.96 | 57.02 $\pm$ 10.26 | 21.01**     | 0.26     | PC,C,PR,A < M PC > A,C; PR > C   |
| Consciousness raising      | 43.29 $\pm$ 10.66 | 46.64 $\pm$ 5.84  | 50.09 $\pm$ 9.28 | 49.15 $\pm$ 8.35 | 53.86 $\pm$ 11.00 | 6.08**      | 0.09     | PC < PR, M; C < M                |
| Dramatic relief            | 41.94 $\pm$ 10.86 | 46.16 $\pm$ 8.38  | 50.04 $\pm$ 9.30 | 51.08 $\pm$ 7.52 | 52.83 $\pm$ 11.01 | 5.90**      | 0.09     | PC < PR, A, M; C < M             |
| Environmental reevaluation | 43.35 $\pm$ 11.07 | 44.72 $\pm$ 9.87  | 52.08 $\pm$ 8.61 | 49.62 $\pm$ 8.47 | 51.00 $\pm$ 11.02 | 5.15*       | 0.08     | PC < PR, M; C < M                |
| Helping relationships      | 43.64 $\pm$ 6.89  | 47.33 $\pm$ 9.18  | 49.36 $\pm$ 9.28 | 50.00 $\pm$ 9.65 | 53.11 $\pm$ 10.97 | 4.46*       | 0.07     | PC < M                           |
| Reinforcement management   | 40.41 $\pm$ 12.81 | 44.20 $\pm$ 9.38  | 49.81 $\pm$ 9.05 | 49.91 $\pm$ 7.93 | 54.61 $\pm$ 8.88  | 12.07**     | 0.17     | PC, C, PR < M; PC < PR, A        |
| Stimulus control           | 41.96 $\pm$ 8.11  | 43.22 $\pm$ 8.55  | 48.58 $\pm$ 9.44 | 51.73 $\pm$ 8.02 | 55.34 $\pm$ 9.62  | 14.05**     | 0.19     | PC,C, PR < M; PC,C < A; PC < PR  |
| Self-liberation            | 40.45 $\pm$ 13.05 | 42.67 $\pm$ 9.34  | 49.22 $\pm$ 7.87 | 52.04 $\pm$ 7.95 | 54.63 $\pm$ 9.52  | 14.60**     | 0.19     | PC,C,PR < M; PC,C < A; PC,C < PR |
| Social liberation          | 42.13 $\pm$ 14.69 | 48.48 $\pm$ 11.09 | 50.86 $\pm$ 8.36 | 50.63 $\pm$ 7.44 | 51.15 $\pm$ 10.74 | 3.63*       | 0.06     | PC < PR, A, M                    |
| Self-reevaluation          | 39.77 $\pm$ 13.30 | 42.81 $\pm$ 10.74 | 50.54 $\pm$ 8.52 | 51.77 $\pm$ 8.27 | 53.03 $\pm$ 9.06  | 11.48**     | 0.16     | PC < PR, A, M; C < PR, A, M      |

† PC indicates precontemplation; C, contemplation; Prep, preparation; A, action; M, maintenance.

\*  $p < 0.01$ .

\*\*  $p < 0.001$ .

participants in maintenance. In addition, participants in contemplation and preparation reported significantly less physical activity compared with participants in action and maintenance (Table 2). Experiential processes of change (consciousness raising, dramatic relief, and self-reevaluation) were slightly correlated with the Godin, ranging from .17 to .24, and the behavioral processes of change (counter conditioning, self-liberation, reinforcement management, and stimulus control) were moderately correlated with the Godin, ranging from .26 to .41. Neither the pros nor cons were correlated with the Godin, whereas self-efficacy was slightly correlated with the Godin ( $r = .23$ ).

## DISCUSSION

This study validated three TTM exercise measures: decisional balance, self-efficacy, and the processes of change in an African-American sample. Confirmatory analyses for the decisional balance, self-efficacy, and processes of change measures demonstrated factor structures consistent with those found in other samples and indicated good model fit.<sup>26,29-31</sup> Results from this comparison and evaluation of alternative structural models for each construct suggested that the structures of these three measures were confirmed in an African-American sample. In addition, the measures showed good internal validity and adequate external validity. This study demonstrated initial validation for the existing TTM measures of regular exercise in a new and important population.

### Decisional Balance

This study replicated a two-factor (pros and cons) uncorrelated measurement structure for the decisional balance instrument in this sample of African-Americans, consistent with prior results showing that the pros and cons are orthogonal, and the scales showed good internal consistency. The decisional balance measurement structure found in this study replicated those found for decisional balance scales previously developed and validated in other samples.<sup>25,26,32</sup> These results suggested that, like other adult

samples, these participants discriminated between benefits and barriers involved in making the decision to increase regular exercise.

This study replicated the finding that the pros of regular exercise varied by stage of change in this sample. This result is consistent with TTM predictions, supporting the external validity of this exercise decisional balance instrument. The significant differences in the pros of exercising across the five stages of change showed a pattern consistent with TTM predictions. Both the pros and cons significantly differed by education level. Individuals with more education reported higher pros for regular exercise and lower cons for regular exercise. These results are in the expected direction and are consistent with previous literature.<sup>4</sup>

In many previous studies, a characteristic pattern of an increase in the pros and a decrease in the cons with a crossover in contemplation or preparation was found for decisional balance.<sup>50,51</sup> Typically, the cons were high in the precontemplation stage and rise in the contemplation stage before beginning a decline from preparation to maintenance.<sup>12</sup> The strong and weak principles<sup>50,51</sup> for progressing through the stages of change state that the pros increase by 1 SD, whereas the cons decrease by .5 SD between precontemplation and action. In the current study, the pros increased by 1 SD, but the cons did not decrease by the expected amount. The cons of regular exercise did not vary significantly across the stages of change, the one result that was inconsistent with TTM predictions. All of the cons items used in this study had low endorsement as evidenced by the item means. Further investigation into the "costs" of increasing regular exercise in this population may lead to better measure of the cons of exercise and provide results comparable to previous studies.

### Self-Efficacy

This study confirmed a general one-factor model for the self-efficacy measure for exercise in this African-American sample. These results replicated the underlying structure found in the previous studies of self-efficacy in primarily white samples.<sup>29</sup> In addition, a similar measurement structure was

found in another multiethnic sample for this TTM self-efficacy measure.<sup>32</sup>

Self-efficacy varied across stage of change consistent with TTM predictions<sup>52,53</sup> and replicated previous studies in adults for regular exercise.<sup>12,29</sup> As expected, participants' confidence to engage in regular exercise was lower in the earlier stages of change and increased as individuals progressed to the later stages. These results provide support for the use of this measure for assessing self-efficacy in an African-American sample and also support intervening to increase confidence to engage in regular exercise as an essential intervention target.

### Processes of Change

This study confirmed the structure of a ten-factor correlated model for the processes of change measure for exercise in this African-American sample. Although Paxton et al.<sup>32</sup> did not replicate this factor structure for physical activity in their multiethnic sample, these results replicate the structure found in previous studies of the processes of change for exercise in primarily white samples.<sup>13,31,39</sup>

In this African-American sample, the processes of change varied significantly across stage of change, consistent with other TTM applications and supporting the external validity of this measure. As expected, participants who reported being further along in their readiness to change also reported using more behavioral processes of change. Furthermore, individuals in precontemplation used the processes of change significantly less often than those in preparation, action, and maintenance.

### Limitations

There are several limitations to the current study, with the foremost being the cross-sectional nature of the data collected. These scales would benefit from longitudinal analysis and should be validated in other African-American samples. Further, invariance testing across different ethnic groups would be essential for a more detailed perspective on potential differences. Another limitation of this study is that the original item development was conducted on primarily white samples, and only the final items from the original development were available for this

study. Thus, the original item development process and final item content may not reflect cultural factors that may be important for African-Americans. More in-depth qualitative research with African-American participants may yield more valuable information about cultural beliefs about regular exercise and the role it plays in their lives. This may be particularly true for the cons scale, which did not replicate the results of previous studies. Because of the recruitment process for the original study design, the stage distribution for this study was disproportionately weighted toward the preparation and action stages. Future research may benefit from collection of a sample that represents each of the stages of change more equally and thus better represent the views of these individuals. In addition, the majority of this sample was female, and gender affected exercise behavior within this sample. Consistent with previous studies, more men reported being in the maintenance stage of change.<sup>54</sup> However, no gender differences were found for the pros, cons, or self-efficacy scales, which is also generally consistent with previous research on nonminority samples. The final limitation was that this sample was recruited from one county in North Carolina; future research would benefit from a more diverse sample of African-Americans to help rule out regional differences in exercise behavior.

## CONCLUSION

The results of this study provide strong support for the internal and external validity of the decisional balance, self-efficacy and processes of change measures for regular exercise in an African-American sample. All of the relationships demonstrated in previous samples were replicated, with the exception of the relationship between the cons scale and stage of change. Further research is necessary to examine why the cons scale did not perform well in the present sample and if it may be beneficial to adapt the existing cons scale to be more culturally relevant by adding items that are of specific importance for African-Americans.

## SO WHAT? Implications for Health Promotion Practitioners and Researchers

### What is already known on this topic?

Theory based interventions for increasing physical activity, such as those based on the transtheoretical model (TTM), rely on valid measures of key dynamic TTM variables. With higher risk factors for chronic disease, Blacks are in even greater need of interventions to increase physical activity that are theory based and employ validated measures. However, TTM measures for exercise have been primarily developed with White samples. Validation of the TTM exercise measures with minority populations can help to ensure that related interventions will be theoretically reliable and valid.

### What does this article add?

Strong support for the applicability of the TTM to African American exercise behavior was found.

### What are the implications for health promotion practice or research?

Results have important implications for efforts to use TTM exercise measures for tailored interventions to increase regular exercise in African-American populations. The results replicated previous research and showed that with continued replication, invariance testing, and longitudinal investigations, the TTM can serve as a framework for interventions aimed at increasing and maintaining exercise behavior in African-American populations.

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