

Applying the Transtheoretical Model to Regular Moderate Exercise in an Overweight Population: Validation of a Stages of Change Measure¹

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Background. The overweight population may benefit from Transtheoretical Model-based interventions focusing on regular moderate exercise. Current stages of change measures assessing regular moderate exercise specific to an overweight population (BMI ≥ 25) are lacking. This study examined the validity of a staging algorithm for moderate exercise for the purposes of healthy weight management.

Methods. A sample of 670 healthy adults (mean age 50.9 ± 15.0 ; mean BMI 30.6 ± 5.5 ; 53% female; 93% Caucasian) completed a questionnaire that included demographics, self-reported levels of exercise, and constructs from the Transtheoretical Model (TTM). Analyses of variance and follow-up tests were used to assess the concurrent and construct validity of the staging algorithm.

Results. The staging algorithm discriminated those in the action stages from those in the preaction stages for the moderate- and strenuous-intensity categories ($P < 0.001$). The constructs of pros and cons ($P < 0.001$) and confidence ($P < 0.001$) differed across the stages.

Conclusions. In addition to demonstrating good concurrent and construct validity for the stages of change measure, the patterns found across the stages of change were consistent with the theoretical predictions of the TTM and replicated the patterns observed in previous studies. © 2001 American Health Foundation and Academic Press

Key Words: exercise; overweight; physical activity; stages of change; transtheoretical model.

INTRODUCTION

All U.S. adults are advised to exercise regularly and maintain a healthful body weight, yet the majority of the population is overweight [1–3] and 40% engage in no leisure-time physical activity [3]. Improving these rates poses a significant public health challenge. The National Institutes of Health have recommended that exercise be included as a component in weight management interventions [4]. There is a clear need for delivering individualized interventions to the entire population rather than to a small percentage of those ready to take action. The Transtheoretical Model of behavior change (TTM) offers a theoretical framework to guide the design, content, implementation, and evaluation of population-based interventions for exercise and physical activity [5].

The TTM [6, 7] has been postulated as an integrative and comprehensive model of intentional behavior change that incorporates process-oriented variables to explain and predict how and when individuals change health behaviors. The TTM has been demonstrated to be extremely useful for intervening across a broad range of health-related behaviors [8–11], including exercise adoption [12].

Stage of change is the central organizing construct of the TTM, representing the temporal and readiness dimension. As people make a behavior change, they progress through a series of stages. *Precontemplation* is the stage in which individuals are not intending to take action in the foreseeable future (the next 6 months). *Contemplation* is the stage in which individuals are seriously intending to make a change in the next few months but have not made a commitment to do so. In the *Preparation* stage, individuals intend to change in the next 30 days and have taken some small

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behavioral steps toward action. *Action* is the stage in which individuals have successfully made the behavior change for less than 6 months. Individuals in *Maintenance* have made a behavior change for more than 6 months. Rather than involving a linear movement, change is cyclical. Most people "recycle" to previous stages several times before successful behavior change is achieved [13].

Accurately assessing exercise stage of change is integral to the design and delivery of behavior change interventions within the framework of the TTM [14]. The first step in the intervention process is to assess stage of change, an indicator of readiness to change a health-related behavior. Stage determines the content of the intervention materials and the timing of their delivery. In addition, it can be used as both a primary outcome variable to evaluate the impact of the intervention, i.e., assessing the proportion of the sample that reached Action, and an indication of whether the intervention increased one's readiness to change.

Quality staging measures are specific to the targeted behavior change and the action criterion that defines when that change has been achieved. The criterion used can impact the validity and reliability of the stage distribution [14]. Based on a comparison of eight staging algorithms for regular exercise, Reed et al. [14] recommend an algorithm that uses an explicit definition of exercise as well as a criterion that includes the frequency, intensity, and duration of exercise. The recommended format is a single-item algorithm that includes five choices, each choice representing a stage of change. In addition, the first three choices should assess one's intention to meet the criterion in order to correctly classify people into the Precontemplation, Contemplation, or Preparation stage. Staging algorithms that do not assess both intention to change and a behavioral criterion for Preparation can overestimate its prevalence [14]. However, in the area of exercise, there is debate over what behavioral criterion should be used for the Preparation stage, e.g., exercising once a week or once a year.

Existing exercise staging algorithms have based the definition of exercise and its criterion on public health guidelines [15,16]. More recently, public health recommendations have targeted regular moderate exercise that is performed five to seven times per week [16]. However, the validated staging measures reported in the literature to date assess regular exercise and regular vigorous-intensity exercise [14,17] and were developed on samples of healthy adults. There is a lack of exercise stage of change measures developed for regular moderate exercise, and there is a need to determine how well these measures generalize to specific populations. One of those populations that could benefit from regular moderate exercise is overweight adults, i.e., body mass index (BMI) of 25 or more [4].

The purpose of this study was to assess the concurrent and construct validity of a stage of change measure that assesses regular moderate exercise in an overweight population for the purposes of healthy weight management.

METHODS

Participants

The study participants were recruited from a list of 2,050 adults provided by a market research company. The list included apparently healthy adults, i.e., those without a diagnosis of a chronic disease, between the ages of 18 and 86 years and was intended to be representative of the population with respect to age, income, geographic region, population density, and number of household members. A 16-page questionnaire was mailed to a nationally representative sample of participants, accompanied by an introductory letter inviting them to participate. One reminder postcard was sent if the participant did not respond within 2 weeks. Data were collected in accordance with the market research company's policies on the protection of human subjects. Complete confidentiality and anonymity were assured. The questionnaires were returned in postage-paid envelopes to the independent market research company. The company sent the participants a small, nonmonetary token, with less than a \$5.00 value, for completing the questionnaire.

Of the 2,050 sent an invitational letter, 1,067 adults completed the questionnaire. Of the 1,067 adults, 670 had a BMI equal to or greater than 25.0. Of the total sample of respondents, 63% were overweight, which is slightly higher than the prevalence rate of 55% reported for the U.S. population [18]. Additional demographics and sample characteristics for those included in and excluded from the study are provided in Table 1.

Measures

The 16-page questionnaire assessed a range of demographic variables and TTM constructs, including stages of change, decisional balance, situational confidence or temptation, processes of change, and behavioral indicators for four different health-related behaviors (regular moderate exercise, calorie reduction, dietary fat reduction, and emotional distress management). The present study focused on regular moderate exercise. For exercise, the measures of stage of change, decisional balance, self-efficacy, and leisure-time exercise were examined.

Stages of change for moderate exercise. Stage of change for moderate exercise was assessed with a single question using a five-choice response format. This format resulted in effect sizes and staging distributions comparable to the yes/no or true/false format [14].

The staging algorithm for the present study focused on regular moderate exercise defined as any planned physical activity such as fast walking, aerobics, jogging, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, dancing, etc., performed to increase physical fitness. The frequency criterion was set at 5 to 7 days per week and the duration criterion was set at least 20 to 40 min per day. To help clarify the moderate intensity criterion, the participants were reminded that exercise does not have to be painful or exhausting to be effective, but should be done at a level that increases the rate of breathing and causes one to break a light sweat. Participants were asked to select one of the five options regarding their intention to engage in regular moderate exercise according to the definition and criterion provided. The five choices were designed to classify participants into one of five stages: Precontemplation (No, and I do not intend to in the next 6 months), Contemplation (No, but I intend to in the next 6 months), Preparation (No, but I intend to in the next 30 days), Action (Yes, and I have been, but for less than 6 months), or Maintenance (Yes, and I have been for more than 6 months).

Godin Leisure Time Exercise Questionnaire. Self-reported leisure-time exercise was assessed with the Godin Leisure-Time Exercise Questionnaire (GTLEQ) [19]. The 3-item GLTEQ [19] is a brief assessment of the number of 20-min bouts of mild, moderate, or strenuous exercise individuals engage in during free time in a typical week. To help respondents classify the intensity level of an exercise, examples of the kinds of physical responses and types of activities were provided. For example, the mild category (no sweating, minimal effort) included easy walking, yoga, and golf; the moderate category (light sweating, not exhausting) included fast walking, tennis, and popular dancing; and the strenuous category (sweating, heart beats rapidly) included running, vigorous swimming, and heavy weight training.

The GLTEQ has been found to have adequate concurrent validity and 2-week test-retest reliability ($R = 0.64$) [19–21]. Godin and Shephard [19] found that $VO_{2\max}$ correlated strongest with reported strenuous intensity ($r = 0.35$). Discriminant function analysis found that the instrument correctly classified those who engage in strenuous and light exercise based on measures of body fatness and $VO_{2\max}$ [22].

Decisional balance for exercise. Decisional balance is a construct that represents the relative weighing of the advantages (pros) and disadvantages (cons) when deciding whether to change a health-related behavior [23,24]. The decisional balance constructs have been applied to vigorous exercise behavior [25] as well as other health-related behaviors [26,27].

The present study used an 8-item decisional balance

scale for regular moderate exercise with 4 items representing the pros and cons, respectively. The participants assigned relative importance to a series of eight questions on a 5-point Likert scale (not at all important, somewhat important, moderately important, very important, extremely important). An example of a pro is "Regular exercise would help me have a more positive outlook on life" and a con is "I think I would be too tired to do my daily work after exercising." The psychometric properties of the measure indicate good validity and reliability. The measure has an average loading of 0.80 on the pros and 0.62 on the cons with a Confirmatory Fit Index (CFI) of 0.95, average absolute standardized residual (AASR) of 0.04, and a root mean squared error of approximation (RMSEA) of 0.09. The internal consistency was $\alpha = 0.87$ for the pros and $\alpha = 0.71$ for the cons.

Exercise situational self-efficacy. Self-efficacy is a component of the TTM framework that represents confidence in one's ability to perform a behavior in a variety of challenging situations [28]. Measures of self-efficacy have been developed for smoking behavior [29,30] and applied to vigorous exercise behavior [17,31,32].

The present study used a 6-item situational confidence scale for regular moderate exercise. Participants were asked to consider six situations in which some people might find it difficult to engage in regular moderate exercise and then rate how confident they are that they could exercise at the criterion level in those situations. Each item was rated on a 5-point Likert scale ranging from 1 (not at all confident) to 5 (completely confident). The items included situations such as being under a lot of stress, being tired, and encountering bad weather. The scale has good psychometric properties: an average loading of 0.79 with a CFI of 0.97, AASR of 0.02, RMSEA of 0.11, and internal consistency of $\alpha = 0.88$.

Data Analyses

Concurrent validity of the stage of change measure for regular moderate exercise was assessed with analyses of variance (ANOVA) and Tukey Honest Significant Difference (HSD) follow-up tests. Mild, moderate, and strenuous intensity levels of leisure-time exercise were examined across the stages of change. Construct validity was assessed by examining the relationship between exercise pros and cons and exercise confidence scores across stages.

Because seven ANOVAs were performed, a Bonferroni correction was used to protect against Type I error. An α level of $P < 0.007$ was used to indicate a statistically significant difference.

RESULTS

Of the 670 participants, 654 completed the single-item algorithm for stage of change for regular moderate

exercise. The stage distribution is presented in Table 1. On average, participants reported engaging in moderate-intensity exercise 2.7 (SD = 3.6) times for 20 or more minutes per session in a typical week. Participants reported 3.7 (SD = 4.2) times per week for mild-intensity exercise and 1.4 times per week for strenuous-intensity exercise.

Concurrent Validity

The results of the ANOVAs and partial η^2 (a measure of effect size) are presented in Table 2. All analyses were statistically significant, $P < 0.001$. Tukey HSD tests were used to examine differences between stages. Participants in Action and Maintenance reported significantly more sessions of strenuous exercise than those in Precontemplation, Contemplation, and Preparation (see Table 2 and Fig. 1 for means across the five stages of change). No significant differences were found between Action and Maintenance for any of the intensity levels ($P > 0.34$).

The mean numbers of times per week for moderate intensity activity were below the five to seven times per week criterion used in the staging algorithm. However, the moderate and strenuous intensity categories on the GLTEQ are intended to assess mutually exclusive intensity levels while the staging criterion may capture exercise performed at moderate intensity or greater. To examine this possibility, a summary score of moderate plus strenuous intensity was computed and

an ANOVA was performed. The mean number of times per week for moderate or greater intensity exercise was 6.5 (SD = 5.7) for Action and 7.8 (SD = 6.5) for Maintenance. The ANOVA was significant, $F(4, 611) = 54.3$, $P < 0.001$, $\eta^2 = 0.26$. Pairwise comparisons found that Action and Maintenance had significantly higher scores than Precontemplation, Contemplation, and Preparation. Action and Maintenance were not significantly different.

Construct Validity

The constructs used to assess the validity of the stage of change algorithm are presented in Table 2. The ANOVAs for pros, cons, and situational confidence were significant ($P < 0.001$) across the stages of change. Table 2 and Figs. 2 and 3 present the mean t scores across the stages of change and results of the Tukey HSD tests.

As the TTM predicts, pairwise comparisons found that Precontemplators had significantly lower scores on the pros of regular moderate exercise than individuals in the other four stages ($P < 0.001$). Precontemplators had significantly higher cons than those in Maintenance ($P < 0.001$). Contemplators had significantly fewer pros than those in Preparation and Action and more cons than those in Action and Maintenance. Those in Preparation had significantly higher pros than those in Precontemplation, Contemplation, and Maintenance ($P < 0.001$) and more cons than those in Action ($P < 0.03$) and Maintenance ($P < 0.001$). Individuals

TABLE 1

Demographics and Sample Characteristics of the Study Sample and Those Not Included in the Study

Variable	Study sample (BMI ≥ 25) $n = 670$			Sample not included (BMI < 25) $n = 397$		
	Statistic	SD	Range	Statistic	SD	Range
Age (mean)	50.9	15.0	18–84	50.0	17.99	19.0–93.0
BMI (mean)	30.6	5.5	25–66	22.2	1.9	16.5–24.9
Female (%) [*]	53.3			63.5		
Education (%) [*]						
Less than high school	8.0			4.9		
High school	26.0			23.9		
Some college	35.0			30.3		
College degree or higher	31.0			40.8		
Ethnicity (%)						
White	92.6			95.4		
African American	3.6			1.8		
Latin/Hispanic	1.3			0.8		
American Indian	0.9			0.3		
Asian American	0.5			0.5		
Other	1.2			1.3		
Exercise stage of change [*]						
Precontemplation	22.6			25.4		
Contemplation	22.5			12.4		
Preparation	15.1			11.4		
Action	14.4			8.1		
Maintenance	25.4			42.6		

^{*} Statistically significant χ^2 at $P < 0.05$.

TABLE 2

Cell Means, Standard Deviations, ANOVAs, and Pairwise Comparison for Exercise by Intensity Level (Godin Leisure-Time Exercise) and TTM Constructs across Stages of Change for Regular Moderate Exercise.

Variable	Stage of change					F	P	η^2	Pairwise comparison
	PC	C	P	A	M				
Mild (times/week)	2.3 (3.44)	3.1 (3.79)	3.4 (3.57)	4.4 (4.28)	5.4 (4.85)	$F(4, 628) = 12.7$	<0.001	0.08	PC < A, M C, P < M
Moderate (times/week)	0.6 (1.3)	1.7 (2.9)	1.7 (2.2)	4.2 (4.2)	4.9 (4.1)	$F(4, 626) = 47.3$	<0.001	0.23	PC < C, A, M C, P < A, M
Strenuous (times/week)	0.3 (0.9)	0.7 (1.5)	0.7 (1.6)	2.3 (3.2)	2.9 (3.6)	$F(4, 616) = 32.1$	<0.001	0.17	PC, C, P < A, M
≥Moderate (times/week)	0.9 (2.1)	2.4 (4.1)	2.4 (3.3)	6.5 (5.7)	7.8 (6.5)	$F(4, 611) = 54.3$	<0.001	0.26	PC, C, P < A, M
Pros (<i>t</i> score)	42.1 (8.3)	51.0 (8.3)	55.8 (8.2)	54.4 (8.6)	50.7 (10.0)	$F(4, 627) = 44.5$	<0.001	0.22	PC < C < P, A M < PC, P, A
Cons (<i>t</i> score)	51.1 (10.7)	53.5 (10.0)	52.4 (9.1)	48.0 (9.1)	45.8 (8.8)	$F(4, 626) = 15.5$	<0.001	0.09	M < PC, C, P
Confidence (<i>t</i> score)	44.8 (9.4)	48.2 (8.3)	49.8 (8.3)	51.9 (8.7)	55.2 (11)	$F(4, 631) = 25.8$	<0.001	0.14	PC < C, P, A, M C < A, M P < M

Note. For the stages of change: PC, precontemplation; C, contemplation; P, preparation; A, action; and M, maintenance. η^2 is partial η^2 . Standard deviations are in parentheses. Mean differences for the Turkey HSD pairwise comparisons presented are significant at $P < 0.05$.

in Action had significantly higher pros than those in Maintenance ($P < 0.02$) but not more cons ($P > 0.37$).

Tukey HSD tests comparing the stages of change on level of confidence found that participants in Maintenance were significantly more confident than those in Precontemplation, Contemplation, and Preparation ($P < 0.001$; refer to Fig. 3). Those in Action were significantly more confident than those in Precontemplation ($P < 0.001$) and Contemplation ($P < 0.035$). Precontemplators were significantly less confident than those in Contemplation ($P < 0.02$), Preparation, Action, and Maintenance ($P < 0.001$).

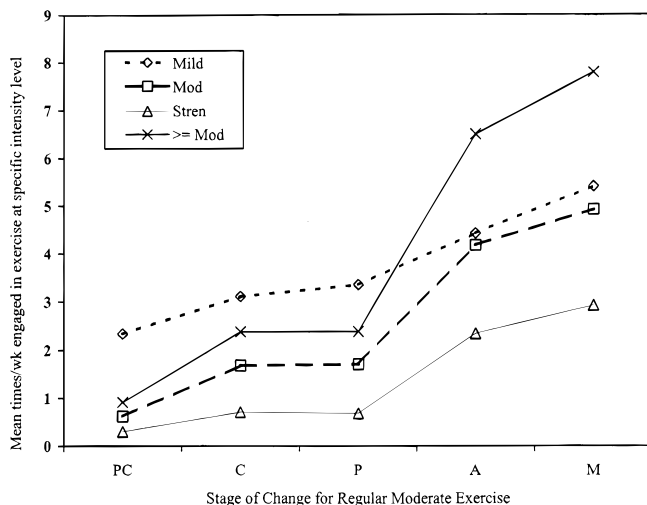


FIG. 1. Mean numbers of times/week mild, moderate, strenuous, and moderate and above exercise was performed for 20 min or more per time across stage of change for regular moderate exercise.

DISCUSSION

Findings of the present study provide preliminary evidence of the validity of applying the TTM to the area of regular moderate exercise in an overweight population. The first step in applying the model was to develop a stages of change algorithm specific to regular moderate exercise for those with a BMI greater than or equal to 25. The algorithm included an explicit definition of moderate exercise and a five-choice single-item response format that met the criteria for a quality staging measure proposed by Reed et al. [14]. In addition, the algorithm has good concurrent and construct validity.

Two aspects of concurrent validity were examined: (1) assessing whether those in Action and Maintenance report greater amounts of exercise than those in Precontemplation, Contemplation, and Preparation and (2) examining whether the frequency, intensity, and duration criteria were met only by those in Action and Maintenance. Multiple significant differences were found in pairwise comparisons between stages on the amount of exercise reported. The algorithm discriminated those in Action and Maintenance from those in Precontemplation, Contemplation, and Preparation for the moderate-intensity and strenuous-intensity categories. Interestingly, those in Maintenance also reported more mild-intensity exercise than those in Precontemplation, Contemplation, and Preparation. This suggests that those who meet the criterion for Maintenance do more lower level or lifestyle activity as well as more moderate and strenuous activity.

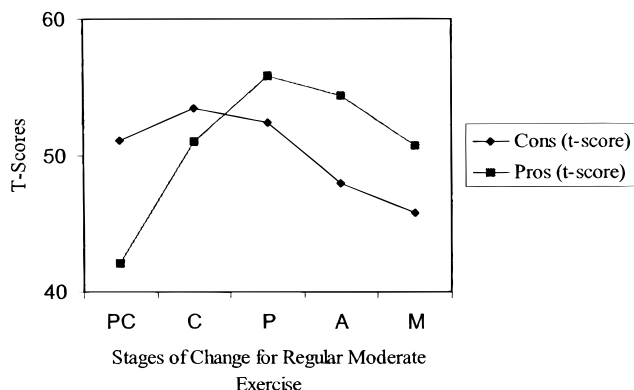


FIG. 2. Exercise pros and cons across the stages of change for regular moderate exercise.

As mentioned previously, the GLTEQ separates exercise into three mutually exclusive categories: mild, moderate, and strenuous. The algorithm categorizes those reporting the highest frequency of moderate-intensity exercise on the GLTEQ into Action (average 4.2 times/week) or Maintenance (average 4.9 times/week). The earlier stages were well below the criteria for regular moderate exercise. Those in Action and Maintenance did not meet the frequency criterion of five to seven times per week if only the moderate-intensity category from the GLTEQ was used to assess validity. However, the criterion was met when moderate and strenuous intensity levels on the GLTEQ were combined. It is possible that when regular exercisers complete the staging measure they are recalling the frequency that they engage in both moderate and strenuous exercise. In other words, they may have combined exercises of both moderate and strenuous intensity when determining whether they met the frequency criterion. Another possibility is that frequency was overestimated. Combining the moderate- and strenuous-intensity categories may be necessary if people are engaging in a variety of intensity levels or exercises in a typical week. If an intervention is concerned with intervening on and assessing only moderate exercise, moderate and strenuous intensity exercise may need to be examined separately.

Construct validity of the staging algorithm was demonstrated using measures that capture the constructs of decisional balance and self-efficacy for regular moderate exercise. Pros and cons of moderate exercise varied systematically across the stages of change in the predicted fashion [25,27]. The results suggest that the earlier stages are differentiated by the pros: individuals in Preparation had more pros than those in Contemplation, and those in Contemplation had more pros than those in Precontemplation. This was not found for the cons.

Earlier studies have found that the pros increase

approximately 1 standard deviation from Precontemplation to Action (known as the strong principle) while the cons decrease approximately 1/2 standard deviation from Contemplation to Action (known as the weak principle) [33]. Consistent with earlier studies [33], the *t* score for pros in Action was 1 standard deviation above the *t* score in Precontemplation, and the cons' *t* score in Action was 1/2 standard deviation less than the *t* score in Contemplation. Replicating this pattern lends further support to the construct validity of the present algorithm.

Similar to previous studies, situational self-efficacy assessed with a measure of exercise confidence increased from Precontemplation to Maintenance [17,32,34,35]. The predicted linear increase from Precontemplation to Maintenance was found (see Fig. 3). Similar to the report of Marcus and Owen [32], the staging algorithm differentiates Precontemplation from the other stages based on levels of exercise confidence. However, confidence did not distinguish those in Contemplation from those in Preparation nor did it differentiate Action from Maintenance. Levels of confidence may be more volatile in Contemplation and Preparation, when individuals are experimenting with exercise, and in Action when the behavior is first attempted regularly and various outcomes are achieved. After each attempt is made, level of confidence is reassessed based on experiential factors. Confidence may not stabilize until the majority of attempts are successful, which is most likely to occur in Action or Maintenance.

Effect sizes, presented as partial η^2 , were examined in the present study to provide an indication of how well the constructs and measures of exercise are differentiated across the staging algorithm. Cohen classifies the strength of the effect size as small (0.01 to 0.059), medium (0.06 to 0.149), and large (0.15 and above) [36]. In the present study, there was a large effect for pros and a medium effect for cons and confidence. Similarly, Reed et al. [14] found a large effect for pros and a

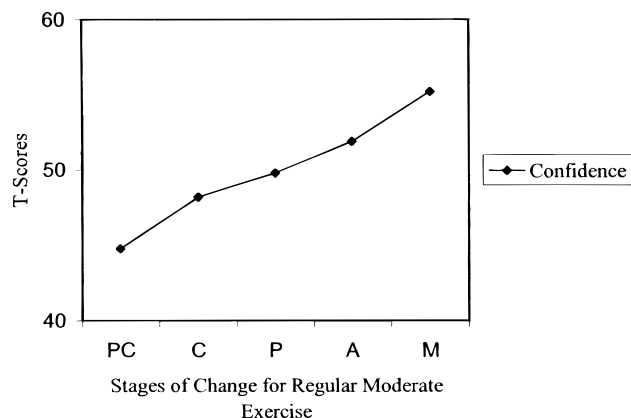


FIG. 3. Situational confidence across the stages of change for regular moderate exercise.

medium effect for cons. However, they reported a large effect for confidence. In the present study, moderate-intensity activity had the largest effect size, suggesting that the algorithm is more precisely assessing moderate activity than it is strenuous.

The present findings suggest that the patterns for moderate exercise may be different from those found for algorithms focusing on vigorous exercise among healthy adults. In comparison to a study that used a worksite sample (mean age of 41 years) [17], the cons varied in a similar fashion but, instead of a slight increase from Contemplation to Maintenance, the pros peaked in Preparation and dipped from Action to Maintenance. Both the pros and cons decrease in Maintenance, suggesting that exercise behavior may be more automatic and less under decisional control than in the earlier stages. The pattern of the pros in the current study is more similar to those found with a stages of change measure for weight control [26]. It is not known if the difference is related to sample characteristics (worksite vs overweight) or the frequency, intensity, or duration criteria.

In addition to demonstrating the validity of the stages of change measure, the patterns found across the stages of change are consistent with the theoretical predictions of the TTM and replicate the patterns observed in previous studies [5,14,17,25,27]. The well-established pattern of the pros and cons across the stages [27] was clear. These patterns are corroborated in Fig. 2 and include: (1) the cons outweighed the pros in Precontemplation, (2) the pros increased from Precontemplation to Contemplation, (3) the cons decreased from Contemplation to Action, (4) the pros and cons show the hallmark crossover pattern occurring prior to Action, and (5) as mentioned previously, the strong and weak principles are supported [33].

There are several limitations to this study, which include using a self-report measure of exercise to validate the staging algorithm and the use of cross-sectional data. Although objective forms of validating exercise staging measures may not be feasible on a population basis, future studies could benefit from the inclusion of an objective measure of exercise in a subsample of the population. Future studies could also include more than one form of physical activity self-report to ensure a comprehensive representation of exercise behavior [22]. The use of cross-sectional data made it difficult to discriminate between Action and Maintenance, which are based on a 6-month criterion. A prospective study design would more accurately assess this time frame as well as help establish how well the measure predicts treatment outcomes and relapse from exercise and/or weight management interventions.

The present study may be limited by the sample characteristics. The prevalence rate of overweight was higher than the national rate (63% vs 55%) [18]. Those

that participated in the study may be different from the entire population of overweight. Those who responded may have been actively trying to manage their weight with exercise. The stage distribution indicates that 40% of this sample was engaging in exercise at criterion, possibly to facilitate weight loss. Unfortunately, the stage distribution cannot be compared with other studies that have developed a staging measure because the criteria are different (moderate vs vigorous intensity).

The present staging measure not only builds on the previous measures but also is designed for an overweight population and is based on more current guidelines for health and for weight loss. This staging measure may be appropriate for health promotion programs that work within the theoretical framework of the TTM and include regular moderate exercise as an intervention component.

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