𝒮hort Communication

Examining the association of transtheoretical model constructs on physical activity: Considerations of anxiety symptomology as a potential moderator

Chelsea Joyner, Paul D. Loprinzi

Department of Health, Exercise Science and Recreation Management, Exercise Psychology Laboratory, Physical Activity Epidemiology Laboratory, University of Mississippi, MS 38677, USA

Address for correspondence:
Paul D. Loprinzi, University of Mississippi, MS 38677, USA.
E-mail: pdloprin@olemiss.edu

ABSTRACT

Background: The purpose of this study was to examine the potential moderating effects of anxiety symptomology on the association between constructs from the transtheoretical model (TTM) and physical activity (PA). **Methods:** Data were collected from 200 University students from October 2015 to June 2016. To assess TTM constructs, a validated TTM survey was utilized. PA was assessed via the validated international PA questionnaire. Anxiety was assessed utilizing the 5-item overall anxiety severity and impairment scale questionnaire. A multivariable logistic regression analysis was used to evaluate the association between TTM constructs and PA. Interaction analyses were computed to see if there was an interaction effect of TTM constructs and anxiety on PA. **Results:** The only TTM construct associated with meeting moderate-to-vigorous PA (MVPA) guidelines was behavioral processes of change (odds ratio = 1.14, 95% confidence interval = 1.07-1.21; $P < 0.05$). Further, there was no interaction effect of anxiety and any of the TTM constructs on MVPA (all $P > 0.05$). **Conclusion:** TTM seems to have some utility of promoting MVPA among University students and does not appear to be a function of anxiety levels.

KEY WORDS: Anxiety, behavioral processes of change, moderate-to-vigorous physical activity, transtheoretical model

INTRODUCTION

Physical activity (PA) has been demonstrated to prevent many common debilitating and deadly diseases such as cardiovascular disease and metabolic syndrome [1]. Thus, the health benefits of regular PA are worthy of an individual's commitment. Despite the known benefits of PA, exercise adherence remains low among all ages [2,3].

One of the most popular models for studying PA behavior is the transtheoretical model (TTM). TTM is an integrative model of behavior change that utilizes key constructs to promote behavior. The model consists of a framework of 5 discrete stages adopted to study health behaviors. These stages include precontemplation, contemplation, preparation, action, and maintenance [4]. Behavioral and cognitive processes of change (CPC), decisional balance which incorporates pros and cons, and self-efficacy are core constructs of TTM. A vast amount of research suggests that TTM is useful in promoting PA behavior change [5].

During the last 10 years, numerous studies report an increased prevalence of anxiety among college students [6]. From a public health prospective, identifying modifiable factors that reduce anxiety is critical to prevent emotional-based disorders, such as anxiety, depression, and panic attacks. Research demonstrates that increased PA is associated with better cardiovascular health and reduced risk of mental disorders [7]. Moreover, studies also report that PA is inversely associated with anxiety symptoms, especially among the University student population [8].

PA adherence may be influenced by anxiety levels [9]. For example, there is consistent evidence that individuals with greater anxiety tend to be less active [10]. It is plausible to suggest that individuals with high levels of anxiety lose motivation due to the consequences associated with anxiety. For example, the risk of developing depression or performing poorly in college may reduce motivation to partake in healthy behaviors such as PA [11].

Collectively, anxiety symptomology appears to be prevalent among college students, PA is declining in this population, and the TTM appears to have some utility from promoting PA among this population, along with other populations. However, to our knowledge, we are unaware of any study evaluating the

utility of the TTM in promoting PA among college students while taking into consideration the potential moderational role of anxiety symptomology. Therefore, the purpose of this brief study was to examine the association of utilizing the TTM to promote PA, with potential moderation considerations of anxiety symptomology.

METHODS

Participants

Recruitment of individuals included 200 currently enrolled University students (undergraduate or graduate students at a non-medical public University), sampled via a convenience-based sampling approach. Participants were recruited from a University in the South of the United States.

Design

This study was a cross-sectional sample with data collection beginning in October 2015 and continued through June of 2016. Participants completed an assessment on the TTM, anxiety, and PA which were all assessed via a physical questionnaire. Body mass index (BMI) (included as a covariate) was directly measured; thus, all assessments took place in person in our laboratory. Notably, among the 200 participants, there were no missing data. A random sample of 10% of the 200 participants completed the questionnaires again 1-week later for test-retest reliability purposes. In addition, these participants also wore a pedometer for 1-week in an effort to assess the possible convergent validity of the self-reported PA assessment. This study was approved by the authors' institutional review board, and participants provided written informed consent.

Measurement of TTM Constructs

Stage of change

To be consistent with stages of change in the TTM, regular participation in exercise was defined as "equal to 5 or more days/week of at least 30-min at a moderate intensity." As used in previous studies, participants were asked to choose one of 5 statements to describe their readiness to change their exercise behavior [12,13]. The 5 different stages of change include precontemplation, contemplation, preparation, action, and maintenance. For example, participants who reported, "No, I do not plan to start in the next 6 months" were classified in the precontemplation stage. The stage of change algorithm has demonstrated evidence of reliability and validity in adults of the general population and those with chronic diseases [12,13]. In this sample, the 1-week test-retest reliability was, intraclass correlation coefficient (ICC) = 0.64.

Processes of change

To examine the strategies individuals use to change their exercise behaviors, a 30-item measure was used to assess both behavioral and CPC. 15 items assessed behavioral process of change (BPC) (i.e., reinforcement management, counterconditioning, helping

relationships, self-liberation, and stimulus control), whereas the other 15-items assessed CPC (i.e., consciousness raising, dramatic relief, environmental reevaluation, self-reevaluation, and social liberation). Participants were asked to respond to each question using a Likert scale, with end points ranging from 1 (never) to 5 (repeatedly). A sample BPC item is "Instead of relaxing by watching TV or eating, I take a walk or do PA." A sample cognitive process of change question is "I believe that regular PA will make me a healthier, happier person." Reliability and validity of both the behavioral and cognitive process of change have been previously established [14]. Behavioral and CPC were calculated by summing the items for each process of change separately. Higher scores indicate the higher use of behavioral processes or CPC. In the present sample, the 1-week test-retest reliability for BPC and CPC, respectively, were, ICC = 0.90, ICC = 0.91. Further, internal consistency, as measured by Cronbach's alpha, for BPC and CPC, respectively, were, α = 0.89, α = 0.83.

Self-efficacy

To assess self-efficacy, or an individual's confidence in ability to overcome barriers, an 18-item measure, which has demonstrated evidence of reliability and validity, was used [15,16]. For each question, participants responded using a Likert scale, with end points ranging from 1 (not at all confident) to 5 (very confident). A sample item is "I feel confident that I can participate in PA when I don't feel like it." Items were summed, with higher scores indicating higher self-efficacy. In the present sample, the 1-week test-retest reliability for self-efficacy was ICC = 0.82. Further, internal consistency, as measured by Cronbach's alpha, was, α = 0.92.

Decisional balance

An individual's reflection of the pros and cons in engaging in regular PA, referred to as decisional balance, was evaluated using a 10-item measure. 5 items assessed pros of regular exercise, whereas the other 5 items evaluated the cons of engaging in regular exercise. Using a Likert scale anchored by 1 (not at all) and 5 (very much), participants were asked to rate their degree of agreement with each perceived positive and negative consequence of exercise involvement. A sample item of pros for exercise is "PA would help me reduce tension or manage stress." A sample item of cons for exercise is "PA would take too much of my time." This measure has previously demonstrated evidence of reliability and validity [17]. Pros and cons were scored separately by summing the respective items, with a higher pros score indicating more perceived pros of exercise and a lower cons score indicating fewer perceived cons of exercise. In the present sample, the 1-week test-retest reliability for pros and cons, respectively, were ICC = 0.93 and ICC = 0.63. Further, internal consistency, as measured by Cronbach's alpha, for pros and cons, respectively, were α = 0.85 and α = 0.72.

Measurement of Anxiety

The overall anxiety severity and impairment scale (OASIS) questionnaire were used to assess anxiety. The OASIS assessment includes 5 questions. The items on this questionnaire ask

questions about anxiety symptomology. The symptoms may include panic attacks, situational anxieties, and worries. For example, a question on this survey is, "In the last week, how often have you felt anxious?" Response options range from 0 to 4, with a higher score indicating greater anxiety symptomology. The OASIS has demonstrated excellent test-retest reliability and convergent and divergent validity according to Norman *et al.* (2006) [18]. The internal consistency of this measure within our sample, as determined by Cronbach's alpha, was 0.82.

Measurement of PA

PA was assessed using the international PA questionnaire (IPAQ). The IPAQ form asks participants about the time they spend being physically active in the last 7 days. For example, a question on the form is "How much time did you usually spend on one of those days doing vigorous physical activities in the garden or yard?" Participants reported their answer in hours per day or minutes. Participants were classified as meeting PA guidelines (vs. Not) if they self-reported at least 150 min/week of moderate-to-vigorous PA (MVPA). The previous research shows the IPAQ to be reliable and valid [19]. Among the 10% random sample of this study, the correlation between IPAQ-determined MVPA and pedometer-determined steps was $R = 0.43$ ($P < 0.001$). The 1-week test-retest reliability (for the IPAQ) of the 20% random sample was, ICC = 0.79.

Data Analysis

All analyses will be performed in Stata (v. 12). A multivariable logistic regression analysis was used to evaluate the association between TTM constructs and MVPA (outcome variable). Notably, there was no evidence of multicollinearity in the model; the highest individual variance inflation factor was 2.43, with a mean variance inflation of 1.58.

Multiplicative interaction was assessed by creating a cross-product term of anxiety and the TTM constructs, and including this cross-product term along with their main effects and the covariates, in the model; separate interaction models were computed for each TTM construct. In the regression models, covariates included age (years; continuous), gender, race-ethnicity (Mexican American, other Hispanic, non-Hispanic white, non-Hispanic black, other), education level (undergraduate, graduate), self-reported health status (excellent, very good, good, fair, and poor), and measured BMI (kg/m^2; continuous). Statistical significance was established as $P < 0.05$.

RESULTS

The study variable characteristics are shown in Table 1. For the sample, the mean age was 21.6 ± 2.25. Participants of the study had an average BMI of 25.95 kg/m^2. The study sample included 86% undergraduate students and 14% graduate students. Mean minutes per week of MVPA was 375.59.

In a multivariable logistic regression analysis, and after adjusting for age, gender, race-ethnicity, education, health status, and BMI, the only TTM parameter associated with meeting MVPA guidelines was behavioral processes of change (odds ratio [OR] = 1.14, 95% confidence interval [CI] = 1.07-1.21). After further adjustment for overall anxiety, behavioral processes

Table 1: Study variable characteristics (*n*=200)

Variable	Point estimate	SD (continuous variables) or 95% CI (categorical variables)
Age, mean years	21.62	2.25
BMI, mean kg/m²	25.95	6.93
Ethnicity, % non-hispanic white	69	62-75
Education, % undergraduate student	86	80-90
Health status		
% excellent	15.5	10-20
% very good	46	39-52
% good	32.5	25-39
% fair	6	2.3-8.6
PA		
MVPA, mean min/day	375.59	324.00
% meets guidelines[a]	75	
TTM constructs		
Stage of change, % precontemplation	0.5	0-1.4
Stage of change, % contemplation	2.5	0.3-4.6
Stage of change, % preparation	19.5	13.9-25.0
Stage of change, % action	17.5	12.1-22.8
Stage of change, % maintenance	60	53.1-66.8
Self-efficacy, mean	64.87	13.25
Decisional balance, cons, mean	8.49	3.16
Decisional balance, pros, mean	21.94	3.17
Processes of change, behavioral, mean	54.83	10.34
Processes of change, cognitive, mean	56.32	8.64
Anxiety		
Overall anxiety, mean	4.75	3.07

[a]MVPA for at least 150 min/week. SD: Standard deviation, CI: Confidence interval, BMI: Body mass index, PA: Physical activity, MVPA: Moderate-to-vigorous physical activity, TTM: Transtheoretical model

of change remained associated with MVPA (OR = 1.14, 95% CI = 1.07-1.21).

With regard to the potential interaction effects of anxiety and the TTM parameters on MVPA, we observed no interaction effects. The interaction for anxiety and self-efficacy on MVPA was (OR = 1.00, P = 0.48, 95% CI = 0.99-1.01). In regards to the TTM construct of pros and anxiety on MVPA, there was no observed interaction effect (OR = 1.00, P = 0.89, 95% CI = 0.95-1.04). The TTM construct of cons and anxiety on MVPA did not demonstrate an interaction effect (OR = 1.03, P = 0.24, 95% CI = 0.98-1.08). The interaction for anxiety and behavioral and CPC on MVPA showed no interaction effect (OR = 1.00, P = 0.21, 95% CI = 0.97-1.01), (OR = 1.00, P = 0.64, 95% CI = 0.98-1.01), respectively.

DISCUSSION

University-aged students are at an increased risk for anxiety [20]. Further, anxiety has been suggested to negatively influence behavioral dimensions such as PA. In addition, the TTM has demonstrated utility in promoting PA among this population. However, to our knowledge, no study has evaluated the effects of the TTM on PA among University students, while considering their anxiety symptomology. Thus, the purpose of this study was to evaluate the influence of the TTM on University student's PA, while considering potential independent and interaction effects of anxiety symptomology. The main findings of our study was that TTM demonstrated some utility for influencing PA among this population, and anxiety symptomology did not appear to influence this relationship.

In our sample, only behavioral processes of change were associated with meeting MVPA guidelines. This finding is similar to other studies [21] demonstrating that behavioral strategies, in particular, may play a key role in shaping and maintaining MVPA behavior across various populations. A plausible explanation for this is University students tend to be more goal-oriented and have more extrinsic motivation [22]. Therefore, despite high anxiety levels among college students, they may be focused on achievement and demonstrate positive health-enhancing behaviors such as PA. TTM construct self-efficacy has been defined as a person's belief in capabilities to overcome personal, social, and environmental barriers to exercising [23]. In this sample, a plausible explanation for our null self-efficacy association is that University students face temptations to engage in specific habits during difficult situations such as academic coursework and newly found responsibilities. CPC tend to be seen in the earlier stages of change (precontemplation and contemplation). Individuals in the later stages of change (preparation, action, and maintenance) apply more pros than cons to PA. For example, individuals in the precontemplation stage are less confident to avoid sedentary behavior and perceive more disadvantages than advantages for becoming physically active compared to those in the preparation, action, and maintenance stage [24]. The majority of our sample (60%) were in the maintenance stage and therefore may provide an explanation why behavioral processes of change

was the only TTM construct associated with meeting MVPA guidelines.

As with any study, there are a few limitations of the present investigation. PA and anxiety measures were both self-reported. Due to the nature of self-report questionnaires, social desirability bias may have influenced PA and anxiety levels. In addition, this study may lack generalizability to other populations. However, strength of our study is limited data on the potential moderational effects of anxiety on promoting PA via TTM constructs, which makes this study novel.

CONCLUSION

TTM seems to have some utility of promoting MVPA and does not appear to be a function of anxiety levels. In individuals with high anxiety, the TTM may still serve as a useful framework to promote PA. Future prospective and experimental work on this topic is warranted.

REFERENCES

1. Penedo FJ, Dahn JR. Exercise and well-being: A review of mental and physical health benefits associated with physical activity. Curr Opin Psychiatry 2005;18:189-93.
2. Lipschitz JM, Yusufov M, Paiva A, Redding CA, Rossi JS, Johnson S, et al. Transtheoretical principles and processes for adopting physical activity: A longitudinal 24-month comparison of maintainers, relapsers, and nonchangers. J Sport Exerc Psychol 2015;37:592-606.
3. Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. Med Sci Sports Exerc 2008;40:181-8.
4. Choi JH, Chung KM, Park K. Psychosocial predictors of four health-promoting behaviors for cancer prevention using the stage of change of transtheoretical model. Psychooncology 2013;22:2253-61.
5. Marshall SJ, Biddle SJ. The transtheoretical model of behavior change: A meta-analysis of applications to physical activity and exercise. Ann Behav Med 2001;23:229-46.
6. Reyes-Rodríguez ML, Rivera-Medina CL, Cámara-Fuentes L, Suárez-Torres A, Bernal G. Depression symptoms and stressful life events among college students in Puerto Rico. J Affect Disord 2013;145:324-30.
7. Doré I, O'Loughlin JL, Beauchamp G, Martineau M, Fournier L. Volume and social context of physical activity in association with mental health, anxiety and depression among youth. Prev Med 2016;91:344-50.
8. Cao H, Qian Q, Weng T, Yuan C, Sun Y, Wang H, et al. Screen time, physical activity and mental health among urban adolescents in China. Prev Med 2011;53:316-20.
9. Cumming J. Investigating the relationship between exercise imagery, leisure-time exercise behavior, and self-efficacy. J Appl Sport Psychol 2008;20:184-98.
10. Stonerock GL, Hoffman BM, Smith PJ, Blumenthal JA. Exercise as treatment for anxiety: Systematic review and analysis. Ann Behav Med 2015;49:542-56.
11. Korte KJ, Schmidt NB. The use of motivation enhancement therapy to increase utilization of a preventative intervention for anxiety sensitivity. Cognit Ther Res 2015;39:520-30.
12. Levy SS, Li KK, Cardinal BJ, Maddalozzo GF. Transitional shifts in exercise behavior among women with multiple sclerosis. Disabil Health J 2009;2:216-23.
13. Reed GR, Velicer WF, Prochaska JO, Rossi JS, Marcus BH. What makes a good staging algorithm: Examples from regular exercise. Am J Health Promot 1997;12:57-66.
14. Nigg CR, Riebe D. The Transtheoretical Model: Research Review of Exercise Behavior and Older Adults. New York: Springer; 2002. p. 147-80.
15. Levy S, Ebbeck V. The exercise and self-esteem model in adult

women: The inclusion of physical acceptance. Psychol Sport Exerc 2005;6:571-84.

16. Marcus B, Eaton C, Rossi J. Self-efficacy, decision-making and stages of change: An integrative model of physical exercise. J Appl Soc Psychol 1994;24:489-508.
17. Plotnikoff RC, Blanchard C, Hotz SB. Validation of the decisional balance scales in the exercise domain from the transtheoretical model: A longitudinal test. Meas Phys Educ Exerc Sci 2001;5:191-206.
18. Norman SB, Cissell SH, Means-Christensen AJ, Stein MB. Development and validation of an overall anxiety severity and impairment scale (OASIS). Depress Anxiety 2006;23:245-9.
19. Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, et al. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc 2003;35:1381-95.
20. Mahmoud JS, Staten RT, Lennie TA, Hall LA. The relationships of coping, negative thinking, life satisfaction, social support, and selected demographics with anxiety of young adult college students. J Child Adolesc Psychiatr Nurs 2015;28:97-108.
21. Loprinzi PD, Cardinal BJ, Si Q, Bennett JA, Winters-Stone KM. Theory-based predictors of follow-up exercise behavior after a supervised exercise intervention in older breast cancer survivors. Support Care Cancer 2012;20:2511-21.
22. D'Lima GM, Winsler A, Kitsantas A. Ethnic and gender differences in first-year college students' goal orientation, self-efficacy, and extrinsic and intrinsic motivation. J Educ Res 2014;107:341-56.
23. Dishman RK, Vandenberg RJ, Motl RW, Nigg CR. Using constructs of the transtheoretical model to predict classes of change in regular physical activity: A multi-ethnic longitudinal cohort study. Ann Behav Med 2010;40:150-63.
24. Han H, Gabriel KP, Kohl HW. Evaluations of validity and reliability of a transtheoretical model for sedentary behavior among college students. Am J Health Behav 2015;39:601-9.