Using the Multitheory Model to Predict Initiation and Sustenance of Physical Activity Behavior Among Osteopathic Medical Students

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Context: The multitheory model (MTM) is a newly developed fourth-generation theoretical framework that addresses both initiation and sustenance of health behavior change. Studies have shown that the MTM is efficacious in predicting a range of health behaviors.

Objective: To assess the utility of the MTM in predicting initiation and sustenance of physical activity behavior among osteopathic medical students.

Methods: In this cross-sectional study, a volunteer convenience sample was recruited from an osteopathic medical school student population at a university in the southeastern region of the United States. An online survey was used to collect self-reported data on sociodemographic information and MTM constructs. Multiple linear regression using the enter method for modeling was performed to determine the predictive ability of the MTM constructs.

Results: Of the 135 participants, 52.6% were women and 67.7% were white. The initiation model explained 25.8% of the variance (adjusted R^2=0.238). Behavioral confidence was a statistically significant predictor of initiation of physical activity behavior change. The sustenance model explained 41.7% of the variance (adjusted R^2=0.402). Changes in social environment and emotional transformation were statistically significant predictors of sustenance of physical activity behavior change.

Conclusion: The MTM appears to be a robust theoretical framework for designing behavior change interventions to increase physical activity among osteopathic medical students.

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Routine physical activity (PA) is known to improve quality of life, decrease stress, and boost mental clarity.[1-4] In addition to the psychological benefits of PA, participants tend to see improvements in muscle strength, bone strength, and aerobic capacity, as well as prevention of many chronic diseases.[5-6] However, a large proportion of the population, including medical students, tend to neglect this healthy behavior.[6] The Centers for Disease Control and Prevention (CDC) recommends that adults complete at least 150 minutes of moderate-intensity PA per week.[7] Adults meet this recommendation at a rate of 51.7%, and medical student rates are improved at 61%.[6,8] Although medical students complete recommended levels of PA at a rate almost

10% greater than the general population, the psychological stressors of medical education place an impetus to increase levels of PA to combat rising burnout rates.[9] Research has shown that among medical students who adhere to the CDC recommendations for exercise, 60% reported high levels of stress, and those reporting no stress exercised at a rate of 80%.[6]

A large national study consisting of more than 7000 physicians and 5900 control participants investigated levels of burnout among various educational degree routes. Assessments of risks of burnout among high school diploma holders were found to be elevated compared with physicians (DO or MD) (odds ratio [OR], 1.36). In comparison, control participants with a bachelor's degree (OR, 0.80), master's degree (OR, 0.71), or doctoral degree other than a medical degree (OR, 0.64) were found to be at lower risk.[10] A meta-analysis of stress and burnout in preclinical medical students found rates of up to 90% and 75%, respectively.[9] More emphasis continues to be placed on burnout research for medical professionals than ever before; therefore, it is imperative to elucidate effective strategies to combat this issue.

Growing evidence supports the benefits of PA in the application of stress and burnout reduction.[1,2,9,11,12] When targeting medical education, showing students how stress reduction strategies can also improve key indicators of student success, such as test scores. Cognitive function in examination environments has been found to inversely correlate with excessive stress.[3] Hence, stress reduction strategies such as PA can be explored as a first line of defense for test-day anxiety. Regular PA has been shown to improve central nervous system processing speed, which is particularly important to medical students throughout the learning process.[4] The connections between PA and increased neurotransmitter signals are strong and provide evidence for the antidepressive benefits of PA.[11,12] Students and health care professionals alike would benefit from engaging in regular PA.

This study used a fourth-generation framework to apply the multitheory model (MTM) for health behavior change with individual empirically tested variables.[13-19] The MTM is a theory for health behavior change unique for its ability to determine one-time and long-term modification that provides health care professionals a quick reference for addressing at-risk health behaviors.[20] The constructs are adaptable from one health behavior to the next and precise because there are no moderating variables. The MTM can be applied to investigate modifiable risk factors for any health behavior. [20] The model separates the constructs based on the 2 dependent variables: initiation of behavior change and sustenance of behavior change. Initiation has been investigated in relation to the constructs of participatory dialogue, behavioral confidence, and changes in the physical environment.[20-23] Sustenance is evaluated based on the constructs of emotional transformation, practice for change, and changes in the social environment.[20,21]

Previous theoretical models used to explain behavior have mixed results, lack substantive predictive power, and have been unable to assess long-term behavior change.[20] The MTM is a new and evolving theory that has shown promising evidence in predicting a variety of health behaviors.[14-20] The MTM is a unique tool for understanding the diverse factors that must be considered when designing and implementing PA interventions that target osteopathic medical students. This study aims to examine the utility of the MTM in predicting initiation and sustenance of PA behavior among osteopathic medical students.

Methods

Ethical approval was obtained from the institutional review board at Lincoln Memorial University before data collection began. The data were collected from fall 2017 to spring 2018.

Study Design, Population, and Sampling

In this cross-sectional study, a volunteer convenience sample was recruited from an osteopathic medical school student population at a Lincoln Memorial

University in Harrogate, Tennessee. Participants were recruited via an email link to the online-based 38-item validated survey that requested their informed consent by following the link. Participants were eligible for inclusion if they did not participate in more than 150 minutes of moderate- to vigorous-intensity aerobic PA during the past week and did not have any medical condition, including any physical disability, that would prevent them from being physically active. The entire survey took approximately 10 to 15 minutes to complete. The independent variables were the constructs of the MTM (participatory dialogue, behavioral confidence, changes in physical environment for initiation model and emotional transformation, practice for change, and changes in social environment for sustenance model). The dependent variables were the intentions of initiating and sustaining greater than 150 minutes of aerobic PA per week. G*Power (University of Kiel, Germany) was used to calculate an a priori sample size. A sample size of 114 was estimated for a power of 0.80 at α=.05 with a medium effect size of 0.10 and 3 predictors in each model. The estimated sample size was inflated by about 20% for any potential missing data to arrive at a target sample size of approximately 135.

Instrumentation

A 38-item survey was used to collect data on self-reported sociodemographic information and the MTM constructs. This scale has been used with a sample of general college students and found to have acceptable validity and reliability.[14] To determine whether participants met the inclusion criteria for the study, the first question screened for students not performing the CDC's recommended amount of PA per week (ie, 150 minutes), and the second question determined whether there were any medical reasons prohibiting students from engaging in PA. To describe characteristics of study participants, the following demographics were collected: age, gender, race/ethnicity, class level, grade point average, housing, and work status. The remaining 29 survey items measured the MTM constructs (ie, participatory dialogue, behavioral confidence, changes in physical environment for initiation model and emotional transformation, practice for change, and changes in social environment for the sustenance model). Internal consistency was established for all items by computing Cronbach α.

Initiation

Five items measured the advantages component of participatory dialogue to determine participants' perceived advantages to engage in PA and willingness to change. The perceived advantages items included statements to assess whether "taking part in more than 150 minutes of aerobic PA per week will help you…be healthy, be relaxed, get sick less often, have more energy, or enjoy life more." Items were rated on a 5-point scale ranging from 0 (never) to 4 (always). Responses were added to produce a total perceived advantages score, ranging from 0 to 20 units as the summative score.

Five items measured the disadvantages component of participatory dialogue to determine participants' perceived disadvantages to engage in PA. Items included statements to assess "taking part in more than 150 minutes of aerobic PA per week will cause you to…be tired, not have enough time for academics, not have enough time for leisure, have to pay for facilities, or get hurt." Items were rated on a 5-point scale ranging from 0 (never) to 4 (always). Responses were added to produce the total disadvantages score, which ranged from 0 to 20. Participatory dialogue disadvantages were then subtracted from advantages to calculate an overall score that ranged from −20 to 20. We hypothesized that a higher score would increase the likelihood of the initiation phase of PA change.

The behavioral confidence construct was assessed by 5 statements to determine participants' self-belief in their ability to change. Statements assessed surety to take part in more than 150 minutes of aerobic PA "this week, this week to complete all academic/work-related tasks, this week while finding time for leisure, this week without getting tired, and this week without getting tired." Items were rated on a 5-point scale

ranging from 0 (not at all sure) to 4 (completely sure). Responses were totaled to produce a score for behavioral confidence ranging from 0 to 20 as the summative score.

The changes in physical environment construct were assessed by 3 statements to determine external influences on behavior. Statements assessed surety to "have a place, be able to afford a place, and be able to use equipment" to take part in more than 150 minutes of aerobic PA per week. Items were rated on a 5-point scale ranging from 0 (not at all sure) to 4 (completely sure). Responses were totaled to produce a score for changes in physical environment ranging from 0 to12 units as the summative score.

Initiation was measured by asking "How likely is it that you will increase your aerobic PA to 150 minutes in the upcoming weeks?" The single question was rated on a 5-point scale ranging from 0 (not at all likely) to 4 (completely likely). The variable was operationalized as a metric variable, with a possible score ranging from 0 to 4 units.

Sustenance

The emotional transformation construct was assessed by 3 statements to determine the participants' belief in their own ability to direct their feelings. Statements assessed surety to "direct your emotions/feelings, motivate yourself, and overcome self-doubt" to take part in more than 150 minutes of aerobic PA per week. Items were rated on a 5-point scale ranging from 0 (not at all sure) to 4 (completely sure). Responses were totaled to produce a score for changes in physical environment ranging from 0 to 12.

The practice for change construct was assessed by 3 statements to conclude ability to adapt to the new plan. Statements assessed surety to "keep a self-diary; encounter barriers; and change your plan" to take part in more than 150 minutes of aerobic PA per week. Items were rated on a 5-point scale ranging from 0 (not at all sure) to 4 (completely sure). Responses were totaled to produce a score for changes in physical environment ranging from 0 to 12.

The changes in social environment construct was assessed by 3 statements to extrapolate participants' confidence in finding help from people around them. Statements assessed surety to "get the help of a family member, friend, and health professional" to take part in more than 150 minutes of aerobic PA per week. Items were rated on a 5-point scale ranging from 0 (not at all sure) to 4 (completely sure). Responses were totaled to produce a score for changes in physical environment ranging from 0 to 12 units as the summative score.

Sustenance was measured by asking "How likely is it that you will increase your aerobic PA to 150 minutes every week from now on?" The single question was rated on a 5-point scale ranging from 0 (not at all likely) to 4 (completely likely). The variable was used as a metric variable with a possible score ranging from 0 to 4.

Data Analysis

Descriptive statistics were computed to find the mean and SD for all metric study variables and the frequencies and percentages for categorical variables. Data were screened for missing and extreme values. Preliminary analyses were performed to ensure that there were no violation of assumptions of a multiple regression (ie, independence of observations, linearity, normality, homoscedasticity, and multicollinearity). Multiple linear regression using the enter method for modeling was conducted to determine the predictive ability of MTM constructs for initiation and sustenance of PA behavior change.[24] There was not adequate statistical power to control the effects of demographic variables; therefore, they were not included in the multiple regression analysis. All data were analyzed using SPSS, version 23 (IBM).[25] $P<.05$ was considered statistically significant.

Results

The survey was completed by 347 osteopathic medical students, and 135 (39%) met the inclusion criteria of

Table 1.
Sociodemographic Characteristics of Respondents to the Multitheory Model Questionnaire to Assess Likelihood of Initiating and Sustaining Physical Activity Behavior Change (N=135)

Characteristic	No. (%)
Age, y	
Gender, Mean (SD)	26.56 (3.52)
Male	64 (47.4)
Female	71 (52.6)
Race/Ethnicity, No. (%)	
White	90 (67.7)
Black	7 (5.3)
Asian American	22 (16.5)
American Indian or Alaska native	1 (0.8)
Hispanic	8 (6.0)
Other	5 (3.8)
Class Level, No. (%)	
First year	66 (49.6)
Second year	25 (18.8)
Third year	24 (18)
Fourth year	17 (12.8)
Other	1 (0.8)
Grade Point Average, No. (%)	
2.00-2.49	3 (2.3)
2.50-2.99	33 (25.2)
3.00-3.49	54 (41.2)
3.50-4.00	41 (31.3)
Living Arrangements, No. (%)	
On campus	18 (13.7)
Off campus	113 (86.3)
Work Status, No. (%)	
Yes	15 (11.5)
No	116 (88.5)

engaging in less than 150 minutes of aerobic PA per week and having no medical condition limiting PA. The students were mostly first-year medical students (66 [49.6%]), women (71 [52.6%]), and white (90 [67.7%]) with a mean (SD) age of 26.56 (3.52) years. The largest segment of the population had a grade point average ranging from 3.00 to 3.49 (54 [41.2%]), lived off-campus (113 [86.3%]), and did not work (116 [88.5%]). Comprehensive demographic data are presented in Table 1.

The intention for initiation and sustenance of more than 150 minutes of aerobic PA per week, with a mean of 1.19 units and 0.90 units, respectively, were on the lower side of their respective scales. All scales and subscales, except participatory dialogue disadvantages and changes in social environment, had a Cronbach α greater than or equal to 0.70, signifying they were acceptable. Additional descriptive statistics of MTM constructs are presented in Table 2.

Table 3 provides regression statistics for the initiation construct. A significant initiation model emerged ($F_{3,16}$=13.414, P<.001). The initiation model explained 25.8% of the variance in initiation of PA (adjusted R^2=0.238). Behavioral confidence (standardized coefficient=0.509, P<.001) was a statistically significant predictor of initiation of PA behavior change.

Table 4 provides regression statistics for the sustenance construct. A significant sustenance model emerged ($F_{3,114}$=27.194, P<.001). The sustenance model explained 41.7% of the variance in sustenance of PA (adjusted R^2=0.402). Changes in social environment (standardized coefficient=0.240, P=.002) and emotional transformation (standardized coefficient=0.435, P<.001) were statistically significant predictors of sustenance of PA behavior change.

Discussion

The purpose of this study was to examine the utility of the MTM constructs in predicting both initiation and sustenance of PA among osteopathic medical students. In our sample, 39% of osteopathic medical students did not engage in adequate PA, which is similar to the findings of Frank et al.[6] For initiating PA, the behavioral confidence construct was statistically significant

Table 2.
Descriptive Statistics of the Study Variables to Assess Likelihood of Initiating and Sustaining Physical Activity Behavior Change Among Osteopathic Medical Students (N=135)

Constructs	Possible Range	Observed Range	Mean (SD)	Cronbach α
Initiation	0-4	0-4	1.19 (1.14)	…
Participatory Dialogue				
Advantages	0-20	3-20	13.97 (3.44)	0.87
Disadvantages	0-20	4-20	8.85 (2.77)	0.54
Advantages – disadvantages score	−20 to 20	−14 to 16	5.19 (4.86)	…
Behavioral confidence	0-20	0-20	5.13 (5.03)	0.90
Changes in physical environment	0-12	0-12	8.27 (3.93)	0.91
Entire initiation scale[a]	…	…	…	0.79
Sustenance	0-4	0-4	0.90 (0.98)	…
Changes in social environment	0-12	0-12	3.48 (2.88)	0.69
Practice for change	0-12	0-12	2.91 (2.79)	0.81
Emotional transformation	0-12	0-12	4.48 (3.42)	0.87
Entire sustenance scale[b]	…	…	…	0.85
Entire Scale[c]	…	…	…	0.85

[a] All items of initiation scale.
[b] All items of sustenance scale.
[c] All items of initiation and sustenance scales.

and explained 25.8% of the variance in intention for initiation of PA. Behavioral confidence is operationalized in MTM as an individual's projection of his or her ability to engage in a health behavior in the future, which was derived from the self-efficacy and perceived behavioral control constructs previously operationalized in health promotion theories.[13] In studies[26-29] that have assessed intention or initiation of PA, both

Table 3.
Multiple Regression Predicting the Likelihood of Initiating Physical Activity Behavior Change Among Osteopathic Medical Students (N=135)

Variables[a]	*B*	SE_B	β	*P* Value[a]	95% CI
Participatory Dialogue					
Advantages–disadvantages score	0.006	0.020	.024	.770	−0.033 to 0.045
Behavioral confidence	0.114	0.019	.509	<.001	0.007-0.151
Changes in physical environment	−0.006	0.024	−.022	.793	−0.055 to 0.042

[a] The dependent variable is initiation for physical activity behavior change. The independent variables are participatory dialogue, behavioral confidence, and changes in physical environment (P<.001; R^2=0.258; adjusted R^2=0.238; $F_{3,116}$=13.414).

Abbreviations: *B*, unstandardized coefficient; SE_B, standard error of the coefficient.

Table 4.
Multiple Regression Predicting the Likelihood of Sustaining Physical Activity Behavior Change Among Osteopathic Medical Students (N=135)

Variables[a]	*B*	SE_B	β	*P* Value	95% CI
Changes in social environment	0.088	0.028	.240	.002	0.032-0.144
Practice for change	0.047	0.034	.121	.177	–0.021 to 0.114
Emotional transformation	0.128	0.027	.435	<.001	0.075-0.182

[a] The dependent variable is sustenance for physical activity behavior change. Independent variables are changes in social environment, practice for change, and emotional transformation (P<.001; R^2=0.417; F(3, 114)=27.194; adjusted R^2=0.402).

Abbreviations: *B*, unstandardized coefficient; SE_B, standard error of the coefficient.

self-efficacy and perceived behavioral control have been found to be significantly related to the initiation of PA, and the finding from the current study also supports the importance of behavioral confidence for PA initiation. When compared with previous research,[30] the findings from the current study show a larger contribution of behavioral confidence in the variance explained for PA behavior. This finding may be because of the unique manner that the MTM operationalizes behavioral confidence by emphasizing conceptualization of future performance of the behavior and includes external and internal sources of confidence. Furthermore, in a 2016 study[14] assessing the predictive capability of the MTM for PA in a sample of college students, researchers also found that behavioral confidence was an important construct in predicting intention for initiation of PA. The findings from these 2 studies using the MTM underscore the importance of behavioral confidence in the initiation of PA.

In the present study, 2 of the 3 proposed constructs, changes in social environment (P=.002) and emotional transformation (P<.001) were significant and explained 41.7% of the variance in intention for sustenance of PA among osteopathic medical students. The first construct, social environment, is derived from other well-known health promotion theoretical constructs (ie, helping relationships and social support), which have been shown to be significant factors in engagement in PA behavior among college students in previous studies.[29,31] The findings from the current study and previous research underscore the importance of emphasizing social support in the social environment for sustaining PA.

The second construct, emotional transformation, is fairly new in health promotion research and is similar to the concept of emotional intelligence. Although there is limited evidence supporting emotional transformation as an important factor for PA, the aforementioned 2016 study[14] using the MTM to predict college students' intention for sustenance of PA also found emotional transformation to be a significant and influential construct. Emotional transformation entails redirecting feelings toward setting goals. For example, a person can positively transform the emotion of anger by setting a goal of exercising for 30 minutes when they feel angry, which will relieve the hormonal and neurotransmitter buildup as well as help accomplish the goal of behavioral change.

The findings from the present study support the need to address the inadequate PA levels of osteopathic medical students. The MTM is an emerging theory in health promotion that may provide an important framework to develop, implement, and evaluate interventions addressing inadequate PA among osteopathic medical students. Notably, for both the initiation and sustenance models, the distribution of scores for the constructs fell within the low range. This finding indicates that there is considerable scope for improvement in these constructs

and corresponding scores through the use of intervention strategies. Using the MTM, interventions could be delivered through one-on-one counseling techniques or in the small- or large-group setting, such as in classrooms or through student organizations.

To influence the initiation of PA behavior change, these findings support modifying the behavioral confidence construct. For example, osteopathic medical students can have help identifying the barriers to engage in sufficient PA and be provided with strategies to overcome these barriers. Furthermore, sources of confidence need to be explored and reinforced among osteopathic medical students to build behavioral confidence. Although the 2 other MTM constructs, advantages outweighing disadvantages and physical environment, were not significant for initiation, they could be modified to increase intention for initiating PA.

To further influence PA sustenance, the findings from this study support modifying the social environment and emotional transformation. Health promotion professionals can assist medical students in modifying their social environments by actively seeking help from friends, family members, or health care professionals to accomplish tasks such as planning and maintaining accountability for an exercise regimen and overcoming barriers like time management to sustain it.

This study had several limitations. It used a cross-sectional research design, which prevented examination of the temporal or sequential relationship among the variables. The study was also limited because we used self-reported information and proxy measures to ascertain all variables, which is susceptible to measurement bias. However self-report was the most viable option to assess participants' attitudes and perceptions. To overcome the limitation of proxy measures, future studies should gather objective measurements of PA, such as the use of accelerometers to record actual PA. Furthermore, the sample selected was a nonprobability, convenience sample of osteopathic medical students. Thus, the findings may not be generalizable to populations beyond this sample. Future studies using this method and model should focus on recruiting random samples to increase the generalizability of the research findings.

Conclusion

The MTM offers a streamlined model for initiating and sustaining PA and provides a framework of malleable constructs that can lead to sustained health behavior change. Health care professionals who are developing programs for reducing stress and increasing PA should consider constructs from the MTM when developing interventions.

Author Contributions

Drs Nahar and Sharma provided substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; all authors drafted the article or revised it critically for important intellectual content; all authors gave final approval of the version of the article to be published; and all authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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