

# Utilizing Multi-Theory Model in Determining Intentions to Smoking Cessation Among Smokers

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## ABSTRACT

**BACKGROUND:** Smoking is a risk factor for lung cancers, and a myriad of other acute and chronic ailments. The purpose of this study was to predict initiation and sustenance of smoking cessation among smokers using a fourth-generation behavioral framework, multi-theory model (MTM) of health behavior change.

**METHODS:** A convenience sample of smokers from a shopping mall in rural, Appalachian Kentucky county was invited to participate in this cross-sectional study. A 38-item, face and content validated, MTM-based survey instrument was administered to the participants.

**RESULTS:** A total of 148 participants completed the study. The mean age of the participants was 35.53 (SD = 14.52) years. Most were male (58.1%) and Caucasian (95.9%). Participants reported smoking for an average of 16.45 (SD = 13.12) years. Participatory dialogue ( $\beta = 0.235$ ,  $P = .003$ ) and behavioral confidence ( $\beta = 0.305$ ,  $P = .005$ ) were significant predictors of intention for initiation for smoking cessation behavior. Emotional transformation ( $\beta = 0.319$ ,  $P = .001$ ) was a significant predictor of intention for sustenance for smoking cessation behavior.

**DISCUSSION:** Two of the MTM constructs for initiation and one of the MTM constructs for sustenance of change accounted for a moderate amount of variance in initiation and sustenance of smoking cessation behavior among community members in a rural, Kentucky county. MTM has utility for predicting both initiation and sustenance of smoking cessation behavior. Future interventions using MTM constructs should be developed for smoking cessation behavior change.

**KEYWORDS:** smoking, multi-theory model, cessation, Appalachia, rural

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## Introduction

Although smoking rates are declining worldwide, in 2015, the prevalence of smokers globally was approximately over 1.1 billion.<sup>1</sup> According to the Centers for Disease Control and Prevention (CDC), an estimated 38 million adults smoked cigarettes in the United States in 2016.<sup>2</sup> Smoking cigarettes damages almost every organ in the body, leads to numerous diseases, and causes health decline in smokers.<sup>3,4</sup> Smoking causes roughly 85% of lung cancers, and tobacco use is the leading cause of cancer death.<sup>5</sup> According to a study conducted by Mallaina et al,<sup>6</sup> smoking can lead to cardiovascular events, and modifying this behavior would result in better health outcomes. Smoking cessation provides a plethora of health benefits including decreased smoking-related morbidity and mortality, slower progression of current illness, improved function, and so on.<sup>7</sup> While research into public health interventions to aid in the promotion of smoking cessation has

shown promise, there are limitations in their effectiveness and potential for application across communities. For example, a program known as the web-based computer-tailored smoking prevention intervention has shown to significantly promote the initiation of smoking cessation.<sup>8</sup> However, while this program is a good step toward promoting the initiation of smoking cessation, it has not shown its efficacy for the sustenance of smoking cessation beyond 6 months, and its complexity may limit its potential for widespread implementation. Other interventions are similarly limited by their focus on initiation of smoking cessation behavior with less attention toward maintenance of behavior. An experiential, dissonance-based smoking intervention was found to be efficacious in increasing motivation to quit; however, it was not applied for long-term sustenance of smoking cessation.<sup>9</sup> A review conducted by Bailey et al<sup>10</sup> also found that none of the pharmacotherapies they reviewed were able to significantly promote



long-term sustenance of smoking cessation. As far as long-term sustenance of smoking cessation is concerned, very few interventions have been found to be efficacious.

The multi-theory model (MTM) is a health behavior theory that uses a fourth-generation framework to predict one-time and long-term modification of health behavior.<sup>11–16</sup> The fluidity of the model allows for the constructs to be adapted to a variety of health behaviors, precisely due to the lack of moderating variables. MTM distinguishes itself from other health behavior models in that practitioners can efficiently determine the best approach to encourage their patient to begin and continue health habits from this unified framework. The MTM breaks down the health behavior change into initiation of the health behavior change and sustenance or continuation of the health behavior change. The constructs influencing initiation of the health behavior change are participatory dialogue (ie, advantages offsetting disadvantages of activity), behavioral confidence (ie, sureness despite various life challenges), and changes in physical environment (ie, availability or accessibility of necessary resources). The constructs influencing sustenance of the health behavior change are emotional transformation (ie, transforming or converting feelings, especially negative ones, into goals), practice for change (ie, creating a habit of transformation and making it a way of life), and changes in social environment (ie, creating social support within the environment). Previous health behavior models used to explain smoking cessation have indecisive results, lack substantive predictive power, and could not assess long-term behavior change. The purpose of this article was to predict initiation and sustenance of smoking cessation among smokers. This inquiry provides empirical evidence to help guide future interventions for smoking cessation, which may significantly influence both initiation and sustenance of smoking cessation behavior.

## Methods

### *Study design, sampling, and procedure*

A cross-sectional design was used to obtain a convenience sample of smokers. Visitors at a shopping mall in a rural, Appalachian Kentucky county were invited to complete a voluntary questionnaire. Data were collected between July and October 2017. Participants were included if they smoked one or more cigarettes during the past 7 days and were 18 years of age or older. With an alpha of 0.05, power of 0.80, three predictors for each model and two covariates and a medium effect size ( $f^2$ ) of 0.08, the G\*Power sample size calculation for hierarchical regression modeling yielded a minimum of 141 participants.<sup>17</sup> Constructs from the initiation model of MTM (participatory dialogue, behavioral confidence, changes in physical environment) and constructs of the sustenance model from MTM (emotional transformation, practice for change, and changes in social environment) were the independent variables. The dependent variables for the two models were intentions for initiation of smoking cessation behavior change and

sustenance of smoking cessation behavior change, respectively. Ethics approval was granted by the Institutional Review Board (IRB) at the parent university.

### *Instrument*

A 38-item, face and content validated, MTM-based survey instrument was administered in this study. The first nine questions of the instrument assessed the smoking status (ie, smoked during past 7 days, years smoked, cigarettes per day) and demographic factors (ie, age, gender, ethnicity, education, work status, income). The remaining 29 items assessed the constructs for the two models of the MTM (ie, initiation and sustenance models).

### *Initiation model*

A total of 19 items measured constructs in the initiation model. Five items measured the advantages of participatory dialogue. An example item states, “If you quit smoking you will get sick less often.” Each item response was scored on a 5-point Likert-type scale from 0 (never) to 4 (always). The scores for each item response were summed to give a total score for advantages, with a maximum possible score of 20 units. Five items also measured the disadvantages of participatory dialogue. An example item states, “If you quit smoking you will not be able to socialize as well.” Each item response and the total scale score was calculated in the same manner as the advantages scale. The disadvantages score was subtracted from the advantages score to give the overall score for the construct of participatory dialogue (range from –20 to +20 units).

The behavioral confidence construct of the initiation model was assessed with 5 items. An example item states, “How sure are you that you will be able to quit smoking this week without getting withdrawal symptoms?” Items were scored using a 5-point Likert-type scale, with responses ranging from 0 (not at all sure) to 4 (completely sure). Each item response was summed to give an overall score for behavioral confidence, with a maximum possible score of 20 units.

Three items in the questionnaire assessed changes in the physical environment. An example item states, “How sure are you that you will be able to substitute smoking time with something else this week?” Item responses were scored on a 5-point Likert-type scale from 0 (not at all sure) to 4 (completely sure), with all responses being summed to give an overall score for this construct (ranging from 0 to 12 units).

Initiation was measured with one item by asking, “How likely is it that you will quit smoking in the upcoming weeks?” This item was scored on a 5-point Likert-type scale ranging from 0 (not at all likely) to 4 (completely likely) units.

### *Sustenance model*

The constructs of the sustenance model were assessed with a total of 10 items. The construct of emotional transformation

was measured with three items. An example item states, “How sure are you that you can motivate yourself to be smoke free every week?” Each item was scored on a 5-point Likert-type scale from 0 (not at all sure) to 4 (completely sure) and scores from all three items in this section were added to give a total score for emotional transformation, with a maximum possible score of 12 units.

Practice for change was assessed with three items. A sample item from the scale states, “How sure are you that you can keep a self-diary to monitor your smoking urge every week?” Item responses were scored on a 5-point Likert-type scale ranging from 0 (not at all sure) to 4 (completely sure). The sum of all responses gave an overall score for this construct, with a maximum possible score of 12 units.

The sustenance construct, changes in social environment, was measured with three items. An example item from the scale states, “How sure are you that you can get the help of a friend to be smoke free every week?” Responses were measured using a 5-point Likert-type scale ranging from 0 (not at all sure) to 4 (completely sure). Each item response was added up to give a total score for changes in social environment, with a maximum possible score of 12 units.

Sustenance was assessed with one item by asking, “How likely is it that you will be smoke free every week from now on?” The item response was assessed using a 5-point Likert-type scale ranging from a score of 0 (not at all likely) to 4 (completely likely) units.

### Validity and reliability

Face and content validity of the instrument was evaluated over a two-round process by a panel of six experts in the field of health behavior and promotion. For establishing internal consistency reliability of the MTM subscales, Cronbach’s alpha values

were calculated. Cronbach’s alpha for all MTM variables was near or above 0.70, indicating acceptable internal consistency reliability. For construct validation, confirmatory factor analysis was used for all seven MTM construct subscales. All MTM subscales confirmed 1 factor solutions with Eigen values greater than 1 and factors loadings for each item greater than 0.38, except for the participatory disadvantages subscale which showed two factors. Clear demarcation within the subscale for item loadings was not discernible on the two factors of the disadvantages subscale. Furthermore, experts had suggested single factor construct validity of this subscale. Hence, no items were deleted from the disadvantages subscale. Deletions would have also interfered with the equivalence in the number of items on the advantages subscale as compared with the disadvantages subscale. Based on this evidence and rationale, the items were retained in the participatory disadvantages subscale for the purposes of this study.

**Table 1.** Socio-demographic characteristics of the participants.

	MEAN (SD)	N (%)
Age (years)	35.53 (14.52)	
Gender		
Male		86 (58.1%)
Female		62 (41.9%)
Race/ethnicity		
White or Caucasian American		142 (95.9%)
Black or African American		3 (2.0%)
Hispanic American		2 (1.4%)
Other		1 (0.7%)
Education		
Some schooling but not completed high school		35 (23.6%)
Completed high school or General Education Diploma (GED)		63 (42.6%)
Some college		33 (22.3%)
Completed college/graduate degree		13 (8.8%)
Postgraduate degree		3 (2.0%)
Professional degree		1 (0.7%)
Household income		
Less than \$50000		112 (77.2%)
\$50000 to \$100000		26 (17.9%)
\$100001 to \$150000		2 (1.4%)
\$150001 to \$200000		3 (2.1%)
More than \$200000		2 (1.4%)
Work status		
Yes		97 (65.5%)
No		51 (34.5%)

### Statistical analysis

Descriptive statistics were calculated for all study variables (Tables 1 and 2). To assess the relationship between demographic variables (covariates) and dependent variables (initiation and sustenance of smoking cessation behaviors), we performed Pearson’s *r*, independent samples t-tests, and one-way analysis of variance (ANOVA) analyses, as appropriate. Since there were two dependent variables in the current study, two hierarchical multiple regression models were conducted in two blocks to determine the predictive ability of the MTM

**Table 2.** Descriptive statistics of constructs of MTM (n=148).

CONSTRUCTS	POSSIBLE RANGE	OBSERVED RANGE	MEAN (SD)	CRONBACH'S ALPHA
Initiation	0 to 4	0 to 4	0.96 (0.98)	—
Participatory dialogue: advantages	0 to 20	0 to 20	14.11 (4.03)	0.80
Participatory dialogue: disadvantages	0 to 20	0 to 20	9.41 (3.61)	0.67
Participatory dialogue: advantages-disadvantages score	-20 to +20	-9 to +20	4.75 (5.67)	—
Behavioral confidence	0 to 20	0 to 20	5.99 (5.24)	0.89
Changes in physical environment	0 to 12	0 to 12	3.29 (3.22)	0.86
Entire initiation scale	—	—	—	0.78
Sustenance	0 to 4	0 to 4	0.81 (0.98)	—
Emotional transformation	0 to 12	0 to 12	3.88 (3.07)	0.90
Practice for change	0 to 12	0 to 12	3.76 (2.91)	0.87
Changes in social environment	0 to 12	0 to 12	4.59 (3.53)	0.79
Entire sustenance scale	—	—	—	0.87
Entire scale	—	—	—	0.88

Abbreviation: MTM, multi-theory model.

**Table 3.** Hierarchical multiple regression predicting initiation for smoking cessation (n=148).

VARIABLES	B	SE <sub>B</sub>	B	P-VALUE	95% CI
<b>Model 1</b>					
Smoking history	-0.012	0.007	-0.146	.097	-0.026, -0.002
Daily smoking	-0.024	0.010	-0.205	.020	-0.044, -0.004
F(2, 127)=5.207, P=.007, R <sup>2</sup> =0.076, adjusted R <sup>2</sup> =0.061					
<b>Model 2</b>					
Smoking history	-0.008	0.007	-0.096	.230	-0.021, 0.005
Daily smoking	-0.011	0.010	-0.096	.243	-0.030, 0.008
Participatory dialogue	0.041	0.014	0.235	.003	0.014, 0.068
Behavioral confidence	0.058	0.020	0.305	.005	0.018, 0.098
Changes in physical environment	0.041	0.032	0.133	.204	-0.023, 0.106
F(5, 124)=8.960, P<.001, R <sup>2</sup> =0.265, adjusted R <sup>2</sup> =0.236, ΔR <sup>2</sup> =0.190, ΔF=10.669					

Abbreviations: B, unstandardized coefficient; CI, confidence interval; P, level of significance; SE<sub>B</sub>, standard error of the coefficient; β, standardized coefficient. Dependent variable is initiation for smoking cessation behavior change; independent variables are smoking history, daily smoking, participatory dialogue, behavioral confidence, and changes in physical environment.

constructs beyond the influence of the demographic variables (Tables 3 and 4). In block 1 for each model, only those demographic variables were entered which were statistically significant in bivariate analysis. In block 2 for each model, all of the MTM constructs were added. A statistical significance level of 0.05 was set a priori. Data analyses were completed using IBM SPSS (version 23.0).

## Results

A total of 148 participants met the inclusion criteria (aged 18 and over and smoked one or more cigarettes during the past 7 days) and completed the paper questionnaire. Mean age of the participants was 35.53 (SD=14.52) years. Participants reported smoking for an average of 16.45 (SD=13.12) years. The mean number of cigarettes smoked per day was 16.49

**Table 4.** Hierarchical multiple regression predicting sustenance for smoking cessation (n = 148).

VARIABLES	B	SE <sub>B</sub>	β	P-VALUE	95% CI
<b>Model 1</b>					
Age	-0.006	0.011	-0.084	.597	-0.027, 0.016
Smoking history	-0.007	0.012	-0.087	.588	-0.031, 0.018
Daily smoking	-0.018	0.010	-0.160	.064	-0.038, 0.001
F(3, 134) = 2.858, P = .039, R <sup>2</sup> = 0.060, adjusted R <sup>2</sup> = 0.039					
<b>Model 2</b>					
Age	-0.013	0.010	-0.197	.180	-0.033, 0.006
Smoking history	0.003	0.011	0.037	.800	-0.019, 0.025
Daily smoking	-0.013	0.009	-0.117	.132	-0.031, 0.004
Emotional transformation	0.102	0.031	0.319	.001	0.041, 0.163
Practice for change	0.041	0.030	0.123	.177	-0.019, 0.101
Changes in social environment	0.030	0.024	0.110	.203	-0.017, 0.077
F(6, 131) = 7.944, P < .001, R <sup>2</sup> = 0.267, adjusted R <sup>2</sup> = 0.233, ΔR <sup>2</sup> = 0.207, ΔF = 12.307					

Abbreviations: B, unstandardized coefficient; CI, confidence interval; P, level of significance; SE<sub>B</sub>, standard error of the coefficient; β, standardized coefficient. Dependent variable is sustenance for smoking cessation behavior change; independent variables are age, smoking history, daily smoking, emotional transformation, practice for change, and changes in social environment.

(SD = 8.26). Most subjects were male (58.1%), Caucasian (95.9%), came from a household with income less than \$50 000 (77.2%), and were employed at the time of survey (65.5%). Only 8.8% of participants had a college degree. Comprehensive demographic information is detailed in Table 1.

Table 2 shows the descriptive statistics and reliability calculation for all MTM constructs. The mean intention to initiate smoking cessation score was 0.96 (SD = 0.98) as measured on a 5-point scale. The mean scores of the constructs within the initiation model were 4.75 units (SD = 5.67, range = -20 to 20) for participatory dialogue, 5.99 (SD = 5.24, range = 0 to 20) for behavioral confidence, and 3.29 (SD = 3.22, range = 0 to 12) for changes in physical environment. The mean intention of sustenance of smoking cessation score was 0.81 (SD = 0.98) as measured on a 5-point scale. The mean scores of constructs within the sustenance model were 3.88 (SD = 3.07, range = 0-12) for emotional transformation, 3.76 (SD = 2.91, range = 0-12) for practice for change, and 4.59 (SD = 3.53, range = 0-12) for changes in social environment.

Results of the hierarchical multiple regression analysis for the initiation model are presented in Table 3. For model 1, daily smoking ( $\beta = -0.205$ ,  $P = .020$ ) was the only significant demographic predictor of initiation for smoking cessation,  $F(2, 127) = 5.207$ ,  $P = .007$ ,  $R^2 = 0.076$ . The addition of the initiation model MTM constructs in model 2 led to a statistically significant increase of 0.190 in the  $R^2$  value for the model. The overall model was statistically significant,  $F(5, 124) = 8.960$ ,  $P < .001$ ,  $R^2 = 0.265$ , adjusted  $R^2 = 0.236$ . Of the initiation model constructs, participatory dialogue ( $\beta = 0.235$ ,  $P = .003$ )

and behavioral confidence ( $\beta = 0.305$ ,  $P = .005$ ) were significant predictors of initiation for smoking cessation behavior in the final model.

Results of the hierarchical multiple regression for the sustenance model are presented in Table 4. For model 1, none of the demographic variables significantly predicted sustenance for smoking cessation,  $F(3, 134) = 2.858$ ,  $P = .039$ ,  $R^2 = 0.060$ , adjusted  $R^2 = 0.039$ . The addition of the sustenance model MTM constructs in model 2 led to a statistically significant increase of 0.207 in the  $R^2$  value for the model. The overall model was statistically significant,  $F(6, 131) = 7.944$ ,  $P < .001$ ,  $R^2 = 0.267$ , adjusted  $R^2 = 0.233$ . Of the sustenance model constructs, emotional transformation ( $\beta = 0.319$ ,  $P = .001$ ) was a significant predictor of sustenance for smoking cessation behavior.

## Discussion

The purpose of this study was to examine the utility of the MTM constructs in predicting both the intentions for initiation and sustenance of smoking behavior among community members in a rural, Kentucky county. Among the participants, mean intention for initiation of smoking cessation (ie, quitting smoking in the near future) and mean intention for sustenance of smoking cessation (ie, sustaining smoking cessation for the foreseeable future) were very low ( $M = 0.96$  and  $0.81$ , respectively). In both the initiation and sustenance regression models, the addition of the MTM constructs led to substantial increases in the  $R^2$  of the model beyond the influence of the demographic covariates (0.233 and 0.236, respectively). For initiation of



smoking cessation, participatory dialogue ( $\beta=0.235$ ,  $P=.003$ ) and behavioral confidence ( $\beta=0.305$ ,  $P=.005$ ) were significant predictors of initiation for smoking cessation behavior. In the sustenance model, only emotional transformation ( $\beta=0.319$ ,  $P=.001$ ) was a significant predictor of sustenance for smoking cessation behavior. Although previous research has not used the MTM to predict initiation and sustenance for smoking cessation, the MTM constructs were adopted and derived from existing health behavior theory constructs. The discussion of the study findings will be presented in the context of findings from previous research utilizing other theoretical frameworks.

In the initiation model, daily smoking and the MTM constructs of participatory dialogue and behavioral confidence explained 23.6% of the variance in initiation for smoking cessation, with both MTM variables demonstrating a positive relationship with initiation for smoking cessation ( $\beta=0.235$  and  $0.305$ , respectively). The MTM participatory dialogue construct was derived from Freire's model of adult education and is based on similar concepts as the decisional balance construct in the transtheoretical model and benefits vs barriers in the health belief model.<sup>18</sup> In previous research, decisional balance as operationalized in the transtheoretical model has also demonstrated a relationship with smoking cessation behavior.<sup>19</sup> In addition, a recent meta-analysis of the health belief model constructs' predictive ability for health behavior revealed that benefits and barriers were consistently the strongest predictors of health behavior.<sup>20</sup> In previous studies exploring the MTM constructs to predict initiation and sustenance of other health behaviors, such as physical activity, participatory dialogue also emerged as a significant predictor of behavior initiation.<sup>12,15,21</sup> The findings from this study suggest that when developing smoking cessation interventions, health promotion researchers and practitioners should consider using techniques to increase participatory dialogue. Participatory dialogue involves the incorporation of a two-way dialogue between the person wanting to quit smoking and the smoking cessation facilitator (eg, counselor, health educator, physician) where the facilitator demonstrates how the advantages of quitting smoking outweigh the disadvantages. Facilitation of participatory dialogue can occur through communication channels including one-on-one discussions, small group discussions, large group discussions, online discussions, social media discussions, or in the community setting.<sup>18</sup>

Behavioral confidence is operationalized in the MTM as a person's confidence to engage in a behavior change in the future and was derived from Bandura's self-efficacy and Ajzen's perceived behavioral control.<sup>18</sup> Previous research utilizing self-efficacy and perceived behavioral control has found both constructs to demonstrate a significant relationship with smoking cessation, demonstrating that increased self-efficacy is related to increased smoking cessation behavior.<sup>22,23</sup> It has been suggested in previous research that perceived behavioral control exerts a substantial influence on smoking behavior and should be strengthened in smoking cessation efforts as a tool

for behavior modification.<sup>23</sup> In addition, in previous research exploring MTM constructs in relation to other health behaviors, including physical activity, sugar sweetened beverage consumption, binge drinking, dietary behavior, and sleep, behavioral confidence has consistently emerged as a significant predictor of initiation of behavior change.<sup>12-15,21,24</sup> Findings from this study and previous research support the use of techniques to increase behavioral confidence when initiating smoking cessation. Practitioners and researchers designing smoking cessation interventions may consider utilizing techniques such as breaking down smoking cessation efforts into smaller steps, assigning cessation efforts to the individual and important others in life, and focusing on a specific quit date.<sup>18</sup>

In the sustenance model, only emotional transformation was a significant predictor and explained 23.3% of the variance in sustenance of smoking cessation. Emotional transformation was derived from emotional intelligence theory and operationalized in the MTM as the ability for an individual to direct emotions and feelings to being smoke free and to overcome uncertainty in accomplishing behavior change.<sup>18</sup> Emotional transformation is a fairly new construct in health behavior research, and overall, the variance explained by the model and this variable is moderately substantial for social science and behavioral research. Thus, this study adds to the literature by presenting a construct that may be an influential variable in the sustenance of smoking cessation. Emotional transformation has also been found to have a positive relationship with sustenance of other health behaviors, including dietary behavior, physical activity, sleep, and sugar sweetened beverage consumption.<sup>12-15</sup> Findings from this research suggest that emotional transformation may be an important variable to target in health promotion interventions encouraging smoking cessation. Emotional transformation can be targeted in smoking cessation interventions through the utilization of role-play or psychodrama to assist participants in developing strategies to redirect emotions associated with quitting smoking (eg, stress, frustration) toward achieving the overall goal of smoking cessation.

In the present study, changes in the physical environment and changes in the social environment were not significant predictors of initiation and sustenance of smoking cessation. In other research utilizing the MTM, changes in the physical environment has been found to be a significant predictor of initiation of other health behaviors, such as binge drinking, sugar sweetened beverage consumption, and physical activity.<sup>12,15,21,24</sup> Findings from this study suggest that the influence of the physical environment on smoking cessation behavior may not be as influential as for other health behaviors. With regard to the social environment, previous studies utilizing the MTM have also found significant associations with the social environment and sustenance of other health behavior, such as binge drinking, sleep, physical activity, and dietary behavior.<sup>12,14,21,24</sup> Contrary to this study, other studies have shown that family and peer support have positive

relationships with smoking cessation behavior.<sup>25,26</sup> The finding from this study with regard to the social environment may be due to the manner in which the construct was operationalized. Participants were asked how sure they could receive help from an influential other in the future when attempting to quit smoking. This may have influenced the results of this study, as people who are intending to quit smoking may need assistance from a practitioner to facilitate social support from others, which has been supported as an effective clinical practice in other research.<sup>26</sup>

### Limitations

The authors would like to acknowledge several shortcomings inherent to the present study. First, the utilization of a cross-sectional research design limits any interpretations about the temporal sequence or time sequence of the study variables. Thus, it cannot be stated that the constructs assessed in both MTM models preceded smoking cessation behavior. However, behavioral theory suggests that psychosocial constructs precede behavior, so when interpreting the study findings, we can assume that the constructs precede smoking cessation behavior. Second, the study relied on self-report data, which are subject to measurement bias. However, due to the assessment of attitudes and perceptions, the researchers were limited to the measurement approaches available for this study. Third, actual smoking cessation behavior was not assessed as part of this cross-sectional study. Other theories, such as the theory of planned behavior, support that behavioral intention, such as the intention for initiation and sustenance of smoking cessation assessed in this study, is largely predictive of behavior and precedes behavior, which supports the manner in which behavior was assessed in this study.<sup>27</sup> However, we do suggest that future studies assess behavior more objectively to remedy this limitation. Finally, the sample ascertained for this study was a convenience sample of visitors at a shopping mall in a rural, Appalachian Kentucky county, so strictly speaking the findings cannot be generalized beyond the study sample. Thus, future research should continue to assess the influence of the MTM constructs on smoking cessation behavior in larger, random samples.

### Conclusions

In this study, two of the MTM constructs for initiation and one of the MTM constructs for sustenance of change accounted for a moderate amount of variance in initiation and sustenance of smoking cessation behavior among community members in a rural, Kentucky county. The findings from this study suggest that the MTM has utility for predicting both initiation and sustenance of smoking cessation behavior. The findings from this study support the use of the MTM constructs in the development of smoking cessation interventions for both initiation and sustenance of behavior change. Smoking cessation interventions based on the MTM should develop modalities to incorporate participatory dialogue and build upon an individual's behavioral confidence to initiate smoking cessation and

should aim to improve an individual's emotional response to behavior change to sustain smoking cessation efforts. Future research should continue to explore the predictive ability and utility of the MTM constructs for smoking cessation intervention development. Moreover, additional studies are needed to determine the predictive ability of the MTM constructs in other, more diverse and randomized samples to further the generalizability of the study's findings.

### Author Contributions

VKN and MS contributed to conception and design; MS and VKN contributed to instrument development; VKN and MS contributed to analysis of data; FCP and RWK contributed to collection 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.

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