Original Investigation

Self-Efficacy Mediates the Effect of Depression on Smoking Susceptibility in Adolescents

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Abstract

Introduction: Research indicates that negative affect and/or depression is associated with increased prevalence for smoking and higher levels of nicotine dependence in adults and adolescents. A previous study with adult smokers attempting to quit indicated that low levels of self-efficacy partially mediated depression's adverse effect on posttreatment cessation.

Method: The current study attempted to test self-efficacy as a potential mediator between depressive symptoms and smoking susceptibility in adolescents. One thousand and ninety-three nonsmoking high-school students who were part of a large clinical trial evaluating an interactive CD-ROM-based smoking prevention/cessation curriculum (project ASPIRE) were included in this analysis. These students completed an extensive battery before treatment and 18 months after treatment, which included measures of depression, self-efficacy, smoking status, and smoking susceptibility.

Results: Results indicated that self-efficacy partially mediated the positive relationship between baseline depressive symptoms and susceptibility to smoke at 18 months, accounting for approximately 27% of the variance.

Conclusions: Perhaps future interventions to prevent smoking in adolescents can target self-efficacy potentially resulting in more effective outcomes, particularly in adolescents with current depressive symptoms or who may be at risk for future depression.

Introduction

There is increasing evidence that adolescents become dependent on nicotine early in their smoking careers. Individuals who initiate smoking at a young age are more likely to develop long-term nicotine addiction than those who start later and often report that they are unable to quit despite having the desire to do so (Breslau & Peterson, 1996; Patterson, Lerman, Kaufmann, Neuner, & Audrain-McGovern, 2004). Although in recent years,

there has been a downward trend in adolescent smoking, a 2007 survey of high-school students revealed that 20% of high-school students had smoked in the past thirty days and that approximately 50% of high-school students had smoked in their lifetime (Centers for Disease Control and Prevention, 2008).

Over the past several decades, researchers have identified and studied factors associated with initiation of smoking in adolescents, including risk-taking behavior, intentions, attitudes, knowledge, and need for peer approval (Conrad, Flay, & Hill, 1992; Wahlgren et al., 1997). In regards to emotional risk factors, a number of longitudinal studies have found that higher levels of depressive symptoms in children and adolescents predict smoking experimentation, regular smoking during adolescence, and conversion to tobacco dependence (Karp, O'Loughlin, Hanley, Tyndale, & Paradis, 2006; Patton et al., 1998; Polen et al., 2004; Prinstein & La Greca, 2009; Repetto, Caldwell, & Zimmerman, 2005). However, the direction of causality in this relationship remains unclear. Several studies have failed to find a relationship between depression and subsequent smoking behavior and have instead found smoking to predict onset of depression (Choi, Patten, Gillin, Kaplan, & Pierce, 1997; Goodman & Capitman, 2000). Other studies have found a bidirectional relationship between depression and smoking in adolescents (McCaffery, Papandonatos, Stanton, Lloyd-Richardson, & Niaura, 2008; Munafo, Hitsman, Rende, Metcalfe, & Niaura, 2008). Several hypotheses have been posed regarding the nature of the relationship between depressive symptoms and smoking in adolescents. The self-medication hypothesis suggests that smoking is used to regulate or alleviate depressive symptoms (Glass, 1990). It has also been suggested that depression increases adolescents' vulnerability to pressure from peers to initiate smoking (Patton et al., 1998). Alternatively, repetitive use of tobacco may induce depression in adolescents by eliciting biochemical changes in the brain that are also associated with abnormalities that mediate depression. Continued use of tobacco is then needed to counteract these neuroadaptations and to avoid onset of depressive symptoms (Balfour & Ridley, 2000; Markou, Kosten, & Koob, 1998). The relationship between depression and smoking may be due to underlying biological

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or environmental factors that predispose individuals to develop both depression and nicotine dependence (Audrain-McGovern, Lerman, Wileyto, Rodriguez, & Shields, 2004; Kendler et al., 1993).

Social cognitive theory assumes that perceived self-efficacy mediates the role of affective states on adolescents' psychosocial functioning, including their ability to resist social inducements for transgressive conduct (Bandura, Caprara, Barbaranelli, Gerbino, & Pastorelli, 2003). Self-efficacy can be defined as "belief in one's capabilities to organize and execute the courses of action required to manage prospective situations" (Bandura, 1995). In the smoking literature, low self-efficacy has been related to smoking initiation and smoking rate as well as greater difficulty quitting and /or higher rates of relapse among adolescents (Engels, Hale, Noom, & De, 2005; Solomon, Bunn, Pirie, Worden, & Flynn, 2006; van Zundert, Engels, & van den Eijnden, 2006). In both adults and adolescents, high levels of depressive symptoms or negative affect have also been associated with low levels of self-efficacy (Engels et al., 2005; Haukkala, Uutela, Vartiainen, McAlister, & Knekt, 2000; Stevens, Colwell, Smith, Robinson, & McMillan, 2005) and have been found to adversely impact smoking-related outcomes (John, Meyer, Rumpf, & Hapke, 2004; Kenney & Holahan, 2008). One study involving 121 adult smokers who were participating in a behavioral/pharmacological smoking cessation trial found that postcessation self-efficacy partially mediated the inverse relationship between precessation depressed mood and abstinence at 6 months (Cinciripini et al., 2003), such that the effect of depressed mood on abstinence was substantially reduced when the effect of self-efficacy was controlled. The relationship between self-efficacy, which could potentially have a "protective" effect on adolescent smoking behavior, and depressive symptoms, which might have an adverse effect on smoking, has not been previously investigated in a prospectively obtained sample.

The current study evaluated self-efficacy as a potential mediator between depressive symptoms and smoking susceptibility in 1,093 high-school students who were participating in a large clinical trial evaluating an interactive CD-ROM-based smoking prevention/cessation curriculum (project ASPIRE) over an 18-month period. More specifically, we evaluated the impact of baseline depressive symptoms on adolescents' susceptibility to initiate smoking 18 months (controlling for the baseline susceptibility to initiate smoking) after completing the intervention, regardless of treatment group. We also assessed the potential mediating effects of the change in self-efficacy from baseline to 18-month follow-up on the relationship between depressive symptoms and susceptibility to initiate smoking.

Self-efficacy was based on a series of questions specifically assessing the participants' beliefs that they could resist smoking a cigarette in a variety of situations often associated with adolescent smoking behavior (see "Method" section). Change in self-efficacy was used as the predicted mediator because all the adolescents participated in a prevention program, which may have precipitated changes in self-efficacy over time. We hypothesized that higher levels of baseline depressive symptoms would predict the likelihood of smoking initiation at 18 months (controlling for baseline susceptibility to initiate smoking) and that this relationship would be meaningfully reduced when the change in self-efficacy from baseline to 18 months was accounted for.

Method

Overview of Study Design

ASPIRE, an interactive multimedia smoking prevention and cessation curriculum for culturally diverse high-school students, was a 4-year, nested-cohort, group-randomized controlled trial designed to compare the effect of a CD-ROM-based smoking prevention and cessation intervention against the effect of a standard care intervention (receipt of the National Cancer Institute's *Clearing the Air* self-help booklet) among culturally diverse high-school students. The study was approved by the Institutional Review Board of the University of Texas M. D. Anderson Cancer Center. Before students participated in the study, informed consent was obtained from parents of students who were younger than 18 years of age and from students who were 18 years of age or older. Complete details of the intervention methodology, project logistics, procedures, intervention program content, and the baseline sample characteristics are provided elsewhere (Prokhorov et al., 2010). Key study parameters are briefly presented here.

Participants

The analyses presented in this paper were performed only on the students who were nonsmokers at baseline and completed all necessary assessments ($N = 1,093$). A full description of the recruitment statistics, dropout rates, and total sample demographics are reported elsewhere (Prokhorov et al., 2008, 2010). Participants were 10th-grade students from a selection of 16 high schools in a large metropolitan area located in ethnically diverse socioeconomically disadvantaged communities. The majority of the students in the sample were Hispanic or Black and between the ages of 15 and 16 years (see Table 1 for demographic information).

Table 1. Correlations Between Baseline and 18-Month Follow-up Characteristics ($N = 1,093$)

Variables	1	2	3	4	5	6
Baseline depressive symptoms	—					
Baseline self-efficacy	-.05	—				
Baseline susceptibility to initiate smoking	.09**	-.16***	—			
Self-efficacy 18 months	-.07*	.41***	-.14***	—		
Susceptibility to initiate smoking 18 months	.03	-.06*	.39***	-.19***	—	
Smokers at 18 months	.00	-.01	.15***	-.18***	.028***	—

Note. * $p < .05$. ** $p < .01$. *** $p < .001$.

Procedures

Treatment Intervention

The 16 participating schools were randomly assigned to the ASPIRE intervention (8 schools) or to the standard care comparison (*Clearing the Air* self-help booklet; 8 schools). Students in the ASPIRE treatment condition were provided with a series of activities that were tailored to stage of intention and designed to promote movement through the stages toward smoking cessation (for smokers) or reduced likelihood of initiation (for nonsmokers). ASPIRE was founded on the Social Cognitive Theory (Bandura, 1977) and the Transtheoretical Model of Change (Prochaska & Velicer, 1997).

ASPIRE was programmed with MacroMedia Director and FLASH software and contained embedded animations, video, and interactive activities. It comprised five weekly sessions in one semester and two “booster” sessions in the following semester (each 30 min in duration) accessed on a desktop computer in the classroom during lesson periods. Overall, ASPIRE featured eight educational “tracks” (over 5 hr worth of videos, animations, interactive quizzes, etc.) and was designed to address the needs of both smokers and nonsmokers. At the commencement of each session, students completed a series of questions designed to determine their smoking status and stage of smoking acquisition or cessation. The follow-up assessment was performed 18 months after the beginning of the intervention program.

Measures

The baseline survey was an 87-item questionnaire addressing sociodemographic characteristics and environmental and behavioral aspects known or hypothesized to be associated with smoking. Many of these items derive from existing scales or were utilized in our previous studies of adolescent smoking (Gritz et al., 1998). This survey (except for sociodemographic factors) was repeated at the 18-month follow-up assessment. The current study limited the analysis to a few select measures associated with the main hypotheses, though more detailed descriptions of other factors have been published elsewhere (Prokhorov et al., 2010, in press).

Self-efficacy was assessed using a 5-point likert scale (1—not confident at all to 5—extremely confident) beginning with the phrase, “How confident are you that you can resist smoking when . . .” followed by 10 sample scenarios. Examples of the scenarios included: “I am angry about something or someone”; “Things are not going my way and I am frustrated”; “My friends offer me a cigarette”; and “I want to be part of a crowd.”

Depression was assessed using the Center for Epidemiological Studies Depression Scale for Children (CES-DC), a 20-item scale suitable for estimating past-week depressive symptoms in children and adolescents (Fendrich, Weissman, & Warner, 1990). A total score was computed by summing the scores for the individual responses (options were 0 = not at all, 1 = a little, 2 = some, and 3 = a lot). The CES-DC total score was dichotomized as less than 16 versus 16 or more based on previously established cutoffs (Fendrich et al., 1990). Students were divided into two groups based on their scores: low depression = CES-DC < 16; high depression = CES-DC ≥ 16.

Our measures to characterize *smoking initiation* derived primarily from susceptibility to smoking framework of Pierce et al.

(Choi, Gilpin, Farkas, & Pierce, 2001; Pierce, Choi, Gilpin, Farkas, & Merritt, 1996), which categorizes adolescents as either “susceptible” or “not susceptible” to initiating smoking. Participants who describe themselves as nonsmokers and respond “definitely not” to the questions, “At any time during the next year, do you think you will smoke a cigarette?” and “If one of your best friends were to offer you a cigarette, would you smoke it?” are classified as not being susceptible to smoking initiation. Participants who describe themselves as current smokers or as nonsmokers and who answer either one or both of the same questions with “probably not,” “probably yes,” or “definitely yes” are classified as being susceptible to smoking initiation. As only 3.73% (41 participants) of the entire sample identified themselves as current smokers at the 18-month follow-up time-point, they were included with the nonsmokers in the “susceptible” group. This is discussed further in the “Results” section.

Statistical Approach

To assess whether self-efficacy at 18 months met statistical criteria for mediation of the relationship between baseline depressive symptoms and susceptibility to smoke at 18 months, we followed the procedures of Baron and Kenny (1986). The four criteria they outlined were tested to evaluate mediation. General linear mixed model regression analyses controlling for school as a random effect were used to test predictions associated with each criterion. Each regression model included baseline self-efficacy, baseline susceptibility to smoke, treatment group, gender, and ethnicity as covariates as appropriate for the condition being tested.

Results

Preliminary analyses revealed that a significantly greater proportion of females compared with males had CES-DC scores ≥16 ($p < .001$). No other significant differences between the high- and low-depression groups were noted. Correlations for the main variables of interest are presented in Table 1. However, gender, ethnicity, treatment group, baseline susceptibility to smoke, and baseline level of self-efficacy were included as covariates. Not surprisingly, baseline susceptibility to initiate smoking significantly predicted susceptibility at 18 months, so all the models presented below present findings above and beyond that relationship. In the analyses presented below, current smokers were included (see “Methods”). However, the same analyses were run excluding these 41 participants (3.73% of the total sample), and the results were similar, so those analyses are not presented here.

The four Baron and Kenny criteria evaluated were as follows:

1. Baseline depression group must be significantly associated with the dependent variable. To test Criterion 1, susceptibility to initiate smoking at 18 months was regressed onto baseline depression group in a model controlling for treatment group, gender, ethnicity, and baseline susceptibility to initiate smoking. Results indicated that a higher proportion of students with CES-DC scores ≥16 were susceptible to initiate smoking at 18 months: $F(1, 962) = 4.50, p = .03$; odds ratio (OR) = 1.4, 95% CI = 1.03–1.89.
2. Baseline depressive symptoms must be significantly associated with the hypothesized mediator. To test Criterion 2,

Table 2. Demographic Characteristics by Baseline Depression Group

Variable	CES-DC score <16 (low-depression group), <i>N</i> = 494	CES-DC score >16 (high-depression group), <i>N</i> = 599	All, <i>N</i> = 1,093
Age, <i>M</i> (<i>SD</i>)	15.6 (0.7)	15.6 (0.9)	15.6 (0.8)
Gender (%)			
Male	47.8	32.1	39.2
Race (%)			
White	3.3	2.2	5.5
Black	16.8	23.6	40.5
Hispanic	23.2	27.1	50.2
Classified as "susceptible to initiate smoking (%)"	24.5	42.4	32.4
Self-efficacy at baseline, <i>M</i> (<i>SD</i>)	42.2 (13.0)	40.5 (13.1)	41.3 (13.1)
Self-efficacy 18 months, <i>M</i> (<i>SD</i>)	44.5 (11.1)	41.9 (12.3)	43.1 (11.9)

Note. CES-DC = Center for Epidemiological Studies Depression Scale for Children.

self-efficacy at 18 months was regressed onto baseline depression group in a model controlling for baseline self-efficacy, treatment group, gender, and ethnicity. Results indicated that those in the low-depression group (CES-DC < 16) had higher self-efficacy scores: $F(1, 973) = 10.68, p = .001$ (see Table 2 for means and *SD*s).

- The hypothesized mediator must be significantly associated with the dependent variable. To test this criterion, the susceptibility to initiate smoking at 18 months was regressed onto self-efficacy scores at 18 months in a model controlling for baseline self-efficacy, baseline susceptibility to initiate smoking, treatment group, gender, and ethnicity. Indeed, those who were susceptible to initiate smoking at 18 months had lower self-efficacy scores: $F(1, 962) = 25.83, p < .0001$; $OR = 1.04, 95\% CI = 1.02-1.05$. Those who were susceptible to initiate smoking had mean self-efficacy scores of 39.8 ($SD = 11.4$), while those who were not susceptible had mean self-efficacy scores of 44.7 ($SD = 11.7$).
- The effect of baseline depressive group on the dependent variable must be meaningfully reduced when including a hypothesized mediator in the model. To test Criterion 4, susceptibility to initiate smoking at 18 months was regressed onto baseline depression group in a model controlling for baseline self-efficacy, baseline susceptibility to initiate smoking, treatment group, gender, ethnicity, and self-efficacy at 18 months, the mediator variable. The association between baseline depression group and the outcome must be meaningfully reduced in the presence of the mediator. When baseline depression group and self-efficacy at 18 months were

both added to the model predicting susceptibility to initiate smoking at 18 months, baseline depression group no longer significantly predicted susceptibility: $F(1, 959) = 3.17, p = .075$; $OR = 1.3, 95\% CI = 0.097-1.82$. However, self-efficacy at 18 months continued to predict susceptibility at 18 months: $F(1, 959) = 24.37, p < .0001$; $OR = 1.04, 95\% CI = 1.02-1.05$ (see Table 3).

To further evaluate Criterion 4, model of MacKinnon (1994) was used to estimate the extent to which self-efficacy at 18 months (the mediator) modified the effect of baseline depression group on the susceptibility to initiate smoking at 18 months. The mediation effect was estimated by taking the product of the standardized regression coefficients for baseline depressive symptoms when predicting self-efficacy at 18 months (the mediator; coefficient *a*) and the standardized regression coefficient of self-efficacy at 18 months when predicting the susceptibility to initiate smoking at 18 months while controlling for baseline depression group and baseline self-efficacy (coefficient *b*). This approach is suitable for situations involving a dichotomous outcome as is the case for susceptibility to initiate smoking. The standardized regression coefficients corresponding to *a* and *b* are $-.1245$ and $-.2002$, respectively. The product of these coefficients is $ab'st = .0249$, which is the mediation effect. The standardized regression coefficient corresponding to *c*, $c'st = .0684$.

The relative magnitude of mediation was assessed by estimating the proportion of the total effect of baseline depressive

Table 3. Models Predicting Susceptibility to Initiate Smoking at 18 Months by Baseline Depressed Mood and Self-efficacy at 18 Months, Controlling for Self-efficacy at Baseline and Susceptibility to Initiate Smoking at Baseline

Variable	<i>B</i> >	<i>SE</i>	<i>p</i> Value	<i>OR</i>	95% <i>CI</i>
Separate models					
Baseline depressive symptoms	0.33	0.16	.03	1.4	1.03-1.89
Self-efficacy at 18 months controlling for self-efficacy at baseline (mediator variable)	-0.04	0.01	<.0001	1.04	1.02-1.05
Both predictors in the model					
Baseline depressive symptoms	0.28	0.16	.075	1.3	0.97-1.82
Self-efficacy at 18 months controlling for self-efficacy at baseline (mediator variable)	-0.04	0.00	<.0001	1.04	1.02-1.05

Note. Bold values indicate significant findings. *OR* = odds ratio.

symptoms on susceptibility to initiate smoking at 18 months attributable to the hypothesized mediator (18-month self-efficacy controlling for baseline self-efficacy). This was computed by taking the standardized mediated effect computed above and dividing it by the standardized total effect, which is equivalent to $ab'st/(ab'st + c'st) = .267$. The model resulted in a coefficient of .267 showing that self-efficacy at 18 months mediated 26.7% of the total effect of baseline depressive symptoms on susceptibility to smoke at 18 months. The null hypothesis of no mediation effect was tested using a z-test obtained by dividing the estimate of the mediation effect by its *SE* ($z = 3.38$), which corresponds to $p < .001$ under the standard normal curve, showing a significant mediation effect.

Discussion

Results indicated that students with higher depression scores were more likely to be susceptible to initiate smoking and that this relationship was partially mediated by self-efficacy. More specifically, low levels of self-efficacy (after accounting for pre-intervention self-efficacy) accounted for a significant proportion of the effect of baseline depressive symptoms on future smoking susceptibility. This relationship remained significant even after controlling for baseline susceptibility to initiate smoking, gender, ethnicity, and treatment group. While the identification of mediators that significantly impact the positive relationship between depressive symptoms and susceptibility to initiate smoking in adolescents has important clinical implications, the initial effect of baseline depression was not huge, and therefore, the meaning of this effect remains somewhat speculative, though hypothesis generating.

Depressive symptoms in adolescence are highly predictive of current or former smoking assessed in early adulthood (Kandel & Davies, 1986) and prospectively predict the initiation of smoking in adolescents who have never smoked (Brown, Lewinsohn, Seeley, & Wagner, 1996). Our findings suggest that preventative efforts may increase overall success by focusing on increasing self-efficacy, especially in adolescents with high levels of depressive symptomatology. In the adult literature, it has been documented that higher levels of self-efficacy predict successful tobacco cessation as well as reduced risk for relapse (Marlatt & Donovan, 2005; Shiffman et al., 2000). Moreover, some cessation interventions have been shown to improve a variety of coping skills as well as increase levels of self-efficacy (Cinciripini et al., 1995). It is also possible that important moderator variables can be identified in order to even further tailor prevention efforts to decrease the chance of smoking initiation. For example, one study showed that low levels of self-efficacy were related to smoking in adolescents with low self-esteem, though no such relationship existed in those with high self-esteem (Engels et al., 2005), suggesting that strategies specifically designed to increase levels of self-efficacy might be most useful for those adolescents with depressive symptoms and lower levels of self-esteem. Future studies can investigate whether intervention efforts that include strategies to increase levels of self-efficacy can mitigate the potential risks that depressive symptoms may harbor for eventual smoking initiation.

Though the current study suggests that the mechanisms relating depressive symptoms, self-efficacy, and smoking in adolescents can be identified to some degree, much more work is

needed to pinpoint the nature of these mechanisms. The relationship between smoking and depression is undoubtedly complex and likely involves multiple causal pathways. The presence of one disorder may influence the development and/or prognosis of the other (Upadhyaya, Deas, Brady, & Kruesi, 2002).

This study had several limitations. Our simultaneous measurement of the outcome variable and mediator variable prevented the establishment of any causal relationships between the hypothesized mediator and smoking initiation at 18 months. Additionally, because we did not follow the students past the 18-month timepoint, we are unable to determine which of the participants may have gone on to become smokers, despite their susceptibility to initiate smoking. It is also possible that other variables may have influenced those who were susceptible to eventually initiate smoking at some point in the future.

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Declaration of Interests

None declared.

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