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Psychosocial factors in adolescent nicotine dependence symptoms: A sample of high school juniors who smoke daily

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Abstract

Cross-sectionally examined seven theory-guided psychosocial factors associated with nicotine dependence symptoms in a representative self-report survey of 794 Washington State high school junior daily smokers (93% participation). Outcomes were four nicotine dependence symptoms. Results showed that low *self-efficacy for quitting smoking* and being around *adults who smoke* were associated with a 3.48 to 10.35 and a 1.47 to 1.77 times *higher* odds, respectively, of each of the four nicotine dependence symptoms. These results, needing replication in a longitudinal study, suggest that interventions to enhance self-efficacy to quit smoking and counter adult smoking influences might reduce adolescent nicotine dependence.

Keywords

smoking; nicotine; dependence; adolescence; adults; self-efficacy

Introduction

The high prevalence of smoking among adolescents is a serious U.S. public health problem. Currently, 26.5% of high school seniors smoke monthly (CDC, 2008), well above the Healthy People 2010 goal of 16% (USDHHS, 2000), and 13.6% smoke 10 or more cigarettes daily (CDC, 2008). To address this critical problem, adolescent smoking cessation intervention trials have been conducted in the past two decades (Fiore et al., 2008; Grimshaw & Stanton, 2006; Sussman, Sun, & Den, 2006). Recent reviews have found that the vast majority of these interventions have modest effectiveness (Garrison, Christakis, Ebel, Wiehe, Rivara, 2003; Grimshaw, & Stanton, 2006; Sussman et al., 2006). For example, in their 2006 meta-analysis of 48 controlled trials, 19 of which were randomized, Sussman et al. (2006) estimated an overall treatment effect size of 2.9% (95% CI: 1.47, 4.33, $p = .0003$; pooled across a broad range of studies with different interventions, settings, endpoint definitions, and post-intervention follow-up lengths). The most recent review of the field concluded that “overall, the evidence base for youth smoking cessation is quite modest” (Curry, Mermelstein, & Sporer, 2009).

Declaration of Interest

Authors have no conflicts of interest.

One possible reason why these interventions have been only modestly effective is that they have not specifically addressed the fact that majority of adolescent daily smokers have nicotine dependence symptoms (O'Loughlin et al., 2003). Nicotine dependence is a strong predictor of remaining a smoker well into the adult years, and is a *major impediment to successful smoking cessation* (Haddock, Lando, Klesges, Talcott, & Renaud, 1999; USDHHS, 2004). Thus, identifying the factors that are associated with adolescent nicotine dependence is a first step in establishing a foundation for the development and testing of interventions to address this major impediment to adolescent smoking cessation (Kandel, Hu, Griesler, & Schaffran, 2007; Wood, Wewers, Groner, & Ahijevych, 2004). While much is known about the psychosocial factors associated with adolescent *smoking* (Turner, Mermelstein, & Flay, 2004; USDHHS, 2004), little is known about the psychosocial factors associated with adolescent *nicotine dependence symptoms* (DiFranza et al., 2000; Kandel et al., 2007) probably because researchers have only recently recognized that many adolescent smokers experience nicotine dependence symptoms (see, for example, DiFranza et al., 2002; O'Loughlin et al., 2003). But rather than focusing on dependence symptoms among adolescents in the general population, most of the studies on adolescent dependence have focused on nicotine dependence symptoms among those with co-morbid psychiatric disorders probably because nicotine dependence is conceptualized as a psychiatric disorder (for a review, see Upadhyaya, Deas, Brady, & Kruesi, 2002).

Thus, cross-sectional studies among a representative general sample of adolescent smokers would now be useful to establish the psychosocial factors associated with adolescent nicotine dependence symptoms. Once identified, these factors could be investigated in longitudinal studies to evaluate their possible role in predicting adolescent smoking dependence symptoms. In turn, this evidence could be used in the development and testing of interventions to help prevent or to treat adolescent smoking dependence symptoms. Accordingly, this study investigates psychosocial factors cross-sectionally associated with the nicotine dependence symptoms of adolescent daily smokers.

Measurement of adolescent nicotine dependence symptoms

Nicotine dependence is not a unitary disorder, but rather a broad set of symptoms reflecting a dysregulated behavior reward system that is difficult to adequately capture as a single summed scale or construct (West, 2006). In light of the many symptoms believed to reflect nicotine dependence, a variety of measures of nicotine dependence are used for adolescents (Colby, Tiffany, Shiffman, & Niaura, 2000; Piper, McCarthy, & Baker, 2006). The measures commonly used for adolescents are (1) variations of the Fagerstrom Test for Nicotine Dependence (FTND), (2) measures based on definitions of dependence in the Diagnostic and Statistical Manual of Mental Disorders *DSM III-R* (American Psychiatric Association, 1987) and *DSM-IV* (American Psychiatric Association, 1994), the International Classification of Diseases (World Health Organization, 1991), and (3) the Hooked on Nicotine Checklist (DiFranza et al., 2002). A commonly used measure is a variation of the FTND: the Heavy Smoking Index (HSI; Heatherton, Kozlowski, Frecker, Rickert, & Robinson, 1989). The HSI has two items: (1) time to first cigarette of the day and (2) number of cigarettes per day. The HSI has good psychometric properties: (1) the two items have high factor loadings on the full scale FTND (Nonnemaker & Homsy, 2007), (2) items correlate highly with the full scale FTND (Heatherton et al., 1989), (3) items correlate highly with biochemical indices of cotinine (Prokhorov et al., 2000). The HSI is highly predictive of smoking cessation (Chaiton, Cohen, McDonald, & Bondy, 2007).

The HSI items may underestimate the level of nicotine dependence symptoms for some adolescent daily smokers. Since adolescents typically live with their parents, adolescents may not want their parents to know that they are smoking (Stein et al., 2002) or the parents may not allow them to smoke at home (Andersen, Leroux, Bricker, Rajan, & Peterson, 2004;

Farkas, Gilpin, White, & Pierce, 2000). As a result, some may delay their first cigarette of the day until they leave home. If so, then these fewer opportunities to smoke early in the day may mean that adolescents smoke fewer cigarettes per day than they would otherwise. Therefore, the current study of adolescent smokers supplements the HSI with two items: (1) how soon *after waking up* do you have the *urge* for a cigarette, and (2) how soon *after leaving home* in the morning do you *smoke* your first cigarette. The first supplementary item measures the timing of craving to use cigarettes even when that craving cannot be satisfied by smoking at home after waking up. The second supplementary item measures time to the first cigarette from a time (i.e., leaving home) when adolescents can smoke without parental detection.

Theory and research on hypothesized psychosocial factors in adolescent nicotine dependence

West's (2006) PRIME theory of addiction and Brandon, Herzog, Irvin, & Gwaltney's (2004) review of social learning and cognitive theories both provide testable hypotheses pertinent to predictors of adolescent nicotine dependence symptoms. PRIME theory states all addictive behavior is guided by a motivational system in which plans for behavior lead to evaluations of the self and the behavior, which in turn lead to motives to engage in that behavior. Impulses and inhibitory forces can moderate the influence of these factors. As a complement to PRIME theory, Brandon et al. (2004) articulate how the constructs of self-efficacy from Bandura's (1986) self-efficacy theory and expectancies from Goldman's expectancy theory (Goldman, 1999) may lead to the development of adolescent nicotine dependence.

Together these theories suggest the following hypotheses about which psychosocial factors are associated with adolescent nicotine dependence symptoms. First, PRIME theory states that self-evaluations may influence the development of addiction, which suggests that those who have positive evaluations of themselves as smokers may be more susceptible to developing nicotine dependence symptoms than those who hold negative evaluations of themselves as smokers. Similar to Bandura's concept of self-efficacy (Bandura, 1986), people who believe that they can control outcomes in their lives are less likely to develop addictive behaviors. Specifically, one's overall evaluation that one can control outcomes in one's life, or, general self-efficacy, may help lower one's vulnerability to nicotine dependence symptoms. There is no known research examining the role of general self-efficacy in adolescent nicotine dependence symptoms. Second, both PRIME theory and Bandura's self-efficacy theory (1986) state that one's specific evaluation that one can quit smoking, or, quitting self-efficacy, may lower one's vulnerability to nicotine dependence symptoms. One study to date, Fagan et al. (2003), found that low self-efficacy to quit smoking is associated with higher levels of nicotine dependence symptoms among employed adolescents.

Third, Goldman's (1999) expectancy theory suggests that an individual's belief that smoking will lead to positive outcomes, such as to relax or manage weight, is important in the development of nicotine dependence symptoms. Brandon et al. (2004) hypothesize that adolescents nicotine dependence develops when they believe that smoking will help them reduce negative affect (e.g., relax, reduce stress) and reduce boredom. There are no known studies in adolescents that examine the association between positive smoking expectancies and nicotine dependence symptoms.

Finally, both PRIME and self-efficacy theory suggest that social factors can increase the drive to engage in smoking behavior. For adolescent smokers, important social factors may include friends', schoolmates', and adults' smoking. Two studies have shown that friends' smoking (Audrian-McGovern et al., 2007; Kandel et al., 2007) is associated with adolescent nicotine dependence symptoms. However, there are no known studies examining

schoolmates' smoking in association with adolescent nicotine dependence. Related to the issue of adults' smoking, parents' smoking was associated with adolescent nicotine dependence in two studies (Lieb, Schreier, Pfister, & Wittchen, 2003; Kandel et al., 2007).

This study

In summary, depending on the factor, little or no empirical research has examined the relationship between the above theory-based factors and nicotine dependence symptoms in adolescents. This study explores to what extent the following theory-based psychological and social factors are associated with *higher* levels of adolescent nicotine dependence symptoms:

Psychological factors

1. *More positive self-evaluation as a smoker* (From PRIME theory)
2. *Lower general self-efficacy* (From self-efficacy theory)
3. *Lower quitting self-efficacy* (From PRIME and self-efficacy theories)
4. *More positive smoking expectancies* (From expectancy theory)

Social factors

1. *Number of friends who smoke* (From PRIME and self-efficacy theories)
2. *Frequency of being around schoolmates who smoke* (From PRIME and self-efficacy theories)
3. *Frequency of being around adults who smoke* (From PRIME and self-efficacy theories)

Exploring these questions will help in pinpointing the specific psychological and social processes that need to be targeted in order to prevent and intervene on adolescent nicotine dependence. These questions were explored in the current study using a relatively large ($N = 794$) cross-sectional sample of high school juniors who smoke daily among all junior classes surveyed with a 93% response rate. This high response rate means that the sample is highly representative of the general population of Washington State adolescent daily smokers.

Methods

Study population

Fifty high schools were randomly selected from 168 Washington State public high schools that met the study's eligibility criteria: located within 200 miles of the Fred Hutchinson Cancer Research Center and with an enrollment of 100–500 seniors. In the 50 participating high schools, 12,141 (93.1% of 13,042 eligible) high school juniors (ages 17–18) completed the baseline survey. (Ineligible for survey were 1,188 juniors who were foreign exchange students, enrolled only in off-campus classes, or unable to read/understand English.)

Through the baseline survey, all smokers who reported currently smoking at least daily (403 males and 391 females) were included in the study. The observed daily smoking rate (6.5%; $794/12,141$) is similar to that of Washington State high school juniors (Washington State Department of Health, 2005). The sample was 76.3% Caucasian, 8.2% multiple races, 4.3% Asian American/Pacific Islander, 3.7% Native American/Alaskan Native, 3% Hispanic, and 4.5% all other ethnicities/races.

Procedures

An in-class survey was administered in regular school classrooms by trained study staff, with a scripted explanation of survey procedures and study information. “Bogus pipeline” saliva samples were collected to encourage accurate self-reporting of smoking behavior (Murray, O’Connell, Schmid, & Perry, 1987). Students absent from the initial survey were contacted two weeks later for an in-class clean-up survey; those still absent were asked to complete a mailed or telephone survey.

Prior to the baseline survey, parents/guardians were mailed a letter describing the study, the survey, the saliva sample procedure, the confidential treatment of the data collected, and the voluntary nature of participation. The letter invited them to call a toll-free telephone number with questions or to decline their teen’s participation. All study procedures were approved by the Fred Hutchinson Cancer Research Center Institutional Review Board.

Measures

Psychological factors—*Self-evaluation as a smoker* was assessed through response to the item “Do you like the idea of being a smoker?” Coding (and distribution) of responses were: No = 1 (49.2% of all responses), Don’t Know = 2 (38.0% of responses), and Yes = 3 (12.8% of responses).

General self-efficacy was the average response to two items, “I can handle anything that comes my way” and “I can do anything I put my mind to.” Responses from the two items were averaged together, yielding a 7-point scale ranging from 0 (“not at all like me”) to 1 (“just like me”). The mean and standard deviation for this scale were 0.78 and 0.22, respectively.

Self-efficacy for quitting was the average response to two items adapted from Carosella, Ossip-Klein, & Owens (1999) and Clemmy, Brooner, Chutuape, Kidorf, & Stitzer (1997): “Do you think that if you put your mind to it, you could stop smoking?” and “If you were to try to stop smoking, how confident are you that you could keep from smoking for at least 6 months?” Responses from the two items were averaged together, yielding an 11-point scale ranging from 0 (lowest quitting self-efficacy) to 1 (highest quitting self-efficacy). The mean and standard deviation for this measure were 0.68 and 0.27, respectively.

Positive smoking expectancies was the sum of responses to five items adapted from Sarason, Mankowski, Peterson, & Dinh (1992), each coded 1 if the respondent agreed with the corresponding reason for smoking: to relax or reduce stress, for pleasure, to reduce boredom, for the good taste, and to keep weight. The mean and standard deviation for this measure were 1.37, and 1.22, respectively.

Social factors—*Friends’ smoking* took values from 0 to 5, depending on response to the item “How many of your five closest friends smoke cigarettes?” Coding (and distribution) of responses was: 0 (2.2 %), 1 (4.8%), 2 (11.8%), 3 (19.1%), 4 (19.8%), 5 (42.3%).

Schoolmates’ smoking was assessed by the item “How often are you around high school students who smoke cigarettes?” Coding (and distribution) of responses was Never = 0 (0.4%), Sometimes/hardly ever = 1 (20.8%), A lot = 2 (78.8%)

Adults’ smoking was assessed by “How often are you around people over age 25 who smoke cigarettes?” Coding (and distribution) of responses was Never = 0 (2.3%), Sometimes/hardly ever = 1 (48.2%), A lot = 2 (49.4%).

Nicotine dependence symptoms

Cigarettes per day: Responses to the item “How many cigarettes per day do you smoke?” were dichotomized (and distributed), at the cut-off point consistent with the response coding of the HSI (Heatherton et al., 1989), as 0 = 1 – 5 cigarettes per day (53.4%) and 1 = 6 or more per day (46.6%).

Time to urge after waking: Responses to the item “How soon after waking up do you have the urge for a cigarette?” were dichotomized (and distributed), at the cut-off point consistent with the response coding of the HSI (Heatherton et al., 1989), as 0 = an hour or more (55.0%) and 1 = within 1/2 hour (45.0%).

Time to first cigarette after waking: Responses to the item “How soon after waking up do you smoke your first cigarette of the day?” were dichotomized (and distributed), at the cut-off point consistent with the response coding of the HSI (Heatherton et al., 1989), as 0 = an hour or more (55.7%) and 1 = within 1/2 hour (44.4%).

Time to first cigarette after leaving home: Responses to the item, “How soon after leaving home in the morning do you smoke your first cigarette?” were dichotomized (and distributed), at the cut-off point consistent with the response coding of the HSI (Heatherton et al., 1989), as 0 = an hour or more (25.8%) and 1 = within 1/2 hour (74.2%).

Covariate

An indicator of *socioeconomic level* was measured by the percentage of high school students eligible for free or reduced-price meals (mean: 23.4% and standard deviation: 12.3%), based on data obtained from the Office of the Washington State Superintendent of Public Instruction.

Statistical analysis

The relationship between these factors and each of the four outcome variables was evaluated with multivariate logistic regression using a generalized linear mixed model with covariate adjustment for socioeconomic level. As a multivariate model, each parameter was controlled for by all other parameters in the model. Reported are odds ratios, which provide *readily-interpretable* exponentiations of the regression coefficients in the logistic model. The logit link function was used to accommodate dichotomized outcomes. School was modeled as a random effect to account for within-school correlations. Primary analyses were conducted for males and females combined. In addition, they were also conducted for males and females separately. As supplementary analyses, the dependence variables were also fit as continuous outcomes in linear regression models and with the four dependence variables combined into one scale. All analyses were implemented with the statistical package SAS 9.0 with macro % GLIMMIX.

Results

Psychosocial factors associated with nicotine dependence symptoms

Table 1 shows the association between the seven psychosocial factors and nicotine dependence symptoms. As shown in row one, each point increase in the *self-evaluation as a smoker* score was significantly associated with a 1.34 times higher odds of having the first cigarette within thirty minutes after waking up but was not significantly associated with the other three nicotine dependence symptoms. Row two shows that there was no significant association between *general self-efficacy* and the four nicotine dependence symptoms. Row three shows that each point decrease in the *self-efficacy for quitting smoking* score (i.e.,

lower self-efficacy) was associated with 3.48 times higher odds of smoking six or more cigarettes per day, 10.35 times higher odds of having an urge to smoke within thirty minutes after waking up, 8.44 times higher odds of having the first cigarette within thirty minutes after waking up, and a 6.38 times higher odds of having the first cigarette within thirty minutes after leaving home. Row four shows that there was no significant association between *positive smoking expectancies* and the four nicotine dependence symptoms. Row five shows that each *friend's smoking* was significantly associated with a 1.21 times higher odds of smoking six or more cigarettes per day but was not significantly associated with the other three nicotine dependence symptoms. Row six shows that being around *schoolmates that smoke* was not associated with the four nicotine dependence symptoms. Finally, row seven indicates that, compared to those who reported never being around *adults who smoke*, each point higher on the measure of how often the respondent is around adults who smoke was associated with a 1.77 times higher odds of smoking six or more cigarettes per day, 1.72 times higher odds of having an urge to smoke within thirty minutes after waking up, 1.74 times higher odds of having the first cigarette within thirty minutes after waking up, and a 1.47 times higher odds of having the first cigarette within thirty minutes after leaving home.

Results for females and males calculated separately were consistent with the combined results from Table 1. Specifically, the results for self-efficacy for quitting smoking, friends' smoking, and adults who smoke were consistent for the females and males. However, for the relationship between being around *adults who smoke* and dependence symptoms among *males*, the confidence intervals fell just outside the significant range for three of nicotine dependence symptoms (urge after waking: OR = 1.46; 95% CI = 0.95, 2.23; first cigarette after waking: OR = 1.46; 95% CI = 0.96, 2.22; first cigarette after leaving home: OR = 1.41; 95% CI = 0.90, 2.23). When all of the analyses were re-run with each of the four dependence variables coded as continuous measures, the pattern of results was the same. Finally, the main pattern of results for self-efficacy to quit smoking and adults' smoking was the same when the four dependence variables were combined into one scale (Cronbach alpha = .80; one scale principal components factor analysis loadings ranged from .69 to .88).

Discussion

Summary

Identifying the psychosocial factors associated with adolescent nicotine dependence is an important first step in establishing a foundation for pinpointing the specific psychological and social processes that need to be targeted in order to prevent and intervene on adolescent nicotine dependence (Kandel et al., 2007; Wood et al., 2004). *Little or no prior empirical research has examined the relationship between the seven theory-based psychosocial factors and adolescent nicotine dependence symptoms.* Indeed, our search of the PubMed and PsychInfo databases showed that, with the exception of one study on quitting self-efficacy (Fagan et al., 2003) and two on the related issue of parent's smoking (Lieb et al., 2003; Kandel et al., 2007), no other published studies have examined the associations between these psychosocial factors and adolescent nicotine dependence. This study adds important new information on this topic using a large and representative sample. Overall, the study showed that two of the seven social factors—lower self-efficacy to quit smoking and being around adults who smoke—were shown to be consistently associated with higher levels of nicotine dependence symptoms. Each of these factors was significant even after controlling for all of the other factors in the model.

Interpretation of results for the psychological factors

For the *psychological* factors examined, the results are consistent with a hypothesis from both PRIME theory (West, 2006) and self-efficacy theory (Bandura, 1986). Specifically, the

results support the hypothesis that a lower self-efficacy for quitting smoking would be strongly associated with a higher odds of nicotine dependence symptoms. These results build on the only other published study on this topic, which reported that self-efficacy to quit smoking is associated with adolescent nicotine dependence symptoms (Fagan et al., 2003). Like the current study, the Fagan et al. study was also cross-sectional. The findings of the current study, while limited by their cross-sectional design, suggest that an adolescent's self-efficacy for quitting smoking may serve to control both the urge to smoke and the subsequent act of smoking. Alternatively, there may be a feedback cycle, such that lower self-efficacy to quit increases nicotine dependence and, in turn, higher nicotine dependence lowers self-efficacy to quit. Breaking this cycle may be possible by intervening on self-efficacy to quit smoking—a factor that is potentially more directly modifiable than nicotine dependence. Promising intervention approaches that may be useful to help adolescents increase their self-efficacy to quit smoking include Motivational Interviewing (MI; Miller & Rollnick, 2002) since a recent review suggests that MI does increase self-efficacy to change a wide variety of maladaptive behaviors in various populations (Apodaca & Longabaugh, 2009). MI (or any other promising approach) may need to intensively target self-efficacy in order to reduce adolescent *dependence* (as compared to adolescent *smoking*) since dependence is a major impediment to successful smoking cessation (Haddock, Lando, Klesges, Talcott, & Renaud, 1999; USDHHS, 2004).

The other psychological hypotheses suggested by PRIME theory (West, 2006), self-efficacy theory (Bandura, 1986) and the expectancy model (Goldman, 1999) concerned self-evaluation as a smoker, general self-efficacy, and positive smoking expectancies. These hypotheses were generally not supported, although the self-evaluation as a smoker results were significant for one dependence symptom (i.e., first cigarette after waking up) and just outside the confidence interval limits of statistical significance for another dependence symptom (i.e., number of cigarettes smoked per day). Given the lack of past empirical research on these specific psychological predictors and smoking dependence outcomes, we view these results as only exploratory and suggest future empirical study to replicate them.

Interpretation of results for the social factors

For the *social* factors examined, the results are consistent with hypothesis from both PRIME theory (West, 2006) and self-efficacy theory (Bandura, 1986) that the frequency of being around adults cues adolescent daily smokers to have the urge to smoke and then to act on that urge by smoking for both females and males. (Results for males were just outside the significant range for three of the dependence symptoms. Additional data would help better determine where in the confidence intervals the true association actually lies.) The most likely adults that adolescents would spend time around are their parents. Parents' smoking is associated with adolescent nicotine dependence symptoms (Lieb et al., 2003; Kandel et al., 2007) as well as smoking initiation and escalation (Bricker et al., 2006; Bricker, Peterson, Sarason, Andersen, & Rajan, 2007). Therefore, the current study's results would be consistent with interpretation that adults' smoking is a proxy indicator of the role of parents' smoking in adolescent nicotine dependence symptoms. If the results do reflect parents' smoking influence, then at least part of the association between parent smoking and adolescent nicotine dependence symptoms is due to heredity. Indeed, recent behavioral genetic studies suggest that heredity accounts for 55% of the variance in the time to first cigarette after waking up and 50% of the variance in the number of cigarettes smoked per day (Haberstick et al., 2007). Future research will need to evaluate the influence of genetically-related (e.g., biological parents) and unrelated (e.g., step-parents) adult smokers on adolescent nicotine dependence symptoms. And testing interventions aimed at reducing the potential (genetic, social, or other) influence of parents and other adults who smoke would be valuable.

Friends' smoking was significantly associated with the number of cigarettes smoked per day and was associated, just outside the confidence interval limits of statistical significance, with two other dependence symptoms (i.e., urge after waking up & first cigarette after waking up). This result is consistent with the hypothesis of PRIME theory (West, 2006) and self-efficacy theory (Bandura, 1986). The current study suggests that friends may provide a social context for smoking cigarettes. That is, the more often an adolescent is in the presence of friends who smoke during the day, the more likely it is that the adolescent will be smoking throughout the day. This result is consistent with the findings of other studies (i.e., Audrian-McGovern et al., 2007; Kandel et al., 2007) and research that close friends' smoking is associated with adolescent smoking initiation and escalation (Bricker et al., 2006; Bricker, Andersen, Rajan, Sarason, & Peterson, 2007). Alternatively, there may be a feedback cycle, such that having friends who smoke increases nicotine dependence and, in turn, higher nicotine dependence leads adolescents to select and maintain friendships with those who smoke. Future longitudinal research can test such a possible bi-directional relationship.

The results for schoolmates' smoking are not consistent with the pertinent hypothesis from PRIME and self-efficacy theories. The result is consistent with recent prospective evidence that *same-age* schoolmates *did not* predict adolescent smoking initiation (Bricker et al., 2007). The consistency between the current study and the Bricker et al. (2007) results suggest the interpretation that being around same-age schoolmates who smoke does not influence adolescent nicotine dependence symptoms. However, since in the Bricker et al. (2007) study, smoking schoolmates who were 2–3 years *older did* predict adolescent smoking initiation, it would be worthwhile in future studies to test the hypothesis that older schoolmates' smoking influences adolescent nicotine dependence symptoms.

Limitations

First, the cross-sectional design limits the inferences that can be drawn from this study. Thus, the associations observed may be a cause or consequence of adolescent nicotine dependence symptoms. This cross-sectional evidence should therefore be viewed as a first step in establishing the evidence base of the psychosocial factors associated with adolescent nicotine dependence symptoms that will need to be followed up with longitudinal studies and subsequent randomized intervention trials. Second, because adolescents reported on the smoking status of friends, schoolmates, adults, the results may have provided biased estimates of these social influences. Third, measurement error might have been introduced by the response option time gap (i.e., thirty minutes to one hour) for the three time-based nicotine dependence outcomes. However, the one hour or more durations tended not be reported more often than the thirty minute or less durations. Moreover, the pattern of results did not change when all dependence items were coded as continuous measures or when they were combined into one scale. And the fact that all items loaded highly on the same factor, yielded a high Cronbach alpha, and yielded a similar pattern of associations with quitting self-efficacy and adults' smoking suggests that they measure the same underlying construct even though they had different items and three items had a response option time gap. Fourth, five of the psychosocial predictors were measured with only one item, thereby contributing to their unknown (due to one item) reliability. (Such brevity was essential in order to survey this large number of adolescents with 93% participation.) The use of one item may also explain why some of these psychosocial variables were not associated with dependence. And the fact that other psychosocial variables were associated with adolescent smoking dependence is a strength of these findings, which may have been even stronger using measures with high reliability. Fifth, while this study did employ a standard measure of nicotine dependence symptoms (i.e., the HSI) supplemented with two items, all the results may not necessarily apply to other measures of nicotine dependence symptoms. Sixth, the

study's racial/ethnic minority population size, although reflective of the community populations in the 50 participating schools, was underpowered to allow for minority-specific investigations. Finally, two valuable questions, while beyond the scope of the current study, would be important for future research: (1) To what extent do the psychosocial predictors of *adolescent* dependence symptoms differ from the psychosocial predictors of *adult* dependence?; (2) To what extent do the psychosocial predictors of adolescent *dependence* symptoms differ from the psychosocial predictors of adolescent *smoking*?

Conclusions

This is one of the few studies to examine psychosocial factors associated with adolescent nicotine dependence symptoms. The results consistently showed that: (1) a low self-efficacy to quit smoking and (2) being around adults who smoked were cross-sectionally associated with higher levels of adolescent nicotine dependence symptoms. These results, needing replication in a longitudinal study, have theoretical implications and suggest that interventions designed to enhance self-efficacy to quit smoking and counter adult smoking influences might reduce adolescent nicotine dependence.

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Table 1

Coefficients (odds ratios) and 95% confidence intervals (95% CI) from logistic regression for psychosocial factors predicting nicotine dependence symptoms

<i>Factor</i>	Cigs per day		Urge after waking		1st cig after waking		1st cig after leaving home	
	<i>OR</i>	<i>95% CI</i>	<i>OR</i>	<i>95% CI</i>	<i>OR</i>	<i>95% CI</i>	<i>OR</i>	<i>95% CI</i>
Self-evaluation as smoker	1.22	0.98, 1.53	1.16	0.93, 1.47	1.34	1.07, 1.69	1.16	0.90, 1.52
Lower general self-efficacy	1.12	0.53, 2.35	0.93	0.43, 1.99	0.58	0.27, 1.25	0.84	0.35, 2.02
Lower self-efficacy for quitting	3.48	1.88, 6.44	10.35	5.37, 19.89	8.44	4.41, 16.15	6.38	2.88, 14.11
Positive smoking expectancies	1.10	0.97, 1.26	1.03	0.90, 1.18	0.92	0.81, 1.05	1.08	0.93, 1.26
Friends' smoking	1.21	1.07, 1.37	1.10	0.97, 1.25	1.11	0.98, 1.26	1.00	0.87, 1.16
Schoolmates' smoking	1.20	0.81, 1.79	0.86	0.58, 1.29	0.89	0.60, 1.33	1.00	0.64, 1.56
Adults' smoking	1.77	1.33, 2.37	1.72	1.28, 2.31	1.74	1.29, 2.34	1.47	1.07, 2.04

All coefficients and confidence intervals significant at $p < .05$ are shown in bold. Analyses were adjusted for socioeconomic level.