

Original Investigation

Cigarette smoking and associated health risks among students at five universities

Abigail C. Halperin, Stevens S. Smith, Eric Heiligenstein, David Brown, & Michael F. Fleming

Abstract

Introduction: While most college students and other young adults who smoke fall into the light and intermittent smoking (LITS) category, they remain at risk for tobacco dependence and other adverse health effects from their smoking. This study examines smoking patterns, tobacco dependence, and other health variables among students at five universities to better understand how to identify and address tobacco use and related risks in a college health clinic setting.

Methods: A health screening survey was completed by 2,091 college and graduate student volunteers seeking routine care at their university health centers or participating in a health class. Independent health variables were analyzed descriptively and in regression analyses with three levels of smoking (none, non-daily, and daily) and tobacco dependence to determine predictors and associated risks.

Results: Nearly a quarter of students reported any current smoking, 41% of whom reported smoking less than 1 cigarette/day (cpd). Of the daily smokers, 80% smoked less than 10 cpd but 45% met criteria for tobacco dependence. Any smoking was associated with high-risk alcohol use, risky driving, relational abuse, depression, less exercise, and utilization of emergency and mental health services. In regression analyses, students who experienced depression had more than double the odds of being dependent smokers (odds ratio [OR] = 2.32), as did those who reported abuse (OR = 2.07) or sought mental health counseling (OR = 2.09).

Discussion: Student health providers should be alerted to the multiple risks and comorbidities that occur among all smokers, including LITS, and intervene concurrently to help prevent or mitigate adverse outcomes that result from these conditions and behaviors.

Introduction

As the prevalence of cigarette smoking in the United States has been declining, the proportion of light (less than 10 cigarettes/day [cpd]) and occasional or intermittent (non-daily) smokers has grown, now accounting for up to half of adult smokers (Centers for Disease Control and Prevention, 2007; Husten, McCarty, Giovino, Chrismon, & Zhu, 1998; Office of Applied Studies, 2003) and more than three quarters of college students (Berg et al., 2009; Wetter et al., 2004) and other young adults (Centers for Disease Control and Prevention; Pierce, White, & Messer, 2009). Recent attention has been drawn to this trend, as tobacco-related disease risk and treatment research has focused almost exclusively on heavier smokers, leaving gaps in our knowledge about health risks of smoking among light and intermittent smokers (LITS) and how to prevent escalation of use or provide aid in quitting (Fagan & Rigotti, 2009; Husten, 2009; Schiffman, 2009). Currently, more than a quarter (28%) of college students smoke cigarettes (Substance Abuse & Mental Health Services Administration, 2007), and despite intentions to quit before graduation (Thompson, Coronado, et al., 2007), most will continue to smoke throughout their college years (Kenford et al., 2005) and beyond (Everett et al., 1999); thus, this is a critical juncture where early intervention could prevent the establishment of life-long smoking and related harms.

The challenge to clinicians who treat college students and other young adults is that LITS are more resistant to antismoking efforts as many do not consider themselves smokers (Berg et al., 2009; Levinson et al., 2007; Moran, Wechsler, & Rigotti, 2004) and believe that they will not become addicted, will be able to quit on their own when they want to, and don't smoke enough to present a risk to their health (Morley, Hall, Hausdorf, & Owen, 2006; Murphy-Hoefer, Alder, & Higbee, 2004; Thompson, Thompson, et al., 2007). Contrary to these beliefs, there is

Abigail C. Halperin, M.D., M.P.H., *Department of Family Medicine, University of Washington School of Medicine, Seattle, WA*

Stevens S. Smith, Ph.D., *Department of Medicine, Center for Tobacco Research and Intervention, University of Wisconsin School of Medicine and Public Health, Madison, WI*

Eric Heiligenstein, M.D., *University Health Services, and Department of Psychiatry, University of Wisconsin School of Medicine and Public Health, Madison, WI*

David Brown, Ph.D., *British Columbia Mental Health and Addiction Research Institute, Vancouver, Canada*

Michael F. Fleming, M.D., M.P.H., *Department of Family Medicine, University of Wisconsin School of Medicine and Public Health, Madison, WI*

Corresponding Author:

Abigail C. Halperin, M.D., M.P.H., *University of Washington, 1107 NE 45th Street, Suite 205, Seattle, WA 98105, USA. Telephone: 206-616-4482; Fax: 206-616-1553; E-mail: abigail@uw.edu*

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growing evidence that even occasional smokers experience greater health risks when compared with nonsmokers (An et al., 2009; Bjerregaard et al., 2006; Husten, 2009; Okuyemi et al., 2002), and they are less successful at quitting when they try (Everett et al., 1999). Additionally, nicotine dependence, which can develop within a month of initiation even after smoking only a few cigarettes per week (DiFranza, 2008), is found among college students across the spectrum of smoking frequency (Dierker et al., 2007). A number of studies have also demonstrated relationships between tobacco use and other behavioral health risks among college smokers, including alcohol and other drug use (Dierker et al., 2006; Reed, Wang, Shillington, Clapp, & Lange, 2007; Rigotti, Lee, & Wechsler, 2000) and depression (Kenney & Holahan, 2008), but there is limited information about how these or other risky behaviors are associated with different levels of smoking or how to address these multiple morbidities in the college health setting.

From a public health perspective, college students should be considered an important target group for cessation programs (Koontz et al., 2004), but, in practice, LITS are less likely than regular smokers to be advised to quit (Reed & Burns, 2008), only half (55%) of college health services offer tobacco treatment for students (Wechsler, Kelley, Seibring, Kuo, & Rigotti, 2001), and existing programs tend to be underutilized (Halperin & Rigotti, 2003). Clinicians may hold beliefs similar to those of many students in assuming that low levels of tobacco use do not present significant risk for nicotine dependence or other health problems (Halperin, Thompson, Hymer, Peterson, & Thompson, 2006) despite the recommendation that interventions be directed at smokers subsequent to their earliest exposures, but before daily smoking patterns are formed (Okuyemi et al., 2002).

The current study investigates potential correlates of smoking with a focus on health and behavioral risks associated with different levels of tobacco use and dependence in a sample of students accessing health education or medical care at five public university health centers. This study goes beyond previous studies by examining a constellation of risky behaviors and mental health issues that accompany smoking in this population, stratified by level of tobacco use and emerging nicotine dependence. Our findings highlight the importance of addressing tobacco use and concomitant morbidities in the college population, even among occasional smokers, and suggest approaches to use within the student health clinic setting.

Methods

Study design and setting

Data for this study were collected as part of a health screening survey (HSS) used in the College Health Intervention Projects (CHIPs) study, a randomized trial of brief clinician intervention to reduce high-risk drinking and alcohol-related harm among college students. Five universities participated in the CHIPs recruitment, including three University of Wisconsin campuses (UW Madison, UW Oshkosh, and UW Stevens Point) and the remaining two sites were the University of Washington (UW Seattle) and the University of British Columbia (UBC). The University of Wisconsin Health Sciences and UW Seattle Institutional Review Boards approved the study, as did the UBC Behavioural Research Ethics Board.

More than 10,000 undergraduate and graduate students (all aged 18 years or older) at the five sites were screened for high-risk drinking to determine eligibility for the main clinical trial; screening occurred between November 2004 and February 2007. A number of methods were utilized for recruitment that varied by site based on the unique characteristics of each health care delivery service. Students were told that the student health center was participating in a research study to assess a number of health behaviors, including tobacco and alcohol use, and that the information provided was confidential. At UW Madison, UW Oshkosh, and the UBC, students were asked to complete the HSS by the clinic receptionist as they checked in for their clinic appointment. Students were recruited 2–3 days a week from the general medical clinic (50% of the sample). UW Stevens Point recruited students in a health class taught by the student health clinic director (15% of the sample), while UW Seattle utilized student research assistants to approach students in the waiting room of two general health clinics 1–2 days a week while they were waiting to see their physician for an appointment (35% of the sample).

The overall response rate among the five sites using these various methods was greater than 90%. Reasons given by nonrespondents included lack of time prior to their physician appointment and lack of interest in research. There was no financial incentive to complete the HSS, and students were asked not to fill out the survey if they had previously completed one. While there is limited information that compares substance use (alcohol and tobacco) among students who attend a student health clinic compared with students who do not access student health services, the substance use frequency among our sample is comparable to national surveys of college campuses (Wechsler et al., 2002; White, Kraus, & Swartzwelder, 2006).

Students were asked to complete one of two versions of the HSS (administered as a self-report, paper-and-pencil questionnaire), which assessed alcohol use embedded in the context of other general health-related behaviors and experiences (Fleming, Barry, Manwell, Johnson, & London, 1997). Most students completed a brief version of the survey that consisted of 23 questions used to determine eligibility for the main CHIPs clinical trial. A systematically selected representative subsample consisting of one of every five students completed a longer version of the survey that had a total of 71 items, including additional questions about depression, emotional and physical abuse, utilization of health services, and other health-related topics. The current analyses are based on the 2,091 students who completed the longer survey.

Measurements

Tobacco use questions. Both screening surveys included an initial question that asked, "In the last three months, have you smoked cigarettes at all?" Respondents who answered yes to this question also answered a question to establish the average number of cigarettes smoked per day (answer categories included less than 1, 1–9, 10–19, 20–29, 30, or more) as well as questions based loosely on the CAGE questionnaire (Mayfield, McLeod, & Hall, 1974), including "In the last three months, have you been waking up in the morning wanting to smoke a cigarette?" Only this question was selected for analysis as it has been validated for detecting emerging tobacco dependence among younger populations (Rubinstein, Thompson, Benowitz, Shiffman, & Moscicki, 2007; Shiffman, Waters, & Hickcox, 2004).

Alcohol use and related risks. To assess frequency and quantity of drinking, the HSS asked three pairs of questions: The first assessed number of days of drinking per week in the past 3 months and the second asked how many drinks were consumed on days when a respondent drank. Risky drinking was defined as 15 or more drinks per week, on average, over the past 3 months for men and 8 or more drinks per week for women (National Institute on Alcohol Abuse and Alcoholism, 2005). In addition, respondents answered a question on episodic heavy (binge) drinking (number of times the respondent had five or more regular drinks on one occasion in the past 30 days) and questions about risky driving (whether or not the respondent had driven after drinking, rode with another driver who had been drinking, or did not routinely use seat belts).

Fitness. Students were asked a single question regarding frequency of exercise: “In the last three months, on average, how many days per week did you exercise for at least 20 minutes without stopping?” Possible answers included not at all, less than one, once per week, two times per week, and on up to seven times per week.

Depression. The HSS included seven items that comprise the Beck Depression Inventory–Primary Care (BDI-PC). Scores on this measure range from 0 to 21; scores of 4 and above are considered indicative of potentially clinically significant depression (Steer, Cavalieri, Leonard, & Beck, 1999).

Adverse relational experiences. Respondents were asked about their experiences with interpersonal relationships in the past 6 months, including separate questions about being emotionally abused, physically abused, or having unwanted sexual encounters. These questions were based on the Conflict Tactics Scale (Strauss, 1979). For each interpersonal experience question, the respondent was asked if a given type of abuse (or unwanted sexual encounter) happened at all in the past 6 months and, if the answer was yes, to answer two or three follow-up questions. Only the occurrence (yes/no) of emotional abuse, physical abuse, or unwanted sexual encounters is examined in the current analyses.

Utilization of health services. Respondents were asked about their use of a variety of health services during the past 6 months, including number of visits to a hospital-based emergency room or urgent care after-hours clinic and number of visits to a physician or other primary care provider for preventive or routine care. The HSS also asked, “In the last six months, how many times have you seen a counselor or other health care provider for depression, anxiety, stress, or other personal issues?” The current analysis includes utilization of urgent care, emergency room, or mental health services.

Sociodemographic questions. Also included in our analysis was HSS questionnaire items providing information on gender, age, race/ethnicity, year of study in college, and living arrangements.

Data analysis

Initial chi-square analyses of the different health-related risk factors (e.g., drinking, depression, and interpersonal violence) and smoking groups were computed to examine bivariate associations unadjusted for other variables. Next, three sets of mul-

tivariate logistic regression analyses were conducted to quantify the association between smoking and the health-related risk factors. The first set of regression analyses included the risk factor models with a dependent variable (DV) consisting of nonsmokers versus all smokers. The second set of analyses included a DV consisting of non-daily smokers (<1 cpd) versus daily smokers (1 cpd or more), while the third set used a DV of smokers reporting tobacco dependence, as measured by waking up wanting to smoke (sometimes, often, or very often vs. no).

As our goal in this analysis was to examine the association between smoking and groups of conceptually related clinically meaningful variables, it was deemed more appropriate to test conceptual groupings of independent variables in a series of six separate models for each of the three dependent smoking variables rather than including all 12 predictors in single comprehensive models. These separate smaller models allowed us to more clearly assess which categories of risk (fitness, drinking, driving, mental health, etc.) predicted each of the three smoking variables (all smokers vs. nonsmokers, daily vs. non-daily, and dependent vs. non-dependent) and thus better discern the clinical significance of our findings.

Model 1 tested the association with fitness, as measured by number of times exercising per week; Model 2 examined alcohol use, including high-risk drinking and binge drinking; and Model 3 looked at driving-related risks (driving after drinking, riding in a car with a driver who had been drinking, and using seat belts less than half the time). Model 4 analyzed the association with depression as measured by the BDI-PC, and Model 5 tested the relationship with adverse relational experiences (emotional or physical abuse and unwanted sexual encounters). Model 6 examined health care utilization in the past 6 months, including visits to a hospital-based emergency room; an urgent care or after-hours clinic; and if respondent saw a counselor for depression, anxiety, stress, or other personal issues.

The following covariates were included in each of the models to control for sociodemographic and site effects: gender, race, year of school (fresh/sophomore, junior/senior, or graduate level, with fresh/sophomore as the reference category), and site (with UW Madison as the reference group). Year of school was selected instead of age for inclusion as a covariate in the models because the HSS age question grouped all participants who were 25 years and older into one category (resulting in a truncated age distribution) and because age and year of school are correlated at ~0.85. Additionally, because the proportion of graduate students attending each campus varied considerably, it was necessary to control for site in each of the models.

Results

Demographic characteristics, drinking, and smoking-related variables of the sample overall and by campus are shown in Table 1. Schools ranged in size from 9,000 to 41,000 students with an average of ~28,000 per school. Consistent with enrollment in the universities, the proportion of graduate versus undergraduate students who completed the surveys at each site varied markedly, with the two smaller schools having more than 97% undergraduates and the three large universities having from 23% to 47% graduate students in the sample. The overall rates of alcohol use and smoking also differed across sites. The

Table 1. Descriptive statistics for total sample and by site, sociodemographic, smoking, and alcohol use variables

Variable	Total sample (n = 2,091)	University of Wisconsin campuses			University of Washington, Seattle (n = 817)	University of British Columbia, Vancouver (n = 280)
		Madison (n = 634)	Stevens point (n = 196)	Oshkosh (n = 164)		
% Female	65.7	63.2	54.6	77.4	68.5	63.9
% Age 18–19 years	25.4	22.7	74.5	37.2	17.7	12.5
% Age 20–21 years	26.3	34.7	20.4	34.1	18.6	29.3
% Age 22–24 years	21.4	27.0	2.0	24.4	19.1	27.1
% Age 25+ years	26.9	15.6	3.1	4.3	44.6	31.1
% Fresh/sophomore	30.3	27.4	85.6	44.5	19.9	20.4
% Junior/senior	40.1	50.0	13.8	52.4	33.6	47.5
% Graduate school	29.6	22.6	0.5	3.0	46.6	32.1
% White	78.5	87.5	93.8	93.3	70.4	63.1
% Black	2.0	1.9	1.0	1.2	2.8	0.7
% Native American	1.4	1.1	1.5	0.6	1.8	1.4
% Asian	12.2	5.5	3.1	3.0	17.5	23.3
% Hawaiian/Pacific Islander	0.9	0.0	0.0	0.0	2.0	1.1
% Hispanic	3.8	4.1	1.0	1.2	4.9	3.2
% Other	4.9	4.0	0.5	1.8	5.5	10.4
% Living on campus	34.0	36.9	72.3	47.6	15.9	45.4
% High-risk drinking	29.0	35.3	40.2	46.5	18.9	25.6
% >1 Binges (past 30 days)	57.3	66.6	67.7	72.7	44.1	59.2
% Driving after drinking	33.7	33.7	31.6	33.3	37.8	23.7
% Riding with a drinking driver	39.3	40.1	39.3	44.5	39.3	34.3
% Used seat belt half or less of the time (past 6 months)	5.6	5.9	14.3	12.2	2.5	4.1
% Smoking at all, (past 3 months)	23.2	24.5	27.0	35.8	19.6	20.8
Among smokers						
<1 cpd, %	41.1	46.2	47.2	32.8	39.6	34.5
1–9 cpd, %	47.2	43.6	41.5	51.7	47.2	56.9
10+ cpd, %	11.8	10.3	11.3	15.5	13.2	8.6
Waking up wanting to smoke, %	29.0	25.2	26.4	43.1	22.8	44.8

Note. cpd = cigarettes per day.

variability in frequency of risky drinking across the five campuses is primarily related to the high percentage of Asian students at UW Seattle and UBC, who tend to drink less than the Caucasian students who predominate at the Wisconsin campuses. In addition, the three Wisconsin sites are located in a state with among the highest rates of binge drinking in the country.

Smoking rate, consumption level, and nicotine dependence (as measured by waking up wanting to smoke) also varied considerably by site. Overall smoking prevalence at the five schools was 23%, ranging from just under 20% to 36%. The higher smoking rates at the two smaller Wisconsin campuses are likely due to the predominance of undergraduate students at those schools, reflecting the inverse relationship between educational attainment and smoking prevalence, although community smoking regulations may also have impacted this result. All five university campuses were essentially smoke free during the study period (i.e., did not allow indoor smoking anywhere, including residence halls). However, regional laws banning smoking in public buildings and workplaces, including bars and restaurants, were in place in Madison, Seattle, and Vancouver but not in Oshkosh or Stevens Point.

Among all smokers, 41% reported smoking <1 cpd, 47% reported 1–9 cpd, and 12% reported 10 or more cpd. The prevalence of daily smoking (those who reported smoking >1 cpd) ranged from about half (53%) to two thirds (67%), while 23%–45% met our definition of tobacco dependence. Chi-square analyses demonstrated a correlation between reported smoking level and nicotine dependence ($r = .44$; $p < .001$), with morning craving seen in a proportion of students at all levels of smoking. Only 5% (10/198) of those who smoked <1 cpd (non-daily smokers) reported waking up wanting to smoke compared with 45% (128/284) of those smoking 1 or more cpd (daily smokers). Among the largest group of smokers (those who smoked 1–9 cpd, $n = 227$), dependence was found in more than a third (37%) as well as in 76% of those who smoked 10–19 cpd and all (100%) of those who smoked 20 or more cpd (Table 2).

Descriptive statistics and bivariate analyses for other health-related variables by smoking status (nonsmoker, non-daily smoker, and daily smoker) and nicotine dependence (waking up wanting to smoke or morning craving) are shown in Table 3. The 12 health-related risk variables examined were all reported more frequently among smokers than among nonsmokers. Half

Table 2. Smoking level (cpd) and nicotine dependence (waking up wanting to smoke) among smokers

Smoked at all, past 3 months (<i>n</i> = 483)	cpd	Waking up wanting to smoke ^a (<i>n</i> = 144)
198 (41%)	<1	10/198 (5%)
227 (47%)	1–9	85/227 (37%)
49 (10%)	10–19	37/49 (76%)
8 (2%)	≥20	8/8 (100%)

Note. cpd = cigarettes per day.

^a*r* = .44.

of these variables (high-risk and binge drinking, driving after drinking or with a driver who had been drinking, and utilization of mental health or emergency services) displayed a distinct linear relationship (*p* < .001) with non-daily smokers falling between nonsmokers and daily smokers. In regard to the other variables, non-daily smokers were more similar to nonsmokers

on frequency of reported exercise, seat belt use, depression, and relational abuse. However, they were closer to daily smokers in frequency of urgent care visits and reported unwanted sexual encounters.

In Table 4, the first set of logistic regression models reveal greater odds of smoking at any level among those reporting a variety of adverse experiences or engaging in risky behaviors, with the greatest effect sizes seen for high-risk or binge drinking (odds ratio [OR] = 2.74 and 3.06, respectively), riding with a drinking driver (OR = 2.76), and unwanted sexual encounters (OR = 2.53). In the second set of models, which compare daily with non-daily smokers, the greatest odds were found among those who lacked exercise (OR = 2.03) and rode without seat belts more than half the time (OR = 3.36). The final set of regression analyses compare odds for dependent versus non-dependent smoking (as measured by waking up wanting to smoke), finding more than a doubling among subjects with depression (OR = 2.32), experience of physical or emotional abuse (OR = 2.09), and those who utilized mental health services (OR = 2.07).

Table 3. Descriptive statistics and unadjusted chi-square analyses for health-related variables, by smoking status and nicotine dependence

Variable	Smoking status			<i>p</i> Value	Waking up wanting to smoke (smokers only)		
	Nonsmoker (<i>n</i> = 1,600)	Non-daily smoker ^a (<i>n</i> = 199)	Daily smoker ^b (<i>n</i> = 285)		No (<i>n</i> = 343)	Yes (<i>n</i> = 142)	<i>p</i> Value
Fitness							
% Exercising ≤2 times per week	41.4	36.7	55.1	<.001	42.9	58.7	.001
Risky drinking							
% High-risk drinking ^c	21.1	48.4	59.1	<.001	53.8	57.1	.499
% ≥1 Binges past 30 days	49.7	79.4	85.7	<.001	83.5	81.0	.521
Risky driving							
% Driving after drinking	30.0	40.7	49.5	<.001	45.0	46.8	.717
% Riding with a drinking driver	32.9	56.3	62.9	<.001	58.5	63.6	.291
% Using seat belt half the time or less	4.0	5.0	14.8	<.001	7.6	17.5	.001
Depression							
% Depressed ^d	22.9	26.8	38.0	<.001	27.4	47.2	<.001
Adverse Relational Experiences							
% Experiencing emotional or physical abuse	14.6	16.8	26.4	<.001	18.4	31.9	.001
% Experiencing unwanted sexual encounters	4.5	11.6	12.4	<.001	10.9	14.7	.236
Healthcare utilization in past 6 months							
% Seeking urgent care	12.2	15.6	16.0	.046	15.5	16.2	.857
% Going to emergency department	12.0	17.7	20.4	<.001	18.7	20.4	.654
% Seeing a counselor for mental health reasons	18.8	25.1	30.3	<.001	23.6	38.5	.001

Note. cpd = cigarettes per day.

^aNon-daily smoking defined as <1 cpd.

^bDaily smoking defined as 1 or more cpd.

^cHigh risk defined as males drinking > 14 drinks per week; females drinking > 7 drinks per week.

^dAs measured by the Beck Depression Inventory–Primary Care; score > 4 = probable depression.

Table 4. Logistic regression results of (a) smoking in past 3 months, (b) smoking daily, and (c) nicotine dependence on risk factors: lack of exercise, risky drinking, risky driving, probable depression, adverse relational experiences, and past 6-month health care utilization

Models ^a	Smoked in past 3 months (<i>n</i> = 483) vs. Nonsmoker (<i>n</i> = 1,590)	Smoked daily (<i>n</i> = 284) vs. Smoked less often (<i>n</i> = 199)	Waking up wanting to smoke (<i>n</i> = 142) vs. not (<i>n</i> = 343)
Model 1. Lack of exercise, <i>OR</i> (95% <i>CI</i>)			
Exercise level (0 = 3 or more times per week; 1 = <3 times per week)	1.33** (1.08–1.64)	2.03*** (1.39–2.96)	1.77** (1.18–2.65)
Model 2. Risky drinking, <i>OR</i> (95% <i>CI</i>)			
High-risk drinking ^b (0 = no, 1 = yes)	2.74*** (2.13–3.52)	1.62* (1.06–2.50)	1.24 (0.78–1.98)
One or more binges in past 30 days (0 = no, 1 = yes)	3.06*** (2.27–4.14)	1.39 (0.80–2.43)	0.74 (0.40–1.35)
Model 3. Risky driving, <i>OR</i> (95% <i>CI</i>)			
Drove after drinking (0 = no, 1 = yes)	1.32* (1.03–1.70)	1.31 (0.85–2.00)	1.05 (0.67–1.67)
Rode with a drinking driver (0 = no, 1 = yes)	2.76*** (2.17–3.51)	1.19 (0.78–1.82)	1.23 (0.77–1.96)
Using seat belt (0 = always or usually, 1 = half the time or less)	1.93*** (1.28–2.92)	3.36*** (1.61–7.04)	2.51** (1.34–4.69)
Model 4. Depression, <i>OR</i> (95% <i>CI</i>)			
Depressed ^c (0 = no, 1 = yes)	1.77*** (1.41–2.22)	1.78** (1.18–2.68)	2.32*** (1.53–3.54)
Model 5. Adverse relational experiences, <i>OR</i> (95% <i>CI</i>)			
Experienced emotional or physical abuse (0 = no, 1 = yes)	1.54*** (1.18–2.02)	1.85* (1.14–3.00)	2.09*** (1.29–3.38)
Experienced unwanted sexual encounters (0 = no, 1 = yes)	2.53*** (1.72–3.71)	1.08 (0.60–1.97)	1.37 (0.74–2.57)
Model 6. Health care utilization past 6 months, <i>OR</i> (95% <i>CI</i>)			
Went to urgent care (0 = no, 1 = yes)	1.09 (0.80–1.50)	0.91 (0.52–1.59)	0.75 (0.41–1.40)
Went to emergency department (0 = no, 1 = yes)	1.53** (1.14–2.05)	1.22 (0.73–2.04)	1.04 (0.60–1.80)
Saw counselor for mental health reasons (0 = no, 1 = yes)	1.80*** (1.41–2.30)	1.26 (0.82–1.95)	2.07*** (1.31–3.26)

Note. ^aAll models included gender, site, and year in school as control variables.

^bHigh risk defined as males drinking >14 drinks per week; females drinking >7 drinks per week.

^cAs measured by the Beck Depression Inventory–Primary Care; score > 4 = probable depression.

p* < .05, *p* < .01, ****p* < .005.

Discussion

The findings from this study expand our knowledge about associations between health-related risk behaviors and different levels of tobacco use, as well as emerging nicotine dependence, among college and graduate school students. Our data show that 23% of students seeking routine care in college health centers report tobacco use in the past 3 months. The vast majority (88%) of these are light (47%) or intermittent (41%) smokers, with less than 2% smoking 20 or more cpd. However, nearly a third (30%) of all smokers, including some of the non-daily smokers, report waking up wanting to smoke, a hallmark of nicotine dependence (Rubinstein et al., 2007). In both bivariate and regression analyses, smoking at any level was associated with a constellation of risk factors, including high alcohol use, unsafe driving practices, less exercise, experience of emotional or physical abuse, depression, and utilization of emergency and mental health services. Further increased odds of daily (vs. non-daily) smoking were found among students who reported not

wearing seat belts (*OR* = 3.36) or exercising less than three times per week (*OR* = 2.03), while dependent smokers were more likely than non-dependent smokers to screen positive for depression (*OR* = 2.32), report emotional or physical abuse (*OR* = 2.09), and seek mental health counseling (*OR* = 2.07).

What are the clinical implications of these findings? First, student health providers should be aware that even LITS, not just heavy daily users, are vulnerable to tobacco addiction and other health and safety risks related to their smoking. This is especially important given that college students who smoke often deny doing so (Berg et al., 2009; Levinson et al., 2007) and may discount the health effects of smoking (Thompson, Thompson, et al., 2007). All students should be screened for any tobacco use with a question that is unambiguous and covers a sufficient time period to capture the multiple transitions between smoking and quitting that non-daily smokers often experience (Hammond, 2005). An affirmative answer to the question, “In the last 3 months, have you smoked cigarettes at all, even a puff?” should be followed by an assessment

of smoking frequency (number of days per month and cpd) to distinguish daily from non-daily smokers. Additionally, since college students (Sledjeski et al., 2007) and other young adults (Levy, Biener, & Rigotti, 2009) who are tobacco dependent are the most likely to continue or escalate their tobacco use, one question, such as “Do you wake up in the morning wanting to smoke a cigarette?” will enable providers to identify these students, who are also at greatest risk for depression or abusive relationships and who may benefit from pharmacotherapy to help them quit smoking.

Second, in terms of interventions to help students quit while clinical practice guidelines do not support the use of certain pharmacologic treatments, such as the nicotine patch or bupropion, for most light or non-daily smokers (Clinical Practice Guideline Treating Tobacco Use and Dependence 2008 Update Panel, 2008), the use of episodic short-acting nicotine products (such as nicotine gum, lozenge, or spray) may be appropriate for treatment of situational smoking (i.e., when drinking, after meals, etc.). Additionally, LITS who screen positive for tobacco dependence may benefit from longer acting nicotine replacement therapy, varenicline, or bupropion. Bupropion may be especially beneficial in the presence of depression or other mental health comorbidities (Clinical Practice Guideline Treating Tobacco Use and Dependence 2008 Update Panel, 2008).

A third clinical implication is the need to screen students who smoke for a number of linked issues, including high-risk drinking and driving, depression, possible interpersonal abuse, and physical fitness. Similarly, when students present with depression, problems related to their drinking, or adverse relational experiences, providers should inquire about their smoking, provide them with information about the relationship between smoking and other health issues, and offer a brief intervention for concurrent behavior change.

This study has several limitations as well as a number of strengths. Strengths include its large relatively diverse sample of public university students across geographic regions. Another is the fact that all students were seeking routine medical care or health education through their university health service. Prior studies have surveyed general student populations as opposed to those seeking care; hence, this sample is likely to be more representative of students that health care providers will encounter in their practices. Another strength is the inclusion of questions on a wide variety of health-related risk factors common to college students.

Owing to the cross-sectional nature of the data and the limited number of questions used to assess tobacco use patterns, a major limitation is our inability to demonstrate a causal relationship in either direction between smoking and the other risks described here. The cross-sectional design also does not permit examination of the hypothesis that smoking cessation will lead to reduction of the associated risk variables examined. However, other studies have demonstrated bidirectional associations between smoking and both risky alcohol use (Dierker et al., 2006) and depression (Kenney & Holahan, 2008), and brief interventions have been shown to facilitate positive behavior change in these arenas (Grossberg, Brown & Fleming, 2004; McCambridge & Strang, 2004). Therefore, it is quite plausible that treating risk behaviors concurrently, particularly smoking and high levels of alcohol use, is a promising strategy.

Lastly, as noted earlier, our analytic approach involved testing conceptual groupings of independent variables in a series of six

separate models rather than using a single model with all the predictors for each DV. This strategy was preferred as it enabled a clearer examination of six areas of health-related behaviors that are conceptually and clinically distinct. However, by increasing the total number of models tested, the likelihood of decisional errors (i.e., Type I errors) is multiplied and thus significant results should be interpreted with appropriate caution. Concern in this regard is lessened by examination of results in Table 4, which indicate that 13 of the 21 statistically significant predictors across the various models would remain significant even if a more stringent Bonferroni-corrected α of .005 were used instead of $\alpha = .05$. Future replication of these findings or confirmation with longitudinal data would also boost confidence in these results.

Conclusions

While most college students who use tobacco are light or intermittent smokers (LITS), student health center clinicians need to be made aware that these students are at risk for nicotine dependence as well as more immediate harms due to their smoking and associated behavioral risks. Our analysis leads us to recommend that campus clinic providers systematically identify students who smoke at any level and seize the opportunity to address tobacco use in conjunction with fitness, risky drinking and driving, depression, and other mental health issues to improve health status and decrease morbidity. More research is warranted on how to integrate effectively screening and brief intervention for tobacco use and related behavior risks in order to prevent or mitigate these adverse outcomes.

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Declaration of Interests

None declared.

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