
Cigarette Use by College Students in Smoke-Free Housing

Results of a National Study

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Background: Cigarette-smoking rates have increased in recent years among college students. Smoke-free residences offer a possible means of reducing or preventing smoking. However, their use has as yet not been evaluated. This paper examines whether students residing in smoke-free residences are less likely to smoke cigarettes than students in other campus residences, and if such lower rates apply to all types of students and colleges.

Methods: The Harvard School of Public Health College Alcohol Study surveyed a nationally representative sample of college students at 128 U.S. 4-year colleges regarding tobacco use and related behaviors in the spring of 1999. The responses of students living in smoke-free and unrestricted residences at 101 campuses were compared.

Results: Current smoking prevalence was significantly lower among residents of smoke-free housing (21.0%) as compared with residents of unrestricted housing (30.6%, $p < 0.0001$). The lower rate of current cigarette use was consistent with all types of student and college characteristics with few exceptions. Current cigarette use was significantly lower for those living in smoke-free housing than for residents of unrestricted housing among students who were not regular smokers before age 19 (10% vs 16.9%, $p < 0.0001$), but not among students who smoked regularly before age 19.

Conclusions: Smoke-free residences may help protect those students who were not regular smokers in high school from smoking in college. However, the difference in smoking rates may be due to self-selection of students into smoke-free residences. Since smoke-free options also protect students from secondhand smoke and dormitory fires, colleges should provide these types of residences for all students who request them, and should also encourage others to choose them.

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Introduction

Smoking rates among young adults appear to be rising.^{1,2} This may be a cohort effect involving an earlier rise in tobacco use among high school and middle school students.³ It may also reflect newer tobacco industry marketing efforts that target young adults (aged 18 to 24), because young adults and college students in particular are the youngest legal targets for tobacco marketing. Whatever the cause, tobacco use among this age group deserves attention.

Approximately one third of young adults attend college. Although fewer college students smoke than non-college-attending peers,³ cigarette-smoking rates have risen in recent years among the college population.^{3,4} Colleges provide a natural site for interventions to reduce tobacco use among young adults, but little is known about how to discourage tobacco use among college students.

One approach that has been implemented on some campuses is to provide smoke-free dormitories. The use of smoke-free areas has been promulgated to reduce the secondhand effects of smoking.⁵ It can also serve as a preventive tool by limiting the opportunity and time for smoking, by reducing the presence of smoking role models and the strength of peer pressure to smoke. In a 1999 survey of college health directors,⁶ the Harvard School of Public Health Survey found that 27% of 4-year residential colleges prohibited smoking every-

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where on campus, including living areas in dormitories. An additional 55% of colleges banned smoking in all public areas, allowing it only in private living quarters. Smoke-free policies in workplaces, which were adopted to protect nonsmokers from the hazards of environmental tobacco smoke, have proved to be effective in reducing employees' daily cigarette consumption and promoting cessation.⁵ Among college students, state and local community smoke-free policies have been found to reduce smoking.⁷ The effect of smoke-free residences on college students' tobacco use has not been examined.

This paper uses data from a nationally representative sample of U.S. 4-year colleges to examine the relationship between students' choice of housing and their use of tobacco products. Our hypothesis is that smoke-free dormitories protect students from becoming regular smokers and reduce the daily cigarette consumption among regular smokers.

Methods

The College and Student Sample

This report is based on the 1999 Harvard School of Public Health College Alcohol Study (CAS). The 1999 CAS was conducted at 128 4-year colleges located in 40 states and the District of Columbia. From a list of accredited 4-year colleges provided by the American Council on Education, an original sample of 140 colleges was selected in 1993 using probability sampling proportionate to the size of undergraduate enrollment at an institution. Administrators at each participating college provided a random sample of undergraduates drawn from the total enrollment of full-time students. Colleges were sent specific guidelines for drawing a random sample of full-time students. Depending on enrollment size, every Xth student was selected from the student registry using a random starting point. The attrition of 12 colleges from the original 140 was due primarily to the college administrators' inability to provide a random sample of students and mailing addresses within the time requirements of the study. In 1999, a sample of 225 was selected from each of the 128 colleges. Details of the method are described elsewhere.⁸⁻¹⁰

The present analysis excluded nine colleges that failed to meet minimum response rate criteria. To be included in the 1999 sample required a minimum response rate of 50% in two of the three surveys (1993, 1997, and 1999) and a rate of at least 40% in the third. For all 3 survey years, 119 of the 128 participating schools (93%) met these criteria. Rates of smoking were almost identical for these 119 colleges and the total sample of 128, indicating that dropping the low-response schools did not change the results of the survey.

The sample of 119 colleges represents a national cross-section of 4-year colleges. Two thirds of the colleges sampled are public institutions, while one third are private. Forty-four percent of the schools have an enrollment of over 10,000 students, while 23% enroll 5001 to 10,000 students and 34% have fewer than 5000 students. About two thirds are located in an urban or suburban setting, and one third in small town or rural settings. Fifteen percent have a religious affiliation. Five percent enroll only women.

Mailing and Response Rate

Between February and April 1999, questionnaires were mailed to 23,751 students at the 119 schools included in the analysis. Three separate mailings were sent within at least a 3-week period selected at each school to avoid coinciding with spring vacation occurring during that period or the preceding month: a questionnaire, a reminder postcard, and a second questionnaire. Responses were voluntary and anonymous. A lottery with several cash awards was used to encourage students to respond.

By the end of April 1999, 89% of the final group of questionnaires had been returned; 10% arrived in May, and 1% in June and July. A total of 14,138 students returned questionnaires (60% response rate). The response rate varied between 40% and 83% among the 119 colleges.

Several procedures were used to examine potential bias introduced by nonresponse and attrition. A short form of the questionnaire including a smoking question was mailed to a sample of students who had failed to return the questionnaire. The 30-day smoking rate of those responding to this short survey did not differ significantly from that of those responding to the entire student survey (chi-square=1.85, $p=0.17$). The Pearson correlation coefficients between a college's response rate and its 30-day cigar and cigarette-smoking rates were 0.04 ($p=0.68$) and 0.01 ($p=0.11$), respectively, indicating little chance for bias on this basis.

Questionnaire and Measures

The 1999 CAS survey used most of the same questions used in 1993 and 1997, focusing on alcohol use but also assessing demographic and background characteristics, tobacco use, and other substance use. The survey questions were standard survey items previously used in other large-scale studies.^{11,12}

To assess cigarette use, respondents were asked when, if ever, they had smoked a cigarette. Response options were "never used," "used, but not in the past 12 months," "used, but not in the past 30 days," or "used in the past 30 days." Parallel questions asked about the use of cigars. Students were also asked to report how many of the past 30 days they had smoked cigarettes and how old they were when they first smoked each and when they started smoking cigarettes regularly.

All students except those who reported that they never smoked cigarettes or cigars were considered to be ever smokers. Former smokers were defined as students who had ever smoked, but not in the past 30 days. Current smokers were defined as students who smoked in the past 30 days. Whether or not they became regular smokers at or before the age of 18 was used as a proxy for whether they did this before coming to college. We focused on being a regular smoker and not the age of first cigarette, because the latter almost always occurred before the age of 19.

Smoke-free living arrangements were defined as dormitories or floors specifically designated by the school where all students living in that area were restricted from smoking. These were identified from the student survey question: "Some universities have housing that is specially designated as 'substance free.' Do you live in this type of housing?" The response options were "No," "Yes, only smoking is prohibited," "Yes, only alcohol is prohibited," or "Yes, both smoking

and alcohol are prohibited.” For the purposes of this paper we categorized students as living in “smoke-free” housing if they lived in either smoke-free or substance-free (both alcohol and smoking are prohibited) quarters. We did not distinguish between smoke-free and substance-free in this report because we found that students living in these two types of arrangements did not differ from each other in their responses on any of the key questions in the analyses. Students who did not live in specially designated housing were classified as unrestricted housing residents.

Data Analysis

The analysis compared the responses of students who lived in smoke-free on-campus housing to those who lived in on-campus unrestricted housing. The analyses excluded 17 schools that did not have dormitories and one in which all housing was smoke-free, leaving 101 schools. A total of 12,076 students at these colleges returned questionnaires. Of these, 4495 students lived in college residences (1842 in smoke-free housing and 2653 in unrestricted) and were included in the study. Data analysis was performed using SAS. Univariate analyses compared the prevalence of tobacco use among students in each type of housing. The chi-square test was used to assess the statistical significance of differences in the univariate analysis. When differences are reported they are statistically significant at $p < 0.05$.

Multiple logistic regression was used to model the association of current cigarette use (use in the past 30 days) with the types of housing after adjusting for smoking history, year in school, gender, race/ethnicity, and regional variations. Results are reported as odds ratios (ORs) with 95% confidence intervals. Our analysis was limited to cigarette use as an outcome variable because cigarettes accounted for most of the tobacco use among college students.⁹ The response rate of each school was also included in the model as a college-level covariate to control its potential confounding with the type of housing, and/or with other student and school characteristics. The generalized estimating equations (GEE) method was employed to fit the logistic regression models using clustered binary outcomes arising from the sampling scheme.^{13,14} The working independent covariance structure seemed the best specification, and was specified throughout the GEE analysis. The point estimates of the ORs obtained from the GEE method were almost identical with those from ordinary logistic regression estimation, while the standard errors of the ORs associated with the college characteristics were slightly greater. Hence, to be conservative, the GEE-based results are reported.

Results

Smoking Prevalence

The overall rate of current (past 30 days) cigarette use was 26.8% (Table 1). Among those, three out of five (58.3%) started smoking regularly before the age of 19. Current smoking prevalence was significantly lower among residents of smoke-free housing. Two of ten (21.0%) residents of smoke-free housing were current smokers compared to three of ten residents of unrestricted housing

Table 1. Prevalence of tobacco use by residence in smoke-free and unrestricted housing

	Prevalence		χ^2 <i>p</i> value
	Residence in smoke-free housing (<i>n</i> = 1842)	Residence in unrestricted housing (<i>n</i> = 2653)	
Cigarette use			
Current smoker	21.0	30.6	<0.0001
Past year smoker	29.9	41.7	<0.0001
Former smoker	19.5	22.4	0.0217
Ever smoker	41.9	53.9	<0.0001
Cigar use			
Current smoker	7.4	9.8	0.0043
Past year smoker	20.5	26.6	<0.0001
Former smoker	21.4	28.3	<0.0001
Ever smoker	30.1	39.0	<0.0001
Cigarettes per day smoked^a			
<½ pack	77.0	72.2	0.0786
>½ pack	23.0	27.8	
Tried to quit smoking and succeeded for 24 hours^b			
Never	49.2	46.7	0.0337
≥1 times	50.8	53.3	

^aAnalysis is limited to respondents who smoked in the past 30 days.

^bAnalysis is limited to respondents who used any tobacco product in the past year.

n, number of students.

(30.6%, $p < 0.0001$). Students in smoke-free residences were also less likely to have ever smoked and to have smoked in past year.

Cigar smoking accounts for the largest share of non-cigarette tobacco use among U.S. college students.⁹ The rates of current, past year, and lifetime cigar use were also significantly lower among residents of smoke-free housing than among residents of unrestricted housing.

Smoking Involvement of Current Smokers

Among students who were current smokers, those who lived in smoke-free housing did not differ from residents of unrestricted housing with respect to how many cigarettes they smoked per day (Table 1). There was also no difference by type of housing in the proportion of current smokers who had tried to quit smoking in past year.

Smoking Prevalence by Student Background Characteristics

Almost all types of students had a lower current cigarette-smoking rate in smoke-free residences (Table 2). The lower rate of current tobacco use was consistent regardless of gender, age, year in school, parental

Table 2. Cigarette use in past 30 days by student characteristics and types of housing

	Prevalence		χ^2 <i>p</i> value
	Residence in smoke-free housing (<i>n</i> =1842)	Residence in unrestricted housing (<i>n</i> =2653)	
Total	21.0	30.6	<0.0001
Gender			
Male	22.2	29.7	0.0009
Female	20.5	31.1	<0.0001
Ethnicity			
Hispanic	16.3	26.4	0.0893
Non-Hispanic	21.3	30.8	<0.0001
White	23.3	32.9	<0.0001
Black/African-American	10.0	17.1	0.0905
Asian/Pacific Islander	15.5	20.3	0.2098
Native American Indian/Other	17.9	30.3	0.0145
Age			
<21 years	22.5	31.8	<0.0001
≥21 years	14.4	27.1	<0.0001
Year in school			
Freshman	24.2	32.1	0.0001
Sophomore	22.5	33.2	<0.0001
Junior	12.3	27.8	<0.0001
Senior	13.6	26.3	0.0017
Parental college education			
Yes	22.3	32.9	<0.0001
No	19.9	27.2	0.0012
Fraternity/sorority member			
Yes	29.8	40.3	0.0143
No	19.7	29.3	<0.0001
Smoking history			
Smoked regularly before 19	79.3	78.8	0.8489
Had not smoked regular before 19	10.0	16.9	<0.0001

n, number of students.

education, and fraternity membership. White students who lived in smoke-free residences were significantly less likely to smoke than white students in unrestricted housing, but African-American, Hispanic, and Asian students in smoke-free housing did not smoke significantly less than their counterparts in unrestricted housing. The lack of statistical significance for these subgroups may be due to small cell sizes.

The relationship of type of residence to smoking status differed according to students' smoking histories. Among students who were not regular smokers before age 19, current cigarette use was significantly lower for those living in smoke-free housing than for those in unrestricted housing (10% vs 16.9%, $p < 0.0001$). Among students who had smoked regularly before age 19, there was no difference in current cigarette use by housing type (79.3% in smoke-free vs 78.8% in unrestricted housing, $p = 0.8489$).

Smoking Prevalence by College Characteristics

The rate of current cigarette use was lower in smoke-free compared to unrestricted housing at all types of colleges with one exception: colleges with medium-sized student enrollments (5001–10,000 undergraduate students) (Table 3).

Correlates of Cigarette Use in Past 30 Days

Table 4 displays the results of a multiple logistic regression examining the association between type of residence and current cigarette use, controlling for whether or not student was a regular smoker before age 19, year in college, gender, race, region of the country, and school response rate. Students living in smoke-free housing were 30% less likely to be current smokers than were students in unrestricted housing, even after these

Table 3. Cigarettes use in past 30 days by college characteristics and types of housing

	N	Prevalence			χ^2 <i>p</i> value
		Total	Residence in smoke-free housing (n=1842)	Residence in unrestricted housing (n=2653)	
Total	101	26.8	21.0	30.6	<0.0001
Small <5000	37	26.6	19.2	30.7	<0.0001
Medium 5001–10,000	21	27.7	26.2	28.7	0.4074
Large >10,001	43	26.7	20.2	31.4	<0.0001
Public	64	27.6	23.4	30.9	<0.0001
Private	37	25.9	17.4	30.2	<0.0001
Northeast	27	27.7	21.3	30.2	0.0006
South	30	26.6	20.0	30.9	<0.0001
North Central	31	27.9	23.7	31.3	0.0014
West	13	21.5	15.5	29.0	0.0004
Religious affiliation	19	27.1	17.8	34.5	<0.0001
Nonreligious	82	26.8	22.1	29.6	<0.0001
Rural/small town	33	27.3	22.3	30.5	0.0002
Suburban/urban	68	26.6	20.3	30.6	<0.0001
Women only	6	23.7	16.8	29.1	0.0044
Coeducational	95	27.1	21.4	30.7	<0.0001
Less competitive ^a	52	29.1	24.9	32.6	0.0002
Very/highly competitive	49	25.1	17.4	29.4	<0.0001

^aCompetitiveness is based on ACT and SAT scores and percentage of applicants accepted.¹⁵

N, number of colleges; n, number of students.

factors were controlled for in the analysis. Smoking was also significantly more likely among freshmen and sophomores, white students, and students who had begun to smoke regularly before age 19.

Discussion

College students who live in smoke-free floors or dormitories are less likely to be current smokers of cigarettes and cigars than their counterparts residing in unrestricted residences. The lower rates observed in smoke-free residences apply to most types of students and occur at nearly all types of colleges. However, the lower rates apply only to those students who were not regular smokers before reaching age 19. Among students who do smoke cigarettes, those living in smoke-free dorms smoke as many cigarettes daily as their counterparts in unrestricted housing. These findings are consistent with the hypothesis that smoke-free dorms help those who are not regular smokers before college avoid taking up tobacco during college.

The results of this study must be viewed with some caution. The study is based on self-reported responses to a mail survey and is subject to sources of error associated with this approach. One potential limitation is nonresponse bias. Although the survey response rate

was 60%, the prevalence of cigarette smoking did not differ between respondents and a sample of nonrespondents, and there was no correlation between smoking rates and response rates at individual schools. Furthermore, in order to control for potential nonresponse bias, we included the college response rate as an independent variable in multivariate analyses. Another potential limitation may be introduced by respondents who may intentionally or unintentionally distort their answers. Biochemical measures have established the validity of relying on self-reported smoking status in national surveys.^{16,17} Under-reporting of smoking status is probably even less likely in this survey, which focused almost entirely on alcohol rather than tobacco.

Furthermore, for some students, there is a possibility that being a regular smoker before age 19 may not be equivalent to being a regular smoker before coming to college. Nevertheless, the results are consistent for students aged <21 and ≥21. Finally, because this is a cross-sectional study, it cannot be used to establish a causal relationship between residing in a smoke-free dorm and remaining a nonsmoker. Because colleges do not randomly assign students to smoke-free housing, it is possible that the apparent protective effect may be due to self-selection of more determined nonsmokers into these living arrangements. A cohort study without

Table 4. Correlates of cigarettes use in past 30 days using multiple logistic regression

	Adjusted OR (95% CI)	<i>p</i> value
Type of housing		
Unrestricted housing	1	
Smoke-free housing	0.70 (0.59–0.83)	<0.0001
Smoking history		
Smoked regularly before age 19	1	
Had not smoked regularly before age 19	0.05 (0.04–0.06)	<0.0001
Year in College		
Freshman and sophomore	1	
Others	0.83 (0.68–1.01)	0.0562
Gender		
Male	1.00 (0.82–1.22)	0.9680
Female	1	
Race		
White	1	
Non-white	0.66 (0.52–0.84)	0.0008
Region		
West	0.82 (0.56–1.20)	0.3050
Others	1	
Response rate	1.00 (0.99–1.02)	0.5614

OR, odds ratio; CI, confidence interval.

random assignment of student to type of dorm would not control for the possibility of self-selection. A randomized trial would have to be conducted to establish a causal link. An additional limitation is that the study did not ascertain the number of years a respondent had lived in a smoke-free dormitory. The study also could not determine the extent to which the no-smoking rules were enforced.

The results are far from definitive. Our findings can only suggest that smoke-free college housing may have a protective effect on students who are not regular smokers at college entry. At best these living arrangements may help protect nonsmokers from becoming smokers. Even if they do not, smoke-free residences protect nonsmokers from the harmful effects of secondhand smoke. Air ventilation systems in all likelihood do not offer sufficient protection when students are allowed to smoke in their sleeping quarters. Smoke-free dormitories may also protect students from fires.

College students are an extremely important population for targeted public health prevention efforts. In the past they have been relatively strong resisters of involvement with tobacco. College administrators need to help this group of students, who are among the

youngest legal targets of tobacco marketing, to keep them from joining the ranks of smokers. Given the potential beneficial effects of smoke-free dormitories, the use of this preventive strategy should be promoted.

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References

- Centers for Disease Control and Prevention. Tobacco use among high school students—United States, 1997. *MMWR Morb Mort Wkly Rep* 1998;47:229–33.
- Centers for Disease Control and Prevention. Cigarette smoking among adults—United States, 1997. *MMWR Morb Mort Wkly Rep* 1999;48:993–6.
- Johnston LD, O'Malley PM, Bachman JG. National survey results on drug use from the Monitoring the Future Study, 1975–1998. Vol. 2: College students and young adults. (NIH Pub. No. 99-4661) Washington, DC: U.S. Department of Health and Human Services, 1999.
- Wechsler H, Rigotti NA, Gledhill-Hoyt J, Lee H. Increased levels of cigarette use among college students: a cause for national concern. *JAMA* 1998;280:1673–8.
- Brownson RC, Eriksen MP, Davis RM, Warner KE. Environmental tobacco smoke: health effects and policies to reduce exposure. *Ann Rev Public Health* 1997;18:170–81.
- Wechsler H, Kelley K, Seibring M, Kuo M, Rigotti NA. College smoking policies and smoking cessation programs: results of a survey of college health center directors. *J Am Coll Health* 2001. In press.
- Chaloupka FJ, Wechsler H. Price, tobacco control policies and smoking among young adults. *J Health Econ* 1997;16:359–73.
- Wechsler H, Davenport A, Dowdall G, Moeykens B, Castillo S. Health and behavioral consequences of binge drinking in college: a national survey of students at 140 campuses. *JAMA* 1994;272:1672–7.
- Rigotti NA, Lee JE, Wechsler H. U.S. college students' use of cigarettes, cigars, pipes, and smokeless tobacco. *JAMA* 2000;284:699–705.
- Wechsler H, Kuo M, Lee H, Dowdall GW. Environmental correlates of underage alcohol use and related problems of college students. *Am J Prev Med* 2000;19:24–9.
- Wechsler H, McFadden M. Drinking among college students in New England. *J Stud Alcohol* 1979;40:969–96.
- Johnston LD, O'Malley PM, Bachman JG. Drug use among American high school seniors, college students, and young adults, 1975–1990, Vol. 2. Washington, DC: U.S. Department of Health and Human Services, 1991.
- Liang KY, Zeger SL. Longitudinal data analysis using generalized linear models. *Biometrik* 1992;73:12–22.
- Zeger SL, Liang KY, Albert PS. Models for longitudinal data: a generalized estimating equation approach. *Biometrics* 1988;44:1049–60.
- Barron's Profiles of American Colleges. Hauppauge, NY: Barron's Educational Series, Inc., 1996.
- Caraballo RS, Giovino GA, Pechacek TF, Mowery P. Agreement between self-reports of cigarette smoking and biochemical measurement of serum nicotine levels. Paper presented at the Annual Meeting of the Society for Research on Nicotine and Tobacco, New Orleans, LA, 27–28 March 1998.
- Frier ME, Bell RM, Ellickson PL. Do teens tell the truth? The validity of self-reported tobacco use by adolescents. (N-3291-CHF). Santa Monica, CA: Rand Corporation, March 1991.