Brief Report

A comparison of students and non-students with respect to orientation toward e-cigarettes

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Significance for public health

This is the first study that we are aware of that looks specifically at the differences between college students' and non-students' behaviours and attitudes toward electronic cigarettes. A critical concern for young adults is whether adoption of electronic cigarettes will eventually lead to adoption of tobacco use. In this study we find that differences between student and non-student groups can be largely accounted for by smoking status. However, students may be more vulnerable to electronic cigarette use due to higher related-information exposure and the integration of vaping into hookah culture.

Abstract

We examine differences between college students and non-students with respect to orientation toward e-cigarettes. Participants were U.S. adults 18-24 (465 students, 409 non-students). Data collection employed an online survey by GfK Custom Research. Smoking, vaping, and use of alternate tobacco were assessed, as were variables from the Theory of Reasoned Action and Diffusion of Innovations. This study showed that smoking status largely explains use and orientation toward electronic cigarettes among both students and non-students, with differences attributable to higher smoking rates among non-students. Results also showed that among student smokers there was a greater level of information exposure concerning electronic cigarettes, and more prevalence in the use of alternate tobacco. Hookah use in that group was significantly greater than for non-student smokers. Together these findings suggest that students may be more vulnerable to electronic cigarette use due to higher related information exposure and the integration of vaping into hookah culture.

Introduction

A growing body of research is available examining e-cigarettes with recent studies focusing on college students. Sutfin and colleagues surveyed college students from eight universities in North Carolina and report that while only 5% of the students had ever used an e-cigarette (in 2009), 12% of those individuals had never been smokers.[1] This is concerning as it is evidence for the potential of nicotine initiation in youth. In a smaller single-campus study, Trumbo and Harper focused on behavioural intention to try e-cigarettes and attitudes toward their use in public spaces.[2] They found that 71% of the students had heard of e-cigarettes and 13% had tried them. They also found that students were strongly more accepting of public vaping compared to smoking, suggesting that differences in social norms associated with e-cigarette use might support wider use. And Pokhrel and colleagues surveyed college students in Hawaii to examine the effect of outcome expectancies on use of e-cigarettes.[3] They present evidence that e-cigarette users are motivated by greater positive expectancies while non-users are motivated by greater negative expectancies.

The purpose of this study was to examine differences between young adults attending and not attending college with respect to their attitudes toward e-cigarettes, use of e-cigarettes, and associated tobacco use behaviour. Such comparisons have been made on a range of topics such as alcohol, hookah, or drugs.[4-6] We found no studies examining this difference for e-cigarettes.

It is important to examine differences in these two broad demographics because in the U.S. the pathway through young adulthood is very strongly determined by whether there is a continuation to higher education or not. While there is strong variance within each group, nonetheless the typical socioeconomic environments for the two groups differ strongly. Additionally, educational attainment is linked to better long-term health outcomes. Finally, an attendant aspect of such a comparison within the present context is to identify the unique effect of student status *versus* smoking status since smoking status has a particularly strong association with orientation and use of other tobacco products, including electronic cigarettes. Therefore, the analysis, detailed below, is designed to test for any student *versus* non-student differences that cannot be accounted for by smoking status.

Design and methods

Ethics and approval

The research presented in this article met the ethical guidelines, including adherence to the legal requirements, of the United States and received approval from the Colorado State University Institutional Review Board.

Study population

This study focuses on the population in the U.S. aged 18-24, 48% of whom are enrolled in a college or professional school (education beyond 12th grade).[7] Data collection was executed by GfK Custom Research through their online KnowledgePanel® survey services. A number of published studies have shown their sampling approach to be superior to random digit dialing (RDD) phone and other internet-based methods.[8] Students who attend a two- or four-year college or university either part- or full-time comprised approximately half of the sample; non-students made up the other half of the sample. Approval by the campus Institutional Review Board was obtained (exempt), and the survey was presented to 2032 KnowledgePanel participants between March 21 and April 2, 2013. Individuals who did not answer the first question, which verified student status, were terminated from

the survey. While free to leave the survey without penalty, respondents were required to complete all items in order to progress through the questionnaire such that missing data were not created. Respondents equalled 874 (465 students, 409 non-students, 43% completion rate). GfK provides a weighting scheme to adjust the sample to the population.

Questionnaire

Determination of variables to include in the study was based on a larger project (in progress) modelling e-cigarette use within the Theory of Reasoned Action and Diffusion of Innovations. Questionnaire items are available from the first author. Means and standard deviations are reported in Table 1.

Smoking and vaping status were each assessed using well-validated ongoing measures from the Behavioural Risk Factor Surveillance System.[9] The measure indicates (1 through 4) never, former, occasional, and daily use. Alternate tobacco use for five activities (hookah, pipe, cigar, snuff, chewing tobacco) was measured using an identical approach (1 through 4, never to daily, α=0.70).

Acceptability of smoking or vaping in public was measured following the Tobacco Use Supplement of the U.S. Census Current Population Survey.[10] This provides an estimate of social norms against tobacco smoking in public places. We asked respondents to state if smoking/vaping should be allowed in all areas, in some areas, or not at all in ten locations. Summing across the items yielded a 10-30 scale (smoking α=0.91, vaping α=0.98).

Behavioural intention, attitude, and perceived social norms were measured using best practice recommendations provided by Ajzen.[11] Intention was a single likelihood item (*How likely do you think it is that you would use an e-cigarette in the not-to-distant future, say in the next six months?* from absolutely not to absolutely yes). Attitude included three items (α=0.82) (*e.g.*, strongly agree to strongly disagree, *The use of e-cigarettes should be legal for adults*). Norms consisted of three pairs of items for *closest friends, most people I know, and closest family members*. This was computed as the sum of the product of the three-paired statements (α =0.84) (*e.g.*, strongly agree to strongly disagree *It would be acceptable to my very closest friends if I used e-cigarettes* with *When it comes to things like using an e-cigarette, it is important to me to follow the wishes of my very closest friends*).

Measures for the perceived innovation characteristics of e-cigarettes were based on the measurement study by Moore and the work of Rogers.[12,13] Two items were used for each of the five elements of an innovation (1-5 agree/disagree) for e-cigarettes' relative advantage, compatibility (*e.g.*, *I believe using e-cigarettes would fit in well with the lifestyle of most smokers*), complexity, trialability, and observability (*e.g.*, *It would be easy to tell whether a person was using an e-cigarette versus smoking tobacco*). The final measure was the sum of the 10 indicators (α=0.93).

An assessment of information exposure was also included. Participants were asked *Where have you heard or seen information about e-cigarettes?* and were provided a yes/no checklist including newspapers, magazines, television, the Web, and point of purchase (on store shelves). This formed an additive measure of the five items from 0 for no exposure to 5 for greatest exposure (α=0.41).

Statistical methods

All measures were coded so as to be consistent such that higher values indicate more positive orientations toward e-cigarettes and the likelihood of their use. Descriptive analyses used appropriate measures of central tendency and dispersion. Cronbach's alpha was used to assess scale reliability. Tests for differences and associations were done so as to separate the effect of student status and smoking status due to their conflation. Factorial ANOVA was used to compare differences in means across student status and smoking status, with effect sizes calculated (η^2). Partial correlations (r and eta) controlling for smoking status were used to assess associations within student status and to compare associations across student status. Across-group comparisons of associations were tested using Fischer's r-to-z transformation. Data were weighted for comparison of student and non-student groups. All analyses were conducted using Stata 13.

Results

Table 1 reports descriptive statistics and tests of differences between students and non-students, without regard to smoking status. The groups were equivalent in terms of sex, but non-students were somewhat older. There were no significant differences on the race/ethnicity

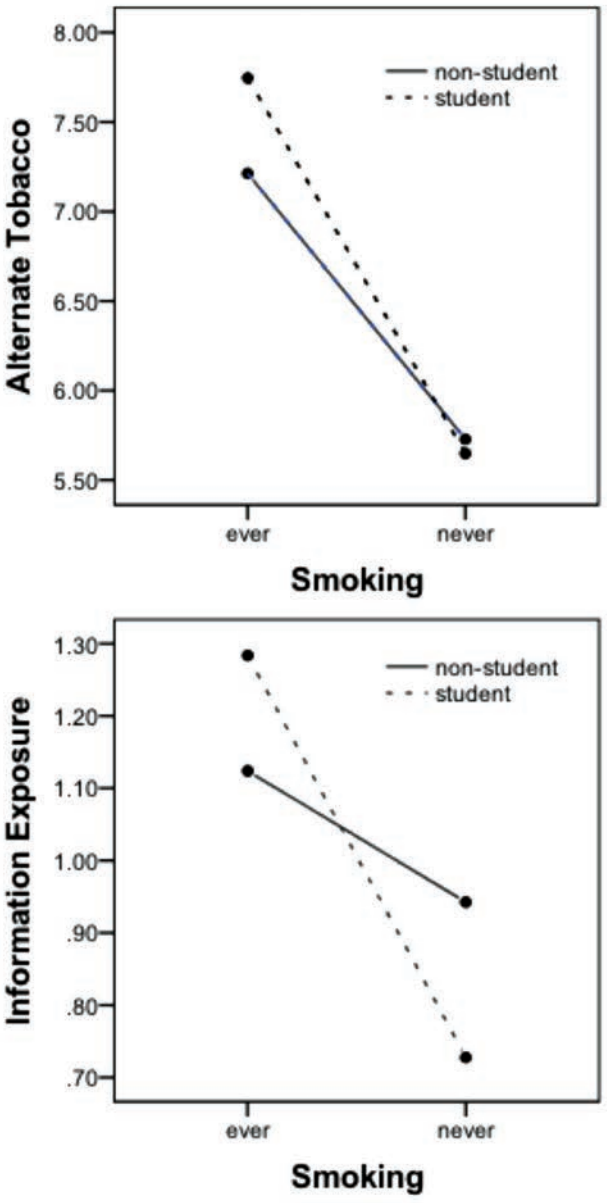

Figure 1. Significant interactions.

measures. While the percentages of former and occasional smoking were equivalent, a significantly greater proportion of students were never smokers, while a significantly greater proportion of non-students were daily smokers. On electronic cigarette use, a greater proportion of students were never vapers and a grater proportion of non-students were occasional vapers. There was not a significant difference at $P<0.05$ in the percentage of dual users (among the 144 current smokers, which might support a relaxed alpha in which case the rate is higher among non-students). Non-students were also significantly more approving of public smoking, had a greater intention to use electronic cigarettes, and reported greater information exposure on electronic cigarettes. There were no significant differences on the remaining items (public vaping, attitude, norms, and innovation).

Table 2 reports the simultaneous effects of smoking status (ever *versus* never) and student status on the eight variables of interest, with allowance for interaction terms. Significant differences were found for each variable conditioned on smoking, with uniformly small-to-medium effect sizes. Student status showed no main effects. Two significant

Table 1. Comparison of measures for student and non-student groups.

Variable	Group	P/M (SD)	test	P
Sex (female)	Student Non-student	52.5% 46.7%	$\chi^2_{(1)}=2.9$	0.09
Age (years)	Student Non-student	20.59 (1.85) 21.36 (2.05)	$t_{(872)}=5.8$	<0.001
White non-Hispanic	Student Non-student	63.0% 57.4%	$\chi^2_{(1)}=3.1$	0.08
Black non-Hispanic	Student Non-student	11.8% 14.5%	$\chi^2_{(1)}=1.3$	0.25
Other non-Hispanic	Student Non-student	8.4% 6.4%	$\chi^2_{(1)}=1.3$	0.25
Hispanic	Student Non-student	16.8% 21.8%	$\chi^2_{(1)}=3.5$	0.06
Never smoker	Student Non-student	84.3% 70.7%	$\chi^2_{(1)}=32.5$	<0.001
Former smoker	Student Non-student	4.3% 7.1%	$\chi^2_{(1)}=3.2$	0.07
Occasional smoker	Student Non-student	7.1% 6.4%	$\chi^2_{(1)}=0.2$	0.66
Daily smoker	Student Non-student	4.3% 15.9%	$\chi^2_{(1)}=33.3$	<0.001
Never vaper	Student Non-student	89.1% 84.1%	$\chi^2_{(1)}=4.6$	0.03
Former vaper	Student Non-student	9.0% 10.7%	$\chi^2_{(1)}=0.7$	0.39
Occasional vaper	Student Non-student	1.7% 4.1%	$\chi^2_{(1)}=4.6$	0.03
Daily vaper	Student Non-student	0.2% 1.0%	$\chi^2_{(1)}=2.2$	0.14
Dual use in current smokers	Student Non-student	9.4% 20.9%	$\chi^2_{(1)}=3.2$	0.08
Alt. tobacco scale	Student Non-student	5.92 (1.52) 6.12 (1.88)	$t_{(872)}=1.7$	0.09
Public smoking	Student Non-student	14.08 (3.86) 15.28 (4.31)	$t_{(872)}=4.3$	<0.01
Public vaping	Student Non-student	18.86 (7.08) 19.74 (7.48)	$t_{(872)}=1.8$	0.08
Behavioral intention	Student Non-student	1.64 (1.24) 1.90 (1.52)	$t_{(872)}=2.8$	<0.01
Attitude	Student Non-student	9.84 (2.83) 10.03 (2.89)	$t_{(872)}=1.0$	0.31
Norms	Student Non-student	22.10 (18.72) 24.47 (19.14)	$t_{(872)}=1.3$	0.21
Innovation	Student Non-student	32.21 (8.05) 33.44 (8.68)	$t_{(872)}=0.4$	0.69
Information	Student Non-student	0.82 (0.98) 0.99 (1.09)	$t_{(872)}=2.4$	<0.05

interaction effects were found, however, as reported in Table 2 and illustrated in Figure 1. A cross-over interaction was found for information exposure in which student ever smokers scored higher than non-student ever smokers and student never smokers scored lower than non-student never smokers (meaning, students who smoked had more exposure to information about e-cigarettes, but students who didn't smoke actually had less exposure to information about e-cigarettes than non-students). Also, student ever smokers scored higher on alternate tobacco use than did non-student ever smokers, while the never smokers were equivalent across student groups. A closer look revealed that hookah use was dominant. Among ever smokers, the hookah use score was significantly higher among students (1.97 *versus* 1.61, $t_{(191)}$=3.1 P<0.01), with 58.3% of the non-students having never tried hookah, compared to 27.4% of students ($\chi^2_{(3)}$=23.5 P<0.001). Further examination also shows a higher rate of vape/hookah dual use. Among the student ever smokers who vape some days or every day, 50% use hookah some days or every day. The rate among non-students is half that, 26.3% ($\chi^2_{(4)}$=17.6 P<0.01).

Table 3 reports partial correlations among the eight variables of interest, controlling for smoking status. Separate correlations were run for students and non-students. The Fischer r-to-z transformation was used to test for differences between coefficients. No significant differences were found, thus the correlations can be interpreted as equivalent. Different sample sizes account for some of the borderline contrasts between the groups (approximately r=0.10 required for significance). Despite no contrasts between student and non-students, the correlation analysis does reveal some interesting results. The variables can be considered as five attitudinal and two behavioural measures (with intention in the latter with alternate tobacco use). Each of the attitude measures presents a significant association with both of the behavioural measures, with the exception of information with intention. Of note, attitude, norms, innovation, and information have medium-to-strong associations with the two key variables of interest: behavioural intention to use an electronic cigarette and acceptability of public vaping.

Discussion and Conclusions

Foremost, this study showed that smoking status explains use and orientation toward electronic cigarettes among both students and non-students. Differences that might be observed based on student status are accounted for by the much higher smoking rate among non-students compared to students. The more subtle differences found in two significant interactions offer some additional insight, however.

The first involved use of alternate tobacco products. While the target outcome of this study was electronic cigarettes, the use of alternate tobacco products was assessed as a predictor. This variable is also of interest as contrasted by smoking and student status. The interaction

Table 2. ANOVA by student and smoking status.

Dependent	Factors	P	η^2
Public smoking	Smoke	<0.01	0.11
	Student	n.s.	
	Interaction	n.s.	
Public vaping	Smoke	<0.01	0.14
	Student	n.s.	
	Interaction	n.s.	
Intention	Smoke	<0.01	0.25
	Student	n.s.	
	Interaction	n.s.	
Attitude	Smoke	<0.01	0.06
	Student	n.s.	
	Interaction	n.s.	
Norms	Smoke	<0.01	0.10
	Student	n.s.	
	Interaction	n.s.	
Innovation	Smoke	<0.01	0.06
	Student	n.s.	
	Interaction	n.s.	
Information	Smoke	<0.01	0.02
	Student	n.s.	
	Interaction	<0.05	0.01
Alt. tobacco	Smoke	<0.01	0.16
	Student	n.s.	
	Interaction	<0.05	0.01

n.s., not significant.

Table 3. Partial correlations (controlling for smoking) for students (N=465) and non-students (N=409).

	Public vaping	Alt. tobacco	Intention	Attitude	Norms	Innovation	Information
Public smoking, students	0.50**	0.21**	0.10*	0.30**	0.19**	0.28**	0.06
Public smoking, non-students	0.46**	0.10	0.10*	0.19**	0.24**	0.23**	0.17**
Public vaping, students		0.15**	0.08	0.55**	0.29**	0.49**	0.13**
Public vaping, non-students		0.08	0.12*	0.51**	0.32**	0.52**	0.25**
Alt. tobacco, students			0.19**	0.19**	0.13**	0.13**	0.14**
Alt. tobacco, non-students			0.30**	0.06	0.05	0.08	0.12*
Intention, students				0.13**	0.13**	0.05	0.07
Intention, non-students				0.12*	0.17**	0.15**	0.03
Attitude, students					0.52**	0.86**	0.18**
Attitude, non-students					0.60**	0.90**	0.20**
Norms, students						0.56**	0.09
Norms, non-students						0.62**	0.13**
Innovation, students							0.19**
Innovation, non-students							0.22**

*P<0.05, **P<0.01. No pairs significantly different at P<0.05 using Fischer r-to-z transformation (two-tailed test).

shows that by a significant margin student ever smokers are more avid users of alternate tobacco products. The role of hookah use and hookah/vape dual use was also examined in this analysis. It is well established that hookah use has become a growing part of college life. The results of this study provide further evidence of this, and also provide a glimpse of the dual use of electronic cigarettes with hookah, an indicator that electronic cigarettes are becoming a part of the nicotine ecology on college campuses.

The second interaction also offers some insight. Student ever smokers report a significantly greater exposure to information on electronic cigarettes. The study did not assess the nature of information, which might be in various forms including news reports or advertising. The study also did not assess passive information exposure *versus* active information seeking. Nonetheless these results point toward the proliferation of electronic cigarette stores near college campuses and suggest the likelihood of electronic cigarette marketing directed at the college demographic. Many studies have shown that a significant proportion of youth tobacco initiation can be linked to advertising exposure,[14] and that Internet-based marketing (the primary method for e-cigarettes) may be particularly effective in the initiation of electronic cigarette use in young adults, especially those in college.[15] Clearly further work is needed on the effect of e-cigarette advertising.

Limitations of this study include self-report items for measurement, the narrow age-range of participants, and the cross-sectional design. A more critical limitation resides in the measurement of smoking and vaping status. The response category *former* fails to allow for the assessment of the extent a respondent had formerly smoked or vaped. These respondents may have tried either only once, or may have experimented for a period and quit.

The results of this study point toward avenues for future investigation and potential policy guidance. Investigation of orientation toward and use of electronic cigarettes in the young adult population should attend especially to the next cohort of individuals, which as noted above are known to be experimenting with electronic cigarettes at a significantly increasing rate. How these individuals will orient toward the range of tobacco products as they move away from home and into independent life on or off of a college campus merits monitoring. Policy efforts to make college campuses entirely tobacco free should certainly continue and expressly include electronic cigarettes, as should smoking prohibited zones elsewhere in communities. In terms of current regulatory policy discussions, this study along with a growing number of others advocate for the extension of tobacco advertising regulations to electronic cigarettes.

In conclusion, this is the first study that we are aware of that looks specifically at the differences between college students' and non-students' behaviours and attitudes toward electronic cigarettes. A critical concern with respect to young adults is whether adoption of electronic cigarettes might lead to adoption of tobacco use, especially since the positive expectancies are similar for both products. In this study we found smoking status to be the main driver for electronic cigarette use, which should offer some positive encouragement for those engaged with promoting healthy behaviours on college campuses – college life does not appear to place young adults at greater risk for electronic cigarette use. However, the results also offer a cautionary note as the student population was shown to be more engaged with electronic cigarette messages and the use of electronic cigarettes is becoming normalized within the broader nicotine social ecology on campuses. These factors may point toward vulnerabilities for the expansion of vaping on campuses.

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Key words: Electronic cigarettes; students; non-students; public use; reasoned action.
Contributions: CT participated in the design of the study. CT and RH conducted data collection and performed the statistical analysis. All authors drafted and approved the final manuscript.
Conflict of interest: the authors declare no potential conflict of interest.
Funding: this research was supported by a Grant from the National Institute on Drug Abuse (1R03DA033578-01) to Dr Trumbo.
Received for publication: 6 July 2015.
Accepted for publication: 12 January 2016.

Journal of Public Health Research 2016;5:595
doi:10.4081/jphr.2016.595

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