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# BMJ Open Prevalence of and factors associated with violations of a campus smoke-free policy: a cross-sectional survey of undergraduate students on a university campus in the USA

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## ABSTRACT

**Objective** The aim of this study is to estimate the prevalence of smoking behaviour on campus and to identify the key factors that influence adherence to a campus smoke-free policy.

**Design & participants** This study employed a cross-sectional, self-administered survey of undergraduate students at the University of Mississippi. A random sample of all available undergraduate classes was recruited for data collection. Students were provided a survey that included questions on demographics, alcohol use, smoking status, policy awareness, policy attitudes, smoking attitudes, policy support, barriers to policy success and policy violations.

**Results** The prevalence of past 30-day smoking was 23%. More than 63% of current smokers report ever smoking on campus, but less than 10% ever received a warning or a ticket for their violation. Nearly all respondents (92.5%) reported witnessing someone smoking on campus, and 22% reported witnessing someone receiving a ticket. Barriers to policy success include lack of reminders about the policy, lack of support from students and University administrators, and insufficient fines. Smoking behaviour (OR: 7.96; 95% CI: 5.13 to 12.36), beliefs about policy adherence (OR: 0.52; 95% CI: 0.40 to 0.69), support for the policy (OR: 0.71; 95% CI: 0.55 to 0.91) and attitudes against smoking behaviour (OR: 0.35; 95% CI: 0.25 to 0.49) were all significantly associated with self-reported policy violations.

**Conclusions** This study found that violations of the campus smoke-free policy were fairly frequent and the policy has been largely ineffective, indicating a need for other interventions. Approaches to improve adherence to the policy should address barriers such as reminders about the policy, better policy enforcement and support from the administration.

## INTRODUCTION

Tobacco use is the single most preventable risk to human health, and is the direct cause of over 480 000 deaths annually in the USA.<sup>1</sup> Coordinated tobacco cessation efforts by several public health agencies and healthcare

## Strengths and limitations of this study

- This study evaluated violations of a campus smoke-free policy using campus-wide survey with a large number of respondents.
- This study assessed both self-reported policy violations and witnessing policy-violations by others, providing multiple perspectives on campus smoking behaviour.
- This study did not assess the effectiveness of the smoke-free policy and only includes data collected after the policy was implemented.

providers have successfully reduced the prevalence of smoking over the past 10–15 years<sup>1–3</sup>. The prevalence of past 30-day cigarette and electronic cigarette (e-cigarette) smoking among US undergraduate students in the fall of 2015 was estimated to be 9.8% and 5.4%, respectively.<sup>4</sup> In the fall of 2018, cigarette and e-cigarette use in this group was estimated to be 7.5% and 15.2%, respectively.<sup>5</sup> While the overall trend for cigarette smoking has been decreasing, there continues to be a small proportion who continue to smoke cigarettes, and the use of e-cigarettes among US college students has increased recently. Tobacco cessation efforts have targeted and continue to target the college student population through policies and interventions aimed at university campuses. The American College Health Association (ACHA), and other organisations, have advocated for prohibition of all tobacco use in indoor and outdoor environments on university campuses.<sup>6</sup> This recommendation is supported by several studies that have demonstrated wide support for smoke-free policies among university students and staff.<sup>7–12</sup> There has been a 300% increase in the use of smoke-free policies since 2010, with



over 2000 universities implementing such policies, as of October, 2017.<sup>2 13</sup>

However, there is wide variation in the nature of these policies with many policies lacking clarity or combined with weak enforcement practices.<sup>14 15</sup> Research into the effectiveness of campus smoke-free policies has found mixed results, with some universities reporting frequent policy violations and low compliance rates,<sup>15–19</sup> while some others report considerable reduction in smoking prevalence and exposure to secondhand smoke.<sup>18 20 21</sup> There is limited research on the factors affecting policy compliance and strategies to improve compliance to smoke-free policies on college campuses.<sup>22–24</sup>

The support for and effectiveness of smoking cessation policies can be influenced by societal antismoking norms,<sup>8 21 25</sup> smoking behaviour,<sup>8 21 26</sup> perceptions of peer tobacco use,<sup>21</sup> and demographic variables such as gender and race.<sup>7</sup> The current study utilises the framework proposed by Fong *et al* that guided the development of the International Tobacco Control policy evaluation project.<sup>27</sup> This project has evaluated the impact of regulations, such as smoke-free policies, in several countries. The framework proposes that policies influence several policy-specific psychosocial variables—such as beliefs and attitudes, normalisation of beliefs, self-efficacy and intentions—which in turn influence policy-related outcomes, such as prevalence of smoking. Other variables, such as socio-demographics and smoking status, may moderate the relationship between psychosocial variables and policy outcomes.<sup>27</sup> The current study focuses on psychosocial variables such as smoking attitudes, policy support and policy attitudes, and examines how the effects of these variables on policy outcomes are influenced by smoking status.

On the campus of the University of Mississippi, a smoke-free policy was implemented on 1 August 2012 to help reduce smoking prevalence. This policy prohibited all students, staff, employees and visitors from all forms of smoking which refers to inhaling, exhaling, burning, carrying or possessing any lighted tobacco product, including cigarettes, cigars, pipe tobacco and any other lit tobacco products, including e-cigarettes that emit smoke and littering of tobacco products.<sup>28</sup> This policy affects all indoor and outdoor grounds including residence halls and personal vehicles. Since implementation, few steps have been taken to evaluate the prevalence of on-campus smoking and students' adherence to the policy. The specific aim of the current study was to evaluate adherence to the campus smoke-free policy, estimate the prevalence of on-campus smoking behaviour, identify the key factors that influence policy violations and measure barriers to successful implementation of a smoke-free policy. While the policy includes prohibition of several other behaviours such as littering and even possessing tobacco products, this study chose to focus specifically on smoking behaviour among college students, because they constituted a high-risk population for such violations.

## METHODS

### Study design and procedures

This study employed a cross-sectional, self-administered survey of undergraduate students at the University of Mississippi. The sampling frame included a list of all undergraduate classes offered in the fall semester of 2015 on the Oxford campus, as recorded by the University's Registrar. After excluding classes that were too small (less than four students), or were independent studies, a random sample of the remaining classes was chosen for inclusion in the study. Instructors of record for the chosen classes were contacted to request permission to distribute surveys in their classes. After obtaining instructor approval, the research team distributed a short survey at the beginning of each class. No additional eligibility criteria were implemented other than being enrolled in the class at the time of the survey. Student participation was voluntary, and no incentives were offered in return for participation. On opening the survey booklet, potential respondents were provided with information about the study, including contact details for the institutional review board (IRB). Respondents' completion of the survey constituted consent, as approved by the IRB. Students who were present in more than one participating class were requested to participate no more than once, to prevent repeat administration.

### Study measures

The survey included questions on respondent demographics, alcohol use, smoking status, policy awareness, policy attitudes, smoking attitudes, policy support, barriers to policy success and policy violations. Respondent demographics and alcohol use questions were modelled after the ACHA's National College Health Assessment report.<sup>4</sup> Current smoking status has been operationalised in a variety of ways in the extant literature.<sup>29</sup> Among adults, current smoking status is defined by the Centers for Disease Control and Prevention as having smoked at least 100 cigarettes in a lifetime *and* smoking every day or on some days at the time of assessment.<sup>30</sup> However, in a population of young adults, among whom new smokers, infrequent smokers and intermittent smokers are common, assessment of past 30-day smoking behaviour can be a better predictor of violation of smoke-free policies. Therefore, this study defined current smokers as those respondents who smoked at least one cigarette during the past 30 days. This characterisation of smoking behaviour was found applicable for the college student and young adult populations in previous studies.<sup>31–33</sup>

In order to measure awareness of the campus smoking policy, respondents were asked to identify the correct policy from a list of four options of varying stringency. Respondents were classified as being aware of the policy if they chose smoke-free campus (the correct policy), or tobacco-free campus, which is more rigorous than the actual policy.<sup>8</sup> Respondents' attitudes about the policy were measured using six items, adapted from Chaaya *et al*, using a five-point Likert response format.<sup>26</sup> Measures

assessing smoking attitudes (six items), support for the policy (four items) and barriers to policy success (11 items) were adapted from prior research and measured using five-point response formats.<sup>7 8 26 34 35</sup>

The variable of interest in this study, policy outcomes, was operationalised in two ways: (1) as a self-violation of the campus smoke-free policy and (2) witnessing violations of the policy by others. Respondents who self-reported smoking on campus and/or receiving a warning/ticket for smoking on campus were identified as violating the policy,<sup>26</sup> creating a dichotomous variable. Respondents' witnessing of policy violations by others was assessed using four dichotomous items that asked if respondents had ever: witnessed someone smoking on campus, knew of someone who received a warning/ticket for smoking on campus, been exposed to secondhand smoke on campus and had to alter their walking route on campus in order to avoid smoke.

### Statistical analyses

Data were collected via paper surveys and entered into Excel. Data entry was conducted by two independent researchers, and data were checked for discrepancies to prevent errors. IBM SPSS V.25 was used for data analysis. Descriptive analyses were conducted for all items in the survey. Bivariate relationships between current smoking status and other demographic variables were tested using  $\chi^2$  tests for categorical variables and t-tests for continuous variables. Principal components analysis (PCA) was conducted to assess the dimensionality of the three multi-item measures that were used as predictors in subsequent regression analyses: policy attitudes, smoking attitudes and policy support. Logistic regression was conducted to predict self-reported violation of the policy using the demographic and psychosocial variables measured in the study as independent variables. Because the effects of demographics and psychosocial variables on the policy outcomes were expected to differ between current smokers and non-smokers, smoking status was introduced as a moderator of the effects of the hypothesised study predictors in the logistic regression model by including interaction terms. Descriptive statistics were used to summarise the prevalence of witnessing policy violations by others.

### Participant and public involvement

There was no direct involvement of participants nor the public in the development, conceptualisation or conduct of the study, nor in the interpretation of the results. An overview of the study was presented at campus meetings, but results were not directly disseminated to individual study participants as the survey was conducted anonymously.

## RESULTS

Forty-seven, out of a total of 94 invited instructors, agreed to the request for study participation. Survey

administrators distributed copies of the surveys to 1704 students in 60 course sections. Fifty students were not eligible to participate either because they were less than 18 years old, or they had already completed the survey in a different class section. Of the remaining 1654 students, 1541 surveys were collected with at least one completed response, leading to a response rate of 93%. After deleting responses that had missing responses on more than 30 out of the 63 items on the survey, analyses were conducted on 1512 responses. As seen in [table 1](#), the sample was composed of nearly 60% women, 78% Caucasians, 50% freshmen/sophomores, 53% state residents and 47% enrolled in Greek organisations. The majority of respondents were 20 years old or younger, lived off-campus and were single. Twenty-three per cent of respondents self-reported smoking in the past 30 days and were classified as current smokers. Nearly 60% of the sample reported being exposed to secondhand smoke on campus at least once in the past week, and almost 20% of the sample reported consuming alcohol at least 10 days in the past month. Women, minorities and students living on-campus were less likely to be current smokers, in bivariate analyses. In contrast, students enrolled in Greek houses were more likely to be current smokers.

Among the variables related to the campus smoke-free policy, 85% of respondents reported being aware of the campus smoking policy and more than 88% of respondents correctly chose smoke-free or tobacco-free as the campus policy. More than 63% of current smokers report ever smoking on campus, but less than 10% ever received a warning or a ticket for their violation. Nearly all respondents (92.5%) reported witnessing someone smoking on campus, but only 22% reported witnessing someone receiving a ticket or warning for smoking on campus. Nearly three-fourths of the respondents reported being exposed to secondhand smoke on campus at least once and more than 25% of respondents reported altering their walk on campus to avoid smoke. Very few respondents reported witnessing none of the violations by others of the campus smoke-free policy (6.3%; [table 1](#)). Overall, witnessing smoking policy violations by others was more likely to be reported by current smokers than non-smokers. Specifically, current smokers were more likely to witness others smoking or receiving a ticket, but non-smokers were more likely than current smokers to report altering their walk on campus to avoid smoke.

### Barriers to policy adherence

Considering all respondents together, the most frequently cited barrier to a successful smoke-free campus policy was inadequate funding for implementation of the policy with 55.6% (840) of all respondents selecting strongly agree or agree ([table 2](#)). Other barriers receiving high levels of agreement from all respondents include difficulty to enforce (40.4%, 611), lack of information about the policy (37.4%, 565), lack of support from staff (35.3%, 534) and faculty (32.6%, 492), and lack of enforcement (31.8%, 481). Current non-smokers

**Table 1** Characteristics of the study sample

Characteristic	Total n=1512	Current smokers* n=353	Current non-smokers n=1158	P value
	N (%)	N (%)	N (%)	
Age				0.318
18 to 20	957 (64.5)	213 (61.2)	744 (65.6)	
21 to 24	491 (33.1)	125 (35.9)	365 (32.3)	
25+	36 (2.4)	10 (2.9)	26 (2.3)	
Female	904 (60.9)	114 (32.8)	789 (69.5)	<0.001
Race				<0.001
White	1177 (77.8)	308 (87.3)	868 (75.0)	
Black	179 (11.8)	12 (3.4)	167 (14.4)	
Non-black minorities	156 (10.3)	33 (9.3)	123 (10.6)	
Past-smoker	45 (3.0)	10 (2.8)	35 (3.0)	0.854
International student	48 (3.2)	13 (3.7)	35 (3.1)	0.548
Resident of the state of Mississippi	790 (53.4)	169 (48.8)	620 (54.7)	0.055
Greek membership	711 (47.9)	185 (53.2)	525 (46.3)	0.025
Class year				0.226
Freshman	295 (19.9)	56 (16.1)	239 (21.1)	
Sophomore	450 (30.3)	111 (31.9)	339 (29.9)	
Junior	406 (27.4)	102 (29.3)	303 (26.7)	
Senior and above	332 (22.4)	79 (22.7)	253 (22.3)	
Mean GPA (SD)	3.19(0.48)	3.06(0.47)	3.23(0.48)	<0.001
On-campus housing	493 (33.2)	91 (26.1)	402 (35.4)	0.001
Marital status				0.691
Single	1422 (95.9)	334 (96.3)	1087 (95.8)	
Married/partnered	44 (3.0)	8 (2.3)	36 (3.2)	
Divorced	5 (0.3)	2 (0.6)	3 (0.3)	
Other	12 (0.8)	3 (0.9)	9 (0.8)	
Frequency of alcohol consumption in past 30 days				<0.001
None (0 days)	298 (20.1)	11 (3.2)	287 (25.4)	
Low (1 to 6 days)	529 (35.8)	72 (20.7)	456 (40.4)	
Medium (7 to 10 days)	353 (23.9)	110 (31.6)	243 (21.5)	
High (more than 10 days)	299 (20.2)	155 (44.5)	144 (12.7)	
Exposure to secondhand smoke on campus in past 7 days				<0.001
0 days	616 (40.8)	142 (40.3)	474 (41.0)	
1 to 3 days	695 (46.1)	140 (39.8)	554 (48.0)	
4 to 6 days	117 (7.8)	33 (9.4)	84 (7.3)	
All 7 days	80 (5.3)	37 (10.5)	43 (3.7)	
E-cigarette smoking frequency				<0.001
Every day	15 (1.0)	4 (1.1)	11 (1.0)	
Some day	54 (3.6)	37 (10.5)	17 (1.5)	
Not at all	1441 (95.4)	312 (88.4)	1129 (97.6)	
Self-reported awareness of smoking policy				0.002
Yes	1291 (85.4)	322 (91.2)	968 (83.6)	
No	67 (4.4)	11 (3.1)	56 (4.8)	
Not sure	154 (10.2)	20 (5.7)	134 (11.6)	

Continued

Table 1 Continued

Characteristic	Total n=1512	Current smokers* n=353	Current non-smokers n=1158	P value
	N (%)	N (%)	N (%)	
What is the smoking policy on campus?				0.123
Tobacco-free campus	360 (24.0)	66 (18.9)	293 (25.5)	
Smoke-free campus	979 (65.4)	245 (70.2)	734 (64.0)	
Limited-smoking campus	122 (8.1)	29 (8.3)	93 (8.1)	
Smoke-free indoors	24 (1.6)	5 (1.4)	19 (1.7)	
Smoking allowed within 25 feet of property	12 (0.8)	4 (1.1)	8 (0.7)	
Policy awareness	1339 (88.6)	311 (88.1)	1027 (88.7)	0.762
Ever smoked on campus	292 (19.3)	223 (63.4)	69 (6.0)	<0.001
Ever received a warning or ticket for smoking on campus	38 (2.5)	32 (9.1)	6 (0.5)	<0.001
Ever witnessed someone smoking on campus	1397 (92.5)	341 (96.6)	1055 (91.2)	0.001
Know of someone else who received a warning or ticketed for smoking on campus	333 (22.1)	160 (45.3)	173 (15.0)	<0.001
Ever exposed to secondhand smoke on campus	1129 (74.7)	269 (76.4)	859 (74.2)	0.397
Ever altered my walk on campus to avoid smoke	391 (25.9)	18 (5.1)	373 (32.2)	<0.001
Self violation of the campus smoking policy†	293 (19.4)	224 (63.6)	69 (6.0)	<0.001
Number of different violations by others of the policy witnessed‡				0.002
0	95 (6.3)	10 (2.8)	85 (7.3)	
1	232 (15.3)	46 (13.0)	186 (16.1)	
2	597 (39.5)	158 (44.8)	438 (37.8)	
3	528 (34.9)	130 (36.8)	398 (34.4)	
4	60 (4.0)	9 (2.5)	51 (4.4)	

Percentages expressed in the table are based on denominators that exclude missing responses.

\*Past 30-day user: Smoked at least one cigarette during the past 30 days.

†Self violation of the campus smoking policy was defined as either ever smoking on campus or receiving a warning or ticket for smoking on campus.

‡Number of different violations by others of the policy witnessed is the sum of four dichotomous items: ever witnessed someone smoking on campus, know of someone else who received a warning or ticketed for smoking on campus, ever exposed to secondhand smoke on campus and ever altered my walk on campus to avoid smoke.

GPA, grade point average.

rated six of the 11 barriers—inadequate funding, lack of information about the policy, lack of support from staff, infringement of personal freedoms, insufficient fines and lack of reminders—less frequently than past 30-day smokers. Only one barrier, difficult to enforce, received a lower agreement by past 30-day smokers compared to non-smokers.

### Smoke-free policy attitudes, smoking attitudes and policy support

Using PCA, a two-factor solution was obtained for respondents' attitudes towards the smoke-free policy. The two factors, labelled 'policy adherence' and 'policy justification', had four items and two items each, with reliabilities (Cronbach's alpha) of 0.81 and 0.72, respectively. On a scale of 1 to 5, respondents rated policy adherence an

average score of 2.6 (SD: 0.8), and policy justification an average score of 3.8 (SD: 0.9). A single-factor solution was obtained for both respondents' attitudes towards smoking (mean: 3.7; SD: 0.9; higher scores are indicative of negative attitudes towards smoking or positive attitudes about non-smoking behaviour) and support for the policy (mean: 3.8; SD: 1.1) with reliabilities of 0.89 and 0.85, respectively. The factor loadings for each of the scales, along with the mean scores and SD for the total sample as well as for current (past 30-day) smokers and non-smokers, are provided in table 3.

### Factors predicting self-reported violation of the campus smoke-free policy

In a logistic regression model predicting self-reported violation of the campus smoke-free policy (table 4), current

**Table 2** Student perceptions of barriers to a successful campus smoke-free policy

Barrier	Total % (N)*	Current smokers† % (N)*	Current non-smokers % (N)*	P value
Inadequate funding	55.6 (840)	62.0 (219)	53.6 (621)	0.005
Difficult to enforce	40.4 (611)	26.1 (92)	44.8 (519)	<0.001
Lack of information about policy	37.4 (565)	42.8 (151)	35.8 (414)	0.017
Lack of support from staff	35.3 (534)	49.9 (176)	30.9 (358)	<0.001
Lack of support from faculty	32.6 (492)	35.4 (125)	31.7 (367)	0.192
Lack of enforcement	31.8 (481)	35.1 (124)	30.8 (357)	0.129
Policy infringes on individuals' personal freedom	27.5 (415)	39.1 (138)	23.9 (277)	<0.001
Insufficient fines	25.9 (391)	39.9 (141)	21.6 (250)	<0.001
Lack of support from University administrators	20.0 (302)	20.7 (73)	19.8 (229)	0.710
Lack of reminders about the policy	16.0 (242)	24.6 (87)	13.4 (155)	<0.001
Lack of support from students	15.8 (238)	15.9 (56)	15.7 (182)	0.947

Barriers were measured using a 1 (not a barrier) to 5 (extreme barrier) response format.

\*Percentage of respondents who selected strongly agree or agree.

†Past 30-day user: Smoked at least one cigarette during the past 30 days.

(past 30-day) smokers unsurprisingly are estimated to have at least five times the odds (OR: 7.96; 95% CI: 5.13 to 12.36) of reporting that they had violated the policy compared to non-smokers and women had lower odds (OR: 0.36, 95% CI: 0.24 to 0.55) of violating the policy compared to men. Stronger beliefs about policy adherence (OR: 0.52; 95% CI: 0.40 to 0.69), greater support for the policy (OR: 0.71; 95% CI: 0.55 to 0.91), stronger attitudes against smoking behaviour (OR: 0.35; 95% CI: 0.25 to 0.49), and higher grade point average (GPA) (OR: 0.54; 95% CI: 0.35 to 0.82) were all related to lower odds of violating the policy. Non-black minorities (OR: 2.66; 95% CI: 1.28 to 5.51), on-campus residents (OR: 1.80; 95% CI: 1.02 to 3.16), in-state students (OR: 1.60; 95% CI: 1.05 to 2.46) and students who reported a high frequency of alcohol consumption (OR: 2.49; 95% CI: 1.17 to 5.31) had higher odds of violating the policy when compared with Caucasians, off-campus residents, out-of-state students and students who reported not consuming any alcohol in the past 30 days, respectively. There were no significant interactions of past 30-day smoking status with any of the predictors in the model.

## DISCUSSION

In an evaluation of adherence to a campus smoke-free policy, this study obtained a response rate of over 90% from a random sample of classes offered on campus. The undergraduate population on campus is composed of 55% females, 77% Caucasians, 30% freshmen, 20% sophomores, 22% juniors, 28% seniors and 42% Greek organisation members, which closely approximates the distribution obtained in this study.<sup>36 37</sup> An annual survey funded by the state Department of Health during the spring semester of 2016 found that 30.2% of respondents smoked at least one cigarette in the past 30 days

which is higher than the 23% found in this study.<sup>38</sup> The discrepancy in the prevalence estimates may be explained by the fact that the Department of Health funded survey had only a 7.3% response rate and included a non-representative distribution of the student population.<sup>38</sup> Nevertheless, the estimated 9.8% national prevalence of past 30-day smoking among undergraduate college students<sup>4</sup> is much lower than the prevalence found in the current study comprised of University of Mississippi undergraduate students.

Overall, almost 90% of the respondents were aware of the campus smoking policy and nearly 20% reported violating the policy. The prevalence of self-reported policy violations was nearly 64% among current smokers and 6% among non-smokers (who have may been past smokers). Even though the survey was completely anonymous, it is possible that social desirability bias led to an underestimate of the prevalence of policy violations. An overwhelming majority of the respondents, 94%, reported witnessing at least one violation of the campus smoke-free policy by others, implying that the policy has been largely unsuccessful. In line with expectations, respondents who believed the policy was effective had lower odds of violating the policy themselves. Self-reported policy violations were also associated with smoking behaviour and alcohol consumption, which is in line with the expectation that these risk behaviours often manifest concomitantly.<sup>39</sup> Extant literature shows risk behaviours such as smoking tend to be associated with a lower GPA,<sup>40 41</sup> and this finding was corroborated in the current study. Neither membership in Greek organisations nor class year were related to self-reported policy violations. In this study, witnessing policy violations by others was reported at a higher rate than self-reporting them, indicating the possible role of social desirability bias in reporting policy violations.

**Table 3** Student attitudes towards smoking and the campus smoke-free policy

Item	Factor loading	Total Mean (SD)	Current smokers* Mean (SD)	Current non-smokers Mean (SD)	P value
<b>Student attitudes towards the campus smoke-free policies: Policy Adherence Subscale</b>					
The current policy is effective	0.765	2.9 (1.1)	2.8 (1.1)	2.9 (1.1)	0.085
The current policy is enforced	0.791	2.7 (1.1)	2.8 (1.0)	2.6 (1.1)	0.032
Most smokers comply with the current policy	0.816	2.6 (1.0)	2.6 (1.0)	2.7 (1.0)	0.155
The current policy is ignored by smokers†	0.774	2.2 (1.0)	2.2 (1.0)	2.2 (1.0)	0.976
Total subscale score (alpha=0.81)	–	2.6 (0.8)	2.6 (0.8)	2.6 (0.8)	0.746
<b>Student attitudes towards the campus smoke-free policies: Policy Justification Subscale</b>					
The current policy is justified	0.880	3.7 (1.1)	3.1 (1.1)	3.82 (1.0)	<0.001
The current policy helps create a healthy environment	0.857	3.9 (1.0)	3.6 (1.0)	4.0 (1.0)	<0.001
Total subscale score (alpha=0.72)	–	3.8 (0.9)	3.4 (0.9)	3.9 (0.9)	<0.001
<b>Student attitudes towards smoking</b>					
If someone smokes cigarettes around me they are causing me harm because of secondhand smoke	0.788	4.0 (1.0)	3.1 (1.1)	4.2 (0.9)	<0.001
I prefer to socialise in a smoke-free environment	0.867	4.0 (1.1)	3.0 (1.0)	4.3 (0.9)	<0.001
I seek out smoke-free environments	0.871	3.5 (1.3)	2.4 (1.0)	3.8 (1.1)	<0.001
It disappoints me when a friend who normally doesn't smoke, smokes cigarettes while drinking	0.821	3.4 (1.3)	2.1 (1.0)	3.8 (1.2)	<0.001
I would rather date a non-smoker	0.693	4.4 (0.9)	3.7 (1.1)	4.6 (0.7)	<0.001
I ask others not to smoke around me	0.795	3.1 (1.3)	2.0 (1.1)	3.4 (1.3)	<0.001
Total scale score (alpha=0.89)	–	3.7 (0.9)	2.7 (0.7)	4.0 (0.8)	<0.001
<b>Student support for the campus smoke-free policy</b>					
Smoking should be banned in all university buildings	0.643	4.5 (0.9)	4.1 (1.2)	4.6 (0.8)	<0.001
Smoking should be banned on all university property	0.874	3.6 (1.3)	2.5 (1.3)	4.0 (1.2)	<0.001
All tobacco products should be banned in all university buildings	0.867	3.7 (1.4)	2.9 (1.5)	4.0 (1.2)	<0.001
All tobacco products should be banned on all university property	0.900	3.2 (1.4)	2.2 (1.2)	3.5 (1.3)	<0.001
Total scale score (alpha=0.85)	–	3.8 (1.1)	2.9 (1.0)	4.0 (1.0)	<0.001

All items were measured using a 1 (strongly disagree) to 5 (strongly agree) response format.

\*Past 30-day user: Smoked at least one cigarette during the past 30 days.

†This item was reverse coded prior to calculation of the scale score.

This study found that, despite high levels of policy awareness, smoke-free policies are largely ineffective at curtailing smoking behaviour on university campuses. The ineffectiveness of the policy was reflected in the fact that nearly 75% of respondents have been exposed to secondhand smoke on campus, which is the primary purpose of a smoke-free policy. The most significant barrier to a successful smoke-free campus policy was the lack of adequate funding and the difficulty of enforcing the policy. However, smokers and non-smokers highlighted different barriers. Smokers rated both inadequate

funding and lack of support from staff very highly, while non-smokers acknowledged the difficulty in enforcing the law much more frequently than smokers. The other highly rated barriers to success, lack of information, lack of support from staff and faculty, and lack of enforcement also indicate a lack of buy-in for policy enforcement. The results of this study must be interpreted in the context of these limited enforcement efforts. Less than 3% of respondents received a ticket, while nearly 20% reported violating the policy. This discrepancy suggests a greater need for reminders which might not be necessary



**Table 4** Logistic regression results predicting self-violation of campus smoke-free policy

Characteristic	Violation of the campus smoke-free policy	
	Adjusted OR (95% CI)	P value
Current smoker*	7.96 (5.13 to 12.36)	<0.001
Policy Adherence Subscale	0.52 (0.40 to 0.69)	<0.001
Policy Justification Subscale	0.98 (0.76 to 1.27)	0.898
Smoking Attitudes Scale	0.35 (0.25 to 0.49)	<0.001
Policy Support Scale	0.71 (0.55 to 0.91)	0.008
Policy awareness	1.24 (0.68 to 2.25)	0.486
Female	0.36 (0.24 to 0.55)	<0.001
Age		
18 to 20 years	Reference	
21 to 24 years	0.76 (0.41 to 1.42)	0.386
25 and older	0.93 (0.24 to 3.62)	0.917
Race		
Caucasian	Reference	
African-American	1.42 (0.69 to 2.89)	0.339
Other minorities	2.66 (1.28 to 5.51)	0.009
Resident of Mississippi	1.60 (1.05 to 2.46)	0.031
International	1.58 (0.52 to 4.79)	0.420
Greek membership	1.21 (0.78 to 1.88)	0.401
Class year		
Freshman	Reference	
Sophomore	1.45 (0.70 to 2.99)	0.316
Junior	1.60 (0.72 to 3.56)	0.250
Senior and above	2.26 (0.88 to 5.79)	0.091
GPA	0.54 (0.35 to 0.82)	0.004
On campus residence	1.80 (1.02 to 3.16)	0.042
Frequency of alcohol use		
None	Reference	
Low	1.24 (0.60 to 2.54)	0.563
Medium	1.77 (0.83 to 3.75)	0.139
High	2.49 (1.17 to 5.31)	0.018

\*Past 30-day user: Smoked at least one cigarette during the past 30 days.

GPA, grade point average.

on campuses where the policy is strictly enforced. The measurement of barriers also shows that many respondents believe it was important to have support from students, faculty and administrators in order to implement the policy. While the nature of this support was not defined as part of the survey, it appears that most respondents believe the entire campus community needs to buy-in in order to successfully implement this policy. This community support may be in the form of students and faculty discouraging campus smoking behaviour, peer approval and social norms, among others.

Contrary to expectations from previous research,<sup>17 21 26 42</sup> the prevalence of smoking on campus may have increased since the implementation of the campus smoke-free policy in 2012.<sup>38</sup> The rising prevalence of smoking and the frequency of policy violations suggest the need for a renewed strategy of policy enforcement. Universities willing to enact or enforce campus smoke-free policies must focus on creating an environment where policy violations are not tolerated, and the administration, faculty and students support the ban on smoking in public places. Strategies to achieve this environment might include strict ticketing policies, strategically placed reminder signs, reinforcement of student beliefs about smoking and overall policy support which were found to be important predictors of policy violation in this study. Further attention must be paid to campus alcohol consumption and social or sporting events where violations of policy might be more prevalent.

While some researchers have sought to stress the importance of education campaigns, the high rates of policy awareness and generally strong attitudes against smoking behaviour found in this study imply that educational campaigns addressing the policy or the hazards of tobacco use might not necessarily be effective at improving policy compliance.<sup>18 26 43</sup> On the other hand, there is much support in the literature on the potential of strong enforcement policies in decreasing smoking prevalence.<sup>14 22</sup> Harris and colleagues recommend the use of passive techniques such as reminder signs about the smoke-free policy, along with more active strategies such as direct contact with violators using volunteers to improve engagement, periodic positive reinforcement and hosting interactive compliance events to serve as additional reminders.<sup>22</sup>

While this study provides critical evidence to support development strategies to improve campus smoke-free policy compliance, it also carries some limitations. Even though the survey had a 90% response rate among invited students, only 50% of invited instructors agreed to participate in the study. While many instructors did not choose to participate, because instructor choices are not expected to be related to smoking behaviour among their students, this is not expected to bias the study's findings. This study used self-report to identify smoking behaviour and policy violations. Both these behaviours can be under-reported due to a combination of social desirability bias and recall bias. This study also did not delineate the use of e-cigarettes from regular cigarettes, or capture frequency of policy violations specifically associated with the use of e-cigarettes; rather, the questions simply referred to 'smoking on campus'. It is possible that many respondents might have a misunderstanding of whether smoke-free policies include a ban on use of e-cigarettes (even though the policy clearly specifies that e-cigarettes are included in the ban)<sup>28</sup> thereby leading to a bias in the estimate of policy violations. Similarly, individuals who incorrectly believed the campus was tobacco-free as opposed to smoke-free might have different perceptions

of barriers or their support for the policy because of their incorrect understanding of what is included in the policy. These differences were not explored in the current study. It is important to recognise that this is an observational study and there are correlations among the predictor variables. The logistic regression model estimated in this study can help to identify possible predictors of policy violations. Future research is necessary to evaluate the meaningfulness of these predictors and whether they can be targeted for possible intervention to reduce violations. Finally, although a large sample was obtained, these data were collected 4 years ago, and although there is no reason to expect so, some of these findings may have changed since then. In addition, this study only included policy violations by smoking and did not assess other behaviours such as littering or possession of tobacco products, as mentioned in the policy. Policy violations were also only assessed in students, whereas such violations could have been committed by staff, employees or visitors. The findings of this study must also be interpreted in the context of the campus where this study was conducted; thus, generalisation to other universities must be made with caution.

## CONCLUSION

This study found that violations of a campus smoke-free policy are fairly common. Policy violations might be related to smoking behaviour, beliefs about policy adherence, smoking attitudes and support for the policy. Important barriers to policy adherence include a lack of reminders about the policy, lack of student and administrative support, and a need for stricter policy enforcement. Additional interventions are needed to improve compliance with the policy and reduce prevalence of smoking on campus.

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