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# BMJ Open

## Factors influencing the adherence to a campus smoke-free policy

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**Abstract:**

Objective: The aim of this study is 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%. Policy awareness was high (nearly 90%), but nearly 20% of respondents reported smoking on campus, in violation of the policy, and 93.7% of respondents reported witnessing policy violations. Barriers to policy success include lack of reminders about the policy, lack of support from students and University administrators, and insufficient fines. Smoking behavior (OR: 7.95; 95% CI: 5.09-12.40), beliefs about policy adherence (OR: 0.53; 95% CI: 0.42-0.66), support for the policy (OR: 0.71; 95% CI: 0.53-0.94), and attitudes against smoking behavior (OR: 0.35; 95% CI: 0.26-0.49) were all significantly associated with self-reported policy violations. A more complicated picture emerges for the prediction of frequency of witnessing a violation of the smoking policy because smoking status was found to significantly moderate the effect of policy adherence beliefs and smoking attitudes on the frequency of witnessing a policy violation.

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 the barriers such as reminders about the policy, better policy enforcement, and support from the administration.

Key words: Public health, Smoke-free policy, campus smoking policy, smoking prevention, policy compliance

#### Strengths & Limitations:

- This study evaluated violations of a campus smoke-free policy using a large, campus-wide survey.
- While this study did not assess prevalence before and after implementation the smoke-free policy, it provides an assessment of adherence to a smoke-free policy.
- This study assessed self-reported policy violations and witnessing others violate a policy, providing multiple perspectives on campus smoking behavior.
- Nearly 20% reported violating the policy and over 93% reported witnessing a violation. Policy violations were predicted by student attitudes about smoking, and support for the policy. Other characteristics such as class year, race, gender, alcohol use, on-campus residence, and GPA were also predictive of policy violations.
- Campus smoke-free policies need active reminders and strict enforcement procedures.

#### 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 United States[1]. Coordinated tobacco cessation efforts by several public health agencies and health care providers have successfully reduced the prevalence of smoking over the past 10-15 years[1-3]. Notwithstanding the general population trend, prevalence of past 30-day smoking among 18 to 25-year old adults is estimated to be 34%, and is increasing[4]. In the past few years, tobacco cessation efforts have targeted this age group through policies and interventions aimed at university campuses. The American College Health Association, and other organizations, have advocated for prohibition of all tobacco use in indoor and outdoor environments on university campuses[5]. This recommendation is supported by

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2  
3 several studies that have demonstrated wide support for smoke-free policies among university  
4 students and staff[6-11]. There has been a 300% increase in the use of smoke-free policies since  
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7  
8 2010, with over 2,000 universities implementing such policies, as of October, 2017[3,12].  
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11 However, due to a lack of clearly defined policies and weak enforcement practices, these  
12 policies have failed to efficiently reduce campus tobacco use[13,14]. Research into the  
13  
14 effectiveness of campus smoke-free policies has found mixed results, with some universities  
15 reporting frequent policy violations and low compliance rates[14-18]. There is limited research  
16  
17 on the factors affecting policy compliance and strategies to improve compliance to smoke-free  
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19 policies on college campuses[19-21].  
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25 The support for and effectiveness of smoking cessation policies can be influenced by  
26 societal antismoking norms[22-24], smoking behavior[23-25], perceptions of peer tobacco use  
27  
28 [23], and demographic variables such as gender and race[26]. The current study utilizes the  
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30 framework proposed by Fong et al. that guided the development of the International Tobacco  
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32 Control (ITC) policy evaluation project[27]. This project has evaluated the impact of regulations,  
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34 such as smoke-free policies, in several countries. The framework proposes that policies influence  
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36 several policy-specific psychosocial variables – such as beliefs and attitudes, normalization of  
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38 beliefs, self-efficacy, and intentions – which in turn influence policy-related outcomes, such as  
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40 prevalence of smoking. Other variables, such as socio-demographics and smoking status, may  
41  
42 moderate the relationship between psychosocial variables and policy outcomes[27]. The current  
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44 study focuses on psychosocial variables such as smoking attitudes, policy support, and policy  
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46 attitudes, and examines how the effects of these variables on policy outcomes are influenced by  
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48 smoking status.  
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3 On the campus of the University of Mississippi, a smoke-free policy was implemented on  
4 August 1<sup>st</sup>, 2012 to help reduce smoking prevalence. The policy affects all indoor and outdoor  
5 grounds including residence halls and personal vehicles. Since implementation, few steps have  
6 been taken to evaluate the students' adherence to the policy. The specific aim of the current  
7 study was to evaluate adherence to the campus smoke-free policy and to identify the key factors  
8 that influence policy violations.  
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## 19 **Methods**

### 20 Study design & procedures:

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22 This study employed a cross-sectional, self-administered survey of undergraduate  
23 students at the University of Mississippi. The sampling frame included a list of all undergraduate  
24 classes offered in the fall semester of 2015 on the Oxford campus, as recorded by the  
25 University's Registrar. After excluding classes that were too small (less than 4 students), or were  
26 independent studies, a random sample of the remaining classes was chosen for inclusion in the  
27 study. Instructors of record for the chosen classes were contacted to request permission to  
28 distribute surveys in their classes. After obtaining instructor approval, the research team  
29 distributed a short survey at the beginning of each class. Student participation was voluntary, and  
30 no incentives were offered in return for participation. Approval was obtained from the  
31 University's Institutional Review Board (IRB) before data collection was started. Upon opening  
32 the survey booklet, potential respondents were provided with information about the study,  
33 including contact details for the IRB. Respondents' completion of the survey constituted consent,  
34 as approved by the IRB. Students who were present in more than one participating class were  
35 requested to participate no more than once, to prevent repeat administration.  
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3 Study measures:  
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5 The survey included questions on respondent demographics, alcohol use, smoking status,  
6 policy awareness, policy attitudes, smoking attitudes, policy support, barriers to policy success,  
7 and policy violations. Respondent demographics and alcohol use questions were modelled after  
8 the American College Health Association's National College Health Assessment (ACHA-  
9 NCHA) report[28]. Current smoking status has been operationalized in a variety of ways in the  
10 extant literature[29]. Among adults, current smoking status is defined by the Centers for Disease  
11 Control and Prevention (CDC) as having smoked at least 100 cigarettes in a lifetime *and*  
12 smoking every day or on some days at the time of assessment[30]. However, in a population of  
13 young adults, among whom new smokers, infrequent smokers, and intermittent smokers are  
14 common, assessment of past 30-day smoking behavior can be a better predictor of violation of  
15 smoke-free policies. Therefore, this study defined current smokers as those respondents who  
16 smoked at least one cigarette during the past 30 days. This characterization of smoking behavior  
17 was found applicable for the college student and young adult populations in previous  
18 studies[4,31,32].  
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38 In order to measure awareness of the campus smoking policy, respondents were asked to  
39 identify the correct policy from a list of four options of varying stringency. Respondents were  
40 classified as being aware of the policy if they chose smoke-free campus (the correct policy), or  
41 tobacco-free campus, which is more rigorous than the actual policy[24]. Respondents' attitudes  
42 about the policy were measured using six items, adapted from Chaaya et al., using a five-point  
43 Likert response format[25]. Measures assessing smoking attitudes (6 items), support for the  
44 policy (4 items), and barriers to policy success (11 items) were all adapted from Burns et al. and  
45 measured using five-point response formats[6, 24, 25, 33].  
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The variable of interest in this study, policy outcomes, was operationalized in two ways: 1) as a self-violation of the campus smoke-free policy and 2) frequency of witnessing a violation 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[25], creating a dichotomous variable. Respondent's frequency of witnessing policy violations by others was assessed using four 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 second-hand smoke on campus, and had to alter their walking route on campus in order to avoid smoke. These items were summed to create a single variable ranging from 0 to 4.

#### 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 version 25 (Chicago, IL) and STATA SE version 15 (College Station, TX) were used for data analysis. Descriptive analyses were conducted for all items in the survey. 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 witnessing policy violations by others was measured as the sum of four items, it was analyzed as a continuous variable using linear regression. 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 hypothesized study predictors in both the logistic and linear regression models by

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3 including interaction terms. Because classes were sampled rather than individual students, both  
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5 regression models used clustered robust standard errors to account for the non-independence of  
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7 observations due to the nesting of students within classes. The cluster option in STATA was used  
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9 to accomplish this.  
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## 12 13 **Results**

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16 Forty-seven, out of a total of 94 invited instructors, agreed to the request for study  
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18 participation. Survey administrators distributed copies of the surveys to 1,704 students in 60  
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20 course sections. Fifty students were not eligible to participate either because they were less than  
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22 18 years old, or they had already completed the survey in a different class section. Of the  
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24 remaining 1,654 students, 1,541 surveys were collected with at least one completed response,  
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26 leading to a response rate of 93%. After deleting responses that had missing responses on more  
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28 than 30 out of the 63 items on the survey, analyses were conducted on 1,512 responses. As seen  
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30 in Table 1, the sample was comprised of nearly 60% women, 78% Caucasians, 50%  
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32 freshmen/sophomores, 53% state residents, and 47% enrolled in Greek organizations. The  
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34 majority of respondents were 20 years old or younger, lived off-campus, and were single.  
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36 Twenty-three percent of respondents self-reported smoking in the past 30 days and were  
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38 classified as a current smoker. More than 36% self-reported smoking e-cigarettes, and about 14%  
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40 smoked more than 100 cigarettes in their lifetimes. Nearly 60% of the sample reported being  
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42 exposed to second-hand smoke on campus at least once in the past week, and almost 20% of the  
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44 sample reported consuming alcohol at least 10 days in the past month. Women, minorities, and  
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46 students living on-campus were significantly less likely to be current smokers, in bivariate  
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48 analyses. In contrast, students enrolled in Greek houses were significantly more likely to be  
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50 current smokers.  
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## &lt;Table 1&gt;

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. Nearly 20% of respondents reported smoking on campus, in violation of the policy, but less than 3% of respondents received a warning or a ticket for their violation. An overwhelming majority of respondents (93.7%) scored at least 1 point or greater on the frequency of witnessing a policy violation, while 22% knew of someone who had received a warning or a ticket for smoking on campus. Three quarters of respondents were exposed to second-hand smoke while on the campus, and more than a quarter of respondents even altered their walking route to avoid second-hand smoke while on campus.

## Barriers to policy adherence:

Considering all respondents together, the most significant barrier to a successful smoke-free campus policy was lack of reminders about the policy, with a mean of 3.6 (SD: 1.2) out of 5 (with 5 being an extreme barrier) (Table 2). Other barriers receiving mean scores above 3 (i.e., the midpoint) include lack of support from students (Mean: 3.5; SD: 1.13) and university administrators (Mean: 3.4; SD: 1.26), insufficient fines (Mean: 3.2; SD: 1.24), and infringement of personal freedom (Mean: 3.2; SD: 1.26). Current non-smokers rated eight of the 11 barriers – lack of policy reminders, insufficient fines, infringement of personal freedoms, lack of enforcement, faculty and staff support, lack of information about the policy, and funding – significantly higher than past 30-day smokers. Only one barrier, difficult to enforce, received a significantly higher mean rating by past 30-day smokers compared to non-smokers.

## &lt;Table 2&gt;

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3 Smoke-free policy attitudes, smoking attitudes, and policy support:  
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6 Using PCA, a two-factor solution was obtained for respondents' attitudes toward the  
7 smoke-free policy. The two factors, labeled "policy adherence" and "policy justification", had  
8 four items and two items each, with reliabilities (Cronbach's alpha) of 0.81 and 0.72,  
9 respectively. On a scale of 1 to 5, respondents rated policy adherence an average score of 2.6  
10 (SD: 0.8), and policy justification an average score of 3.8 (SD: 0.9). A single-factor solution was  
11 obtained for both respondent's attitudes toward smoking (mean: 3.7; SD: 0.9; higher scores are  
12 indicative of negative attitudes toward smoking or positive attitudes about non-smoking  
13 behavior) and support for the policy (mean: 3.8; SD: 1.1) with reliabilities of 0.89 and 0.85,  
14 respectively. The factor loadings for each of the scales, along with the mean scores and standard  
15 deviations for the total sample as well as for current (past 30-day) smokers and non-smokers, are  
16 provided in Table 3.  
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31 <Table 3>  
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35 Factors predicting campus smoke-free policy violations:  
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38 In a logistic regression model predicting self-violation of campus smoke-free policy  
39 (Table 4), current (past 30-day) smokers unsurprisingly had nearly 8 times the odds (OR: 7.95;  
40 95% CI: 5.09-12.40) of reporting that they had violated the policy as compared to non-smokers  
41 and women had lower odds (OR: 0.36, 95% CI: 0.22-0.58) of violating the policy compared to  
42 men. Stronger beliefs about policy adherence (OR: 0.53; 95% CI: 0.42-0.66), greater support for  
43 the policy (OR: 0.71; 95% CI: 0.53-0.94), and stronger attitudes against smoking behavior (OR:  
44 0.35; 95% CI: 0.26-0.49) were all related to lower odds of violating the policy. Non-Black  
45 minorities (OR: 2.65; 95% CI: 1.07-6.55), on-campus residents (OR: 1.79; 95% CI: 1.00-3.20),  
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3 in-state students (OR: 1.60; 95% CI: 1.13-2.28), seniors (OR: 2.25; 95% CI: 1.06-4.76) and  
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5 students who reported a high frequency of alcohol consumption (OR: 2.47; 95% CI: 1.13-5.41)  
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7 had higher odds of violating the policy when compared to Caucasians, off-campus residents, out-  
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9 of-state students, freshmen, and students who reported not consuming any alcohol in the past 30  
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11 days, respectively. Higher GPA was also associated with higher odds (OR: 1.37; 95% CI: 1.12-  
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13 1.67) of violating the policy. There were no significant interactions of past 30-day smoking  
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15 status with any of the predictors in the model.  
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19 <Table 4>  
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22 Witnessing a violation of the smoke-free policy by others was calculated as a count  
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24 variable from four items that assessed witnessing various kinds of policy violations. This  
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26 variable, ranging in scores from 0 to 4, was found to have a distribution very close to normal  
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28 with an absence of any meaningful floor or ceiling effects (Table 1), thereby justifying the use of  
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30 a linear regression model for its prediction (Table 5). After controlling for all other variables,  
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32 gender ( $p < 0.0005$ ), and Greek membership ( $p < 0.0005$ ) were found to be significantly  
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34 predictive of witnessing a violation of the smoke-free policy. When compared to Caucasians,  
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36 African Americans ( $p = 0.005$ ) witnessed fewer violations of the smoke-free policy. When  
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38 compared to freshmen, juniors ( $p = 0.010$ ), and seniors ( $p = 0.027$ ) witnessed more policy  
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40 violations. Respondents who reported low ( $p = 0.068$ ), medium ( $p = 0.034$ ), or high frequency ( $p$   
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42  $= 0.050$ ) of alcohol use in the previous 30 days witnessed more policy violations than those who  
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44 no reported no alcohol consumption. The effect of smoking attitudes ( $p < 0.0005$  for the  
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46 interaction) and beliefs about policy adherence ( $p = 0.001$  for the interaction) on witnessing  
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48 policy violations were both moderated by current (past 30-day) smoking status. Among non-  
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50 smokers, stronger attitudes against smoking were related to witnessing more policy violations  
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(regression coefficient = 0.289;  $p < 0.0005$ ), and stronger beliefs about policy adherence were related to witnessing fewer violations of policy (regression coefficient = -0.360;  $p < 0.0005$ ). However, among current (past 30-day) smokers, smoking attitudes were not predictive of witnessing policy violations (regression coefficient = -0.041;  $p = 0.545$ ), and beliefs about policy adherence were still related to witnessing fewer violations of policy ( $p = 0.027$ ), but this relationship was not as strong as it was among non-smokers (regression coefficients = -0.142 vs -0.360).

<Table 5>

## 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 comprised of 55% females, 77% Caucasians, 30% freshmen, 20% sophomores, 22% juniors, 28% seniors, and 42% Greek organization members, which closely approximates the distribution obtained in this study[34, 35]. An annual survey funded by the state Department of Health during the spring semester of 2016 found that 37.3% of respondents smoked at least one cigarette in the past 30 days, which is much higher than the 23% found in this study[36]. 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[36]. Nevertheless, the estimated 12% national prevalence of past 30-day smoking among college students[28] is much lower than the prevalence found in the current study comprised of University of Mississippi undergraduate students.

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3 Overall, almost 90% of the respondents were aware of the campus smoking policy and  
4 nearly 20% reported violating the policy. Among current (past 30-day) smokers, the prevalence  
5 of self-reported policy violations was nearly 64%. Even though the survey was completely  
6 anonymous, it is possible that social desirability bias led to an underestimate of the prevalence of  
7 policy violations. An overwhelming majority of the respondents, 94%, reported witnessing at  
8 least one violation of the campus smoke-free policy by others, implying that the policy has been  
9 largely unsuccessful. In line with expectations, respondents who believed the policy was  
10 effective had lower odds of violating the policy themselves and also witnessed fewer policy  
11 violations by others. Policy violations were also associated with smoking behavior and alcohol  
12 consumption, which is in line with the expectation that these risk behaviors often manifest  
13 concomitantly[37]. Extant literature shows risk behaviors such as smoking tend to be associated  
14 with a lower GPA[38, 39], but this current study found that a one-unit increase in GPA was  
15 associated with a 36% increase in the odds of violating the policy. While students with higher  
16 GPAs might smoke less frequently, it is possible that they have a greater propensity for policy  
17 violations because higher GPA might be indicative of greater time spent on campus, leading to a  
18 greater chance of policy violations. Seniors and juniors were more likely to witness a policy  
19 violation when compared to freshmen, which might be a reflection of the greater amount of time  
20 they have spent on the campus. Neither membership in Greek organizations nor class year were  
21 related to self-reported policy violations, but were both found to have an association with  
22 witnessing a policy violation by others, indicating the possibility of social desirability bias. The  
23 effects of policy adherence beliefs and smoking attitudes on witnessing others violate the policy  
24 were greater among non-smokers than smokers. Given the high likelihood of witnessing policy  
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3 violations among smokers, it is not unexpected that behavioral factors are less likely to be  
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5 significant in this population.  
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8 This study found that, despite high levels of policy awareness, smoke-free policies are  
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10 largely ineffective at curtailing smoking behavior on university campuses. The ineffectiveness of  
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12 the policy was reflected in the fact that nearly 75% of respondents have been exposed to  
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14 secondhand smoke on campus, which is the primary purpose of a smoke-free policy. The most  
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16 significant barrier to a successful smoke-free campus policy was the lack of reminders about the  
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18 policy. The other highly rated barriers to success include lack of support from students and  
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20 University administrators, indicating a lack of buy-in for policy enforcement. While policy  
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22 reminders might be lacking, the results of this study must be interpreted in the context of the  
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24 limited enforcement efforts. Less than 3% of respondents received a ticket, while nearly 20%  
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26 reported violating the policy. This discrepancy suggests a greater need for reminders, which  
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28 might not be necessary on campuses where the policy is strictly enforced.  
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34 Contrary to expectations from previous research[16, 23, 25, 40], the prevalence of  
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36 smoking on campus may have increased since the implementation of the campus smoke-free  
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38 policy in 2012[36]. The rising prevalence of smoking and the frequency of policy violations  
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40 suggest the need for a renewed strategy of policy enforcement. Universities willing to enact or  
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42 enforce campus smoke-free policies must focus on creating an environment where policy  
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44 violations are not tolerated, and the administration, faculty, and students support the ban on  
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46 smoking in public places. Strategies to achieve this environment might include strict ticketing  
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48 policies, strategically placed reminder signs, reinforcement of student beliefs about smoking and  
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50 overall policy support, which were found to be important predictors of policy violation in this  
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3 study. Further attention must be paid to campus alcohol consumption and social or sporting  
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5 events where violations of policy might be more prevalent.  
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8 While some researchers have sought to stress the importance of education campaigns, the  
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10 high rates of policy awareness and generally strong attitudes against smoking behavior found in  
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12 this study imply that educational campaigns addressing the policy or the hazards of tobacco use  
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14 might not necessarily be effective at improving policy compliance[17, 25, 41]. On the other  
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16 hand, there is much support in the literature on the potential of strong enforcement policies in  
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18 decreasing smoking prevalence[19, 42]. Harris and colleagues recommend the use of passive  
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20 techniques such as reminder signs about the smoke-free policy, along with more active strategies  
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22 such as direct contact with violators using volunteers to improve engagement, periodic positive  
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24 reinforcement, and hosting interactive compliance events to serve as additional reminders[19].  
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29 While this study provides critical evidence to support development strategies to improve  
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31 campus smoke-free policy compliance, it also carries some limitations. This study used self-  
32  
33 report to identify smoking behavior and policy violations. Both these behaviors can be  
34  
35 underreported due to a combination of social desirability bias and recall bias. This study also did  
36  
37 not delineate the use of e-cigarettes from regular cigarettes, or capture frequency of policy  
38  
39 violations, by specifically using e-cigarettes. It is possible that many respondents might have a  
40  
41 misunderstanding of whether smoke-free policies include a ban on use of e-cigarettes (even  
42  
43 though the policy clearly specifies that e-cigarettes are included in the ban[43]), thereby leading  
44  
45 to a bias in the estimate of policy violations. Finally, although a large sample was obtained, the  
46  
47 findings of this study must be interpreted in the context of the campus where this study was  
48  
49 conducted; thus, generalization to other universities must be made with caution.  
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## 53 54 **Conclusion**

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3 This study found that violations of a campus smoke-free policy are fairly common. Policy  
4  
5 violations might be related to smoking behavior, beliefs about policy adherence, smoking  
6  
7 attitudes, and support for the policy. Important barriers to policy adherence include a lack of  
8  
9 reminders about the policy, lack of student and administrative support, and a need for stricter  
10  
11 policy enforcement. Additional interventions are needed to improve compliance with the policy  
12  
13 and reduce prevalence of smoking on campus.  
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### 19 **List of Abbreviations:**

20  
21 ACHA: American College Health Association

22  
23 CDC: Centers for Disease Control and Prevention

24  
25 GPA: Grade Point Average

26  
27 ITC: International Tobacco Control

28  
29 NCHA: National College Health Assessment

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31 PCA: Principal Components Analysis  
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### 36 **Declarations:**

37  
38 Ethics approval: This study was approved by the University of Mississippi Institutional Review  
39  
40 Board (UM IRB) before data were collected (Protocol #16x-011). Respondents provided consent  
41  
42 to participate by completing the paper-based survey (this approach to consent was approved by  
43  
44 the UM IRB and a statement was included on the front of the survey booklet that stated, “By  
45  
46 completing the survey, I consent to participate in the study”).

47  
48 Data Availability Statement: The datasets used and/or analyzed during the current study are  
49  
50 available from the corresponding author on reasonable request.

51  
52 Competing interests: None declared

53  
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55  
56 commercial or not-for-profit sectors  
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## Tables

**Table 1: Characteristics of the study sample**

| Characteristic   | Total<br>N = 1512<br>N (%) | Current<br>smoker <sup>1</sup><br>N = 353<br>N (%) | Current<br>non-smoker<br>N = 1158<br>N (%) |
|--|----------------------------|--|--|
| Age  |                            |  |  |
| 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)                                 |
| Race***  |                            |  |  |
| 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)                                 |
| Smoker (according to CDC definition <sup>2</sup> ) *** | 172 (11.4)                 | 170 (48.3)   | 1 (0.1)                                    |
| Past-smoker  | 45 (3.0)                   | 10 (2.8)   | 35 (3.0)                                   |
| International student                                  | 48 (3.2)                   | 13 (3.7)   | 35 (3.1)                                   |
| Resident of the state of MS                            | 790 (53.4)                 | 169 (48.8)   | 620 (54.7)                                 |
| Greek membership*                                      | 711 (47.9)                 | 185 (53.2)   | 525 (46.3)                                 |
| Class year   |                            |  |  |
| 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] ***                                      | 2.62 [0.9]                 | 2.86 [0.9]   | 2.54 [0.9]                                 |
| On-campus housing**                                    | 493 (33.2)                 | 91 (26.1)  | 402 (35.4)                                 |
| Marital Status   |                            |  |  |
| 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***    |                            |  |  |
| 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)                                 |
| Smoked 100 cigarettes in a lifetime***                 | 217 (14.4)                 | 180 (51.1)   | 36 (3.1)                                   |



|  |             |            |             |
|--|-------------|------------|-------------|
| Change in smoking frequency in past 30 days***                                   |             |            |             |
| Increased  | 44 (2.9)    | 39 (11.0)  | 4 (0.3)     |
| Decreased  | 112 (7.4)   | 84 (23.8)  | 28 (2.4)    |
| Same   | 1353 (89.7) | 230 (65.2) | 1123 (97.2) |
| Exposure to second-hand smoke on campus in past 7 days***                        |             |            |             |
| 0 days   | 616 (40.8)  | 142 (40.3) | 474 (41.0)  |
| 1 or 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 use at least once***   | 555 (36.7)  | 266 (75.4) | 288 (24.9)  |
| E-Cigarette smoking frequency***   |             |            |             |
| 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**                                      |             |            |             |
| 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)  |
| What is the smoking policy on campus?  |             |            |             |
| 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) |
| Ever smoked on campus***   | 292 (19.3)  | 223 (63.4) | 69 (6.0)    |
| Ever received a warning or ticket for smoking on campus***                       | 38 (2.5)    | 32 (9.1)   | 6 (0.5)     |
| Ever witnessed someone smoking on campus**                                       | 1397 (92.5) | 341 (96.6) | 1055 (91.2) |
| Know of someone else who received a warning or ticketed for smoking on campus*** | 333 (22.1)  | 160 (45.3) | 173 (15.0)  |
| Ever exposed to secondhand smoke on campus                                       | 1129 (74.7) | 269 (76.4) | 859 (74.2)  |
| Ever altered my walk on campus to avoid smoke***                                 | 391 (25.9)  | 18 (5.1)   | 373 (32.2)  |
| Self violation of the campus smoking policy*** <sup>3</sup>                      | 293 (19.4)  | 224 (63.6) | 69 (6.0)    |
| Witnessing others violate the policy**   |             |            |             |
| 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)    |

\* Difference between past 30-day smokers and non-smokers is significant at  $p < 0.05$

\*\* Difference between past 30-day smokers and non-smokers is significant at  $p < 0.005$

\*\*\* Difference between past 30-day smokers and non-smokers is significant at  $p < 0.0005$

<sup>1</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

<sup>2</sup>CDC definition of current smoker: Smoked at least 100 cigarettes in a lifetime *and* smoking every day or on some days at the time of assessment.

<sup>3</sup>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.

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

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

| Barrier  | Total      | Current Smokers <sup>1</sup> | Current non-smokers |
|--|------------|------------------------------|---------------------|
|  | Mean (SD)  | Mean (SD)                    | Mean (SD)           |
| Lack of reminders about the policy***                | 3.6 (1.21) | 3.3 (1.27)                   | 3.8 (1.17)          |
| Lack of support from students                        | 3.5 (1.13) | 3.5 (1.17)                   | 3.5 (1.12)          |
| Lack of support from University administrators       | 3.4 (1.26) | 3.4 (1.28)                   | 3.5 (1.25)          |
| Insufficient fines***                                | 3.2 (1.24) | 2.7 (1.26)                   | 3.4 (1.19)          |
| Policy infringes on individuals' personal freedom*** | 3.2 (1.26) | 2.8 (1.26)                   | 3.3 (1.23)          |
| Lack of enforcement*                                 | 2.9 (1.18) | 2.8 (1.17)                   | 3.0 (1.19)          |
| Lack of support from faculty*                        | 2.9 (1.18) | 2.8 (1.16)                   | 3.0 (1.19)          |
| Lack of information about policy**                   | 2.8 (1.22) | 2.6 (1.18)                   | 2.9 (1.23)          |
| Lack of support from staff***                        | 2.8 (1.22) | 2.4 (1.18)                   | 2.9 (1.21)          |
| Difficult to enforce***                              | 2.7 (1.28) | 3.2 (1.29)                   | 2.6 (1.25)          |
| Inadequate funding***                                | 2.1 (1.08) | 1.9 (1.0)                    | 2.2 (1.10)          |

\* Difference between past 30-day smokers and non-smokers is significant at  $p < 0.05$

\*\* Difference between past 30-day smokers and non-smokers is significant at  $p < 0.005$

\*\*\* Difference between past 30-day smokers and non-smokers is significant at  $p < 0.0005$

<sup>1</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

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

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

| Item  | Factor loading | Total     | Current Smokers <sup>1</sup> | Current non-smokers |
|---|----------------|-----------|------------------------------|---------------------|
|   |                | Mean (SD) | Mean (SD)                    | Mean (SD)           |
| <b>Student attitudes toward 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)           |
| The current policy is enforced*   | 0.791          | 2.7 (1.1) | 2.8 (1.0)                    | 2.6 (1.1)           |
| Most smokers comply with the current policy   | 0.816          | 2.6 (1.0) | 2.6 (1.0)                    | 2.7 (1.0)           |
| The current policy is ignored by smokers <sup>2</sup>                                     | 0.774          | 2.2 (1.0) | 2.2 (1.0)                    | 2.2 (1.0)           |
| Total subscale score (alpha = 0.81)   | -              | 2.6 (0.8) | 2.6 (0.8)                    | 2.6 (0.8)           |



| <b>Student attitudes toward 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) |
| The current policy helps create a healthy environment***  | 0.857 | 3.9 (1.0) | 3.6 (1.0) | 4.0 (1.0)  |
| Total subscale score (alpha = 0.72)***  | -     | 3.8 (0.9) | 3.4 (0.9) | 3.9 (0.9)  |
| <b>Student attitudes toward smoking</b>   |       |           |           |            |
| If someone smokes cigarettes around me they are causing me harm because of second-hand smoke*** | 0.788 | 4.0 (1.0) | 3.1 (1.1) | 4.2 (0.9)  |
| I prefer to socialize in a smoke-free environment***  | 0.867 | 4.0 (1.1) | 3.0 (1.0) | 4.3 (0.9)  |
| I seek out smoke-free environments***   | 0.871 | 3.5 (1.3) | 2.4 (1.0) | 3.8 (1.1)  |
| 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)  |
| I would rather date a non-smoker***   | 0.693 | 4.4 (0.9) | 3.7 (1.1) | 4.6 (0.7)  |
| I ask others not to smoke around me***  | 0.795 | 3.1 (1.3) | 2.0 (1.1) | 3.4 (1.3)  |
| Total scale score (alpha = 0.89)***   | -     | 3.7 (0.9) | 2.7 (0.7) | 4.0 (0.8)  |
| <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)  |
| Smoking should be banned on all university property***  | 0.874 | 3.6 (1.3) | 2.5 (1.3) | 4.0 (1.2)  |
| All tobacco products should be banned in all university buildings***                            | 0.867 | 3.7 (1.4) | 2.9 (1.5) | 4.0 (1.2)  |
| All tobacco products should be banned on all university property***                             | 0.900 | 3.2 (1.4) | 2.2 (1.2) | 3.5 (1.3)  |
| Total scale score (alpha = 0.85)  | -     | 3.8 (1.1) | 2.9 (1.0) | 4.0 (1.0)  |

\* Difference between current smokers and non-smokers is significant at  $p < 0.05$

\*\*\* Difference between current smokers and non-smokers is significant at  $p < 0.0005$

<sup>1</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

<sup>2</sup>This item was reverse coded prior to calculation of the scale score.

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

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

| Characteristic                | Violation of the campus smoke-free policy |          |
|-------------------------------|---|----------|
|                               | Adjusted odds ratio (95% CI)              | p        |
| Current smoker <sup>1</sup>   | 7.95 (5.09-12.40)                         | < 0.0005 |
| Policy adherence subscale     | 0.53 (0.42-0.66)                          | < 0.0005 |
| Policy justification subscale | 0.98 (0.76-1.28)                          | 0.902    |

|                          |                  |          |
|--------------------------|------------------|----------|
| Smoking attitudes scale  | 0.35 (0.26-0.49) | < 0.0005 |
| Policy support scale     | 0.71 (0.53-0.94) | 0.016    |
| Policy awareness         | 1.24 (0.69-2.21) | 0.472    |
| Female                   | 0.36 (0.22-0.58) | < 0.0005 |
| Age                      |                  |          |
| 18 to 20 years           | Reference        |          |
| 21 to 24 years           | 0.76 (0.42-1.37) | 0.359    |
| 25 and older             | 0.94 (0.36-2.44) | 0.901    |
| Race                     |                  |          |
| Caucasian                | Reference        |          |
| African American         | 1.42 (0.72-2.81) | 0.312    |
| Other minorities         | 2.65 (1.07-6.55) | 0.035    |
| Resident of MS           | 1.60 (1.13-2.28) | 0.008    |
| International            | 1.58 (0.48-5.22) | 0.454    |
| Greek membership         | 1.21 (0.82-1.79) | 0.343    |
| Class year               |                  |          |
| Freshman                 | Reference        |          |
| Sophomore                | 1.44 (0.79-2.62) | 0.228    |
| Junior                   | 1.59 (0.84-3.02) | 0.156    |
| Senior & above           | 2.25 (1.06-4.76) | 0.035    |
| GPA                      | 1.37 (1.12-1.67) | 0.002    |
| On campus residence      | 1.79 (1.00-3.20) | 0.048    |
| Frequency of alcohol use |                  |          |
| None                     | Reference        |          |
| Low                      | 1.23 (0.60-2.50) | 0.574    |
| Medium                   | 1.75 (0.83-3.68) | 0.139    |
| High                     | 2.47 (1.13-5.41) | 0.024    |

<sup>1</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

**Table 5: Linear regression results predicting frequency of witnessing a violation of the campus smoke-free policy by others**

| Predictor                                  | Witness violation of campus smoke-free policy |          |
|--|---|----------|
|  | Unstandardized coefficient<br>(Std. Error)    | p        |
| Current smoker <sup>1,2</sup>              | 0.718 (0.256)                                 | 0.007    |
| Policy adherence subscale <sup>3</sup>     | -0.360 (0.039)                                | < 0.0005 |
| Policy justification subscale <sup>4</sup> | 0.048 (0.032)                                 | 0.138    |
| Smoking attitudes scale                    | 0.289 (0.040)                                 | < 0.0005 |
| Policy support scale                       | 0.024 (0.028)                                 | 0.395    |
| Policy awareness                           | 0.129 (0.091)                                 | 0.163    |
| Female                                     | -0.204 (0.054)                                | < 0.0005 |
| Age  |   |          |
| 18 to 20 years                             | Reference                                     |          |
| 21 to 24 years                             | -0.033 (0.068)                                | 0.630    |
| 25 and older                               | -0.159 (0.167)                                | 0.345    |
| Race                                       |   |          |
| Caucasian                                  | Reference                                     |          |
| African American                           | -0.262 (0.090)                                | 0.005    |
| Other minorities                           | 0.201 (0.106)                                 | 0.064    |
| Resident of MS                             | -0.008 (0.046)                                | 0.870    |
| International                              | -0.093 (0.235)                                | 0.693    |
| Greek membership                           | 0.174 (0.037)                                 | <0.0005  |
| Class year                                 |   |          |
| Freshman                                   | Reference                                     |          |
| Sophomore                                  | 0.130 (0.084)                                 | 0.128    |
| Junior                                     | 0.210 (0.079)                                 | 0.010    |
| Senior & above                             | 0.251 (0.111)                                 | 0.027    |
| GPA  | -0.021 (0.026)                                | 0.424    |
| On campus residence                        | 0.120 (0.068)                                 | 0.083    |
| Frequency of alcohol use                   |   |          |
| None                                       | Reference                                     |          |
| Low  | 0.130 (0.070)                                 | 0.068    |
| Medium                                     | 0.178 (0.082)                                 | 0.034    |
| High                                       | 0.180 (0.090)                                 | 0.050    |
| Current smoker x Smoking attitudes scale   | -0.330 (0.064)                                | < 0.0005 |
| Current smoker x Policy adherence subscale | 0.218 (0.064)                                 | 0.001    |

<sup>1</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

<sup>2</sup>The estimate for smoking status is the effect of smoking status when policy adherence and policy smoking attitudes are equal to zero.

<sup>3</sup>This estimate is the effect of policy adherence among non-smokers

<sup>4</sup>This estimate is the effect of smoking attitudes among non-smokers.

# 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 U.S.A.

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5 Title: Prevalence of and factors associated with violations of a campus smoke-free policy: A  
6 cross-sectional survey of undergraduate students on a University campus in the U.S.A.  
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**Abstract:**

Objective: The aim of this study is to estimate the prevalence of smoking behavior 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. Barriers to policy success include lack of reminders about the policy, lack of support from students and University administrators, and insufficient fines. Smoking behavior (OR: 7.95; 95% CI: 5.09-12.40), beliefs about policy adherence (OR: 0.53; 95% CI: 0.42-0.66), support for the policy (OR: 0.71; 95% CI: 0.53-0.94), and attitudes against smoking behavior (OR: 0.35; 95% CI: 0.26-0.49) were all significantly associated with self-reported policy violations. A more complicated picture emerges for the prediction of frequency of witnessing a violation of the smoking policy because smoking status was found to significantly moderate the effect of policy adherence beliefs and smoking attitudes on the frequency of witnessing a policy violation.

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 the barriers such as reminders about the policy, better policy enforcement, and support from the administration.

Key words: Public health, campus smoking policy, smoking prevention, policy compliance

Strengths & Limitations:

- 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 frequency of witnessing policy-violation by others, providing multiple perspectives on campus smoking behavior.
- This study did not assess the effectiveness of the smoke-free policy and only includes data collected after the policy was implemented.

## 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 United States<sup>1</sup>. Coordinated tobacco cessation efforts by several public health agencies and health care 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 U.S. 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 U.S. 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, and other organizations, 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



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2  
3 students and staff<sup>7-12</sup>. There has been a 300% increase in the use of smoke-free policies since  
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5 2010, with over 2,000 universities implementing such policies, as of October, 2017<sup>2,13</sup>.  
6

7  
8 However, there is wide variation in the nature of these policies with many policies  
9  
10 lacking clarity or combined with weak enforcement practices<sup>14,15</sup>. Research into the effectiveness  
11  
12 of campus smoke-free policies has found mixed results, with some universities reporting  
13  
14 frequent policy violations and low compliance rates<sup>15-19</sup>, while some others report considerable  
15  
16 reduction in smoking prevalence and exposure to second-hand smoke<sup>20-22</sup>. There is limited  
17  
18 research on the factors affecting policy compliance and strategies to improve compliance to  
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20 smoke-free policies on college campuses<sup>23-25</sup>.  
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24 The support for and effectiveness of smoking cessation policies can be influenced by  
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26 societal antismoking norms<sup>8,22,26</sup>, smoking behavior<sup>22,27,28</sup>, perceptions of peer tobacco use<sup>22</sup>, and  
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28 demographic variables such as gender and race<sup>29</sup>. The current study utilizes the framework  
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30 proposed by Fong et al. that guided the development of the International Tobacco Control (ITC)  
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32 policy evaluation project<sup>30</sup>. This project has evaluated the impact of regulations, such as smoke-  
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34 free policies, in several countries. The framework proposes that policies influence several policy-  
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36 specific psychosocial variables – such as beliefs and attitudes, normalization of beliefs, self-  
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38 efficacy, and intentions – which in turn influence policy-related outcomes, such as prevalence of  
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40 smoking. Other variables, such as socio-demographics and smoking status, may moderate the  
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42 relationship between psychosocial variables and policy outcomes<sup>30</sup>. The current study focuses on  
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44 psychosocial variables such as smoking attitudes, policy support, and policy attitudes, and  
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46 examines how the effects of these variables on policy outcomes are influenced by smoking  
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3 On the campus of the University of Mississippi, a smoke-free policy was implemented on  
4 August 1<sup>st</sup>, 2012 to help reduce smoking prevalence. This policy prohibited all students, staff,  
5 employees, and visitors from all forms of smoking, which refers to inhaling, exhaling, burning,  
6 carrying or possessing any lighted tobacco product, including cigarettes, cigars, pipe tobacco,  
7 and any other lit tobacco products, including e-cigarettes that emit smoke, and littering of  
8 tobacco products<sup>31</sup>. This policy affects all indoor and outdoor grounds including residence halls  
9 and personal vehicles. Since implementation, few steps have been taken to evaluate the  
10 prevalence of on-campus smoking and students' adherence to the policy. The specific aim of the  
11 current study was to evaluate adherence to the campus smoke-free policy, estimate the  
12 prevalence of on-campus smoking behavior, identify the key factors that influence policy  
13 violations, and measure barriers to successful implementation of a smoke-free policy. While the  
14 policy includes prohibition of several other behaviors such as littering and even possessing  
15 tobacco products, this study chose to focus specifically on smoking behavior among college  
16 students, because they constituted a high-risk population for such violations.  
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## 38 **Methods**

### 39 Study design & procedures:

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42 This study employed a cross-sectional, self-administered survey of undergraduate  
43 students at the University of Mississippi. The sampling frame included a list of all undergraduate  
44 classes offered in the fall semester of 2015 on the Oxford campus, as recorded by the  
45 University's Registrar. After excluding classes that were too small (less than 4 students), or were  
46 independent studies, a random sample of the remaining classes was chosen for inclusion in the  
47 study. Instructors of record for the chosen classes were contacted to request permission to  
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3 distribute surveys in their classes. After obtaining instructor approval, the research team  
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5 distributed a short survey at the beginning of each class. No additional eligibility criteria were  
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7 implemented other than being enrolled in the class at the time of the survey. Student participation  
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9 was voluntary, and no incentives were offered in return for participation. Approval was obtained  
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11 from the University's Institutional Review Board (IRB) before data collection was started. Upon  
12  
13 opening the survey booklet, potential respondents were provided with information about the  
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15 study, including contact details for the IRB. Respondents' completion of the survey constituted  
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17 consent, as approved by the IRB. Students who were present in more than one participating class  
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19 were requested to participate no more than once, to prevent repeat administration.  
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#### 23 24 Study measures:

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26 The survey included questions on respondent demographics, alcohol use, smoking status,  
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28 policy awareness, policy attitudes, smoking attitudes, policy support, barriers to policy success,  
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30 and policy violations. Respondent demographics and alcohol use questions were modelled after  
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32 the American College Health Association's National College Health Assessment (ACHA-  
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34 NCHA) report<sup>4</sup>. Current smoking status has been operationalized in a variety of ways in the  
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36 extant literature<sup>32</sup>. Among adults, current smoking status is defined by the Centers for Disease  
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38 Control and Prevention (CDC) as having smoked at least 100 cigarettes in a lifetime *and*  
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40 smoking every day or on some days at the time of assessment<sup>33</sup>. However, in a population of  
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42 young adults, among whom new smokers, infrequent smokers, and intermittent smokers are  
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44 common, assessment of past 30-day smoking behavior can be a better predictor of violation of  
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46 smoke-free policies. Therefore, this study defined current smokers as those respondents who  
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48 smoked at least one cigarette during the past 30 days. This characterization of smoking behavior  
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50 was found applicable for the college student and young adult populations in previous studies<sup>34-36</sup>.  
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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>28</sup>. Measures assessing smoking attitudes (6 items), support for the policy (4 items), and barriers to policy success (11 items) were all adapted from Burns et al. and measured using five-point response formats<sup>7,27,28,37</sup>.

The variable of interest in this study, policy outcomes, was operationalized in two ways: 1) as a self-violation of the campus smoke-free policy and 2) frequency of witnessing a violation 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>28</sup>, creating a dichotomous variable. Respondents' frequency of witnessing policy violations by others was assessed using four 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 second-hand smoke on campus, and had to alter their walking route on campus in order to avoid smoke. These items were summed to create a single variable ranging from 0 to 4.

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 version 25 (Chicago, IL) and STATA SE version 15 (College Station, TX) were used for data analysis. Descriptive analyses were conducted for all items in the survey. 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 witnessing policy violations by others was measured as the sum of four items, it was analyzed as a continuous variable using linear regression. 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 hypothesized study predictors in both the logistic and linear regression models by including interaction terms. Because classes were sampled rather than individual students, both regression models used clustered robust standard errors to account for the non-independence of observations due to the nesting of students within classes. The cluster option in STATA was used to accomplish this.

#### Participant & public involvement:

There was no direct involvement of participants nor the public in the development, conceptualization, 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 1,704 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 1,654 students, 1,541 surveys were collected with at least one completed response,

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3 leading to a response rate of 93%. After deleting responses that had missing responses on more  
4 than 30 out of the 63 items on the survey, analyses were conducted on 1,512 responses. As seen  
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6 in Table 1, the sample was comprised of nearly 60% women, 78% Caucasians, 50%  
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8 freshmen/sophomores, 53% state residents, and 47% enrolled in Greek organizations. The  
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10 majority of respondents were 20 years old or younger, lived off-campus, and were single.  
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12 Twenty-three percent of respondents self-reported smoking in the past 30 days and were  
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14 classified as current smokers. Nearly 60% of the sample reported being exposed to second-hand  
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16 smoke on campus at least once in the past week, and almost 20% of the sample reported  
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18 consuming alcohol at least 10 days in the past month. Women, minorities, and students living on-  
19  
20 campus were significantly less likely to be current smokers, in bivariate analyses. In contrast,  
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22 students enrolled in Greek houses were significantly more likely to be current smokers.  
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29 <Table 1>

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31 Among the variables related to the campus smoke-free policy, 85% of respondents  
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33 reported being aware of the campus smoking policy, and more than 88% of respondents correctly  
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35 chose smoke-free or tobacco-free as the campus policy. More than 63% of current smokers  
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37 report ever smoking on campus, but less than 10% ever received a warning or a ticket for their  
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39 violation. An overwhelming majority of respondents (93.7%) scored at least 1 point or greater on  
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41 the frequency of witnessing a policy violation, while 22% knew of someone who had received a  
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43 warning or a ticket for smoking on campus. Three quarters of respondents were exposed to  
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45 second-hand smoke while on the campus, and more than a quarter of respondents even altered  
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47 their walking route to avoid second-hand smoke while on campus.  
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### Barriers to policy adherence:

Considering all respondents together, the most significant 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 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 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 – significantly less frequently than past 30-day smokers. Only one barrier, difficult to enforce, received a significantly lower agreement by past 30-day smokers compared to non-smokers.

<Table 2>

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

Using PCA, a two-factor solution was obtained for respondents' attitudes toward the smoke-free policy. The two factors, labeled "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 toward smoking (mean: 3.7; SD: 0.9; higher scores are indicative of negative attitudes toward smoking or positive attitudes about non-smoking behavior) 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 standard



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3 deviations for the total sample as well as for current (past 30-day) smokers and non-smokers, are  
4 provided in Table 3.  
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11 Factors predicting campus smoke-free policy violations:  
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13 In a logistic regression model predicting self-violation of campus smoke-free policy  
14 (Table 4), current (past 30-day) smokers unsurprisingly had nearly 8 times the odds (OR: 7.95;  
15 95% CI: 5.09-12.40) of reporting that they had violated the policy as compared to non-smokers  
16 and women had lower odds (OR: 0.36, 95% CI: 0.22-0.58) of violating the policy compared to  
17 men. Stronger beliefs about policy adherence (OR: 0.53; 95% CI: 0.42-0.66), greater support for  
18 the policy (OR: 0.71; 95% CI: 0.53-0.94), and stronger attitudes against smoking behavior (OR:  
19 0.35; 95% CI: 0.26-0.49) were all related to lower odds of violating the policy. Non-Black  
20 minorities (OR: 2.65; 95% CI: 1.07-6.55), on-campus residents (OR: 1.79; 95% CI: 1.00-3.20),  
21 in-state students (OR: 1.60; 95% CI: 1.13-2.28), seniors (OR: 2.25; 95% CI: 1.06-4.76) and  
22 students who reported a high frequency of alcohol consumption (OR: 2.47; 95% CI: 1.13-5.41)  
23 had higher odds of violating the policy when compared to Caucasians, off-campus residents, out-  
24 of-state students, freshmen, and students who reported not consuming any alcohol in the past 30  
25 days, respectively. Higher GPA was also associated with higher odds (OR: 1.37; 95% CI: 1.12-  
26 1.67) of violating the policy. There were no significant interactions of past 30-day smoking  
27 status with any of the predictors in the model.  
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48 <Table 4>  
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50 Witnessing a violation of the smoke-free policy by others was calculated as a count  
51 variable from four items that assessed witnessing various kinds of policy violations. This  
52 variable, ranging in scores from 0 to 4, was found to have a distribution very close to normal  
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with an absence of any meaningful floor or ceiling effects (Table 1), thereby justifying the use of a linear regression model for its prediction (Table 5). After controlling for all other variables, gender ( $p < 0.0005$ ), and Greek membership ( $p < 0.0005$ ) were found to be significantly predictive of witnessing a violation of the smoke-free policy. When compared to Caucasians, African Americans ( $p = 0.005$ ) witnessed fewer violations of the smoke-free policy. When compared to freshmen, juniors ( $p = 0.010$ ), and seniors ( $p = 0.027$ ) witnessed more policy violations. Respondents who reported low ( $p = 0.068$ ), medium ( $p = 0.034$ ), or high frequency ( $p = 0.050$ ) of alcohol use in the previous 30 days witnessed more policy violations than those who no reported no alcohol consumption. The effect of smoking attitudes ( $p < 0.0005$  for the interaction) and beliefs about policy adherence ( $p = 0.001$  for the interaction) on witnessing policy violations were both moderated by current (past 30-day) smoking status. Among non-smokers, stronger attitudes against smoking were related to witnessing more policy violations (regression coefficient = 0.289;  $p < 0.0005$ ), and stronger beliefs about policy adherence were related to witnessing fewer violations of policy (regression coefficient = -0.360;  $p < 0.0005$ ). However, among current (past 30-day) smokers, smoking attitudes were not predictive of witnessing policy violations (regression coefficient = -0.041;  $p = 0.545$ ), and beliefs about policy adherence were still related to witnessing fewer violations of policy ( $p = 0.027$ ), but this relationship was not as strong as it was among non-smokers (regression coefficients = -0.142 vs -0.360).

<Table 5>

## 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 comprised of 55% females, 77% Caucasians, 30% freshmen, 20% sophomores, 22% juniors, 28% seniors, and 42% Greek organization members, which closely approximates the distribution obtained in this study<sup>38,39</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>40</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>40</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 and also witnessed fewer policy violations by others. Policy violations were

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3 also associated with smoking behavior and alcohol consumption, which is in line with the  
4 expectation that these risk behaviors often manifest concomitantly<sup>41</sup>. Extant literature shows risk  
5 behaviors such as smoking tend to be associated with a lower GPA<sup>42,43</sup>, but this current study  
6 found that a one-unit increase in GPA was associated with a 36% increase in the odds of  
7 violating the policy. While students with higher GPAs might smoke less frequently, it is possible  
8 that they have a greater propensity for policy violations because higher GPA might be indicative  
9 of greater time spent on campus, leading to a greater chance of policy violations. Seniors and  
10 juniors were more likely to witness a policy violation when compared to freshmen, which might  
11 be a reflection of the greater amount of time they have spent on the campus. Neither membership  
12 in Greek organizations nor class year were related to self-reported policy violations, but were  
13 both found to have an association with witnessing a policy violation by others, indicating the  
14 possibility of social desirability bias. The effects of policy adherence beliefs and smoking  
15 attitudes on witnessing others violate the policy were greater among non-smokers than smokers.  
16 Given the high likelihood of witnessing policy violations among smokers, it is not unexpected  
17 that behavioral factors are less likely to be significant in this population.

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19 This study found that, despite high levels of policy awareness, smoke-free policies are  
20 largely ineffective at curtailing smoking behavior on university campuses. The ineffectiveness of  
21 the policy was reflected in the fact that nearly 75% of respondents have been exposed to  
22 secondhand smoke on campus, which is the primary purpose of a smoke-free policy. The most  
23 significant barrier to a successful smoke-free campus policy was the lack of adequate funding  
24 and the difficulty of enforcing the policy. However, smokers and non-smokers highlighted  
25 different barriers. Smokers rated both inadequate funding and lack of support from staff very  
26 highly, while non-smokers acknowledged the difficulty in enforcing the law much more

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3 frequently than smokers. The other highly rated barriers to success, lack of information, lack of  
4 support from staff and faculty, and lack of enforcement also indicate a lack of buy-in for policy  
5 enforcement. The results of this study must be interpreted in the context of these limited  
6 enforcement efforts. Less than 3% of respondents received a ticket, while nearly 20% reported  
7 violating the policy. This discrepancy suggests a greater need for reminders, which might not be  
8 necessary on campuses where the policy is strictly enforced. The measurement of barriers also  
9 shows that many respondents believe it was important to have support from students, faculty, and  
10 administrators in order to implement the policy. While the nature of this support was not defined  
11 as part of the survey, it appears that most respondents believe the entire campus community  
12 needs to buy-in in order to successfully implement this policy. This community support may be  
13 in the form students and faculty discouraging campus smoking behavior, peer approval and  
14 social norms, among others.

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31 Contrary to expectations from previous research<sup>17,22,28,44</sup>, the prevalence of smoking on  
32 campus may have increased since the implementation of the campus smoke-free policy in  
33 2012<sup>40</sup>. The rising prevalence of smoking and the frequency of policy violations suggest the need  
34 for a renewed strategy of policy enforcement. Universities willing to enact or enforce campus  
35 smoke-free policies must focus on creating an environment where policy violations are not  
36 tolerated, and the administration, faculty, and students support the ban on smoking in public  
37 places. Strategies to achieve this environment might include strict ticketing policies, strategically  
38 placed reminder signs, reinforcement of student beliefs about smoking and overall policy  
39 support, which were found to be important predictors of policy violation in this study. Further  
40 attention must be paid to campus alcohol consumption and social or sporting events where  
41 violations of policy might be more prevalent.

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3 While some researchers have sought to stress the importance of education campaigns, the  
4 high rates of policy awareness and generally strong attitudes against smoking behavior found in  
5 this study imply that educational campaigns addressing the policy or the hazards of tobacco use  
6 might not necessarily be effective at improving policy compliance<sup>18,28,45</sup>. On the other hand,  
7 there is much support in the literature on the potential of strong enforcement policies in  
8 decreasing smoking prevalence<sup>14,23</sup>. Harris and colleagues recommend the use of passive  
9 techniques such as reminder signs about the smoke-free policy, along with more active strategies  
10 such as direct contact with violators using volunteers to improve engagement, periodic positive  
11 reinforcement, and hosting interactive compliance events to serve as additional reminders<sup>23</sup>.  
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14 While this study provides critical evidence to support development strategies to improve  
15 campus smoke-free policy compliance, it also carries some limitations. Even though the survey  
16 had a 90% response rate among invited students, only 50% of invited instructors agreed to  
17 participate in the study. While many instructors did not choose to participate, because instructor  
18 choices are not expected to be related to smoking behavior among their students, this is not  
19 expected to bias the study's findings. This study used self-report to identify smoking behavior  
20 and policy violations. Both these behaviors can be underreported due to a combination of social  
21 desirability bias and recall bias. This study also did not delineate the use of e-cigarettes from  
22 regular cigarettes, or capture frequency of policy violations specifically associated with the use  
23 of e-cigarettes; rather, the questions simply referred to "smoking on campus". It is possible that  
24 many respondents might have a misunderstanding of whether smoke-free policies include a ban  
25 on use of e-cigarettes (even though the policy clearly specifies that e-cigarettes are included in  
26 the ban<sup>31</sup>), thereby leading to a bias in the estimate of policy violations. Similarly, individuals  
27 who incorrectly believed the campus was tobacco-free as opposed to smoke-free might have  
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3 different perceptions of barriers or their support for the policy because of their incorrect  
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5 understanding of what is included in the policy. These differences were not explored in the  
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7 current study. Finally, although a large sample was obtained, these data were collected four  
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9 years ago, and although there is no reason to expect so, some of these findings may have  
10  
11 changed since then. In addition, this study only included policy violations by smoking and did  
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13 not assess other behaviors such as littering or possession of tobacco products, as mentioned in  
14  
15 the policy. Policy violations were also only assessed in students, whereas such violations could  
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17 have been committed by staff, employees, or visitors. The findings of this study must also be  
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19 interpreted in the context of the campus where this study was conducted; thus, generalization to  
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21 other universities must be made with caution.  
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## 25 26 **Conclusion**

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28 This study found that violations of a campus smoke-free policy are fairly common. Policy  
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30 violations might be related to smoking behavior, beliefs about policy adherence, smoking  
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32 attitudes, and support for the policy. Important barriers to policy adherence include a lack of  
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34 reminders about the policy, lack of student and administrative support, and a need for stricter  
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36 policy enforcement. Additional interventions are needed to improve compliance with the policy  
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38 and reduce prevalence of smoking on campus.  
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## 44 **List of Abbreviations:**

45  
46 ACHA: American College Health Association

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48 CDC: Centers for Disease Control and Prevention

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50 GPA: Grade Point Average

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52 ITC: International Tobacco Control

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54 NCHA: National College Health Assessment  
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3 PCA: Principal Components Analysis  
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### 8 **Declarations:**

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10 Ethics approval: This study was approved by the University of Mississippi Institutional Review  
11 Board (UM IRB) before data were collected (Protocol #16x-011). Respondents provided consent  
12 to participate by completing the paper-based survey (this approach to consent was approved by  
13 the UM IRB and a statement was included on the front of the survey booklet that stated, “By  
14 completing the survey, I consent to participate in the study”).  
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17 Data Availability Statement: The datasets used and/or analyzed during the current study are  
18 available from the corresponding author on reasonable request.  
19

20 Competing interests: None declared  
21

22 Funding: This research received no specific grant from any funding agency in the public,  
23 commercial or not-for-profit sectors  
24  
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26 Author contributions: SB and JB designed the survey and the data collection procedure. Data  
27 collection and data entry was coordinated by SB and EC. Data analysis was conducted by SR  
28 and JB. All authors contributed to the interpretation of results and manuscript preparation. All  
29 authors read and approved the final manuscript.  
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## Tables

**Table 1: Characteristics of the study sample**

| Characteristic                                      | Total<br>N = 1512<br>N (%) | Current<br>smoker <sup>1</sup><br>N = 353<br>N (%) | Current<br>non-smoker<br>N = 1158<br>N (%) |
|---|----------------------------|--|--|
| Age   |                            |  |  |
| 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)                                 |
| Race***   |                            |  |  |
| 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)                                   |
| International student                               | 48 (3.2)                   | 13 (3.7)   | 35 (3.1)                                   |
| Resident of the state of MS                         | 790 (53.4)                 | 169 (48.8)   | 620 (54.7)                                 |
| Greek membership*                                   | 711 (47.9)                 | 185 (53.2)   | 525 (46.3)                                 |
| Class year  |                            |  |  |
| 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] ***                                   | 2.62 [0.9]                 | 2.86 [0.9]   | 2.54 [0.9]                                 |
| On-campus housing**                                 | 493 (33.2)                 | 91 (26.1)  | 402 (35.4)                                 |
| Marital Status                                      |                            |  |  |
| 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*** |                            |  |  |
| 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 second-hand smoke on campus in past 7 days***                        |             |            |             |
| 0 days   | 616 (40.8)  | 142 (40.3) | 474 (41.0)  |
| 1 or 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***   |             |            |             |
| 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**                                      |             |            |             |
| 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)  |
| What is the smoking policy on campus?  |             |            |             |
| 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   |             |            |             |
| Ever smoked on campus***   | 292 (19.3)  | 223 (63.4) | 69 (6.0)    |
| Ever received a warning or ticket for smoking on campus***                       | 38 (2.5)    | 32 (9.1)   | 6 (0.5)     |
| Ever witnessed someone smoking on campus**                                       | 1397 (92.5) | 341 (96.6) | 1055 (91.2) |
| Know of someone else who received a warning or ticketed for smoking on campus*** | 333 (22.1)  | 160 (45.3) | 173 (15.0)  |
| Ever exposed to secondhand smoke on campus                                       | 1129 (74.7) | 269 (76.4) | 859 (74.2)  |
| Ever altered my walk on campus to avoid smoke***                                 | 391 (25.9)  | 18 (5.1)   | 373 (32.2)  |
| Self violation of the campus smoking policy*** <sup>2</sup>                      | 293 (19.4)  | 224 (63.6) | 69 (6.0)    |
| Witnessing others violate the policy**   |             |            |             |
| 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)    |

\* Difference between past 30-day smokers and non-smokers is significant at  $p < 0.05$

\*\* Difference between past 30-day smokers and non-smokers is significant at  $p < 0.005$

\*\*\* Difference between past 30-day smokers and non-smokers is significant at  $p < 0.0005$

<sup>1</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

<sup>2</sup>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.

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

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

| Barrier  | Total                    | Current Smokers <sup>2</sup> | Current non-smokers |
|--|--------------------------|------------------------------|---------------------|
|  | Percent (N) <sup>1</sup> | Percent (N)                  | Percent (N)         |
| Inadequate funding*                                  | 55.6 (840)               | 62.0 (219)                   | 53.6 (621)          |
| Difficult to enforce***                              | 40.4 (611)               | 26.1 (92)                    | 44.8 (519)          |
| Lack of information about policy*                    | 37.4 (565)               | 42.8 (151)                   | 35.8 (414)          |
| Lack of support from staff***                        | 35.3 (534)               | 49.9 (176)                   | 30.9 (358)          |
| Lack of support from faculty                         | 32.6 (492)               | 35.4 (125)                   | 31.7 (367)          |
| Lack of enforcement                                  | 31.8 (481)               | 35.1 (124)                   | 30.8 (357)          |
| Policy infringes on individuals' personal freedom*** | 27.5 (415)               | 39.1 (138)                   | 23.9 (277)          |
| Insufficient fines***                                | 25.9 (391)               | 39.9 (141)                   | 21.6 (250)          |
| Lack of support from University administrators       | 20.0 (302)               | 20.7 (73)                    | 19.8 (229)          |
| Lack of reminders about the policy***                | 16.0 (242)               | 24.6 (87)                    | 13.4 (155)          |
| Lack of support from students                        | 15.8 (238)               | 15.9 (56)                    | 15.7 (182)          |

\* Difference between past 30-day smokers and non-smokers is significant at  $p < 0.05$

\*\* Difference between past 30-day smokers and non-smokers is significant at  $p < 0.005$

\*\*\* Difference between past 30-day smokers and non-smokers is significant at  $p < 0.0005$

<sup>1</sup>Percentage of respondents who selected strongly agree or agree.

<sup>2</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

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



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

| Item  | Factor loading | Total Mean (SD) | Current Smokers <sup>1</sup> Mean (SD) | Current non-smokers Mean (SD) |
|---|----------------|-----------------|--|-------------------------------|
| <b>Student attitudes toward 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)                     |
| The current policy is enforced*   | 0.791          | 2.7 (1.1)       | 2.8 (1.0)                              | 2.6 (1.1)                     |
| Most smokers comply with the current policy   | 0.816          | 2.6 (1.0)       | 2.6 (1.0)                              | 2.7 (1.0)                     |
| The current policy is ignored by smokers <sup>2</sup>   | 0.774          | 2.2 (1.0)       | 2.2 (1.0)                              | 2.2 (1.0)                     |
| Total subscale score (alpha = 0.81)   | -              | 2.6 (0.8)       | 2.6 (0.8)                              | 2.6 (0.8)                     |
| <b>Student attitudes toward 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)                    |
| The current policy helps create a healthy environment***  | 0.857          | 3.9 (1.0)       | 3.6 (1.0)                              | 4.0 (1.0)                     |
| Total subscale score (alpha = 0.72)***  | -              | 3.8 (0.9)       | 3.4 (0.9)                              | 3.9 (0.9)                     |
| <b>Student attitudes toward smoking</b>   |                |                 |  |                               |
| If someone smokes cigarettes around me they are causing me harm because of second-hand smoke*** | 0.788          | 4.0 (1.0)       | 3.1 (1.1)                              | 4.2 (0.9)                     |
| I prefer to socialize in a smoke-free environment***  | 0.867          | 4.0 (1.1)       | 3.0 (1.0)                              | 4.3 (0.9)                     |
| I seek out smoke-free environments***   | 0.871          | 3.5 (1.3)       | 2.4 (1.0)                              | 3.8 (1.1)                     |
| 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)                     |
| I would rather date a non-smoker***   | 0.693          | 4.4 (0.9)       | 3.7 (1.1)                              | 4.6 (0.7)                     |
| I ask others not to smoke around me***  | 0.795          | 3.1 (1.3)       | 2.0 (1.1)                              | 3.4 (1.3)                     |
| Total scale score (alpha = 0.89)***   | -              | 3.7 (0.9)       | 2.7 (0.7)                              | 4.0 (0.8)                     |
| <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)                     |
| Smoking should be banned on all university property***  | 0.874          | 3.6 (1.3)       | 2.5 (1.3)                              | 4.0 (1.2)                     |
| All tobacco products should be banned in all university buildings***                            | 0.867          | 3.7 (1.4)       | 2.9 (1.5)                              | 4.0 (1.2)                     |
| All tobacco products should be banned on all university property***                             | 0.900          | 3.2 (1.4)       | 2.2 (1.2)                              | 3.5 (1.3)                     |
| Total scale score (alpha = 0.85)  | -              | 3.8 (1.1)       | 2.9 (1.0)                              | 4.0 (1.0)                     |

\* Difference between current smokers and non-smokers is significant at  $p < 0.05$

\*\*\* Difference between current smokers and non-smokers is significant at  $p < 0.0005$

<sup>1</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

<sup>2</sup>This item was reverse coded prior to calculation of the scale score.



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

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

| Characteristic                | Violation of the campus smoke-free policy |          |
|-------------------------------|---|----------|
|                               | Adjusted odds ratio (95% CI)              | p        |
| Current smoker <sup>1</sup>   | 7.95 (5.09 – 12.40)                       | < 0.0005 |
| Policy adherence subscale     | 0.53 (0.42 – 0.66)                        | < 0.0005 |
| Policy justification subscale | 0.98 (0.76 – 1.28)                        | 0.902    |
| Smoking attitudes scale       | 0.35 (0.26 – 0.49)                        | < 0.0005 |
| Policy support scale          | 0.71 (0.53 – 0.94)                        | 0.016    |
| Policy awareness              | 1.24 (0.69 – 2.21)                        | 0.472    |
| Female                        | 0.36 (0.22 – 0.58)                        | < 0.0005 |
| Age                           |   |          |
| 18 to 20 years                | Reference                                 |          |
| 21 to 24 years                | 0.76 (0.42 – 1.37)                        | 0.359    |
| 25 and older                  | 0.94 (0.36 – 2.44)                        | 0.901    |
| Race                          |   |          |
| Caucasian                     | Reference                                 |          |
| African American              | 1.42 (0.72 – 2.81)                        | 0.312    |
| Other minorities              | 2.65 (1.07 – 6.55)                        | 0.035    |
| Resident of MS                | 1.60 (1.13 – 2.28)                        | 0.008    |
| International                 | 1.58 (0.48 – 5.22)                        | 0.454    |
| Greek membership              | 1.21 (0.82 – 1.79)                        | 0.343    |
| Class year                    |   |          |
| Freshman                      | Reference                                 |          |
| Sophomore                     | 1.44 (0.79 – 2.62)                        | 0.228    |
| Junior                        | 1.59 (0.84 – 3.02)                        | 0.156    |
| Senior & above                | 2.25 (1.06 – 4.76)                        | 0.035    |
| GPA                           | 1.37 (1.12 – 1.67)                        | 0.002    |
| On campus residence           | 1.79 (1.00 – 3.20)                        | 0.048    |
| Frequency of alcohol use      |   |          |
| None                          | Reference                                 |          |
| Low                           | 1.23 (0.60 – 2.50)                        | 0.574    |
| Medium                        | 1.75 (0.83 – 3.68)                        | 0.139    |
| High                          | 2.47 (1.13 – 5.41)                        | 0.024    |

<sup>1</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

**Table 5: Linear regression results predicting frequency of witnessing a violation of the campus smoke-free policy by others**

| Predictor                                  | Witness violation of campus smoke-free policy |          |
|--|---|----------|
|  | Unstandardized coefficient<br>(95% CI)        | p        |
| Current smoker <sup>1,2</sup>              | 0.718 (0.174,1.262)                           | 0.007    |
| Policy adherence subscale <sup>3</sup>     | -0.360 (-0.423,-0.296)                        | < 0.0005 |
| Policy justification subscale <sup>4</sup> | 0.048 (-0.010-0.106)                          | 0.138    |
| Smoking attitudes scale                    | 0.289 (0.208,0.371)                           | < 0.0005 |
| Policy support scale                       | 0.024 (-0.038,0.086)                          | 0.395    |
| Policy awareness                           | 0.129 (-0.17,0.274)                           | 0.163    |
| Female                                     | -0.204 (-0.307,0.101)                         | < 0.0005 |
| Age  |   |          |
| 18 to 20 years                             | Reference                                     |          |
| 21 to 24 years                             | -0.033 (-0.184,0.118)                         | 0.630    |
| 25 and older                               | -0.159 (-0.474,0.157)                         | 0.345    |
| Race                                       |   |          |
| Caucasian                                  | Reference                                     |          |
| African American                           | -0.262 (-0.416,-0.108)                        | 0.005    |
| Other minorities                           | 0.201 (0.028,0.374)                           | 0.064    |
| Resident of MS                             | -0.008 (-0.107,0.091)                         | 0.870    |
| International                              | -0.093 (-0.376,0.190)                         | 0.693    |
| Greek membership                           | 0.174 (0.070,0.278)                           | <0.0005  |
| Class year                                 |   |          |
| Freshman                                   | Reference                                     |          |
| Sophomore                                  | 0.130 (-0.030,0.290)                          | 0.128    |
| Junior                                     | 0.210 (0.039,0.380)                           | 0.010    |
| Senior & above                             | 0.251 (0.021,0.463)                           | 0.027    |
| GPA  | -0.021 (-0.071,0.029)                         | 0.424    |
| On campus residence                        | 0.120 (-0.008,0.248)                          | 0.083    |
| Frequency of alcohol use                   |   |          |
| None                                       | Reference                                     |          |
| Low  | 0.130 (0.003,0.257)                           | 0.068    |
| Medium                                     | 0.178 (0.030,0.326)                           | 0.034    |
| High                                       | 0.180 (0.017,0.344)                           | 0.050    |
| Current smoker x Smoking attitudes scale   | -0.330 (-0.476,-0.185)                        | < 0.0005 |
| Current smoker x Policy adherence subscale | 0.218 (0.084,0.352)                           | 0.001    |

<sup>1</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

<sup>2</sup>The estimate for smoking status is the effect of smoking status when policy adherence and policy smoking attitudes are equal to zero.

<sup>3</sup>This estimate is the effect of policy adherence among non-smokers

<sup>4</sup>This estimate is the effect of smoking attitudes among non-smokers.

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STROBE Statement—checklist of items that should be included in reports of observational studies

|                           | Item No. | Recommendation  | Page No. | Relevant text from manuscript  |
|---------------------------|----------|---|----------|--|
| <b>Title and abstract</b> | 1        | (a) Indicate the study’s design with a commonly used term in the title or the abstract              | 1        | Cross-sectional survey   |
|                           |          | (b) Provide in the abstract an informative and balanced summary of what was done and what was found | 2, 3     | 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... 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 the barriers such as reminders about the policy, better policy enforcement, and support from the administration. |
| <b>Introduction</b>       |          |   |          |  |
| Background/rationale      | 2        | Explain the scientific background and rationale for the investigation being reported                | 4        | Research into the effectiveness of campus smoke-free policies has found mixed results, with some universities reporting frequent policy violations and low compliance rates[14-18]. There is limited research on the factors affecting policy compliance and strategies to improve compliance to smoke-free policies on college campuses[19-21].   |
| Objectives                | 3        | State specific objectives, including any prespecified hypotheses                                    | 5        | The specific aim of the current study was to evaluate adherence to the campus smoke-free policy, estimate the prevalence of on-campus smoking behavior, and to identify the key factors that influence policy violations, and measure barriers to successful implementation of a smoke-free policy.  |
| <b>Methods</b>            |          |   |          |  |

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|                              |    |  |      |  |
|------------------------------|----|--|------|--|
| Study design                 | 4  | Present key elements of study design early in the paper  | 5    | This study employed a cross-sectional, self-administered survey of undergraduate students at the University of Mississippi ...   |
| Setting                      | 5  | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection  | 5, 6 | 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 4 students) or were independent studies, a random sample of the remaining classes was chosen for inclusion in the study.  |
| Participants                 | 6  | (a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up  | 6    | 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. |
|                              |    | <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls |      |  |
|                              |    | <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants  |      |  |
|                              |    | (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed   | N/A  |  |
|                              |    | <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case   |      |  |
| Variables                    | 7  | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable   | 6-8  | Study measures section   |
| Data sources/<br>measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group       | 6-8  | Study measures section   |
| Bias                         | 9  | Describe any efforts to address potential sources of bias  | 8    | 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  |

hypothesized study predictors in both the logistic and linear regression models by including interaction terms. Because classes were sampled rather than individual students, both regression models used clustered robust standard errors to account for the non-independence of observations due to the nesting of students within classes.

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 1,704 students in 60 course sections.

Study size                      10      Explain how the study size was arrived at                      8

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|------------------------|-----|---|-----|--|
| Quantitative variables | 11  | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why  | 7,  | Statistical analysis section   |
| Statistical methods    | 12  | (a) Describe all statistical methods, including those used to control for confounding   | 7,  | Statistical analysis section   |
|                        |     | (b) Describe any methods used to examine subgroups and interactions   | 7,  | Statistical analysis section   |
|                        |     | (c) Explain how missing data were addressed   | 9   | After deleting responses that had missing responses on more than 30 out of the 63 items on the survey, analyses were conducted on 1,512 responses  |
|                        |     | (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed<br><i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed<br><i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy | 8   | Because classes were sampled rather than individual students, both regression models used clustered robust standard errors to account for the non-independence of observations due to the nesting of students within classes.  |
|                        |     | (e) Describe any sensitivity analyses   | N/A |  |
| <b>Results</b>         |     |   |     |  |
| Participants           | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed   | 9   | 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 1,704 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 1,654 students, 1,541 surveys were collected with at least |

|    |                  |     |  |                                      |   |
|----|------------------|-----|--|--------------------------------------|---|
| 1  |                  |     |  |                                      |   |
| 2  |                  |     |  | one completed response, leading to   |   |
| 3  |                  |     |  | a response rate of 93%. After        |   |
| 4  |                  |     |  | deleting responses that had missing  |   |
| 5  |                  |     |  | responses on more than 30 out of     |   |
| 6  |                  |     |  | the 63 items on the survey, analyses |   |
| 7  |                  |     |  | were conducted on 1,512 responses.   |   |
| 8  |                  |     |  |                                      |   |
| 9  |                  |     |  |                                      |   |
| 10 |                  |     | (b) Give reasons for non-participation at each stage   | 9                                    | As shown above  |
| 11 |                  |     | (c) Consider use of a flow diagram   | N/A                                  |   |
| 12 | Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 9                                    | As seen in Table 1, the sample was comprised of nearly 60% women, 78% Caucasians, 50% freshmen/sophomores, 53% state residents, and 47% enrolled in Greek organizations. The majority of respondents were 20 years old or younger, lived off-campus, and were single. |
| 13 |                  |     |  |                                      |   |
| 14 |                  |     |  |                                      |   |
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| 21 |                  |     |  |                                      |   |
| 22 |                  |     |  |                                      |   |
| 23 |                  |     |  |                                      |   |
| 24 |                  |     | (b) Indicate number of participants with missing data for each variable of interest  | 9                                    | After deleting responses that had missing responses on more than 30 out of the 63 items on the survey, analyses were conducted on 1,512 responses.  |
| 25 |                  |     |  |                                      |   |
| 26 |                  |     |  |                                      |   |
| 27 |                  |     |  |                                      |   |
| 28 |                  |     |  |                                      |   |
| 29 |                  |     |  |                                      |   |
| 30 |                  |     | (c) Cohort study—Summarise follow-up time (eg, average and total amount)   | N/A                                  |   |
| 31 | Outcome data     | 15* | Cohort study—Report numbers of outcome events or summary measures over time  | N/A                                  |   |
| 32 |                  |     | Case-control study—Report numbers in each exposure category, or summary measures of exposure   | N/A                                  |   |
| 33 |                  |     | Cross-sectional study—Report numbers of outcome events or summary measures   | 9, 2008                              | More than 63% of current smokers report ever smoking on campus, in violation of the policy, but less than 10% of respondents ever received a warning or a ticket for their violation. An overwhelming   |
| 34 |                  |     |  |                                      |   |
| 35 |                  |     |  |                                      |   |
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|--------------|----|--|-------|---|
|              |    |  |       | majority of respondents (93.7%) scored at least 1 point or greater on the frequency of witnessing a policy violation, while 22% knew of someone who had received a warning or a ticket for smoking on campus. |
| Main results | 16 | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | 26/28 | Table 4 and 5   |
|              |    | (b) Report category boundaries when continuous variables were categorized  | 11    | This variable, ranging in scores from 0 to 4, was found to have a distribution very close to normal   |
|              |    | (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period   | N/A   |   |

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|                   |    |  |        |   |
|-------------------|----|--|--------|---|
| Other analyses    | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses   | N/A    |   |
| <b>Discussion</b> |    |  |        |   |
| Key results       | 18 | Summarise key results with reference to study objectives   | 13     | The prevalence of self-reported policy violations was nearly 64% among current smokers and 6% among non-smokers (who have may been past smokers).   |
| Limitations       | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias                 | 16, 17 | Limitations paragraph   |
| Interpretation    | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 17     | This study found that violations of a campus smoke-free policy are fairly common. Policy violations might be related to smoking behavior, 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. |
| Generalisability  | 21 | Discuss the generalisability (external validity) of the study results  | 17     | The findings of this study must also be interpreted in the context of the campus where this study was conducted; thus, generalization to other universities must be made with caution.  |

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**Other information**

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|---------|----|---|----|--|
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 18 | This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors |
|---------|----|---|----|--|

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\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# 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 U.S.A.

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6 cross-sectional survey of undergraduate students on a University campus in the U.S.A.  
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## Abstract

Objective: The aim of this study is to estimate the prevalence of smoking behavior 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. Barriers to policy success include lack of reminders about the policy, lack of support from students and University administrators, and insufficient fines. Smoking behavior (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 behavior (OR: 0.35; 95% CI: 0.25 to 0.49) were all significantly associated with self-reported policy violations. A more complicated picture emerges for the prediction of witnessing violations of the smoking policy because smoking status was found to significantly moderate the effect of policy adherence beliefs and smoking attitudes on witnessing 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 the barriers such as reminders about the policy, better policy enforcement, and support from the administration.



Key words: Public health, campus smoking policy, smoking prevention, policy compliance

### Strengths & Limitations

- 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 behavior.
- This study did not assess the effectiveness of the smoke-free policy and only includes data collected after the policy was implemented.

### 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 United States<sup>1</sup>. Coordinated tobacco cessation efforts by several public health agencies and health care 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 U.S. 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 U.S. 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, and other organizations, 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

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3 students and staff<sup>7-12</sup>. There has been a 300% increase in the use of smoke-free policies since  
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5 2010, with over 2,000 universities implementing such policies, as of October, 2017<sup>2,13</sup>.  
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8 However, there is wide variation in the nature of these policies with many policies  
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10 lacking clarity or combined with weak enforcement practices<sup>14,15</sup>. Research into the effectiveness  
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12 of campus smoke-free policies has found mixed results, with some universities reporting  
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14 frequent policy violations and low compliance rates<sup>15-19</sup>, while some others report considerable  
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16 reduction in smoking prevalence and exposure to second-hand smoke<sup>20-22</sup>. There is limited  
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18 research on the factors affecting policy compliance and strategies to improve compliance to  
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20 smoke-free policies on college campuses<sup>23-25</sup>.  
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24 The support for and effectiveness of smoking cessation policies can be influenced by  
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26 societal antismoking norms<sup>8,22,26</sup>, smoking behavior<sup>22,27,28</sup>, perceptions of peer tobacco use<sup>22</sup>, and  
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28 demographic variables such as gender and race<sup>29</sup>. The current study utilizes the framework  
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30 proposed by Fong et al. that guided the development of the International Tobacco Control (ITC)  
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32 policy evaluation project<sup>30</sup>. This project has evaluated the impact of regulations, such as smoke-  
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34 free policies, in several countries. The framework proposes that policies influence several policy-  
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36 specific psychosocial variables – such as beliefs and attitudes, normalization of beliefs, self-  
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38 efficacy, and intentions – which in turn influence policy-related outcomes, such as prevalence of  
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40 smoking. Other variables, such as socio-demographics and smoking status, may moderate the  
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42 relationship between psychosocial variables and policy outcomes<sup>30</sup>. The current study focuses on  
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44 psychosocial variables such as smoking attitudes, policy support, and policy attitudes, and  
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46 examines how the effects of these variables on policy outcomes are influenced by smoking  
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3 On the campus of the University of Mississippi, a smoke-free policy was implemented on  
4 August 1<sup>st</sup>, 2012 to help reduce smoking prevalence. This policy prohibited all students, staff,  
5 employees, and visitors from all forms of smoking, which refers to inhaling, exhaling, burning,  
6 carrying or possessing any lighted tobacco product, including cigarettes, cigars, pipe tobacco,  
7 and any other lit tobacco products, including e-cigarettes that emit smoke, and littering of  
8 tobacco products<sup>31</sup>. This policy affects all indoor and outdoor grounds including residence halls  
9 and personal vehicles. Since implementation, few steps have been taken to evaluate the  
10 prevalence of on-campus smoking and students' adherence to the policy. The specific aim of the  
11 current study was to evaluate adherence to the campus smoke-free policy, estimate the  
12 prevalence of on-campus smoking behavior, identify the key factors that influence policy  
13 violations, and measure barriers to successful implementation of a smoke-free policy. While the  
14 policy includes prohibition of several other behaviors such as littering and even possessing  
15 tobacco products, this study chose to focus specifically on smoking behavior among college  
16 students, because they constituted a high-risk population for such violations.  
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## 38 **Methods**

### 39 Study design & procedures

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42 This study employed a cross-sectional, self-administered survey of undergraduate  
43 students at the University of Mississippi. The sampling frame included a list of all undergraduate  
44 classes offered in the fall semester of 2015 on the Oxford campus, as recorded by the  
45 University's Registrar. After excluding classes that were too small (less than 4 students), or were  
46 independent studies, a random sample of the remaining classes was chosen for inclusion in the  
47 study. Instructors of record for the chosen classes were contacted to request permission to  
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3 distribute surveys in their classes. After obtaining instructor approval, the research team  
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5 distributed a short survey at the beginning of each class. No additional eligibility criteria were  
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7 implemented other than being enrolled in the class at the time of the survey. Student participation  
8  
9 was voluntary, and no incentives were offered in return for participation. Approval was obtained  
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11 from the University's Institutional Review Board (IRB) before data collection was started. Upon  
12  
13 opening the survey booklet, potential respondents were provided with information about the  
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15 study, including contact details for the IRB. Respondents' completion of the survey constituted  
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17 consent, as approved by the IRB. Students who were present in more than one participating class  
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19 were requested to participate no more than once, to prevent repeat administration.  
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#### 23 24 Study measures

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26 The survey included questions on respondent demographics, alcohol use, smoking status,  
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28 policy awareness, policy attitudes, smoking attitudes, policy support, barriers to policy success,  
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30 and policy violations. Respondent demographics and alcohol use questions were modelled after  
31  
32 the American College Health Association's National College Health Assessment (ACHA-  
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34 NCHA) report<sup>4</sup>. Current smoking status has been operationalized in a variety of ways in the  
35  
36 extant literature<sup>32</sup>. Among adults, current smoking status is defined by the Centers for Disease  
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38 Control and Prevention (CDC) as having smoked at least 100 cigarettes in a lifetime *and*  
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40 smoking every day or on some days at the time of assessment<sup>33</sup>. However, in a population of  
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42 young adults, among whom new smokers, infrequent smokers, and intermittent smokers are  
43  
44 common, assessment of past 30-day smoking behavior can be a better predictor of violation of  
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46 smoke-free policies. Therefore, this study defined current smokers as those respondents who  
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48 smoked at least one cigarette during the past 30 days. This characterization of smoking behavior  
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50 was found applicable for the college student and young adult populations in previous studies<sup>34-36</sup>.  
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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>28</sup>. Measures assessing smoking attitudes (6 items), support for the policy (4 items), and barriers to policy success (11 items) were all adapted from Burns et al. and measured using five-point response formats<sup>7,27,28,37</sup>.

The variable of interest in this study, policy outcomes, was operationalized 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>28</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 second-hand 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 version 25 (Chicago, IL) and Mplus version 8.1 (Los Angeles, CA) were 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 square

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3 tests for categorical variables and t-tests for continuous variables. Principal components analysis  
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5 (PCA) was conducted to assess the dimensionality of the three multi-item measures that were  
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7 used as predictors in subsequent regression analyses: policy attitudes, smoking attitudes, and  
8  
9 policy support. Factor analysis assuming categorical factor indicators (i.e., using the  
10  
11 CATEGORICAL option in Mplus) and a robust weighted least squares estimator (i.e., WLSMV)  
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13 was used to assess the dimensionality of the measure of witnessing policy violations by others.  
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15 Logistic regression was conducted to predict self-reported violation of the policy using the  
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17 demographic and psychosocial variables measured in the study as independent variables.  
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19 Because witnessing policy violations by others was measured as the sum of dichotomous items,  
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21 it was analyzed as a continuous variable using linear regression. Although this sum is technically  
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23 an ordinal variable, examples of such sums being modeled with linear regression include the  
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25 number of correct items on a knowledge assessment and counts of difficulty with activities of  
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27 daily living (ADL) as a measure of functional status. There is some debate regarding the use of  
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29 an ordinal variable in the manner and Norman<sup>38</sup> provides some justifications of this approach.  
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31 Given potential controversy concerning this analytical approach, a supportive analysis was  
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33 conducted whereby a continuous latent variable was extracted from the dichotomous items  
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35 concerning witnessing policy violation by others and this latent variable served as the dependent  
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37 variable in the linear regression analysis (this was conducted in Mplus using the WLSMV  
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39 estimator and the dichotomous items were assumed categorical). Because the effects of  
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41 demographics and psychosocial variables on the policy outcomes were expected to differ  
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43 between current smokers and non-smokers, smoking status was introduced as a moderator of the  
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45 effects of the hypothesized study predictors in both the logistic and linear regression models by  
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47 including interaction terms.  
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## Participant & public involvement

There was no direct involvement of participants nor the public in the development, conceptualization, 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 1,704 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 1,654 students, 1,541 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 1,512 responses. As seen in Table 1, the sample was comprised of nearly 60% women, 78% Caucasians, 50% freshmen/sophomores, 53% state residents, and 47% enrolled in Greek organizations. The majority of respondents were 20 years old or younger, lived off-campus, and were single. Twenty-three percent 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 second-hand 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.

<Table 1>



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3 Among the variables related to the campus smoke-free policy, 85% of respondents  
4 reported being aware of the campus smoking policy, and more than 88% of respondents correctly  
5 chose smoke-free or tobacco-free as the campus policy. More than 63% of current smokers  
6 report ever smoking on campus, but less than 10% ever received a warning or a ticket for their  
7 violation. An overwhelming majority of respondents (93.5%) scored at least 1 point or greater on  
8 the witnessing policy violations measure, with most respondents (92.5%) reporting that they  
9 have witnessed someone smoking on campus. Three quarters of respondents were exposed to  
10 second-hand smoke while on the campus, and more than a quarter of respondents even altered  
11 their walking route to avoid second-hand smoke while on campus.  
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### 29 Barriers to policy adherence

31 Considering all respondents together, the most frequently cited barrier to a successful  
32 smoke-free campus policy was inadequate funding for implementation of the policy with 55.6%  
33 (840) of all respondents selecting strongly agree or agree (Table 2). Other barriers receiving high  
34 levels of agreement from all respondents include difficulty to enforce (40.4%, 611), lack of  
35 information about the policy (37.4%, 565), lack of support from staff (35.3%, 534) and faculty  
36 (32.6%, 492), and lack of enforcement (31.8%, 481). Current non-smokers rated six of the 11  
37 barriers – inadequate funding, lack of information about the policy, lack of support from staff,  
38 infringement of personal freedoms, insufficient fines, and lack of reminders –less frequently than  
39 past 30-day smokers. Only one barrier, difficult to enforce, received a lower agreement by past  
40 30-day smokers compared to non-smokers.  
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55 <Table 2>

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

Using PCA, a two-factor solution was obtained for respondents' attitudes toward the smoke-free policy. The two factors, labeled "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 toward smoking (mean: 3.7; SD: 0.9; higher scores are indicative of negative attitudes toward smoking or positive attitudes about non-smoking behavior) 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 standard deviations for the total sample as well as for current (past 30-day) smokers and non-smokers, are provided in Table 3.

<Table 3>

## Factors predicting campus smoke-free policy violations

In a logistic regression model predicting self-violation of the campus smoke-free policy (Table 4), current (past 30-day) smokers unsurprisingly are estimated to have at least 5 times the odds (OR: 7.96; 95% CI: 5.13 to 12.36) of reporting that they had violated the policy as 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 behavior (OR: 0.35; 95% CI: 0.25 to 0.49), and higher 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 to 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.

<Table 4>

Witnessing violations of the smoke-free policy by others was first assessed for dimensionality using factor analysis. An initial attempt with all four dichotomous items suggested that one of the items, “Do you know of someone else who received a warning or was ticketed for smoking on campus,” did not load well with the others (standardized loading of 0.19). This item was removed and the factor analysis was re-estimated. The remaining three items all had standardized loadings greater than 0.55 with a large first eigenvalue relative to the second (i.e., 2.22 vs. 0.59). Thus, a score was calculated as a sum of these three dichotomous items that assessed witnessing various kinds of policy violations. This variable, ranging in scores from 0 to 3, was found to have a distribution very close to normal with an absence of any meaningful floor or ceiling effects (Table 1), thereby justifying the use of a linear regression model for its prediction (Table 5). Because the supportive analysis treating this variable as a latent continuous variable is easier to interpret when the latent variable is standardized (i.e., Y-standardization), the sum score was standardized prior to linear regression to facilitate model comparisons.

When compared to Caucasians, African Americans witnessed fewer violations of the smoke-free policy (coefficient:  $-0.33$ ; 95% CI:  $-0.48$  to  $-0.17$ ). When compared to freshmen, juniors (coefficient:  $0.18$ ; 95% CI:  $0.01$  to  $0.36$ ), and seniors (coefficient:  $0.24$ ; 95% CI:  $0.02$  to

0.45) witnessed more policy violations. The effects of smoking attitudes (coefficient for interaction term:  $-0.29$ ; 95% CI:  $-0.44$  to  $-0.15$ ;  $p < 0.001$ ) and beliefs about policy adherence (coefficient for interaction term:  $0.29$ ; 95% CI:  $0.15$  to  $0.43$ ;  $p < 0.001$ ) on witnessing policy violations were both moderated by current (past 30-day) smoking status. Among non-smokers, stronger attitudes against smoking were related to witnessing more policy violations (coefficient =  $0.34$ ; 95% CI:  $0.26$  to  $0.43$ ;  $p < 0.001$ ), and stronger beliefs about policy adherence were related to witnessing fewer violations of policy (coefficient =  $-0.47$ ; 95% CI:  $-0.53$  to  $-0.41$ ;  $p < 0.001$ ). However, among current (past 30-day) smokers, smoking attitudes were not associated with witnessing policy violations (coefficient =  $0.05$ ; 95% CI:  $-0.09$  to  $0.19$ ;  $p = 0.482$ ), and beliefs about policy adherence were still related to witnessing fewer violations of policy (coefficient =  $-0.18$ ; 95% CI:  $-0.30$  to  $-0.06$ ;  $p = 0.004$ ), but the point estimate for this relationship was not as strong as it was among non-smokers. The supportive analysis where the three dichotomous items were used to extract a latent variable showed essentially the same results as the analysis that used a sum of the dichotomous items (Supplemental Table 1).

<Table 5>

## 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 comprised of 55% females, 77% Caucasians, 30% freshmen, 20% sophomores, 22% juniors, 28% seniors, and 42% Greek organization members, which closely approximates the distribution obtained in this study<sup>39,40</sup>. An annual survey funded by the state Department of Health during the spring semester of 2016 found that 30.2% of

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3 respondents smoked at least one cigarette in the past 30 days, which is higher than the 23%  
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5 found in this study<sup>41</sup>. The discrepancy in the prevalence estimates may be explained by the fact  
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7 that the Department of Health funded survey had only a 7.3% response rate and included a non-  
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9 representative distribution of the student population<sup>41</sup>. Nevertheless, the estimated 9.8% national  
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11 prevalence of past 30-day smoking among undergraduate college students<sup>4</sup> is much lower than  
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13 the prevalence found in the current study comprised of University of Mississippi undergraduate  
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15 students.  
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19 Overall, almost 90% of the respondents were aware of the campus smoking policy and  
20  
21 nearly 20% reported violating the policy. The prevalence of self-reported policy violations was  
22  
23 nearly 64% among current smokers and 6% among non-smokers (who have may been past  
24  
25 smokers). Even though the survey was completely anonymous, it is possible that social  
26  
27 desirability bias led to an underestimate of the prevalence of policy violations. An overwhelming  
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29 majority of the respondents, 94%, reported witnessing at least one violation of the campus  
30  
31 smoke-free policy by others, implying that the policy has been largely unsuccessful. In line with  
32  
33 expectations, respondents who believed the policy was effective had lower odds of violating the  
34  
35 policy themselves and also witnessed fewer policy violations by others. Policy violations were  
36  
37 also associated with smoking behavior and alcohol consumption, which is in line with the  
38  
39 expectation that these risk behaviors often manifest concomitantly<sup>42</sup>. Extant literature shows risk  
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41 behaviors such as smoking tend to be associated with a lower GPA<sup>43,44</sup>, and this finding was  
42  
43 corroborated in the current study. Neither membership in Greek organizations nor class year  
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45 were related to self-reported policy violations, but class year was found to have an association  
46  
47 with witnessing a policy violation by others, indicating the possibility of social desirability bias.  
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54 The effects of policy adherence beliefs and smoking attitudes on witnessing others violate the  
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3 policy were greater among non-smokers than smokers. Given the high likelihood of witnessing  
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5 policy violations among smokers, it is not unexpected that behavioral factors are less likely to be  
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7 significant in this population.  
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10 This study found that, despite high levels of policy awareness, smoke-free policies are  
11 largely ineffective at curtailing smoking behavior on university campuses. The ineffectiveness of  
12 the policy was reflected in the fact that nearly 75% of respondents have been exposed to  
13  
14 secondhand smoke on campus, which is the primary purpose of a smoke-free policy. The most  
15  
16 significant barrier to a successful smoke-free campus policy was the lack of adequate funding  
17  
18 and the difficulty of enforcing the policy. However, smokers and non-smokers highlighted  
19  
20 different barriers. Smokers rated both inadequate funding and lack of support from staff very  
21  
22 highly, while non-smokers acknowledged the difficulty in enforcing the law much more  
23  
24 frequently than smokers. The other highly rated barriers to success, lack of information, lack of  
25  
26 support from staff and faculty, and lack of enforcement also indicate a lack of buy-in for policy  
27  
28 enforcement. The results of this study must be interpreted in the context of these limited  
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30 enforcement efforts. Less than 3% of respondents received a ticket, while nearly 20% reported  
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32 violating the policy. This discrepancy suggests a greater need for reminders, which might not be  
33  
34 necessary on campuses where the policy is strictly enforced. The measurement of barriers also  
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36 shows that many respondents believe it was important to have support from students, faculty, and  
37  
38 administrators in order to implement the policy. While the nature of this support was not defined  
39  
40 as part of the survey, it appears that most respondents believe the entire campus community  
41  
42 needs to buy-in in order to successfully implement this policy. This community support may be  
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44 in the form students and faculty discouraging campus smoking behavior, peer approval and  
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46 social norms, among others.  
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Contrary to expectations from previous research<sup>17,22,28,45</sup>, the prevalence of smoking on campus may have increased since the implementation of the campus smoke-free policy in 2012<sup>41</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 behavior 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>18,28,46</sup>. On the other hand, there is much support in the literature on the potential of strong enforcement policies in decreasing smoking prevalence<sup>14,23</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>23</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



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3 participate in the study. While many instructors did not choose to participate, because instructor  
4 choices are not expected to be related to smoking behavior among their students, this is not  
5 expected to bias the study's findings. This study used self-report to identify smoking behavior  
6 and policy violations. Both these behaviors can be underreported due to a combination of social  
7 desirability bias and recall bias. This study also did not delineate the use of e-cigarettes from  
8 regular cigarettes, or capture frequency of policy violations specifically associated with the use  
9 of e-cigarettes; rather, the questions simply referred to "smoking on campus". It is possible that  
10 many respondents might have a misunderstanding of whether smoke-free policies include a ban  
11 on use of e-cigarettes (even though the policy clearly specifies that e-cigarettes are included in  
12 the ban<sup>31</sup>), thereby leading to a bias in the estimate of policy violations. Similarly, individuals  
13 who incorrectly believed the campus was tobacco-free as opposed to smoke-free might have  
14 different perceptions of barriers or their support for the policy because of their incorrect  
15 understanding of what is included in the policy. These differences were not explored in the  
16 current study. It is important to recognize that this is an observational study and there are  
17 correlations among the predictor variables. The logistic and linear regression models estimated in  
18 this study can help to identify possible predictors of policy violations. Future research is  
19 necessary to evaluate the meaningfulness of these predictors and whether they can be targeted for  
20 possible intervention to reduce violations. Finally, although a large sample was obtained, these  
21 data were collected four years ago, and although there is no reason to expect so, some of these  
22 findings may have changed since then. In addition, this study only included policy violations by  
23 smoking and did not assess other behaviors such as littering or possession of tobacco products, as  
24 mentioned in the policy. Policy violations were also only assessed in students, whereas such  
25 violations could have been committed by staff, employees, or visitors. The findings of this study  
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3 must also be interpreted in the context of the campus where this study was conducted; thus,  
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5 generalization to other universities must be made with caution.  
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## 10 **Conclusion**

11  
12 This study found that violations of a campus smoke-free policy are fairly common. Policy  
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14 violations might be related to smoking behavior, beliefs about policy adherence, smoking  
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16 attitudes, and support for the policy. Important barriers to policy adherence include a lack of  
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18 reminders about the policy, lack of student and administrative support, and a need for stricter  
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20 policy enforcement. Additional interventions are needed to improve compliance with the policy  
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22 and reduce prevalence of smoking on campus.  
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## 28 **List of Abbreviations:**

29  
30 ACHA: American College Health Association

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32 CDC: Centers for Disease Control and Prevention

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34 GPA: Grade Point Average

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36 ITC: International Tobacco Control

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38 NCHA: National College Health Assessment

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40 PCA: Principal Components Analysis

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42 WLSMV: Weighted Least Squares Mean and Variance adjusted  
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## 48 **Declarations:**

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50 Ethics approval: This study was approved by the University of Mississippi Institutional Review  
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52 Board (UM IRB) before data were collected (Protocol #16x-011). Respondents provided consent  
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54 to participate by completing the paper-based survey (this approach to consent was approved by  
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56 the UM IRB and a statement was included on the front of the survey booklet that stated, “By  
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58 completing the survey, I consent to participate in the study”).  
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3 Data Availability Statement: The datasets used and/or analyzed during the current study are  
4 available from the corresponding author on reasonable request.  
5

6 Competing interests: None declared  
7

8  
9 Funding: This research received no specific grant from any funding agency in the public,  
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11

12 Author contributions: SB and JB designed the survey and the data collection procedure. Data  
13 collection and data entry was coordinated by SB and EC. Data analysis was conducted by SR  
14 and JB. All authors contributed to the interpretation of results and manuscript preparation. All  
15 authors read and approved the final manuscript.  
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## Tables

**Table 1: Characteristics of the study sample**

| Characteristic  | Total<br>N = 1512<br>N (%) | Current<br>smokers <sup>1</sup><br>N = 353<br>N (%) | Current<br>non-smokers<br>N = 1158<br>N (%) | p value |
|---|----------------------------|---|---|---------|
| 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 MS                               | 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<br>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 second-hand smoke on<br>campus in past 7 days |                            |   |   | <0.001  |
| 0 days  | 616 (40.8)                 | 142 (40.3)  | 474 (41.0)                                  |         |
| 1 or 3 days   | 695 (46.1)                 | 140 (39.8)  | 554 (48.0)                                  |         |



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|---|-------------|------------|-------------|--------|
| 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)  |        |
| 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 <sup>2</sup>                      | 293 (19.4)  | 224 (63.6) | 69 (6.0)    | <0.001 |
| Witnessing others violate the policy <sup>3</sup>                             |             |            |             | <0.001 |
| 0   | 99 (6.5)    | 11 (3.1)   | 88 (7.6)    |        |
| 1   | 272 (18.0)  | 71 (20.1)  | 201 (17.4)  |        |
| 2   | 778 (51.5)  | 256 (72.5) | 521 (45.0)  |        |
| 3   | 363 (24.0)  | 15 (4.2)   | 348 (30.1)  |        |

<sup>1</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

<sup>2</sup>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.

<sup>3</sup>Witnessing others violate the policy is the sum of three dichotomous items: ever witnessed someone smoking on campus, ever exposed to secondhand smoke on campus, and ever altered my walk on campus to avoid smoke.

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

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

| <b>Barrier</b>                                       | <b>Total<br/>Percent (N)<sup>1</sup></b> | <b>Current<br/>smokers<sup>2</sup><br/>Percent (N)<sup>1</sup></b> | <b>Current<br/>non-smokers<br/>Percent (N)<sup>1</sup></b> | <b>p value</b> |
|--|--|--|--|----------------|
| 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<br>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'<br>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<br>University administrators    | 20.0 (302)                               | 20.7 (73)  | 19.8 (229)   | 0.710          |
| Lack of reminders about the<br>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          |

<sup>1</sup>Percentage of respondents who selected strongly agree or agree.

<sup>2</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

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

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

| Item  | Factor loading | Total Mean (SD) | Current smokers <sup>1</sup> Mean (SD) | Current non-smokers Mean (SD) | p value |
|---|----------------|-----------------|--|-------------------------------|---------|
| <b>Student attitudes toward 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 <sup>2</sup>   | 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 toward 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 toward smoking</b>   |                |                 |  |                               |         |
| If someone smokes cigarettes around me they are causing me harm because of second-hand smoke  | 0.788          | 4.0 (1.0)       | 3.1 (1.1)                              | 4.2 (0.9)                     | <0.001  |
| I prefer to socialize 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  |

|    |                                |       |           |           |           |        |
|----|--------------------------------|-------|-----------|-----------|-----------|--------|
| 1  |                                |       |           |           |           |        |
| 2  |                                |       |           |           |           |        |
| 3  | All tobacco products should be | 0.867 | 3.7 (1.4) | 2.9 (1.5) | 4.0 (1.2) | <0.001 |
| 4  | banned in all university       |       |           |           |           |        |
| 5  | buildings                      |       |           |           |           |        |
| 6  | All tobacco products should be | 0.900 | 3.2 (1.4) | 2.2 (1.2) | 3.5 (1.3) | <0.001 |
| 7  | banned on all university       |       |           |           |           |        |
| 8  | property                       |       |           |           |           |        |
| 9  | Total scale score (alpha =     | -     | 3.8 (1.1) | 2.9 (1.0) | 4.0 (1.0) | <0.001 |
| 10 | 0.85)                          |       |           |           |           |        |

<sup>1</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

<sup>2</sup>This item was reverse coded prior to calculation of the scale score.

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

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

| Characteristic                | Violation of the campus smoke-free policy |         |
|-------------------------------|---|---------|
|                               | Adjusted odds ratio (95% CI)              | p value |
| Current smoker <sup>1</sup>   | 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 MS                | 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 & 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   |

<sup>1</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

**Table 5: Linear regression results predicting witnessing violations of the campus smoke-free policy by others (count variable of three possible violations)**

| Predictor                                  | Witness violations of campus smoke-free policy  |         |
|--|---|---------|
|  | Regression coefficient <sup>1</sup><br>(95% CI) | p value |
| Current smoker <sup>2,3</sup>              | 0.29 (−0.26 to 0.85)                            | 0.296   |
| Policy adherence subscale <sup>4</sup>     | −0.47 (−0.53 to −0.41)                          | <0.001  |
| Policy justification subscale              | 0.06 (−0.00 to 0.12)                            | 0.057   |
| Smoking attitudes scale <sup>5</sup>       | 0.34 (0.26 to 0.43)                             | <0.001  |
| Policy support scale                       | 0.06 (−0.01 to 0.12)                            | 0.076   |
| Policy awareness                           | 0.07 (−0.08 to 0.22)                            | 0.343   |
| Female                                     | −0.03 (−0.13 to 0.08)                           | 0.599   |
| Age  |   |         |
| 18 to 20 years                             | Reference                                       |         |
| 21 to 24 years                             | 0.03 (−0.12 to 0.19)                            | 0.669   |
| 25 and older                               | 0.05 (−0.27 to 0.37)                            | 0.775   |
| Race                                       |   |         |
| Caucasian                                  | Reference                                       |         |
| African American                           | −0.33 (−0.48 to −0.17)                          | <0.001  |
| Other minorities                           | 0.13 (−0.04 to 0.31)                            | 0.133   |
| Resident of MS                             | 0.01 (−0.10 to 0.11)                            | 0.910   |
| International                              | −0.19 (−0.48 to 0.10)                           | 0.195   |
| Greek membership                           | 0.09 (−0.02 to 0.20)                            | 0.093   |
| Class year                                 |   |         |
| Freshman                                   | Reference                                       |         |
| Sophomore                                  | 0.14 (−0.02 to 0.30)                            | 0.090   |
| Junior                                     | 0.18 (0.01 to 0.36)                             | 0.037   |
| Senior & above                             | 0.24 (0.02 to 0.45)                             | 0.032   |
| GPA  | 0.06 (−0.04 to 0.16)                            | 0.227   |
| On campus residence                        | 0.06 (−0.07 to 0.19)                            | 0.397   |
| Frequency of alcohol use                   |   |         |
| None                                       | Reference                                       |         |
| Low  | 0.09 (−0.04 to 0.22)                            | 0.163   |
| Medium                                     | 0.08 (−0.07 to 0.23)                            | 0.281   |
| High                                       | 0.09 (−0.08 to 0.26)                            | 0.295   |
| Current smoker x Smoking attitudes scale   | −0.29 (−0.44 to −0.15)                          | <0.001  |
| Current smoker x Policy adherence subscale | 0.29 (0.15 to 0.43)                             | <0.001  |

R<sup>2</sup> = 0.256

<sup>1</sup>Y-standardization was used; thus, coefficients are interpreted as the change in the Y variable (witnessing violations of campus smoke-free policy by others) in Y standard deviation units when the predictor increases by 1-unit, holding the other predictors constant.

<sup>2</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

<sup>3</sup>Because of the interaction terms, the estimate for smoking status is the effect of smoking status when policy adherence and policy smoking attitudes are equal to zero.

<sup>4</sup>Because of the interaction terms, this estimate is the effect of policy adherence among non-smokers.

<sup>5</sup>Because of the interaction terms, this estimate is the effect of smoking attitudes among non-smokers.

**Supplemental Table 1: Linear regression results predicting witnessing violations of the campus smoke-free policy by others (continuous latent variable extracted from three dichotomous policy violation items)**

| Predictor                                  | Witness violations of campus smoke-free policy |         |
|--|--|---------|
|  | Regression coefficient <sup>1</sup>            | p value |
| Current smoker <sup>2,3</sup>              | 0.26 (−0.52 to 1.04)                           | 0.517   |
| Policy adherence subscale <sup>4</sup>     | −0.60 (−0.68 to −0.52)                         | <0.001  |
| Policy justification subscale              | 0.10 (0.01 to 0.19)                            | 0.028   |
| Smoking attitudes scale <sup>5</sup>       | 0.38 (0.27 to 0.49)                            | <0.001  |
| Policy support scale                       | 0.07 (−0.01 to 0.15)                           | 0.100   |
| Policy awareness                           | 0.09 (−0.11 to 0.29)                           | 0.396   |
| Female                                     | −0.03 (−0.18 to 0.11)                          | 0.640   |
| Age  |  |         |
| 18 to 20 years                             | Reference                                      |         |
| 21 to 24 years                             | 0.04 (−0.19 to 0.27)                           | 0.704   |
| 25 and older                               | 0.11 (−0.33 to 0.55)                           | 0.617   |
| Race                                       |  |         |
| Caucasian                                  | Reference                                      |         |
| African American                           | −0.38 (−0.58 to −0.17)                         | <0.001  |
| Other minorities                           | 0.18 (−0.07 to 0.43)                           | 0.151   |
| Resident of MS                             | 0.00 (−0.14 to 0.15)                           | 0.951   |
| International                              | −0.21 (−0.60 to 0.18)                          | 0.296   |
| Greek membership                           | 0.17 (0.02 to 0.32)                            | 0.029   |
| Class year                                 |  |         |
| Freshman                                   | Reference                                      |         |
| Sophomore                                  | 0.19 (−0.04 to 0.42)                           | 0.101   |
| Junior                                     | 0.25 (0.00 to 0.49)                            | 0.046   |
| Senior & above                             | 0.31 (0.00 to 0.61)                            | 0.050   |
| GPA  | 0.08 (−0.06 to 0.22)                           | 0.243   |
| On campus residence                        | 0.08 (−0.11 to 0.26)                           | 0.422   |
| Frequency of alcohol use                   |  |         |
| None                                       | Reference                                      |         |
| Low  | 0.14 (−0.04 to 0.32)                           | 0.127   |
| Medium                                     | 0.10 (−0.11 to 0.31)                           | 0.352   |
| High                                       | 0.10 (−0.14 to 0.34)                           | 0.395   |
| Current smoker x Smoking attitudes scale   | −0.25 (−0.45 to −0.05)                         | 0.017   |
| Current smoker x Policy adherence subscale | 0.26 (0.05 to 0.47)                            | 0.014   |

$R^2 = 0.394$

<sup>1</sup>Y-standardization was used; thus, coefficients are interpreted as the change in the Y variable (witnessing violations of campus smoke-free policy by others) in Y standard deviation units when the predictor increases by 1-unit, holding the other predictors constant.

<sup>2</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

<sup>3</sup>Because of the interaction terms, the estimate for smoking status is the effect of smoking status when policy adherence and policy smoking attitudes are equal to zero.

<sup>4</sup>Because of the interaction terms, this estimate is the effect of policy adherence among non-smokers.

<sup>5</sup>Because of the interaction terms, this estimate is the effect of smoking attitudes among non-smokers.



## STROBE Statement—checklist of items that should be included in reports of observational studies

|                           | Item No. | Recommendation  | Page No.  | Relevant text from manuscript  |
|---------------------------|----------|---|-----------|--|
| <b>Title and abstract</b> | 1        | (a) Indicate the study's design with a commonly used term in the title or the abstract<br>(b) Provide in the abstract an informative and balanced summary of what was done and what was found | 1<br>2, 3 | Cross-sectional survey<br>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... 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 the barriers such as reminders about the policy, better policy enforcement, and support from the administration. |
| <b>Introduction</b>       |          |   |           |  |
| Background/rationale      | 2        | Explain the scientific background and rationale for the investigation being reported  | 4         | Research into the effectiveness of campus smoke-free policies has found mixed results, with some universities reporting frequent policy violations and low compliance rates[14-18]. There is limited research on the factors affecting policy compliance and strategies to improve compliance to smoke-free policies on college campuses[19-21].   |
| Objectives                | 3        | State specific objectives, including any prespecified hypotheses  | 5         | The specific aim of the current study was to evaluate adherence to the campus smoke-free policy, estimate the prevalence of on-campus smoking behavior, and to identify the key factors that influence policy violations, and measure barriers to successful implementation of a smoke-free policy.  |
| <b>Methods</b>            |          |   |           |  |

|                              |    |  |      |  |
|------------------------------|----|--|------|--|
| Study design                 | 4  | Present key elements of study design early in the paper  | 5    | This study employed a cross-sectional, self-administered survey of undergraduate students at the University of Mississippi ...   |
| Setting                      | 5  | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection  | 5, 6 | 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 4 students) or were independent studies, a random sample of the remaining classes was chosen for inclusion in the study.  |
| Participants                 | 6  | (a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up  | 6    | 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. |
|                              |    | <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls |      |  |
|                              |    | <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants  |      |  |
|                              |    | (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed   | N/A  |  |
|                              |    | <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case   |      |  |
| Variables                    | 7  | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable   | 6-8  | Study measures section   |
| Data sources/<br>measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group       | 6-8  | Study measures section   |
| Bias                         | 9  | Describe any efforts to address potential sources of bias  | 8    | 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  |

hypothesized study predictors in both the logistic and linear regression models by including interaction terms. Because classes were sampled rather than individual students, both regression models used clustered robust standard errors to account for the non-independence of observations due to the nesting of students within classes.

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 1,704 students in 60 course sections.

Study size 10 Explain how the study size was arrived at 9

Continued on next page

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|----|------------------------|-----|---|-----|--|
| 1  |                        |     |   |     |  |
| 2  | Quantitative variables | 11  | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why  | 7,  | Statistical analysis section   |
| 3  |                        |     |   |     |  |
| 4  | Statistical methods    | 12  | (a) Describe all statistical methods, including those used to control for confounding   | 7,  | Statistical analysis section   |
| 5  |                        |     | (b) Describe any methods used to examine subgroups and interactions   | 7,  | Statistical analysis section   |
| 6  |                        |     | (c) Explain how missing data were addressed   | 9   | After deleting responses that had missing responses on more than 30 out of the 63 items on the survey, analyses were conducted on 1,512 responses  |
| 7  |                        |     |   |     |  |
| 8  |                        |     | (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed   | 8   | Because classes were sampled rather than individual students, both regression models used clustered robust standard errors to account for the non-independence of observations due to the nesting of students within classes.  |
| 9  |                        |     | <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed  |     |  |
| 10 |                        |     | <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy  |     |  |
| 11 |                        |     |   |     |  |
| 12 |                        |     | (e) Describe any sensitivity analyses   | N/A |  |
| 13 |                        |     |   |     |  |
| 14 | <b>Results</b>         |     |   |     |  |
| 15 | Participants           | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | 9   | 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 1,704 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 1,654 students, 1,541 surveys were collected with at least |
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|------------------|-----|--|--------|---|
|                  |     |  |        | 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 1,512 responses.   |
|                  |     | (b) Give reasons for non-participation at each stage   | 9      | As shown above  |
|                  |     | (c) Consider use of a flow diagram   | N/A    |   |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 9      | As seen in Table 1, the sample was comprised of nearly 60% women, 78% Caucasians, 50% freshmen/sophomores, 53% state residents, and 47% enrolled in Greek organizations. The majority of respondents were 20 years old or younger, lived off-campus, and were single. |
|                  |     | (b) Indicate number of participants with missing data for each variable of interest  | 9      | After deleting responses that had missing responses on more than 30 out of the 63 items on the survey, analyses were conducted on 1,512 responses.  |
|                  |     | (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)   | N/A    |   |
| Outcome data     | 15* | <i>Cohort study</i> —Report numbers of outcome events or summary measures over time  | N/A    |   |
|                  |     | <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure                                     | N/A    |   |
|                  |     | <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures   | 9, 950 | More than 63% of current smokers report ever smoking on campus, in violation of the policy, but less than 10% of respondents ever received a warning or a ticket for their violation. An overwhelming   |

|              |    |  |       |   |
|--------------|----|--|-------|---|
|              |    |  |       | majority of respondents (93.7%) scored at least 1 point or greater on the frequency of witnessing a policy violation, while 22% knew of someone who had received a warning or a ticket for smoking on campus. |
| Main results | 16 | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | 28/09 | Table 4 and 5   |
|              |    | (b) Report category boundaries when continuous variables were categorized  | 12    | This variable, ranging in scores from 0 to 4, was found to have a distribution very close to normal   |
|              |    | (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period   | N/A   |   |

Continued on next page

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|-------------------|----|--|--------|---|
| Other analyses    | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses   | N/A    |   |
| <b>Discussion</b> |    |  |        |   |
| Key results       | 18 | Summarise key results with reference to study objectives   | 13     | The prevalence of self-reported policy violations was nearly 64% among current smokers and 6% among non-smokers (who have may been past smokers).   |
| Limitations       | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias                 | 16, 17 | Limitations paragraph   |
| Interpretation    | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 17     | This study found that violations of a campus smoke-free policy are fairly common. Policy violations might be related to smoking behavior, 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. |
| Generalisability  | 21 | Discuss the generalisability (external validity) of the study results  | 17     | The findings of this study must also be interpreted in the context of the campus where this study was conducted; thus, generalization to other universities must be made with caution.  |



**Other information**

|         |    |   |    |  |
|---------|----|---|----|--|
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 18 | This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors |
|---------|----|---|----|--|

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# 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 U.S.A.

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5 Title: Prevalence of and factors associated with violations of a campus smoke-free policy: A  
6 cross-sectional survey of undergraduate students on a University campus in the U.S.A.  
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35 Abstract: 267/300 words

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37 Word count: 3,821/4,000 words

## Abstract

Objective: The aim of this study is to estimate the prevalence of smoking behavior 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 behavior (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 behavior (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.

Key words: Public health, campus smoking policy, smoking prevention, policy compliance

## Strengths & Limitations

- 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 behavior.
- This study did not assess the effectiveness of the smoke-free policy and only includes data collected after the policy was implemented.

For peer review only

## 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 United States<sup>1</sup>. Coordinated tobacco cessation efforts by several public health agencies and health care 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 U.S. 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 U.S. 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, and other organizations, 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 2,000 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 second-hand smoke<sup>20-22</sup>. There is limited



1  
2  
3 research on the factors affecting policy compliance and strategies to improve compliance to  
4  
5 smoke-free policies on college campuses<sup>23–25</sup>.  
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8 The support for and effectiveness of smoking cessation policies can be influenced by  
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10 societal antismoking norms<sup>8,22,26</sup>, smoking behavior<sup>22,27,28</sup>, perceptions of peer tobacco use<sup>22</sup>, and  
11  
12 demographic variables such as gender and race<sup>29</sup>. The current study utilizes the framework  
13  
14 proposed by Fong et al. that guided the development of the International Tobacco Control (ITC)  
15  
16 policy evaluation project<sup>30</sup>. This project has evaluated the impact of regulations, such as smoke-  
17  
18 free policies, in several countries. The framework proposes that policies influence several policy-  
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20 specific psychosocial variables – such as beliefs and attitudes, normalization of beliefs, self-  
21  
22 efficacy, and intentions – which in turn influence policy-related outcomes, such as prevalence of  
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24 smoking. Other variables, such as socio-demographics and smoking status, may moderate the  
25  
26 relationship between psychosocial variables and policy outcomes<sup>30</sup>. The current study focuses on  
27  
28 psychosocial variables such as smoking attitudes, policy support, and policy attitudes, and  
29  
30 examines how the effects of these variables on policy outcomes are influenced by smoking  
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32 status.  
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38 On the campus of the University of Mississippi, a smoke-free policy was implemented on  
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40 August 1<sup>st</sup>, 2012 to help reduce smoking prevalence. This policy prohibited all students, staff,  
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42 employees, and visitors from all forms of smoking, which refers to inhaling, exhaling, burning,  
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44 carrying or possessing any lighted tobacco product, including cigarettes, cigars, pipe tobacco,  
45  
46 and any other lit tobacco products, including e-cigarettes that emit smoke, and littering of  
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48 tobacco products<sup>31</sup>. This policy affects all indoor and outdoor grounds including residence halls  
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50 and personal vehicles. Since implementation, few steps have been taken to evaluate the  
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52 prevalence of on-campus smoking and students' adherence to the policy. The specific aim of the  
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3 current study was to evaluate adherence to the campus smoke-free policy, estimate the  
4 prevalence of on-campus smoking behavior, identify the key factors that influence policy  
5 violations, and measure barriers to successful implementation of a smoke-free policy. While the  
6 policy includes prohibition of several other behaviors such as littering and even possessing  
7 tobacco products, this study chose to focus specifically on smoking behavior among college  
8 students, because they constituted a high-risk population for such violations.  
9

## 17 **Methods**

### 19 Study design & procedures

21 This study employed a cross-sectional, self-administered survey of undergraduate  
22 students at the University of Mississippi. The sampling frame included a list of all undergraduate  
23 classes offered in the fall semester of 2015 on the Oxford campus, as recorded by the  
24 University's Registrar. After excluding classes that were too small (less than 4 students), or were  
25 independent studies, a random sample of the remaining classes was chosen for inclusion in the  
26 study. Instructors of record for the chosen classes were contacted to request permission to  
27 distribute surveys in their classes. After obtaining instructor approval, the research team  
28 distributed a short survey at the beginning of each class. No additional eligibility criteria were  
29 implemented other than being enrolled in the class at the time of the survey. Student participation  
30 was voluntary, and no incentives were offered in return for participation. Approval was obtained  
31 from the University's Institutional Review Board (IRB) before data collection was started. Upon  
32 opening the survey booklet, potential respondents were provided with information about the  
33 study, including contact details for the IRB. Respondents' completion of the survey constituted  
34 consent, as approved by the IRB. Students who were present in more than one participating class  
35 were requested to participate no more than once, to prevent repeat administration.  
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## 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 American College Health Association's National College Health Assessment (ACHA-NCHA) report<sup>4</sup>. Current smoking status has been operationalized in a variety of ways in the extant literature<sup>32</sup>. Among adults, current smoking status is defined by the Centers for Disease Control and Prevention (CDC) as having smoked at least 100 cigarettes in a lifetime *and* smoking every day or on some days at the time of assessment<sup>33</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 behavior 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 characterization of smoking behavior was found applicable for the college student and young adult populations in previous studies<sup>34-36</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>28</sup>. Measures assessing smoking attitudes (6 items), support for the policy (4 items), and barriers to policy success (11 items) were adapted from prior research and measured using five-point response formats<sup>7,27,28,37,38</sup>.

The variable of interest in this study, policy outcomes, was operationalized 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>28</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 second-hand 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 version 25 (Chicago, IL) 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 square 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 hypothesized study predictors in the logistic regression model by including

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2  
3 interaction terms. Descriptive statistics were used to summarize the prevalence of witnessing  
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5 policy violations by others.  
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## 8 Participant & public involvement 9

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11 There was no direct involvement of participants nor the public in the development,  
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13 conceptualization, or conduct of the study, nor in the interpretation of the results. An overview of  
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15 the study was presented at campus meetings, but results were not directly disseminated to  
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17 individual study participants as the survey was conducted anonymously.  
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19

## 20 21 Results 22

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24 Forty-seven, out of a total of 94 invited instructors, agreed to the request for study  
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26 participation. Survey administrators distributed copies of the surveys to 1,704 students in 60  
27  
28 course sections. Fifty students were not eligible to participate either because they were less than  
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30 18 years old, or they had already completed the survey in a different class section. Of the  
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32 remaining 1,654 students, 1,541 surveys were collected with at least one completed response,  
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34 leading to a response rate of 93%. After deleting responses that had missing responses on more  
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36 than 30 out of the 63 items on the survey, analyses were conducted on 1,512 responses. As seen  
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38 in Table 1, the sample was comprised of nearly 60% women, 78% Caucasians, 50%  
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40 freshmen/sophomores, 53% state residents, and 47% enrolled in Greek organizations. The  
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42 majority of respondents were 20 years old or younger, lived off-campus, and were single.  
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44 Twenty-three percent of respondents self-reported smoking in the past 30 days and were  
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46 classified as current smokers. Nearly 60% of the sample reported being exposed to second-hand  
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48 smoke on campus at least once in the past week, and almost 20% of the sample reported  
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50 consuming alcohol at least 10 days in the past month. Women, minorities, and students living on-  
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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.

<Table 1>

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 second-hand 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

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3 (32.6%, 492), and lack of enforcement (31.8%, 481). Current non-smokers rated six of the 11  
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5 barriers – inadequate funding, lack of information about the policy, lack of support from staff,  
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7 infringement of personal freedoms, insufficient fines, and lack of reminders – less frequently  
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9 than past 30-day smokers. Only one barrier, difficult to enforce, received a lower agreement by  
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11 past 30-day smokers compared to non-smokers.  
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15 <Table 2>  
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18 Smoke-free policy attitudes, smoking attitudes, and policy support  
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21 Using PCA, a two-factor solution was obtained for respondents' attitudes toward the  
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23 smoke-free policy. The two factors, labeled "policy adherence" and "policy justification", had  
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25 four items and two items each, with reliabilities (Cronbach's alpha) of 0.81 and 0.72,  
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27 respectively. On a scale of 1 to 5, respondents rated policy adherence an average score of 2.6  
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29 (SD: 0.8), and policy justification an average score of 3.8 (SD: 0.9). A single-factor solution was  
30  
31 obtained for both respondents' attitudes toward smoking (mean: 3.7; SD: 0.9; higher scores are  
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33 indicative of negative attitudes toward smoking or positive attitudes about non-smoking  
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35 behavior) and support for the policy (mean: 3.8; SD: 1.1) with reliabilities of 0.89 and 0.85,  
36  
37 respectively. The factor loadings for each of the scales, along with the mean scores and standard  
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39 deviations for the total sample as well as for current (past 30-day) smokers and non-smokers, are  
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41 provided in Table 3.  
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47 <Table 3>  
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50 Factors predicting self-reported violation of the campus smoke-free policy

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52 In a logistic regression model predicting self-reported violation of the campus smoke-free  
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54 policy (Table 4), current (past 30-day) smokers unsurprisingly are estimated to have at least 5  
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3 times the odds (OR: 7.96; 95% CI: 5.13 to 12.36) of reporting that they had violated the policy as  
4 compared to non-smokers and women had lower odds (OR: 0.36, 95% CI: 0.24 to 0.55) of  
5 violating the policy compared to men. Stronger beliefs about policy adherence (OR: 0.52; 95%  
6 CI: 0.40 to 0.69), greater support for the policy (OR: 0.71; 95% CI: 0.55 to 0.91), stronger  
7 attitudes against smoking behavior (OR: 0.35; 95% CI: 0.25 to 0.49), and higher GPA (OR: 0.54;  
8 95% CI: 0.35 to 0.82) were all related to lower odds of violating the policy. Non-Black  
9 minorities (OR: 2.66; 95% CI: 1.28 to 5.51), on-campus residents (OR: 1.80; 95% CI: 1.02 to  
10 3.16), in-state students (OR: 1.60; 95% CI: 1.05 to 2.46), and students who reported a high  
11 frequency of alcohol consumption (OR: 2.49; 95% CI: 1.17 to 5.31) had higher odds of violating  
12 the policy when compared to Caucasians, off-campus residents, out-of-state students, and  
13 students who reported not consuming any alcohol in the past 30 days, respectively. There were  
14 no significant interactions of past 30-day smoking status with any of the predictors in the model.  
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31 <Table 4>  
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### 33 Discussion

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35 In an evaluation of adherence to a campus smoke-free policy, this study obtained a  
36 response rate of over 90% from a random sample of classes offered on campus. The  
37 undergraduate population on campus is comprised of 55% females, 77% Caucasians, 30%  
38 freshmen, 20% sophomores, 22% juniors, 28% seniors, and 42% Greek organization members,  
39 which closely approximates the distribution obtained in this study<sup>39,40</sup>. An annual survey funded  
40 by the state Department of Health during the spring semester of 2016 found that 30.2% of  
41 respondents smoked at least one cigarette in the past 30 days, which is higher than the 23%  
42 found in this study<sup>41</sup>. The discrepancy in the prevalence estimates may be explained by the fact  
43 that the Department of Health funded survey had only a 7.3% response rate and included a non-  
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3 representative distribution of the student population<sup>41</sup>. Nevertheless, the estimated 9.8% national  
4 prevalence of past 30-day smoking among undergraduate college students<sup>4</sup> is much lower than  
5  
6 the prevalence found in the current study comprised of University of Mississippi undergraduate  
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8 students.  
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11 Overall, almost 90% of the respondents were aware of the campus smoking policy and  
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13 nearly 20% reported violating the policy. The prevalence of self-reported policy violations was  
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15 nearly 64% among current smokers and 6% among non-smokers (who have may been past  
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17 smokers). Even though the survey was completely anonymous, it is possible that social  
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19 desirability bias led to an underestimate of the prevalence of policy violations. An overwhelming  
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21 majority of the respondents, 94%, reported witnessing at least one violation of the campus  
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23 smoke-free policy by others, implying that the policy has been largely unsuccessful. In line with  
24  
25 expectations, respondents who believed the policy was effective had lower odds of violating the  
26  
27 policy themselves. Self-reported policy violations were also associated with smoking behavior  
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29 and alcohol consumption, which is in line with the expectation that these risk behaviors often  
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31 manifest concomitantly<sup>42</sup>. Extant literature shows risk behaviors such as smoking tend to be  
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33 associated with a lower GPA<sup>43,44</sup>, and this finding was corroborated in the current study. Neither  
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35 membership in Greek organizations nor class year were related to self-reported policy violations.  
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37 In this study, witnessing policy violations by others was reported at a higher rate than self-  
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39 reporting them, indicating the possible role of social desirability bias in reporting policy  
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41 violations.  
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49 This study found that, despite high levels of policy awareness, smoke-free policies are  
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51 largely ineffective at curtailing smoking behavior on university campuses. The ineffectiveness of  
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53 the policy was reflected in the fact that nearly 75% of respondents have been exposed to  
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3 secondhand smoke on campus, which is the primary purpose of a smoke-free policy. The most  
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5 significant barrier to a successful smoke-free campus policy was the lack of adequate funding  
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7 and the difficulty of enforcing the policy. However, smokers and non-smokers highlighted  
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9 different barriers. Smokers rated both inadequate funding and lack of support from staff very  
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11 highly, while non-smokers acknowledged the difficulty in enforcing the law much more  
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13 frequently than smokers. The other highly rated barriers to success, lack of information, lack of  
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15 support from staff and faculty, and lack of enforcement also indicate a lack of buy-in for policy  
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17 enforcement. The results of this study must be interpreted in the context of these limited  
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19 enforcement efforts. Less than 3% of respondents received a ticket, while nearly 20% reported  
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21 violating the policy. This discrepancy suggests a greater need for reminders, which might not be  
22  
23 necessary on campuses where the policy is strictly enforced. The measurement of barriers also  
24  
25 shows that many respondents believe it was important to have support from students, faculty, and  
26  
27 administrators in order to implement the policy. While the nature of this support was not defined  
28  
29 as part of the survey, it appears that most respondents believe the entire campus community  
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31 needs to buy-in in order to successfully implement this policy. This community support may be  
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33 in the form students and faculty discouraging campus smoking behavior, peer approval and  
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35 social norms, among others.  
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42 Contrary to expectations from previous research<sup>17,22,28,45</sup>, the prevalence of smoking on  
43  
44 campus may have increased since the implementation of the campus smoke-free policy in  
45  
46 2012<sup>41</sup>. The rising prevalence of smoking and the frequency of policy violations suggest the need  
47  
48 for a renewed strategy of policy enforcement. Universities willing to enact or enforce campus  
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50 smoke-free policies must focus on creating an environment where policy violations are not  
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52 tolerated, and the administration, faculty, and students support the ban on smoking in public  
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3 places. Strategies to achieve this environment might include strict ticketing policies, strategically  
4 placed reminder signs, reinforcement of student beliefs about smoking and overall policy  
5 support, which were found to be important predictors of policy violation in this study. Further  
6 attention must be paid to campus alcohol consumption and social or sporting events where  
7 violations of policy might be more prevalent.  
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11 While some researchers have sought to stress the importance of education campaigns, the  
12 high rates of policy awareness and generally strong attitudes against smoking behavior found in  
13 this study imply that educational campaigns addressing the policy or the hazards of tobacco use  
14 might not necessarily be effective at improving policy compliance<sup>18,28,46</sup>. On the other hand,  
15 there is much support in the literature on the potential of strong enforcement policies in  
16 decreasing smoking prevalence<sup>14,23</sup>. Harris and colleagues recommend the use of passive  
17 techniques such as reminder signs about the smoke-free policy, along with more active strategies  
18 such as direct contact with violators using volunteers to improve engagement, periodic positive  
19 reinforcement, and hosting interactive compliance events to serve as additional reminders<sup>23</sup>.  
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35 While this study provides critical evidence to support development strategies to improve  
36 campus smoke-free policy compliance, it also carries some limitations. Even though the survey  
37 had a 90% response rate among invited students, only 50% of invited instructors agreed to  
38 participate in the study. While many instructors did not choose to participate, because instructor  
39 choices are not expected to be related to smoking behavior among their students, this is not  
40 expected to bias the study's findings. This study used self-report to identify smoking behavior  
41 and policy violations. Both these behaviors can be underreported due to a combination of social  
42 desirability bias and recall bias. This study also did not delineate the use of e-cigarettes from  
43 regular cigarettes, or capture frequency of policy violations specifically associated with the use  
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3 of e-cigarettes; rather, the questions simply referred to “smoking on campus”. It is possible that  
4 many respondents might have a misunderstanding of whether smoke-free policies include a ban  
5 on use of e-cigarettes (even though the policy clearly specifies that e-cigarettes are included in  
6 the ban<sup>31</sup>), thereby leading to a bias in the estimate of policy violations. Similarly, individuals  
7 who incorrectly believed the campus was tobacco-free as opposed to smoke-free might have  
8 different perceptions of barriers or their support for the policy because of their incorrect  
9 understanding of what is included in the policy. These differences were not explored in the  
10 current study. It is important to recognize that this is an observational study and there are  
11 correlations among the predictor variables. The logistic regression model estimated in this study  
12 can help to identify possible predictors of policy violations. Future research is necessary to  
13 evaluate the meaningfulness of these predictors and whether they can be targeted for possible  
14 intervention to reduce violations. Finally, although a large sample was obtained, these data were  
15 collected four years ago, and although there is no reason to expect so, some of these findings  
16 may have changed since then. In addition, this study only included policy violations by smoking  
17 and did not assess other behaviors such as littering or possession of tobacco products, as  
18 mentioned in the policy. Policy violations were also only assessed in students, whereas such  
19 violations could have been committed by staff, employees, or visitors. The findings of this study  
20 must also be interpreted in the context of the campus where this study was conducted; thus,  
21 generalization to other universities must be made with caution.  
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## 49 **Conclusion**

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51 This study found that violations of a campus smoke-free policy are fairly common. Policy  
52 violations might be related to smoking behavior, beliefs about policy adherence, smoking  
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3 attitudes, and support for the policy. Important barriers to policy adherence include a lack of  
4 reminders about the policy, lack of student and administrative support, and a need for stricter  
5 policy enforcement. Additional interventions are needed to improve compliance with the policy  
6 and reduce prevalence of smoking on campus.  
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#### 14 **List of Abbreviations:**

15 ACHA: American College Health Association

16 CDC: Centers for Disease Control and Prevention

17 GPA: Grade Point Average

18 ITC: International Tobacco Control

19 NCHA: National College Health Assessment

20 PCA: Principal Components Analysis

21 WLSMV: Weighted Least Squares Mean and Variance adjusted  
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#### 34 **Declarations:**

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36 Ethics approval: This study was approved by the University of Mississippi Institutional Review  
37 Board (UM IRB) before data were collected (Protocol #16x-011). Respondents provided consent  
38 to participate by completing the paper-based survey (this approach to consent was approved by  
39 the UM IRB and a statement was included on the front of the survey booklet that stated, “By  
40 completing the survey, I consent to participate in the study”).  
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43 Data Availability Statement: The datasets used and/or analyzed during the current study are  
44 available from the corresponding author on reasonable request.  
45  
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47 Competing interests: None declared  
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49 Funding: This research received no specific grant from any funding agency in the public,  
50 commercial or not-for-profit sectors  
51

52 Author contributions: SB and JB designed the survey and the data collection procedure. Data  
53 collection and data entry was coordinated by SB and EC. Data analysis was conducted by SR  
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and JB. All authors contributed to the interpretation of results and manuscript preparation. All authors read and approved the final manuscript.

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## Tables

Table 1: Characteristics of the study sample

| Characteristic  | Total<br>N = 1512<br>N (%) | Current<br>smokers <sup>1</sup><br>N = 353<br>N (%) | Current<br>non-smokers<br>N = 1158<br>N (%) | p value |
|---|----------------------------|---|---|---------|
| 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 MS                               | 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<br>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 second-hand smoke on<br>campus in past 7 days |                            |   |   | <0.001  |
| 0 days  | 616 (40.8)                 | 142 (40.3)  | 474 (41.0)                                  |         |
| 1 or 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)  |        |
| 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 <sup>2</sup>                      | 293 (19.4)  | 224 (63.6) | 69 (6.0)    | <0.001 |
| Number of different violations by others of the policy witnessed <sup>3</sup> |             |            |             | 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)    |        |

<sup>1</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

<sup>2</sup>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.

<sup>3</sup>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.

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

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

| <b>Barrier</b>                                       | <b>Total<br/>Percent (N)<sup>1</sup></b> | <b>Current<br/>smokers<sup>2</sup><br/>Percent (N)<sup>1</sup></b> | <b>Current<br/>non-smokers<br/>Percent (N)<sup>1</sup></b> | <b>p value</b> |
|--|--|--|--|----------------|
| 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<br>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'<br>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<br>University administrators    | 20.0 (302)                               | 20.7 (73)  | 19.8 (229)   | 0.710          |
| Lack of reminders about the<br>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          |

<sup>1</sup>Percentage of respondents who selected strongly agree or agree.

<sup>2</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

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



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

| Item  | Factor loading | Total Mean (SD) | Current smokers <sup>1</sup> Mean (SD) | Current non-smokers Mean (SD) | p value |
|---|----------------|-----------------|--|-------------------------------|---------|
| <b>Student attitudes toward 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 <sup>2</sup>   | 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 toward 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 toward smoking</b>   |                |                 |  |                               |         |
| If someone smokes cigarettes around me they are causing me harm because of second-hand smoke  | 0.788          | 4.0 (1.0)       | 3.1 (1.1)                              | 4.2 (0.9)                     | <0.001  |
| I prefer to socialize 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  |



|    |                                |       |           |           |           |        |
|----|--------------------------------|-------|-----------|-----------|-----------|--------|
| 1  |                                |       |           |           |           |        |
| 2  |                                |       |           |           |           |        |
| 3  | All tobacco products should be | 0.867 | 3.7 (1.4) | 2.9 (1.5) | 4.0 (1.2) | <0.001 |
| 4  | banned in all university       |       |           |           |           |        |
| 5  | buildings                      |       |           |           |           |        |
| 6  | All tobacco products should be | 0.900 | 3.2 (1.4) | 2.2 (1.2) | 3.5 (1.3) | <0.001 |
| 7  | banned on all university       |       |           |           |           |        |
| 8  | property                       |       |           |           |           |        |
| 9  | Total scale score (alpha =     | -     | 3.8 (1.1) | 2.9 (1.0) | 4.0 (1.0) | <0.001 |
| 10 | 0.85)                          |       |           |           |           |        |

<sup>1</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

<sup>2</sup>This item was reverse coded prior to calculation of the scale score.

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

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

| Characteristic                | Violation of the campus smoke-free policy |         |
|-------------------------------|---|---------|
|                               | Adjusted odds ratio (95% CI)              | p value |
| Current smoker <sup>1</sup>   | 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 MS                | 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 & 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   |

<sup>1</sup>Past 30-day user: Smoked at least one cigarette during the past 30 days.

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STROBE Statement—checklist of items that should be included in reports of observational studies

|                           | Item No. | Recommendation  | Page No. | Relevant text from manuscript  |
|---------------------------|----------|---|----------|--|
| <b>Title and abstract</b> | 1        | (a) Indicate the study’s design with a commonly used term in the title or the abstract              | 1        | Cross-sectional survey   |
|                           |          | (b) Provide in the abstract an informative and balanced summary of what was done and what was found | 2, 3     | 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... 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 the barriers such as reminders about the policy, better policy enforcement, and support from the administration. |
| <b>Introduction</b>       |          |   |          |  |
| Background/rationale      | 2        | Explain the scientific background and rationale for the investigation being reported                | 4        | Research into the effectiveness of campus smoke-free policies has found mixed results, with some universities reporting frequent policy violations and low compliance rates[14-18]. There is limited research on the factors affecting policy compliance and strategies to improve compliance to smoke-free policies on college campuses[19-21].   |
| Objectives                | 3        | State specific objectives, including any prespecified hypotheses                                    | 5        | The specific aim of the current study was to evaluate adherence to the campus smoke-free policy, estimate the prevalence of on-campus smoking behavior, and to identify the key factors that influence policy violations, and measure barriers to successful implementation of a smoke-free policy.  |
| <b>Methods</b>            |          |   |          |  |

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|                              |    |  |      |  |
|------------------------------|----|--|------|--|
| Study design                 | 4  | Present key elements of study design early in the paper  | 5    | This study employed a cross-sectional, self-administered survey of undergraduate students at the University of Mississippi ...   |
| Setting                      | 5  | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection  | 5, 6 | 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 4 students) or were independent studies, a random sample of the remaining classes was chosen for inclusion in the study.  |
| Participants                 | 6  | (a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up  | 6    | 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. |
|                              |    | <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls |      |  |
|                              |    | <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants  |      |  |
|                              |    | (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed   | N/A  |  |
|                              |    | <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case   |      |  |
| Variables                    | 7  | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable   | 6-8  | Study measures section   |
| Data sources/<br>measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group       | 6-8  | Study measures section   |
| Bias                         | 9  | Describe any efforts to address potential sources of bias  | 8    | 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  |

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hypothesized study predictors in both the logistic and linear regression models by including interaction terms. Because classes were sampled rather than individual students, both regression models used clustered robust standard errors to account for the non-independence of observations due to the nesting of students within classes.

|            |    |   |   |  |
|------------|----|---|---|--|
| Study size | 10 | Explain how the study size was arrived at | 9 | 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 1,704 students in 60 course sections. |
|------------|----|---|---|--|

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| Quantitative variables | 11  | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why  | 7,  | Statistical analysis section   |
| Statistical methods    | 12  | (a) Describe all statistical methods, including those used to control for confounding   | 7,  | Statistical analysis section   |
|                        |     | (b) Describe any methods used to examine subgroups and interactions   | 7,  | Statistical analysis section   |
|                        |     | (c) Explain how missing data were addressed   | 9   | After deleting responses that had missing responses on more than 30 out of the 63 items on the survey, analyses were conducted on 1,512 responses  |
|                        |     | (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed<br><i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed<br><i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy | 8   | Because classes were sampled rather than individual students, both regression models used clustered robust standard errors to account for the non-independence of observations due to the nesting of students within classes.  |
|                        |     | (e) Describe any sensitivity analyses   | N/A |  |
| <b>Results</b>         |     |   |     |  |
| Participants           | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed   | 9   | 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 1,704 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 1,654 students, 1,541 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 1,512 responses.   |
|                  |     | (b) Give reasons for non-participation at each stage   | 9      | As shown above  |
|                  |     | (c) Consider use of a flow diagram   | N/A    |   |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 9      | As seen in Table 1, the sample was comprised of nearly 60% women, 78% Caucasians, 50% freshmen/sophomores, 53% state residents, and 47% enrolled in Greek organizations. The majority of respondents were 20 years old or younger, lived off-campus, and were single. |
|                  |     | (b) Indicate number of participants with missing data for each variable of interest  | 9      | After deleting responses that had missing responses on more than 30 out of the 63 items on the survey, analyses were conducted on 1,512 responses.  |
|                  |     | (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)   | N/A    |   |
| Outcome data     | 15* | <i>Cohort study</i> —Report numbers of outcome events or summary measures over time  | N/A    |   |
|                  |     | <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure                                     | N/A    |   |
|                  |     | <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures   | 9, 950 | More than 63% of current smokers report ever smoking on campus, in violation of the policy, but less than 10% of respondents ever received a warning or a ticket for their violation. An overwhelming   |



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|--------------|----|--|-------|---|
|              |    |  |       | majority of respondents (93.7%) scored at least 1 point or greater on the frequency of witnessing a policy violation, while 22% knew of someone who had received a warning or a ticket for smoking on campus. |
| Main results | 16 | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | 28/29 | Table 4 and 5   |
|              |    | (b) Report category boundaries when continuous variables were categorized  | 12    | This variable, ranging in scores from 0 to 4, was found to have a distribution very close to normal   |
|              |    | (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period   | N/A   |   |

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|                   |    |  |        |   |
|-------------------|----|--|--------|---|
| Other analyses    | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses   | N/A    |   |
| <b>Discussion</b> |    |  |        |   |
| Key results       | 18 | Summarise key results with reference to study objectives   | 13     | The prevalence of self-reported policy violations was nearly 64% among current smokers and 6% among non-smokers (who have may been past smokers).   |
| Limitations       | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias                 | 16, 17 | Limitations paragraph   |
| Interpretation    | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 17     | This study found that violations of a campus smoke-free policy are fairly common. Policy violations might be related to smoking behavior, 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. |
| Generalisability  | 21 | Discuss the generalisability (external validity) of the study results  | 17     | The findings of this study must also be interpreted in the context of the campus where this study was conducted; thus, generalization to other universities must be made with caution.  |

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**Other information**


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|         |    |   |    |  |
|---------|----|---|----|--|
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 18 | This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors |
|---------|----|---|----|--|

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\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).