Title

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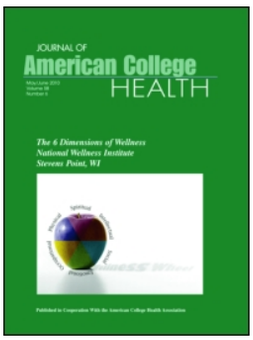
Publication Date

2020-07-01

Peer reviewed



Journal of American College Health

ISSN: 0744-8481 (Print) 1940-3208 (Online) Journal homepage: https://www.tandfonline.com/loi/vach20

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To cite this article: Elaine Cheung, Tamineh Romero, Catherine M. Crespi, Claudia Perez, Janice E. Huang, Cornelia Pechmann & William J. McCarthy (2020): Undergraduate support for university smoke-free and vape-free campus policies and student engagement: a quasi-experimental intervention, Journal of American College Health, DOI: 10.1080/07448481.2020.1782920

To link to this article: https://doi.org/10.1080/07448481.2020.1782920

JOURNAL OF AMERICAN COLLEGE HEALTH
https://doi.org/10.1080/07448481.2020.1782920

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MAJOR ARTICLE

Undergraduate support for university smoke-free and vape-free campus policies and student engagement: a quasi-experimental intervention

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ABSTRACT

Background: College campuses have policies restricting smoking/vaping on campus. Previous studies involving mostly European-American students showed smoking prevalence declines following implementation of such policies.

Objective: To evaluate a social media campaign promotive of stronger campus support for an existing campus no-smoking/no-vaping policy where most (~75%) of the undergraduates were non-European-American. A demographically comparable university served as a no-intervention control.

Participants: Target was 200 random intercept surveys at each university during fall 2016, spring 2017. Of 800 respondents, 681 were undergraduates.

Methods: Baseline and post-intervention surveys assessed awareness of and support for campus-wide smoke-free/vape-free policies. Staged smoke-free/vape-free policy violations assessed students' propensity to intervene in support of the policy.

Results: Respondent support for the no-smoking/no-vaping policy did not change.

Conclusions: The social media campaign and Policy Ambassadors program did not increase support for the campus no-smoking/no-vaping policy. Most (~90%) respondents agreed that the campus no-smoking/no-vaping policy was important for public health.

ARTICLE HISTORY
Received 30 July 2019
Revised 13 April 2020
Accepted 7 June 2020

KEYWORDS
College; public policy; smoke-free/vape-free; social marketing; tobacco-control

Background/introduction

Tobacco use is the single greatest contributor to premature mortality.[1–3] To discourage student tobacco use and to protect campus community members from involuntary exposure to secondhand smoke, the campuses of the University of California system adopted campus-wide bans on smoking or vaping tobacco products in 2013–2014.[4] The system-wide smoke-free/vape-free campus policies included reliance on education and smoking cessation outreach to motivate compliance with the policy. These campuses typically offer free clinical tobacco cessation services to registered students wanting to be free of their nicotine addiction and to staff covered by university-sponsored health plans. While falling short of the recommendations of the American College Health Association (ACHA), these policies were expected to reduce campus community members' exposure to secondhand smoke or nicotine vapor.[5]

As of November 2017, at least 2,082 U.S. colleges and university campuses were smoke-free.[6] Previous research on the impact of university campus smoke-free/vape-free policies showed: (1) increasingly negative attitudes toward smoking and secondhand smoke exposure following adoption of smoke-free policies, (2) declines in on-campus tobacco use following adoption, (3) increasing support for campus smoke-free/vape-free policies.[7–10] This previous research was largely restricted to universities with majority European-American student populations.[8] Furthermore, little research has examined the effectiveness of a campus-wide, comprehensive media campaign designed to increase undergraduate student support for the campus no-smoking/no-vaping policy. Recent findings suggest that most campus community members are reluctant to intervene when confronted by flagrant violations of the policy.[11] Evidence from successful university Web-based communication efforts to reduce undergraduate underage alcohol consumption suggests that a student-driven comprehensive social media campaign in support of the campus no-smoking/no-vaping policy might decrease community member reluctance to intervene when encountering violations of the policy.[12] To assess the impact of a campus-wide social media campaign designed to increase campus support for a campus no-smoking/no-vaping policy, the investigators proposed two novel outcome measures, namely, an objective and a self-report

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Supplemental data for this article can be accessed online at https://doi.org/10.1080/07448481.2020.1782920.

assessment of how comfortable campus community members were about actively intervening when encountering an on-campus violation of the campus no-smoking/no-vaping policy.

In the U.S., non-European-American adolescents/young adults are prone to initiating tobacco use after graduating from high school, in contrast to European-Americans, who typically initiate tobacco use before high school graduation.[13] Hence, it may be particularly important in universities with large non-European-American student populations to discourage student tobacco use. In 2017, the undergraduate population of the University of California system was only 22% European-American; more numerous were Asians/Pacific Islanders (34%) and Hispanics (24%).[14] The corresponding percentages for UC-Los Angeles (UCLA) were 27%, 28%, and 22%; for UC Irvine (UCI), the corresponding percentages were 13%, 36%, and 26%.[15]

This study reports a quasi-experiment involving two University of California campuses designed to evaluate the impact of an interactive smoke-free/vape-free intervention campaign to increase undergraduate support for campus smoke-free/vape-free policies at one of these campuses. The campaign consisted of a social media campaign and a Policy Ambassadors program (see examples of images used during the campaign in supplemental file), both highlighting the negative health effects of exposure to cigarette smoke[16] and nicotine vapor,[17] in accordance with findings from preliminary focus group research. A 2015 meta-analysis of advertising repetition studies[18] confirmed earlier qualitative research[19] that repeated exposure to visual stimuli/advertisements increased memorability and improved positive attitudes toward the advertising content. Thus, the campaign sought to increase awareness, liking and support for the campus smoke-free/vape-free policy through repeated exposure to persuasive information about the policy. This study evaluated the hypothesis that a student-designed social media campaign conducted at only one of these two campuses would increase awareness, liking and support for the campus smoke-free/vape-free policy at the intervention campus compared to the control campus.

UCLA was selected as the experimental campus for implementing the intervention phase of the project, which involved exposure to social media and marketing efforts in support of the smoke-free/vape-free campus policy. UCLA was the first of the UC system campuses to be declared smoke-free/tobacco-free on April 22, 2013. UCI was chosen to be the control campus for the project because of its similar institutional demographics, proximity, and similar status as a public state university. UCI became smoke-free/tobacco-free on January 1, 2014.

Materials and methods

Study design

The survey data for this quasi-experimental intervention study were obtained from university campus community members via random intercept surveys. Survey participants at UCLA but not UCI were given non-monetary items such as pens or stress balls as incentives to participate. A total of 800 surveys were collected by the end of the study. All participants gave verbal/written informed consent.

Study baseline

The social media intervention phase occurred at UCLA during the winter quarter. Baseline and follow-up assessments occurred at both campuses during the fall and spring quarters, respectively. At each campus, a target of 200 random intercept surveys involved students, faculty, and staff randomly selected from high-foot traffic areas distributed around the campus. The surveys contained questions regarding the respondent's knowledge of the campus smoke-free/vape-free policy and what they believed about the health impacts of exposure to smoking/vaping. In addition, staged violations of the campus smoke-free/vape-free policy were conducted with a vaping actor/confederate at selected locations on campus to see whether campus community members would spontaneously intervene and approach the smoker/vaper to inform them that their smoking/vaping violated campus-wide policies. These staged violations were conducted during daylight hours where passersby had a clear view of the vaping actor/confederate.

Study intervention

In fall quarter 2016, the researchers conducted five focus groups at UCLA lasting 30 minutes per session to assess different social media intervention ideas. Participants were mostly undergraduate students. Each focus group comprised 10 – 15 UCLA campus community members recruited via department and student club emails. Major themes from the focus group discussions were 1) The smoke-free/vape-free policy needed stronger enforcement from campus officials (e.g. community service officers or Tobacco-Free Task Force members), 2) Online messages through mainstream social media platforms (such as Facebook, Instagram, and Twitter) would be a viable way to reach campus community members, 3) A positive campaign mascot to promote the smoke-free/vape-free policy would help to reinforce anti-smoking/vaping messages for campus community members. These ideas shaped the social media campaign.

During winter quarter (January 9th 2017 to March 19th 2017), UCLA undergraduate volunteers implemented the "Clearing the Air" social media campaign on platforms such as Facebook, Instagram, Twitter and YouTube. The UCLA undergraduate volunteers created a cartoon mascot, named Fresh Air Bear (see photos in supplemental file), to brand the Clearing the Air campaign. Previous studies showed that placing social media brand posts on fan pages enhances brand popularity.[12] The four online platforms provided over 100 messages supportive of the campus smoke-free/vape-free policies throughout winter quarter. Messages were framed positively to encourage healthy tobacco-free lifestyles and campus community wellness[13] but also highlighted the harmfulness of exposure to tobacco smoke or vapor.[20]

As part of UCLA's Healthy Campus Initiative (HCI) and its BreatheWell subgroup, a Policy Ambassadors (PA) program was implemented in winter quarter 2017. This program consisted of face-to-face interactions with campus community members, to teach them polite ways to approach smokers or vapers seen on campus and remind them of the campus smoke-free/vape-free policies. Previous work showed that word-of-mouth communications can strengthen and raise awareness of social marketing campaigns.[14]

PAs were mainly undergraduates recruited via email, Facebook groups, and word of mouth. Following a two-hour training session, they promoted the campus' smoke-free/vape-free policies for an hour each week during the winter quarter. PAs wore uniform T-shirts during their rounds around campus, identifying them as campus "Policy Ambassadors." During each round, at least two PAs interacted with smoke-free/vape-free policy violators and campus community members about the smoke-free/vape-free policy. There were at least two shifts of PAs each weekday for five weeks in the winter quarter. The goal of each PA round was to share informational flyers and speak with at least 5 individuals. PAs were incentivized with community service credit and membership on the UCLA Tobacco-Free Task Force. PAs supplemented the work of campus community service officers (CSOs) and campus police, given that no additional campus safety resources were allocated to enforce the smoke/vape-free policy when it was adopted.

Additional campus outreach events were hosted in winter quarter at UCLA to promote policy awareness and health education about smoking and vaping. On two occasions, information tables were set up in high traffic areas of campus to provide campus members with "Clearing the Air" pamphlets, T-shirts, smoking cessation quit kits, and posters featuring the Fresh Air Bear mascot. Visually appealing artwork and flyers were created to spread the message.[10,11] Additionally, two hour-long educational workshops took place in on-campus dormitories. Previous studies showed that increasing tobacco-free policy awareness and health education promoted increased adherence to the campus's tobacco-free policy.[7,8] Collaborations with campus student health groups, such as the Student Wellness Commission and Colleges Against Cancer, also facilitated transmission of the Clearing the Air Campaign social marketing messages.[21] Finally, the UCLA Tobacco-Free Task Force posted approximately 500 signs across campus during the 2016-2017 academic year, reinforcing awareness of the smoke/vape-free policy.

By contrast, the UCI Tobacco-Free Task Force reported posting 721 signs on campus during the 2016-2017 academic year. Although UCI's Tobacco-Free Task Force did have an online presence, UCI did not have the social media or social marketing initiatives that were implemented at UCLA. The UCI campus, however, did deploy policy enforcers periodically to approach policy violators and inform them of their vaping/smoking violated campus policy, similar to UCLA PA practices. UCI's Student Wellness & Health Promotion center also made smoking cessation counseling accessible to campus community members, like UCLA.

Study post-intervention

During spring quarter 2017, another 200 random intercept surveys were collected at both UCLA and UCI for follow-up data, collected from the same campus locations that were used during baseline assessment. In addition, follow-up staged violations of the smoke-free/vape-free policies were conducted at UCLA and UCI to assess campus community members' spontaneous willingness to intervene with policy violators.

Participants

Participants providing survey data or who were observed during the staged violations of the campus no-smoking/no-vaping policy were randomly selected pedestrian community members, most of whom were undergraduates.

Sampling

Trained research assistants were randomly assigned to one of 10 high-traffic footpaths around campus at UCLA and 6 high-traffic footpaths around campus at UCI. Their selection of potential respondents was governed by computer-generated random numbers ranging from 1 through 6, with 1 meaning request the next immediate person on the footpath to complete the survey and 6 meaning wait until the 6th person to invite them to complete the survey. Only students, faculty and staff of the university were eligible to participate; visitors were not eligible. The response rates on both campuses were low: 18% at UCLA and 37% at UCI.

Measures

Survey measures

The baseline survey instrument consisted of 22 close-ended questions and one final open-ended question. The follow-up survey instrument consisted of 28 close-ended and one final open-ended question. The questionnaire was designed to be interviewer-administered, required 10 minutes of the respondents' time and included no personally identifiable information. The survey items elicited general demographic information about the respondent such as gender, campus role (i.e. faculty, staff, graduate student, undergraduate) and information about the respondent's attitudes/beliefs about campus smoke-free/vape-free policies and current tobacco use behavior. To minimize respondent burden and preserve respondent anonymity, no information about respondent race/ethnicity was recorded.

Measures of campus awareness of the smoke-free/vape-free campus policy and of the campus task force charged with implementing it

Two questions queried respondents about their awareness of the smoke-free/vape-free campus policy and the campus task force charged with implementing it. The first question was: Does UCLA/UCI have a tobacco use policy for all people on its campus? If so, what is it? Answer options were 1) No

smoking/vaping is allowed anywhere on campus, 2) Smoking/vaping is allowed outside, at least 20 feet from buildings, 3) Smoking is allowed on campus only in designated areas, 4) Smoking/vaping is allowed everywhere on the UCLA/UCI campus, and 7) Don't know/not sure. The second question was: Have you heard about the [UCI/UCLA] Tobacco-Free Control Task Force? Answer options were 1) Yes, 2) No, 3) Don't know/not sure.

Measures of campus support for smoke-free/vape-free campus

Three questions were related to respondent and campus level of support for the campus smoke-free/vape-free policy. The first question was: Would you be comfortable approaching someone you saw smoking/vaping on campus and politely telling them about [UCI/UCLA]'s Smoke-free and Vape – free campus policy? Answer options were 1) Yes, perfectly comfortable, 2) Yes, but I would be a little apprehensive about conveying a negative message, 3) No, but I would not mind letting campus police know about the violator, 4) No, I do not think that it is my responsibility to tell others how to behave, 7) Don't know/not sure. For analysis purposes, the responses were dichotomized such that the don't know/not sure answers were grouped with options 3 and 4 and coded as zero whereas options 1 and 2 were grouped together and coded as 1. The second question was: Have you witnessed a smoker or vaper being confronted by a bystander/campus community member to stop smoking on campus in the last 12 months? Answer options were 1) Yes, 2) No, 7) Don't know/not sure. For analysis purposes, option 7 was grouped with option 1 and coded as 1; option 2 was coded as zero. The third question was open-ended: What more would you like to see UCLA/UCI do with respect to encouraging campus community support for UCLA's/UCI's smoke-free/vape-free campus policy? Responses were content-analyzed and common themes were extracted.

Measure of respondent attitude toward the public health importance of the campus no-smoking/no-vapingpolicy

How important is UCLA's/UCI's smoke-free/vape-free campus policy for public health? Answer options were 1) The policy will have no impact on public health, 2) The policy might have a small effect on public health, 3) The policy could have a large impact on public health, 7) Don't know/not sure. For analysis purposes, option 7 was grouped with option 1 and coded as zero; options 2 and 3 were grouped together and coded as 1.

Measures of smoking/vaping behavior by respondents, their friends and other campus members

Two questions were asked of respondents concerning their own smoking/vaping behavior. The first question was: Do you now smoke cigarettes/vape nicotine vapor every day, some days, or not at all? Answer options were 1) Every day, 2) Some days, 3) Not at all. The second question was: Have you smoked or vaped tobacco products on campus in the last 12 months? (dorms, stairwells, etc.) Three questions concerned the smoking/vaping behavior of the respondents' friends. One was: How many of your four closest friends/buddies/colleagues on campus smoke/vape cigarettes? Answer options were 1) None, 2) One, 3) Two, 4) Three, 5) All four, 6) Not sure. The second question was: Have you [ever] witnessed someone smoking or vaping on campus? Answer options were 1) Yes, 2) No, 3) Don't know/not sure. A more time-limited question was: Have you seen someone smoking cigarettes or vaping E-cigarettes on campus in the last 30 days? Answer options were 1) Yes, 2) No, 7) Don't know/not sure.

Observed reactions of passersby to staged violations

Trained research assistants used paper observational data collection forms on clipboards to tally the number and observable demographic characteristics of campus pedestrians encountering actors/confederates flagrantly violating the campus no-smoking/no-vaping policy. An information sheet was provided to all campus members who intervened, explaining that the violation was staged for research purposes.

Ethical approval

This study was approved by the UCLA Institutional Review Board (IRB) (IRB), application IRB#16-001313-CR-00001. The UCI IRB relied on the UCLA IRB's review for approval of the study procedures involving UCI personnel.

Statistical analyses

The chi square test was used to evaluate contingency tables involving categorical measures. The binomial exact test was used to evaluate changes in proportions over time within each campus. The impact of the social media intervention on willingness to promote the smoke-free/vape-free campus policy was assessed by using logistic regression to examine the interaction of quarter and university campus. Regression models were typically adjusted for gender, weekly frequency of coming to campus, and undergraduate year or age. Results were considered significant if p-value < 0.05. Incomplete questionnaires were excluded from analyses ($n = 17$) and most analyses were restricted to the undergraduate participants. Data were analyzed using Stata/IC versions 14.2-15.0 (StataCorp LLC).

Results

Sample characteristics

Table S1 (found in supplementary file) provides details on how many of the randomly surveyed respondents were undergraduates, graduate students, faculty, or other staff stratified by the participating university campuses and time of survey. Undergraduates comprised 76%–86% of respondents at UCLA and 92%–89% of respondents at UCI.

Table 1. Descriptive characteristics of 343 undergraduates responding to a random intercept survey on campus in the 2016 fall quarter, stratified by campus.

		UCLA Fall	UCI Fall	UCLA vs. UCI χ^2
Gender identity	male	69 (43.1%)	67 (36.6%)	$\chi^2_{(2)} = 11.66$, P = .003
	female	88 (55.0%)	111 (60.7%)	
	other	3 (1.4%)	5 (2.7%)	
	Total	**160**	**183**	
Age (years)	<= 18	42 (26.6%)	48 (26.2%)	$\chi^2_{(3)} = 0.01$, P > .999
	19 – 20	66 (41.8%)	75 (41.0%)	
	21 – 22	36 (22.8%)	42 (23.0%)	
	>= 23	14 (8.9%)	18 (9.8 %)	
	Total	**158**	**183**	
Undergraduate year	1st	51 (32.1%)	51 (27.9%)	$\chi^2_{(3)} = 4.87$, P = .181
	2nd	41 (25.6%)	34 (18.6%)	
	3rd	33 (20.8%)	52 (28.4%)	
	4th	35 (22.0%)	46 (25.1%)	
	Total	**160**	**183**	
How frequently attend school (days/week)?	< 5	47 (29.4%)	49 (26.8%)	$\chi^2_{(1)} = 0.29$, P = .593
	5	113 (70.6%)	134 (73.2%)	
	Total	**160**	**183**	
Do you smoke/vape?	yes	31 (19.4%)	26 (14.2%)	$\chi^2_{(1)} = 1.64$, P = .200
	no	129 (80.6%)	157 (85.8%)	
	Total	**160**	**183**	
Have you smoked or vaped tobacco products on campus in the last 12 months?	yes	21 (13.1%)	17 (9.3%)	$\chi^2_{(2)} = 2.67$, P = .263
	not sure	2 (1.2%)	6 (3.3%)	
	no	137 (85.6%)	160 (87.4%)	
	Total	**160**	**183**	
Do any of your four closest friends smoke or vape?	yes	57 (36.6%)	53 (29.0%)	$\chi^2_{(1)} = 2.19$, P = .334
	not sure	20 (12.5%)	30 (16.4%)	
	no	83 (51.9%)	100 (54.6%)	
	Total	**160**	**183**	

Graduate students (5%–14%), faculty (0%-2%) and staff (3%-8%) comprised so few of the remaining respondents that they were excluded from the following analyses.

Table 1 describes the baseline characteristics of the undergraduates who participated in the random intercept surveys during fall 2016, stratified by campus. The baseline demographic characteristics of undergraduate respondents were comparable between campuses except for gender distribution. More males responded to the fall UCLA intercept survey (43.1%) than to the UCI survey (36.6%, $\chi^2_{(2)} = 11.66$, $p = .003$). The prevalence of tobacco use among respondents and their friends was comparable between campuses, with the baseline percentage of respondents who reported vaping/smoking ranging from 14.2% to 19.4%, while the percentage who vaped/smoked on campus within the last 12 months ranged from 9.3% to 13.1%. At both campuses, a little over 50% of respondents from each campus reported being sure that none of their close friends smoked or vaped.

Support for the campus smoke-free/vape-free policy

Objective evidence of support

It was expected that a higher proportion of passersby would approach the violating actors/actresses smoking/vaping on campus during the staged violations of the campus smoke-free/vape-free policy in spring compared to the fall quarter at UCLA; and no significant change was expected at UCI. At UCLA, there were 6 intervenors out of 2,281 passersby (0.26%) in fall 2016 and 7 out of 2,285 (0.31%) in spring 2017 (Table S2, See supplementary material). At UCI, there were 2 out of 2,310 (0.09%) in fall and 0 out of 1,858 (0%) in Spring. The expected time by campus interaction was not significant. When the fall and spring data were combined, a test of the between-university difference did show a higher level of objectively-observed, spontaneous interventions to enforce the campus smoke-free/vape-free policy at UCLA compared to UCI (Fisher exact test, p = 0.008).

Random intercept survey results

The percent of survey respondents who stated that they were willing to intervene to persuade violators to adhere to the campus smoke-free/vape-free policy was low for both campuses: 19.8% (95% CI: 17.1%, 22.6%). In addition to gender (female vs male), student age (<22 y vs >= 22 y) and frequency of campus weekly attendance (1–4 days/week vs 5 days/week) were included as covariates because undergraduates older than 22 years-old were hypothesized to be more likely to approach a violator and those who attended UCLA daily were more likely to be exposed to the campus-wide social media intervention. The expected association between the self-reported willingness to approach a violator and exposure to the UCLA social media intervention was not significant and remained nonsignificant when the covariate age was replaced with the respondent's school year. As expected, undergraduate students older than 22 were more likely than younger undergraduates to express a willingness to intervene: (33.5% versus 18.0%; adjOR = 2.29; 95% CI: 1.19, 4.42; $p = .013$). Across both campuses, males were more likely to intervene than females (22.9% vs. 15.7%; adjOR = 1.62, 95% CI: 1.08, 2.41; $p = .019$).

When asked if they had ever witnessed in the last 12 months an instance where a campus member had intervened to stop a violation of the campus no-smoking/no-vaping policy, an average of 13.2% of respondents said "Yes."

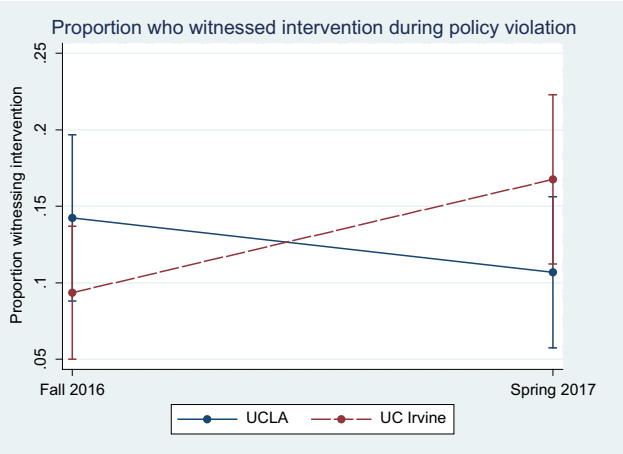

Figure 1. Quarter by university effect on respondents reporting having witnessed a campus member intervening to stop a violation of the campus no-smoking/no-vaping policy.

Unexpectedly, the proportion of respondents saying "Yes" in the fall and spring quarters declined from 14.2% to 9.7% at UCLA but increased from 11.6% to 16.8% at UCI ($adjOR_{interaction\ effect} = 2.73$; 95% CI: 1.06, 7.04; p = .038. The difference between fall to spring at UCI was significant ($\chi^2_{(1)} = 4.26$; $p = .039$)(See Figure 1).

Only a minority of the surveyed students (13.7%–16.9% at UCLA; 22.4%–23.2% at UCI) were aware of their respective campus' Smoke & Tobacco-Free Task Force, established to implement each campus' smoke-free/vape-free policy. We tested whether variation in student awareness of their local Task Force affected their willingness to intervene with violators of the policy. At UCLA, awareness of the campus Task Force was found to be unrelated to respondent willingness to intervene when encountering a person violating the campus smoke-free/vape-free policy (both quarters, p > .50) but was related to respondent readiness to intervene during the spring quarter at UCI (b = 0.16, 95% CI: 0.003, 0.317, p = .046, but not during the fall quarter (p = .87).

Attitudes and changes from fall 2016 to spring 2017 in attitudes toward the campus smoke-free/vape-free policy

Survey results indicated that respondents' attitudes toward smoking were strongly associated with their smoking status ($p < 0.001$) (see Table S2, supplementary material), and that female undergraduates reported more negative attitudes toward smoking/vaping on campus than males ($adjOR_{(male\ vs.\ female)}$: 1.99, 95% CI: 1.45–2.73, $p < 0.001$). Over 95% of respondents on both campuses agreed that inhaling smoke from combustible cigarettes was harmful; 76% to 84% agreed that inhaling nicotine from electronic cigarettes was harmful.

Table S3 (supplementary material) includes variables used to measure respondents' attitudes, beliefs and knowledge about tobacco smoking and vaping. The percentage of respondents from both campuses who admitted to lacking knowledge about the harmfulness of inhaling smoke from combustible tobacco products ranged from 1.5-3.0%. The corresponding percentage of respondents acknowledging a lack of knowledge about the harmfulness of e-cigarette vapor was larger, ranging from 14.0% to 18.0%.

On both campuses, although the number of students reporting current smoking/vaping decreased in the spring quarter (Table S2, supplementary material), respondents reported having witnessed smoking/vaping on campus more often in the spring quarter than in the fall quarter (adjOR = 2.89, 95% CI: 1.67–5.03, $p < 0.001$). Because university affiliation was unrelated to respondent reports of having witnessed policy violations, the data from both universities were combined. For all undergrad years, there was an increase from fall to spring in reports of having witnessed on-campus policy violations (adjOR = 3.98, 95% CI: 2.03, 7.78) but the increase was significant only for first and second year students ($\chi^2_{(1)(first\ years)} = 19.6$, $p < .001$; $\chi^2_{(1)(second\ years)} = 8.73$, $p = .003$) (See supplementary material, Figure S1). As hypothesized, frequency of coming on campus was positively associated with the probability of witnessing a violation of the campus policy (adjOR = 1.89, 95% CI: 1.21, 2.94; p = .003). Those who came on campus only twice a week had a 50% (95% CI: 29.8%, 70.0%) likelihood of witnessing a violation of the campus policy compared to 80.6% likelihood (95% CI: 77.3%, 84.0%) for those coming to campus five days per week.

Student awareness of their campus smoke-free/vape-free policy was high at both campuses (80% at UCLA, 95% CI: 75.9%, 83.6%; 86.0% at UCI, 95% CI: 82.2%, 89.1%) and did not change appreciably from fall to spring at either campus. Students' belief that having a smoke-free/vape-free campus would have a significant effect on public health was high on both campuses (88.6% at UCLA-95% CI: 85.1%, 91.3%; 90.0% at UCI – 95% CI: 86.7%, 92.6%), particularly among females ($b = .255$, 95% CI: .155, .365; $p < .001$). Older students were more likely to endorse the public health importance of the policy than younger students ($b = .289$, 95% CI: .092, .486; $p == .004$). Curiously, there was a quarter by university interaction effect (see Supplementary material, Figure S2), such that the proportion of respondents endorsing the public health importance of the no-smoking/no-vaping policy at UCLA declined from fall to spring even as the corresponding proportion increased at UCI ($b_{(interaction\ effect)} = 0.365$, 95% CI: .167, .564; $p < .001$).

Open-ended question about ways to improve compliance to the no-smoking/no-vaping policy

Looking at all respondents (not just undergraduates), more UCI respondents (68.5%) were likely to offer suggestions for improving compliance with the campus no-smoking/no-vaping policy than UCLA respondents (46.3%; adjOR = 2.43; 95% CI: 1.61, 3.67, $p < .0001$). Women (60.6%) were more likely to offer suggestions than men (54.1%; adjOR= 0.73; 95% CI: 0.56,0.96; $p = .023$). The most common suggestions were 1) more/stronger enforcement of the policy (25.8%), 2) increased campus signage reminding campus members that the campus was smoke-free/vape-free (16%), 3) the university should conduct social media campaigns and otherwise

increase publicity about the policy (13.8%), and 4) increased health education (10.4%). Twenty-two percent (21.7%) said that they were unsure or were satisfied with the current steps being taken to support the policy. Less than five percent reported each of the following suggestions: designate specific areas on campus as smoking areas, increase campus access to tobacco cessation services, and provide support groups for campus members struggling with nicotine addiction.

Discussion

Main outcomes analyses

The survey data from undergraduates showed that only 19.8% of respondents reported willingness to intervene if they encountered a violation of the no smoking/vaping campus policy and this did not change significantly over time on either campus. The results of the staged violations of the campus smoke-free/vape-free policy also showed little change in the students' propensity to intervene. Awareness of the smoke-free/vape-free policy was high (80%–86%) at both campuses and did not change significantly from the fall to the spring, despite winter quarter exposure to the social media campaign and the face-to-face encounters with Policy Ambassadors at UCLA.

Although the frequency of self-reported vapers decreased on both campuses/vapers decreased on both campuses (Table S2), the undergraduate respondents reported an increase in witnessing smoking/vaping on campus (Supplementary material, Figure 1). Part of the apparent increase may have been an artifact of first year undergraduates becoming familiar with locations where smokers/vapers congregate on campus. Frequency of witnessed violations was also a positive function of how often the respondent came to campus each week.

UCLA experienced an overall decline in the proportion of undergraduates who believed in the positive public health impact of the campus smoke-free/vape-free policy, whereas the UCI campus, which had not received the social media and Policy Ambassador interventions, experienced an increase in the proportion of students who had positive beliefs about the public health impact of having a smoke-free campus. This could conceivably be attributable to a psychological reactance[22,23] against the UCLA interventions to promote the policy. Alternatively, differences in UCI's and UCLA's political and built environments may have contributed to these unexpected trends.

This study occurred as California voters debated on, then voted for Proposition 64, which legalized recreational marijuana use. Tobacco control leaders expressed concern that recreational marijuana legalization could "re-normalize" combustible tobacco use.[24] Indeed, early use of e-cigarettes in adolescent marijuana non-users may double the risk of subsequent marijuana use at 1-year follow-up.[25] In any case, the sociopolitical environments around the two campuses differed with respect to marijuana legalization, with the more conservative community around UCI opposing Proposition 64 and the more liberal community around UCLA supporting Proposition 64.[26,27]

Differences in urbanicity/population density between UCI and UCLA may also have contributed to differences in student support for controlling smoking/vaping. UCI is located in a suburban area, where the closest commercial smoking/vaping business identified in a Google Maps search was 2.5 miles away, a 52-minute walk. The corresponding search for UCLA identified a vaping lounge 0.6 miles from the center of campus, a 11-minute walk. Eight tobacco-related shops were located within 1.7 miles of UCLA.

Limitations

We acknowledge that the results of the study could be potentially skewed by recall bias when respondents were asked about having witnessed smoking/vaping on campus during the past 30 days or when asked to recall any smoking/vaping on campus during the past 12 months. Similarly, social desirability bias may have influenced respondents to under-report their own smoking status and violations of the campus no-smoking/no-vaping policy. In addition, due to the nonrandom assignment of university to condition, there may be unmeasured confounders that could explain the observed differences by university. Finally, low response rates to requests to complete the survey could have reduced the representativeness of the data.

Future directions

More research is needed to understand the divergent trends by gender with women reporting greater support of the campus no-smoking/no-vaping policy, but men reporting greater willingness to take action when encountering a violation of the policy. Also, future research on campus tobacco control policies should take into account respondents' familiarity with the campus and the frequency with which they visit the campus weekly. The possibility that marijuana legalization could re-normalize tobacco use among university students is concerning; its effect on campus tobacco use warrants investigation.

Universities featuring high student ethnic diversity may require greater cultural tailoring and narrow-casting of social media campaign strategies and social marketing messages supportive of the campus no-smoking/no-vaping policy in order to obtain an intervention impact as large as that typically observed at ethnically more homogeneous universities. To this end, administrators/health professionals could meet with the different ethnic or cultural group organizations on campus and gauge their support for specific social media campaign strategies and candidate intervention messages. Co-branding of messages with ethnic specific student organizations is a possible intervention strategy, particularly if formative research identifies what messages resonate best with representatives of the major ethnic/racial groups on campus.

Administrators of the UC system should take notice that there is plurality support for the use of stronger enforcement

measures to motivate compliance with the UC system's no-smoking/no-vaping policy. It is also clear that a significant minority of respondents want on-campus support for campus members struggling to quit their nicotine addiction. Administrators could do this by increasing on-campus quit-smoking support groups, increasing access to on-campus clinical smoking cessation resources and increasing the social marketing of these increased cessation resources to those who could benefit. Given the consensus[28] that multi-level (individual-level and campus-level) interventions are more effective than single-level interventions, administrators should not abandon current tobacco control efforts but instead add campus-level supports to facilitate both individual and environmental changes supportive of freedom from nicotine addiction.

Conclusions

A campus-wide social marketing of anti-tobacco messaging in an ethnically diverse, mostly non-European-American undergraduate population failed to increase campus members' self-reported or objectively-assessed support for the campus no-smoking/no-vaping policy. The gender differences in propensity to support the campus smoke-free/vape-free policy attitudinally and behaviorally were interesting and deserve replication. Variations with respect to witnessing campus violations of the smoke-free/vape-free policy, depending on whether one was a first year student or an older upperclassman, and whether one attended campus only a few times a week versus usually attending campus 4-5 days per week were also noteworthy. Fortunately for public health, absolute levels of student belief in the public health importance of a campus smoke-free/vape-free policy were uniformly high. The still challenging goal is to translate this latent support into more active engagement, so that violators of the policy are held accountable. More research involving multiethnic university campuses is needed, as what worked in previous social marketing studies involving mostly European-American students may not work in universities with greater ethnic diversity. In particular, more research is needed into how to identify social media campaign strategies and culturally tailor and narrow-cast smoke-free/vape-free messaging that would resonate with the major ethnic groups on campus.

Acknowledgements

We thank Professor Michael Ong, MD, Ph.D., chair, as well as staff of the UCLA Smoke and Tobacco-free Task Force for their support, for the dedicated undergraduate volunteers at both UCLA and UCI whose data collection efforts and simulated policy violations made this study possible. We thank the members of Breathe L.A. at UCLA, who helped design and carry out the social media intervention. We thank the UCLA Healthy Campus initiative for its support of our Policy Ambassadors program.

Conflict of interest disclosure

The authors have no conflicts of interest to report. The authors confirm that the research presented in this article met the ethical guidelines, including adherence to the legal requirements of the USA and received approval from the UCLA and UC Irvine Institutional Review Boards . The funders played no role in the authors' analyses or conclusions.

Funding

The intervention and evaluation activities described in this report were supported by a Smoke- and Tobacco-free Fellowship from the California Tobacco-Related Disease Research Program to the first author and by a grant from the UCLA Healthy Campus Initiative in support of the Policy Ambassadors Program.

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