

# Vaping in the Workplace

## *Prevalence and Attitudes Among Employed US Adults*

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**Objective:** Describe workplace vaping, prevalence of observed use, attitudes, and perceptions among US adults. **Methods:** Employees of companies with more than 150 employees, drawn from an opt-in national online panel ( $N = 1607$ ), ages 18 to 65, completed an online survey in November 2019. **Results:** Majority (61.6%) observed coworkers vaping at work and 19.1% reported vaping at work themselves. Participants perceived workplace vaping as moderately harmful ( $M = 1.9$  out of 3), 63.2% were bothered by workplace vaping and 52.1% thought it decreased workplace productivity among non-users. Multiple regression models found workplace vaping prevalence varied by industry and participant characteristics, and attitudes about it varied by tobacco use status. **Conclusions:** Workplace vaping and vaping exposure is common in US workplaces. Employees, particularly non-users, hold generally negative perceptions of workplace vaping. Comprehensive policies to prevent workplace vaping are needed to protect workers.

**Keywords:** e-cigarette, e-cigarette free air, e-cigarette prevalence, harm perception, nicotine, prevention, smokefree air, vaping, workplace tobacco policies

The use of e-cigarettes, or vaping, has escalated in popularity over the last several years. By 2019, more than one-third (33.2%) of 15 to 34-year-olds had tried e-cigarettes.<sup>1</sup> While much of the research has focused on surges in teen use, 8.1 million adults use e-cigarettes, representing 3.2% of the general adult population.<sup>2,3</sup> Vaping is most common among young adults and among current and former cigarette smokers.<sup>1</sup> Among current smokers in 2018, 27.7% were also current e-cigarette users and among former smokers, 12.9% were current e-cigarette users.<sup>4</sup>

To our knowledge, no research has addressed the prevalence of vaping behaviors in the workplace. Research suggests that prevalence of adult use differs based on individuals' employment status and industry.<sup>5</sup> A recent study using a nationally representative

sample found that vaping among working adults was higher than among adults in the United States generally.<sup>6</sup> The study found 4.8% of working adults were current e-cigarette users, and about half of those were dual users of e-cigarettes and combustible cigarettes.<sup>6</sup> Working adults who vape are also more likely to be younger, male, non-Hispanic white, to have less education, and to be without healthcare coverage than working adults who don't use e-cigarettes or combustible cigarettes.<sup>5,6</sup>

People vape for a variety of reasons, including as a partial or complete substitute for cigarettes or other tobacco products, a belief that e-cigarettes are less harmful than cigarettes, and the ability to vape in places where other types of tobacco use is prohibited,<sup>7</sup> including workplaces.<sup>8,9</sup> Such use may be due to the legal permissibility and social acceptance of vaping, or because vaping can be done "stealthily" to avoid detection.<sup>10</sup> Vaping may not always be detectable due to the design of e-cigarettes, which produce vapor (technically, an aerosol) instead of smoke and may not have a pronounced odor.<sup>11</sup> New generation pod-based devices produce less vapor than earlier e-cigarettes, making them easier to conceal.<sup>12</sup> Studies of the relative harmfulness of secondhand vapor are ongoing, but recent studies suggest negative effects on air quality, with e-cigarettes producing exposure to toxic substances and the current generation of powerful e-cigarettes creating more vapor that could expose bystanders.<sup>13,14</sup> Use among vulnerable populations, such as pregnant women, could also inflict harm.<sup>11</sup>

While the environmental effects of vaping are not fully known, existing policy frameworks can be applied to blunt future harm. Smoke-free policies have been found to be effective in reducing the harms of tobacco use by both reducing exposure to secondhand smoke and reducing smoking rates.<sup>15</sup> Yet, given their relatively recent entry into the marketplace, e-cigarettes are not always formally included in smoke-free or other policies prohibiting tobacco use.<sup>6</sup> According to the Public Health Law Center, as of December 2019, only 19 states ban vaping in most workplaces.<sup>16</sup> One recent study found that less than 20% of workplaces reported having comprehensive smoke-free policies banning all tobacco use.<sup>17</sup> Another small 2017 study found that the overwhelming majority of e-cigarette users (73.9%) reported no restrictions on vaping where smoking is typically banned.<sup>10</sup> However, most adults perceive at least some risk of harm from secondhand vapor. A recent study found that secondhand vapor was perceived to be moderately harmful (3.8 on a seven-point scale) and harm perceptions were positively associated with knowledge of the chemicals present in vapor.<sup>18</sup> Most adults do not think it is safe for children to breathe secondhand vapor.<sup>19,20</sup> Those who use e-cigarettes tend to perceive less harm from secondhand vaping relative to those who do not.<sup>20,21</sup>

With Americans spending the majority of their time at work, it is critical to examine the prevalence of vaping at work and attitudes specifically around workplace vaping. Studies examining attitudes about restricting vaping have typically asked about indoor use generally, rather than focusing on the workplace specifically, and have often focused only on those who use e-cigarettes or smoke combustible cigarettes.<sup>8,18,22,23</sup> Less studied is how nonsmokers and non-tobacco users feel about workplace vaping and their employer's

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Clinical significance: A majority of a national sample of adults reported exposure to workplace vaping, and most perceived workplace vaping as harmful, bothersome and decreasing the productivity of non-vaping coworkers. Companies should implement vaping policies that safeguard the health and wellbeing of their employees.

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response to it. Vaping in the workplace may impact nonusers in a variety of ways, including potential exposure to secondhand aerosol, which may be bothersome or perceived as harmful and lead to decreased productivity. This novel and exploratory study is one of the first to measure how e-cigarette use is impacting people in the workplace not only for those who vape but for nonusers as well. The study objective was to advance our understanding of workplace vaping by collecting information about the prevalence of workplace vaping as well as measuring the attitudes and perceptions about workplace vaping among US adults.

## METHODS

### Participants

A national sample of working adults ( $N = 1607$ ), ages 18 to 65, was recruited to take a web-based survey using Qualtrics Online Sample, an opt-in panel provider. Participants self-reported their employment status and company size (see Table 1). Participation was limited to US residents who worked full-time (35 hours or more per week) in a workplace setting that was not primarily located in their home or a remote/telework location at a company with at least 150 employees. This study focused on larger companies because smaller organizational units may be more variable in their individual cultures and regulations with respect to vaping. Quotas were set to obtain a sample evenly distributed across three company sizes (150 to 999 employees; 1000 to 4999; 5000+). Data were collected from 1620 participants, but 13 participants were removed from the dataset for providing inconsistent responses to questions about their own vaping behavior, resulting in the final analytical dataset of 1607 participants.

### Measures

Data were collected November 1–14, 2019. The survey asked about e-cigarette use in the workplace, participant attitudes about workplace vaping and knowledge of their company's policies and programs regarding smoking and vaping. This study was reviewed and ruled exempt by Advarra Institutional Review Board.

Questions about vaping were preceded with the following explanatory text: "We are interested in the use of vapes/e-cigarettes, or 'vaping' at your workplace. Vapes are also known as e-cigarettes, e-cigs, vape pens, mods, and tanks. These devices heat a liquid nicotine solution to produce an aerosol that is inhaled. Examples of e-cigarette and vape brands include *JUUL*, *blu*, *Vuse*, *Morpheus*, *VaporFi*, *Vapresso*, and *SMOK*." The text was accompanied by an image from the CDC e-cigarette fact sheet with examples of different types of vapes, including tanks, vape pens, pods, and disposable devices.<sup>24</sup>

### Workplace Vaping Behaviors

Participants were asked whether they had vaped at work with the yes/no item "Do you vape/use e-cigarettes at work?" Coworker vaping was measured with the yes/no item "Have you seen coworkers vape/use e-cigarettes in or around your workplace?" Those who responded yes to the coworker item were asked about the frequency of vaping-related activities in their workplace with the item: "The next few questions are about how often you see vaping at work. During an average workday, how frequently do the following occur in your workplace?" with activities such as "I see coworkers vaping/using e-cigarettes indoors" (see Table 1 for full list of items) and response options "Never, Rarely, Sometimes, Often."

### Attitudes About Workplace Vaping

Three items measured perceived harm from second-hand vapor: "Second-hand vapor from vapes/e-cigarettes is harmless," "Vaping/using e-cigarettes in the workplace is not harmful to my health," and "Vaping/using e-cigarettes in the workplace is not

harmful to the health of other people nearby who do not vape," with response options Strongly Disagree, Disagree, Agree, Strongly Agree. Responses to these three items were correlated with one another (correlations ranging from 0.63 to 0.71) and alpha for a scale including all three items was 0.86. Thus, responses were averaged to form a perceived harm scale. Participants who were missing data for one of the three scale items were given the average of the two items they did respond to as their scale score. Participants who were missing data for more than one scale item were treated as missing for the scale, resulting in a total of 1574 participants with data for the scale. The perceived harm of workplace vaping scale ranged from 0 to 3, with higher scores representing higher perceived harm (ie, stronger disagreement with the items). Given this study was exploratory in nature, we dichotomized this and the other attitude measures to serve as outcomes for logistic regression. Those with a perceived harm scale score of 2 or greater ( $N = 980$ ) in the High perceived harm group and those with a scale score less than 2 ( $N = 594$ ) in the Low perceived harm group.

Additional attitudes about workplace vaping were measured with the items "Vaping/using e-cigarettes in the workplace bothers me" and "Vaping/using e-cigarettes in the workplace decreases productivity for those who do not vape," using the same agreement scale. For analyses, responses to these items were dichotomized to agree/disagree.

### Tobacco Product Use

Participants were classified as current e-cigarette users if they reported vaping on any of the past 30 days, consistent with other studies of e-cigarette use.<sup>2,25,26</sup> Former e-cigarette users were defined as those having ever "tried vaping/using e-cigarettes even one or two times" but did not vape in the past 30 days.<sup>27</sup> All other participants were classified as never e-cigarette users. Participants were classified as current smokers if they reported having smoked at least 100 cigarettes in their lifetime and had smoked on any of the past 30 days, and as former smokers if they reported 100 lifetime cigarettes but no past-30-day smoking. Participants who were current e-cigarette and cigarette users were also classified as dual users. All others were classified as never smokers.

### Workplace Characteristics

Employer size was measured with the item "How large is your employer? By employer, we mean all locations your employer operates," with response options 1 to 149 employees, 150 to 999 employees, 1000 to 4999 employees, 5000 or more employees, I don't know. Respondents who chose 1 to 149 or reported that they didn't know were ineligible to participate and terminated from the survey.

Participants reported the industry in which they worked by selecting from a list of industries adapted from categories used by the US Bureau of Labor Statistics<sup>28</sup> or selecting "other" and writing in a response. Text responses were coded into one of the other categories on the list as appropriate; those that could not be recoded were left in an "Other Industry" category. Industries that accounted for less than 5% of the sample (Construction, Leisure and Hospitality, and Wholesale Trade) were also combined into the "Other" category. The list of industries is provided in Table 2.

### State-Wide E-Cigarette-Free Policies

State-specific legislature was reviewed across all 50 states for policies limiting the use of e-cigarettes in workplace settings by searching individual state government websites, the Public Health Law Center e-cigarette regulation database,<sup>16</sup> and the American Nonsmokers' Rights Foundation.<sup>29</sup> A total of 19 states were identified as having comprehensive state-wide e-cigarette workplace policies that explicitly mentioned that e-cigarette use must follow regulations surrounding 100% smoke free laws and the state's laws prohibited

**TABLE 1.** Sample Demographic, Tobacco Use, and Workplace Characteristics and Frequency and Percentage Prevalence of Observing a Coworker Use of E-Cigarettes/Vaping In/Around the Workplace, Being Bothered by Vaping in the Workplace, Believing That Workplace Vaping Decreases Productivity for Those Who Do Not Vape, and Mean Perceived Harm Scale Score

	Sample Characteristics <i>N</i> (%)	Observed a Coworker Vaping <i>n</i> (%)	Perceived Harm of Workplace Vaping* <i>M</i> (SD)	Bothered by Workplace Vaping <i>n</i> (%)	Workplace Vaping Decreases Productivity <i>n</i> (%)
E-cigarette use <sup>‡,§,¶,  </sup>					
Current	404 (25.1)	354 (87.6)	1.26 (0.83)	158 (39.6)	166 (41.8)
Former	260 (16.2)	191 (73.5)	1.77 (0.71)	127 (49.0)	101 (39.9)
Never	943 (58.7)	445 (47.2)	2.28 (0.73)	713 (77.4)	540 (60.0)
Cigarette smoking <sup>‡,§,¶,  </sup>					
Current	422 (26.3)	362 (85.8)	1.45 (0.83)	165 (39.7)	164 (39.8)
Former	294 (18.3)	180 (61.2)	1.96 (0.85)	170 (58.8)	136 (47.6)
Never	891 (55.4)	448 (50.3)	2.17 (0.79)	663 (75.9)	507 (59.5)
Age <sup>‡,§,¶,  </sup>					
18–30 years	353 (22.0)	253 (71.7)	1.62 (0.86)	179 (51.0)	160 (46.4)
31–45 years	555 (34.5)	377 (67.9)	1.79 (0.91)	332 (61.1)	248 (46.6)
46–65 years	699 (43.5)	360 (51.5)	2.22 (0.75)	487 (71.1)	399 (59.3)
Gender					
Female	891 (55.4)	543 (60.9)	1.96 (0.85)	545 (62.0)	429 (49.7)
Male	713 (44.4)	445 (62.4)	1.91 (0.89)	451 (64.7)	377 (55.2)
Race/Ethnicity <sup>‡</sup>					
Non-Hispanic, White	1130 (70.3)	666 (58.9)	1.96 (0.88)	720 (64.8)	578 (52.7)
Non-Hispanic, Black	169 (10.5)	129 (76.3)	1.81 (0.89)	95 (56.9)	77 (47.2)
Hispanic	165 (10.3)	115 (69.7)	1.89 (0.82)	94 (58.4)	78 (49.7)
Non-Hispanic, others	129 (8.0)	76 (58.9)	1.97 (0.86)	80 (63.5)	67 (55.8)
Household income <sup>‡,§,¶,  </sup>					
Less than \$34,999	177 (11.0)	133 (75.1)	1.85 (0.86)	96 (55.2)	76 (44.2)
\$35,000–\$49,999	256 (15.9)	174 (68.0)	1.82 (0.85)	141 (55.3)	115 (46.7)
\$50,000–\$74,900	365 (22.7)	238 (65.2)	1.87 (0.89)	208 (57.9)	161 (46.0)
\$75,000–\$99,999	307 (19.1)	198 (64.5)	1.97 (0.81)	198 (65.4)	153 (51.3)
\$100,000 or greater	464 (28.9)	236 (50.9)	2.06 (0.90)	330 (72.7)	282 (62.9)
Education <sup>‡,§,¶,  </sup>					
High school/GED or less	224 (13.9)	163 (72.8)	1.81 (0.88)	113 (51.1)	94 (43.1)
Some college	542 (33.7)	372 (68.7)	1.85 (0.85)	296 (55.1)	243 (46.5)
Bachelor's degree	519 (32.3)	314 (60.5)	1.97 (0.85)	349 (68.7)	279 (55.2)
Graduate study or degree	322 (20.0)	141 (43.8)	2.13 (0.90)	240 (76.7)	191 (62.8)
Employer size <sup>‡,§</sup>					
150–999 employees	534 (33.2)	342 (64.0)	1.87 (0.89)	321 (61.5)	257 (49.5)
1000–4999 employees	526 (32.7)	341 (64.8)	1.89 (0.88)	330 (63.5)	274 (53.6)
5000 or more employees	547 (34.0)	307 (56.1)	2.06 (0.83)	347 (64.6)	276 (53.1)
Industry <sup>‡,§,¶,  </sup>					
Health services	264 (16.4)	150 (56.8)	2.00 (0.85)	164 (63.1)	119 (46.3)
Retail	187 (11.6)	138 (73.8)	1.94 (0.83)	99 (54.1)	85 (47.5)
Education	183 (11.4)	56 (30.6)	2.29 (0.80)	135 (74.6)	107 (61.1)
Manufacturing	159 (9.9)	100 (62.9)	1.87 (0.88)	93 (60.8)	81 (51.9)
Information technology	157 (9.8)	123 (78.3)	1.57 (0.93)	99 (64.7)	80 (52.6)
Government and non-profit	150 (9.3)	75 (50.0)	2.08 (0.78)	106 (70.7)	80 (56.7)
Professional and Business services	139 (8.6)	80 (57.6)	2.05 (0.80)	85 (63.0)	65 (49.2)
Financial activities	125 (7.8)	86 (68.8)	1.87 (0.90)	79 (64.2)	64 (52.5)
Transportation and Warehousing	80 (5.0)	63 (78.8)	1.76 (0.87)	41 (51.2)	45 (57.7)
Other	163 (10.1)	119 (73.0)	1.78 (0.87)	97 (60.6)	81 (51.3)
State-wide policy <sup>‡,¶</sup>					
Covered state	1063 (66.1)	328 (60.3)	1.98 (0.87)	366 (68.0)	287 (55.2)
Not covered state	544 (33.9)	662 (62.3)	1.92 (0.87)	632 (60.7)	520 (50.5)

For each outcome measure, percentages represent the proportion of respondents in that subgroup that endorsed the outcome (ie, row percentages).

Full sample size (*n*) = 1607, totals for some measures do not reach 1607 because of missing data.

\*The perceived harm scale ranged from 0 to 4, with higher scores indicating greater perceived harm.

†State-wide policy refers to whether a state has a state-wide e-cigarette policy applying to workplaces.

‡Significant difference in “Have observed co-worker vaping” (chi-square *P*-value <0.01).

§Significant difference in “Perceived harm of workplace vaping” (wald *P*-value <0.01).

¶Significant difference in “Are bothered by vaping in the workplace” (chi-square *P*-value <0.01).

||Significant difference in “Believe workplace vaping decreases productivity for non-users” (chi-square *P*-value <0.01).

cigarette use in private and public workplace settings.<sup>30–48</sup> A state-wide policy variable was created with a value of 1 for those participants living in the 19 identified states and a value of 0 for all others.

## Demographic Characteristics

Participants reported their age, sex, race/ethnicity (Hispanic, non-Hispanic white, non-Hispanic black, non-Hispanic other or

**TABLE 2.** Frequency of Observed Workplace Vaping Behaviors Among Those Who Say They've Seen a Coworker Vape In/ Around Their Workplace (*N* = 990)

Measure	Never	Rarely	Sometimes	Often
I see coworkers vaping/using e-cigarettes indoors	42.3%	17.4%	23.6%	16.7%
I see coworkers vaping/using e-cigarettes outdoors	1.3%	8.9%	36.1%	53.6%
I see coworkers take breaks to vape/use e-cigarettes	1.9%	10.2%	38.2%	49.6%
Coworkers vaping/using e-cigarettes near my work-space or while conducting business with me	42.5%	16.7%	23.9%	16.9%
I see vapor clouds from vapes/e-cigarettes	9.7%	18.7%	38.8%	32.8%
I smell vapor from a vape/e-cigarette at work	24.5%	23.0%	31.3%	21.3%

multiple races), highest education attained (high school degree/ GED or less, some college, Bachelor's degree, graduate study or degree) and household income.

### Analytic Plan

Response frequencies and percentages were calculated for each of the workplace vaping behavior and attitude measures. Coworker vaping and workplace vaping attitudes (perceived harm of workplace vaping, being bothered by workplace vaping, perceiving decreased productivity for non-vapers because of workplace vaping) served as dependent measures and were cross-tabulated with the measures of tobacco product use and workplace and demographic characteristics. Bivariate relationships were tested using chi-square. Logistic multiple regression was used to estimate adjusted odds ratios predicting each of the four focal variables. Tobacco users were expected to both be more likely to observe workplace vaping and to hold more positive attitudes about it than non-users. Because of this, we made current users the reference group for the use variables when modeling in order to get direct model estimates for non-users, which make up the majority of the sample and employees overall.

## RESULTS

### Participant Characteristics

Participant characteristics can be found in Table 2. Mean age was 43.0 years (*SD* = 13.0) and 55.4% were women. The sample was majority non-Hispanic white (70.3%), and 52.3% had a Bachelor's degree or more education. Participants reported working in a range of industries, and 88% reported working indoors only. Across the four designated US census regions, 18.9% resided in the Northeast, 25.0% in the Midwest, 40.8% in the South, and 15.4% in the West.

While the majority of the sample (58.7%) had never tried vaping, 25.1% were current e-cigarette users. A similar proportion (26.3%) were current cigarette smokers. Dual users of e-cigarettes and combustible cigarettes accounted for 66.1% of current e-cigarette users (16.6% of the total sample). Analyses revealed no significant differences between dual users and e-cigarette-only users for any of the outcomes (all *P* > 0.05); therefore dual users were not examined separately in the bivariate analyses and models.

### Prevalence of Vaping at Work

Vaping at work and exposure to others who vape at work was common among participants. The majority (76.0%) of current e-cigarette users reported having vaped at work, representing 19.1% of the total sample (*N* = 307). The majority of participants, 61.6% (*N* = 990), reported having seen a coworker vape at work. Chi-square tests revealed that exposure to coworker vaping varied significantly by participant e-cigarette and combustible cigarette use status, age, race/ethnicity, household income, and education.

Additionally, exposure to coworker vaping varied significantly by workplace size and industry (Table 2).

Participants who reported exposure to coworker vaping (*N* = 990) were asked about the frequency of vaping-related activities in their workplace on a typical workday. The response percentages for these items among this subsample are presented in Table 1. Nearly all participants reported outdoor vaping (98.6%), but over half (57.7%) reported seeing coworkers vape indoors. Strikingly, 57.5% of respondents indicated that a coworker had vaped while conducting business with or while in the respondents' workspace, with 16.9% of respondents reporting that this happened often. About half of respondents (49.6%) reported often seeing coworkers take breaks to vape and 32.8% and 21.3% reported often seeing or smelling vapor at work, respectively.

Table 3 presents the adjusted odds of exposure to coworker vaping when accounting for multiple variables. Odds of exposure varied by tobacco use status, with never e-cigarette users (*OR* = 0.27, *CI*: 0.18 to 0.41) and former e-cigarette users (*OR* = 0.55, *CI*: 0.35 to 0.85) having significantly lower odds of exposure to coworker vaping than current e-cigarette users. Never smokers (*OR* = 0.43, *CI*: 0.29 to 0.63) and former smokers (*OR* = 0.58, *CI*: 0.38 to 0.88) likewise had lower odds of exposure to coworker vaping than current smokers. Exposure to workplace vaping was also associated with a number of demographic characteristics. Significantly lower odds of exposure to workplace vaping were associated with those aged 46 to 65 years old relative to younger respondents, and those with a graduate education relative to those with a Bachelor's degree (see Table 3 for model estimates). Higher odds of exposure to workplace vaping were associated with identifying as non-Hispanic black relative to non-Hispanic white, and household income less than \$35,000 relative to those with household income of \$100,000 or more. Finally, odds of exposure to workplace vaping also varied by industry. Those working in Information Technology (*OR* = 2.44, *CI*: 1.43 to 4.16) and in Retail (*OR* = 1.89, *CI*: 1.19 to 2.99) had higher odds of exposure to coworker vaping and those working in Education (*OR* = 0.39, *CI*: 0.25 to 0.61) had lower odds relative to those in Health Services. Health services was chosen as the reference because it represented the largest share of sample.

### Perceived Harm of Workplace Vaping

Overall, participants perceived vaping in the workplace as harmful, with an average perceived harm score of 1.94 (*SD* = 0.87) out of 3. Bivariate tests (Table 2) revealed that perceived harm of workplace vaping varied significantly by participants' e-cigarette and combustible cigarette use status, age, household income, and education. Additionally, perceived harm scores varied significantly by workplace size and industry.

Table 4 presents the adjusted odds of greater perceived harm of workplace vaping when accounting for multiple variables. E-cigarette users (*OR* = 6.54, *CI*: 4.57 to 9.34) and former e-cigarette

**TABLE 3.** Multiple Logistic Regression Results Predicting Having Observed a Coworker Vape In/Around the Workplace

Sample Demographics, Tobacco Use and Workplace Characteristics	OR	95% CI
E-cigarette use		
Current	Ref	
Former	0.55 <sup>†</sup>	0.35–0.85
Never	0.27 <sup>†</sup>	0.18–0.41
Cigarette smoking		
Current	Ref	
Former	0.58 <sup>‡</sup>	0.38–0.88
Never	0.43 <sup>†</sup>	0.29–0.63
Age		
18–30 years	0.76	0.54–1.08
31–45 years	Ref	
46–65 years	0.75 <sup>‡</sup>	0.56–1.00
Gender		
Female	0.86	0.66–1.12
Male	Ref	
Race/Ethnicity		
Non-Hispanic, White	Ref	
Non-Hispanic, Black	2.13 <sup>†</sup>	1.39–3.27
Hispanic	1.50	0.99–2.26
Non-Hispanic, others	1.05	0.67–1.65
Household income		
Less than \$34,999	2.11 <sup>†</sup>	1.32–3.39
\$35,000–\$49,999	1.39	0.94–2.05
\$50,000–\$74,900	1.34	0.95–1.88
\$75,000–\$99,999	1.53 <sup>‡</sup>	1.08–2.15
\$100,000 or greater	Ref	
Education		
High school/GED or less	1.07	0.71–1.61
Some college	1.00	0.73–1.36
Bachelor's degree	Ref	
Graduate study or degree	0.78	0.56–1.08
Employer size		
150–999 employees	Ref	
1000–4999 employees	1.17	0.87–1.57
5000 or more employees	0.92	0.69–1.23
Industry		
Health services	Ref	
Retail	1.89 <sup>†</sup>	1.19–3.00
Education	0.39 <sup>†</sup>	0.25–0.62
Manufacturing	1.39	0.87–2.22
Information Technology	2.44 <sup>†</sup>	1.43–4.16
Government & Non-Profit	1.00	0.63–1.57
Professional & Business Services	1.21	0.75–1.96
Financial Activities	1.55	0.93–2.56
Transportation & Warehousing	2.34 <sup>‡</sup>	1.21–4.53
Other	1.78 <sup>‡</sup>	1.10–2.88
State-wide policy*		
Covered state	0.98	0.76–1.27
Not covered State	Ref	

Sample size included in model = 1556 because of some missing data on covariates. CI, confidence interval; OR, odds ratio.

\*State-wide policy refers to whether a state has a state-wide e-cigarette policy applying to workplaces.

<sup>†</sup>P-value significant at the 0.01 level.

<sup>‡</sup>P-value significant at the 0.05 level.

users (OR = 2.40, CI: 1.68 to 3.43) had higher odds of perceiving greater harm than current e-cigarette users. Surprisingly, there was no difference in harm perceptions by cigarette use status. Participants aged 46 to 65 years had higher odds of greater perceived harm relative to younger adults (OR = 2.09, CI: 1.56 to 2.80), as did women relative to men (OR = 1.37, CI: 1.05 to 1.79).

## Being Bothered by Workplace Vaping

The majority of participants (63%,  $N=998$ ) reported that they are bothered by vaping in the workplace. Bivariate tests revealed that prevalence of being bothered by workplace vaping varied significantly by participants' e-cigarette and combustible cigarette use status, age, household income, education, and workplace industry.

The effects of tobacco use status on being bothered by workplace vaping remained significant when accounting for multiple variables, as shown in Table 4. Never e-cigarette users had triple the odds of being bothered relative to current e-cigarette users (OR = 2.97, CI: 2.11 to 4.18) and never smokers had 2.5 times higher odds relative to current smokers (OR = 2.46, CI: 1.78 to 3.39); there were no statistically significant differences between former and current users of either product. Relative to those with a Bachelor's degree, those with a high school education (OR = 0.66, CI: 0.45 to 0.97) and those with some college but no degree (OR = 0.73, CI: 0.54 to 0.98) had lower odds of being bothered by workplace vaping.

## Perception that Vaping Decreases Workplace Productivity for Non-Vapers

Approximately half of participants believed vaping at work decreases productivity among non-vapers (52.1%,  $N=807$ ). Table 2 shows that the perception that workplace vaping decreases productivity varies significantly by participants' e-cigarette and combustible cigarette use status, age, household income, education, and workplace industry.

The adjusted model (Table 4) found that both never e-cigarette users (OR = 1.42, CI: 1.02 to 1.98) and never cigarette users (OR = 1.60, CI: 1.17 to 2.19) had higher odds of perceiving decreased productivity due to workplace vaping than current users of each product. There were no statistically significant differences between former and current users of either product. Additionally, higher odds of negative perceptions of vaping on productivity were associated with participants ages 46 to 65, relative to younger adults (OR = 1.33, CI: 1.03 to 1.73) and those with household incomes \$50,000 to \$74,900 (OR = 0.66, CI: 0.49 to 0.91) and \$75,000 to \$99,999 (OR = 0.72, CI: 0.53 to 0.99) relative to those with household incomes of \$100,000 or more.

## DISCUSSION

This study is the first that we know of to document workplace vaping in the United States among medium and large workplaces. A majority of participants reported observing a coworker vape at work and three-quarters of current e-cigarette users reported vaping at work themselves. Most participants also perceived workplace vaping to be harmful to non-users and the majority thought that vaping at work was bothersome and believed that it decreased productivity. We found consistent differences in perceptions of workplace vaping based on e-cigarette use status. Non-users, who comprised 59% of our sample and who constitute an even larger share of the US workforce, were much more likely to have negative perceptions of workplace vaping than e-cigarette users.

These results reveal differences in the prevalence of vaping across industries, with those working in health services reporting the lowest prevalence of workplace vaping and those working in information technology reporting the highest prevalence, even after controlling for other factors such as the respondent's tobacco use status. These findings should be interpreted with caution, as the survey sample was not designed to generate representative data across industries and the sample size within any particular industry was small. However, it is well established that tobacco use overall varies by industry and occupation.<sup>5,49</sup> Blue collar workers have higher prevalence of smoking and tobacco use than white collar

**TABLE 4.** Estimates From the Multiple Logistic Regression Models Predicting Attitudes About Vaping in the Workplace

Overall	Higher Perceived Harm of Workplace Vaping		Bothered by Workplace Vaping		Workplace Vaping Decreases Productivity	
	OR	95% CI	OR	95% CI	OR	95% CI
Vape use						
Current	Ref		Ref		Ref	
Former	2.40 <sup>†</sup>	1.67–3.43	1.36	0.96–1.93	0.89	0.62–1.26
Never	6.55 <sup>†</sup>	4.58–9.37	2.99 <sup>†</sup>	2.13–4.22	1.42 <sup>‡</sup>	1.02–1.98
Cigarette smoking						
Current	Ref		Ref		Ref	
Former	1.14	0.78–1.66	1.43 <sup>‡</sup>	1.01–2.04	1.08	0.78–1.56
Never	1.34	0.95–1.88	2.46 <sup>†</sup>	1.78–3.40	1.60 <sup>†</sup>	1.17–2.19
Age						
18–30 years	1.00	0.73–1.38	0.80	0.59–1.10	1.09	0.81–1.46
31–45 years	Ref		Ref		Ref	
46–65 years	2.10 <sup>†</sup>	1.57–2.80	1.10	0.83–1.46	1.34 <sup>‡</sup>	1.03–1.73
Gender						
Female	1.37 <sup>‡</sup>	1.05–1.79	1.10	0.85–1.42	0.98	0.77–1.23
Male	Ref		Ref		Ref	
Race/Ethnicity						
Non-Hispanic, White	Ref		Ref		Ref	
Non-Hispanic, Black	0.70	0.47–1.03	0.88	0.60–1.28	0.92	0.65–1.32
Hispanic	0.94	0.63–1.39	0.76	0.52–1.11	0.96	0.67–1.38
Non-Hispanic, others	1.00	0.63–1.58	0.74	0.47–1.14	1.07	0.71–1.62
Household income						
Less than \$34,999	0.93	0.58–1.48	0.82	0.53–1.28	0.70	0.46–1.06
\$35,000–\$49,999	0.97	0.65–1.45	0.84	0.57–1.24	0.75	0.52–1.07
\$50,000–\$74,900	1.15	0.80–1.66	0.90	0.63–1.26	0.68 <sup>‡</sup>	0.50–0.93
\$75,000–\$99,999	1.11	0.77–1.59	0.95	0.67–1.35	0.73 <sup>‡</sup>	0.53–1.00
\$100,000 or greater	Ref		Ref		Ref	
Education						
High school/GED or less	0.89	0.59–1.35	0.66 <sup>‡</sup>	0.45–0.97	0.74	0.51–1.07
Some college	0.82	0.59–1.13	0.73 <sup>‡</sup>	0.54–0.98	0.88	0.66–1.17
Bachelor’s degree	Ref		Ref		Ref	
Graduate study or degree	0.97	0.67–1.41	1.22	0.85–1.75	1.25	0.91–1.71
Employer size						
150–999 employees	Ref		Ref		Ref	
1000–4999 employees	1.07	0.80–1.43	0.96	0.72–1.28	1.11	0.86–1.44
5000 or more employees	1.14	0.84–1.54	0.79	0.59–1.06	0.93	0.71–1.22
Industry						
Health Services	Ref		Ref		Ref	
Retail	1.46	0.92–2.32	0.87	0.56–1.35	1.26	0.83–1.91
Education	1.56	0.94–2.59	1.12	0.69–1.80	1.31	0.85–2.00
Manufacturing	0.78	0.48–1.26	0.87	0.54–1.40	1.20	0.78–1.86
Information Technology	0.77	0.47–1.27	1.43	0.88–2.34	1.24	0.79–1.94
Government & Non-Profit	1.04	0.62–1.72	0.88	0.54–1.43	1.15	0.74–1.80
Professional & Business Services	1.51	0.90–2.54	0.95	0.58–1.55	1.03	0.66–1.62
Financial Activities	1.07	0.64–1.78	1.18	0.71–1.96	1.25	0.79–1.98
Transportation & Warehousing	0.90	0.49–1.66	0.86	0.48–1.54	2.01 <sup>‡</sup>	1.16–3.49
Other	0.94	0.58–1.51	1.09	0.68–1.74	1.32	0.86–2.04
State-wide policy*						
Covered State	1.07	0.82–1.39	1.25	0.97–1.62	1.16	0.92–1.46
Not Covered State	Ref		Ref		Ref	

Some participants were missing data on one or more predictors or the outcome and were excluded from the models. Sample size for each model: 1528 (perceived harm); 1532 (bothered by workplace vaping); 1501 (decreases productivity).

CI, confidence interval; OR, odds ratio.

\*State-wide policy refers to whether a state has a state-wide e-cigarette policy applying to workplaces.

<sup>†</sup>P-value significant at the 0.01 level.

<sup>‡</sup>P-value significant at the 0.05 level.

workers, for example.<sup>26</sup> Smoking prevalence has been found to be higher among those working in the accommodation and food services industry, and several studies since the early 1990s have shown that objectively measured markers of exposure to second-hand smoke vary substantially by industry.<sup>49</sup> While studies of e-cigarette use by industry have been limited, higher e-cigarette use has also been reported in accommodation and food services, as

well as retail and wholesale trade and manufacturing, with lower prevalence in education services.<sup>5</sup> Our findings are broadly similar to these general patterns, with the exception of the higher prevalence of coworker vaping among those working in information technology.

Our data reveal that employees feel negatively impacted by others’ use of e-cigarettes in the workplace. In particular, we found

that many felt that workplace vaping decreases productivity even among those who do not vape. While this survey did not examine why that may occur, there are myriad ways workplace vaping could disrupt work. Employees who take breaks to vape could disrupt others' work in addition to their own. Those who vape indoors at work or near others' workspaces may distract those around them and be particularly bothersome or anxiety-inducing for those who perceive secondhand vapor to be harmful.

Understanding vaping behaviors in the workplace is critical to developing company policies and government regulations that ensure clean indoor air and a healthy work environment. Our data suggest that those working for medium to very large employers feel impacted by coworker vaping, with the presence of vapor clouds and coworkers taking breaks to vape a regular part of their environment. For some employees, vaping is so normalized within their work environment that coworkers vape while conducting business or while in the employee's work area. The prevailing negative perceptions of vaping in the workplace found in this study are consistent with other national data from the United States. Nearly half of participants in a 2013 nationally-representative study supported banning vaping in restaurants, bars, and parks.<sup>50</sup> More recent data from a nationally representative sample found that more than 80% of adults oppose vaping in indoor public places in 2017.<sup>27</sup> Our findings suggest that workplaces are an important component for understanding the impact of public vaping.

Fully restricting workplace vaping can support employee health and ensure clean indoor air. While the effects of e-cigarette vapor on indoor air quality are not fully established, particularly given the rapidly-changing product landscape, there is clear evidence for the presence of toxicants in vapor.<sup>14,51</sup> Workplace smoking bans have effectively reduced passive smoking and exposure to toxins from cigarette smoke.<sup>15</sup> Workplace smoking bans also contribute to decreased smoking prevalence, increased smoking cessation, and decreased cigarettes smoked per day.<sup>15</sup> While indoor vaping bans have not yet been fully evaluated, some evidence suggests that e-cigarette users who encounter restrictions tend to vape less and have lower e-cigarette dependence than those who do not.<sup>10</sup> A cross-sectional study found lower prevalence of vaping in states that included vaping in their state-wide smoke-free air policies.<sup>52</sup> In the present study, we did not find differences in the odds of observed coworker vaping between those living in states with and without these restrictions. Because our sample was not designed to be representative at the state level, this finding cannot be used to evaluate those state-wide policies. However, it does suggest that individual company cultures may contribute to workplace vaping behaviors independent of state-wide policies.

This study is subject to several limitations. The sample was drawn from opt-in panels, rather than address-based, and may not be representative of the general population of adults working in medium to very large companies. The study relied on self-reports of both participants' own and their coworker's vaping behavior. While our description of e-cigarette use and vaping specifically referenced nicotine, we cannot rule out that some respondents were vaping cannabis. There were many more current e-cigarette users in the sample than in the general working adult population.<sup>6</sup> Given that those who vape were more likely to observe coworkers vaping, this oversample of e-cigarette users may have inflated the prevalence of observed workplace vaping and our results should not be interpreted as a precise estimate of workplace vaping. However, the oversample of users is likely to have led to an underestimate of the prevalence of negative attitudes about workplace vaping. This cross-sectional study cannot tell us about how perceptions of workplace vaping are shaped over time or what role exposure to workplace vaping or smoking may play in shaping employees' perceptions and behaviors. It was also not designed to create a representative sample of specific industries. Future research using longitudinal data or

carefully designed datasets should address how workplace vaping behaviors and perceptions develop over time and how specific industry or workplace cultures contribute to or discourage vaping at work.

## CONCLUSION

This study provides valuable insight into how employees are impacted by current vaping trends and informs workplace vaping policies by presenting information about both the prevalence of vaping in the workplace as well as the attitudes and perceptions about workplace vaping among US adults. Understanding workplace vaping culture is important for making strong tobacco control policies that support smoking and vaping cessation, prevent vaping initiation among non-smokers, and prevent exposure to environmental toxins. Vaping is present in the workplace in medium to very large companies and has ramifications for employee health, morale, and productivity. Employers and regulatory agencies should consider how policies can support the health and wellbeing of both users and non-users of e-cigarettes.

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