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Perceived risk, attitudes, and behavior of cigarette smokers and nicotine vapers receiving buprenorphine treatment for opioid use disorder during the COVID-19 pandemic

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ABSTRACT

Background: Cigarette smoking may increase the risk of COVID-19 complications, reinforcing the urgency of smoking cessation in populations with high smoking prevalence such as individuals with opioid use disorder (OUD). Whether the COVID-19 pandemic has altered perceptions, motivation to quit, or tobacco use among cigarette smokers and nicotine e-cigarette vapers with OUD is unknown.
Methods: A telephone survey was conducted in March-July 2020 of current cigarette smokers or nicotine vapers with OUD who were stable on buprenorphine treatment at five Boston (MA) area community health centers. The survey assessed respondents' perceived risk of COVID-19 due to smoking or vaping, interest in quitting, quit attempts and change in tobacco consumption during the pandemic.
Results: 222/520 patients (43 %) completed the survey, and 145 were asked questions related to COVID-19. Of these, 61 % smoked cigarettes only, 13 % vaped nicotine only, and 26 % were dual users. Nearly 80 % of participants believed that smoking and vaping increased their risk of COVID-19 infection or complications. Smokers with this belief reported an increased interest in quitting (AOR 4.6, 95 % CI:1.7–12.4). Overall, 49 % of smokers and 42 % of vapers reported increased interest in quitting due to the pandemic; 24 % and 20 %, respectively, reported attempting to quit since the pandemic. However, 35 % of smokers and 27 % of vapers reported increasing smoking and vaping, respectively, during the pandemic.
Conclusions: Most patients with OUD believed that smoking and vaping increased their vulnerability to COVID-19, half reported increased interest in quitting, but others reported increasing smoking and vaping during the COVID-19 pandemic.

1. Introduction

The Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV2) outbreak and subsequent coronavirus (COVID-19) pandemic have raised concerns that cigarette smoking or electronic cigarette (e-cigarette) vaping of nicotine might increase the risk of contracting COVID-19 or developing a severe case (NIDA, 2020). Recent systematic reviews have suggested a likely association between cigarette smoking and progression of COVID-19 infection to adverse outcomes (Patanavanich and Glantz, 2020; Vardavas and Nikitara, 2020), although this relationship is still debated (Lippi and Henry, 2020). There are few data on e-cigarette use and COVID-19 risk, although some have hypothesized that vaping might increase susceptibility to COVID-19 (Kaur et al., 2020; Pino et al., 2020).

Whether or not smoking cigarettes or vaping nicotine are risk factors for COVID-19 infection or progression, tobacco cessation remains an urgent public health priority during the pandemic. The pandemic may have altered cigarette smokers' and nicotine vapers' perceptions of the risk of these behaviors, level of interest in quitting, or amount of product use. These impacts could be positive or negative. The pandemic might

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prompt quit attempts if it increases smokers' or vapers' perceived vulnerability to COVID-19 infection. Alternately, the stress caused by the pandemic's economic and social consequences might increase cigarette smoking and nicotine vaping and decrease interest in quitting. Very little evidence is available to answer these questions. A web-based survey of people who smoke cigarettes or vape nicotine that was conducted in April 2020 found mixed responses to questions about changes in tobacco use and motivation to quit in response to the COVID-19 pandemic (Klemperer et al., 2020).

Understanding the impact of COVID-19 on the attitudes and behaviors of populations that smoke at high rates is especially important. Individuals with opioid use disorder (OUD) represent such a population, with smoking prevalence estimates as high as 90 %, a quit rate less than one-quarter that of the general population, and a high prevalence of comorbid psychiatric disorders (Guydish et al., 2011; Miller and Sigmon, 2015; Strain, 2002). Further, it has been suggested that individuals with OUD may be particularly impacted by the COVID-19 pandemic (Becker and Fiellin, 2020). Preliminary clinical data suggest that COVID-19 is associated with an increase in overdoses, suggesting multiple negative downstream effects of the pandemic in this population (Atler et al., 2020; Dubey et al., 2020; Wan and Long, 2020).

This study investigated associations between the COVID-19 pandemic and health risk perceptions, motivation to quit, and self-reported product use among cigarette smokers and nicotine e-cigarette users (i.e., nicotine vapers) with OUD receiving office-based buprenorphine treatment. Applying the framework of the Health Belief Model (Rosenstock, 1974), which proposes that behavior change is associated with an individual's belief that he or she is susceptible to a serious or severe disease and that behavior change can reduce this risk, we sought to examine whether the COVID-19 pandemic was a potential "cue to action" for changing smoking or vaping behavior. For this investigation, we focused on individuals who were stable in OUD treatment because they report interest and readiness to quit smoking and quitting does not jeopardize their stability in opioid treatment (Richter and Ahluwalia, 2000). Smoking cessation and harm reduction could be especially impactful in this population due to their ongoing high risk of tobacco-related mortality and reduced risk of serious OUD-related health complications due to buprenorphine treatment (Richter and Ahluwalia, 2000).

2. Methods

2.1. Design

We report results of a cross-sectional, single time-point survey conducted as part of the mixed-methods Vaping In Buprenorphine-treated patients Evaluation (VIBE) study, which is assessing the self-reported prevalence, patterns and attitudes associated with cigarette smoking and e-cigarette vaping among patients with OUD receiving buprenorphine treatment. The study was approved by the Mass General Brigham Institutional Review Board. VIBE study enrollment occurred from February 2020 to July 2020. This report includes respondents who answered COVID-19-related questions that were added to the survey in March 2020, at the start of the COVID-19 surge in Massachusetts.

2.2. Participants

Patients were recruited from five community health centers (CHCs) affiliated with Massachusetts General Hospital (MGH) in the Boston, MA area. These CHCs care for most of the outpatients with OUD in the MGH system and are located in communities with high numbers of COVID-19 cases (Waller, 2020). In response to the COVID-19 pandemic, Massachusetts' governor declared a state of emergency on March 10, 2020, including the issuance of a stay at home advisory which paused all in-person operations for all non-essential services (Mass.gov, 2020). As a result, in the Mass General Brigham umbrella healthcare system, telehealth visits increased from 0.2 % of outpatient visits in February 2020 to 62 % of visits by April 2020 (Massgeneralbrigham.org, 2020). At the MGH CHCs, patients continued their OUD treatment and primarily saw their addiction treatment providers via telehealth platforms, except for urgent care visits or administration of extended-release formulations of medication for addiction treatment, in which case an in-person visit was conducted adhering to COVID-19 infection control precautions.

Participants were eligible if they were >18 years old, English-speaking, receiving buprenorphine treatment for OUD, and had received a buprenorphine prescription from the CHC in the past 2 months. We excluded patients who were unable to provide informed consent due to psychiatric or cognitive impairment or for any other reason provided by their treatment provider at the CHC.

2.3. Enrollment

Potential participants were identified using an electronic health record (EHR) registry of MGH patients receiving buprenorphine treatment. Patients' primary care physicians (PCPs) or their CHC medical director reviewed the list of potential patients and had the option to exclude patients from study contact. Patients not excluded by the provider were mailed a letter describing the study and given the opportunity to opt out of further contact. Patients not opting out were contacted by study staff, who offered study participation, obtained verbal informed consent, and administered the telephone survey. Study staff made a minimum of five telephone calls during two weeks to reach participants. Participants received a $50 gift card for survey completion.

2.4. Measures

2.4.1. COVID-19 measures

Respondents who had smoked cigarettes in the past 30-days were asked about four COVID-19 related smoking measures: (1) whether being a cigarette smoker affected their risk of contracting COVID-19 or having a more severe case (5-point Likert scale, from "definitely increases my risk" to "definitely decreases my risk"); (2) if their amount of smoking had changed since hearing about COVID-19 (5-point Likert scale, from "increased a lot" to "decreased a lot"); (3) if their interest in reducing or stopping smoking had changed (decreased, increased, or no effect) in response to hearing about COVID-19, and (4) if they had made a quit attempt in response to hearing about COVID-19 (yes/no). Respondents who reported nicotine vaping in the past 30-days were asked comparable questions about their perceived risk of contracting COVID-19 due to vaping and about COVID-19′s effects on nicotine vaping amount, interest in quitting, and quit attempts.

2.4.2. Covariates

Covariates included demographics (age, sex, health insurance, education level, race/ethnicity, and employment status), smoking behavior (average number of cigarettes smoked per day, time to first cigarette in the morning (Transdisciplinary Tobacco Use Research Center (TTURC) Tobacco Dependence et al., 2007), and nicotine vaping behavior (device type and number of days of use in the past 30 days). Use of other substances was assessed via the Alcohol Use Disorder Identification Test-Concise (AUDIT-C; Bush et al., 1998) and past 30-day use of cocaine/crack and non-medical use of opioids, stimulants, and injection drug use. Depression and anxiety symptoms were assessed via the Patient Health Questionnaire (PHQ-8) and Generalized Anxiety Disorder scale (GAD-7), respectively (Kroenke et al., 2009; Spitzer et al., 2006). Scores on these measures were summed to create total composite scores (PHQ-8 range 0–24 and GAD-7 range 0–21) and dichotomized based on established clinical cut scores of >10 reflecting clinical levels of depression and anxiety, respectively (Kroenke et al., 2009; Spitzer et al., 2006).

Buprenorphine medication dose (mg), duration of current buprenorphine treatment (years), and last oral or urine toxicology screen

results (buprenorphine, other opioids) were extracted from the EHR.

2.5. Statistical analysis

Demographic, smoking, nicotine vaping and psychiatric symptom characteristics were compared by nicotine use status (current cigarette smoking only, current nicotine vaping only, dual use) using chi square tests for categorical outcomes and analysis of variance for continuous outcomes. Response options for all COVID-19 Likert scale questions for smoking and vaping measures were dichotomized or trichotomized based on examination of frequency distributions. GAD-7 and PHQ-8 composite scores were imputed with the mean score of available items for participants with incomplete data on these measures. Univariate logistic regression analyses examined associations between covariates and changes in respondents' smoking and nicotine vaping and change in quit interest due to COVID-19. For respondents who smoked cigarettes, multivariate logistic regression models adjusted for gender, race, employment, cigarettes per day, and dual use status (cigarette smoking only vs. dual use). The multivariate model predicting change in cigarette quit interest also included anxiety symptoms (GAD-7 >10 vs. <10). We conducted only a univariate analysis of factors associated with making a cigarette smoking quit attempt due to the small number of events. The small number of respondents who vaped nicotine precluded conducting multivariate analyses of vaping measures. Significance was set at alpha $= .05$ and all analyses were conducted in STATA 16 (StataCorp, College Station, TX).

3. Results

3.1. Participant characteristics

The VIBE study attempted to contact 520 patients and reached 323 (62 %). Of those reached, 222 (69 %) completed a survey, for an overall response rate of 43 %. Age, sex, and ethnicity of survey respondents and nonrespondents did not differ significantly (p's>.05). The prevalence of past 30-day smoking and nicotine vaping were 77 % and 31 %, respectively. COVID-19 questions were asked of the 145 participants who enrolled on or after March 16, 2020 and reported past 30-day cigarette smoking or nicotine vaping. Table 1 shows characteristics of this sample, which was 53 % male, 81 % white, 10 % Hispanic, and had a mean age of 46 years. Overall, participants were in stable OUD treatment; they had been in the office-based buprenorphine treatment program for an average of 3 years, had a mean daily buprenorphine dose of 18 mg, and 90 % had a negative toxicology for illicit opioids at their last CHC visit.

In terms of nicotine use, 61 % smoked cigarettes only, 13 % vaped nicotine only, and 26 % used both products (i.e., dual use). There were few significant differences in characteristics among these nicotine groups other than age. Those vaping nicotine only were younger and those smoking cigarettes only were older than those who used both products (Table 1). People who smoked cigarettes only consumed more cigarettes per day than people with dual use, while people who vaped nicotine only vaped more frequently than people with dual use (Table 1).

3.2. Cigarette smoking measures

Nearly 80 % of people who smoked cigarettes, including both those who smoked cigarettes only and those who smoked cigarettes and vaped nicotine, perceived that smoking increased their risk of contracting COVID-19 or having a more severe case, while 17 % perceived no difference in risk and 4% perceived a lower risk of COVID-19 (Fig. 1, upper panel). Nearly half of people who smoked cigarettes (49 %) reported an increased interest in quitting since hearing about the COVID-19 pandemic and 24 % reported having made a quit attempt. However, participants' responses varied in whether their cigarette consumption

Table 1
Participant characteristics by past 30-day nicotine use status.

		Past 30-day Nicotine Use Status			
	All (N = 145)	Cigarette Smoking Only (n = 89, 61 %)	Dual Use (n = 37, 26 %)	Nicotine Vaping Only (n = 19, 13 %)	P value
Demographic factors					
Age, years (M + SD)	46 + 11	48 + 11	43 + 11	39 + 10	**<.01**
Sex					0.12
Male	77 (53)	53 (60)	17 (46)	7 (37)	
Female	68 (47)	36 (40)	20 (54)	12 (63)	
Hispanic, Latino or Spanish origin	15 (10)	10 (11)	3 (8)	2 (11)	0.87
Race					0.48
White	117 (81)	68 (76)	31 (84)	18 (95)	
Black	9 (6)	7 (8)	2 (5)	0 (0)	
Other single race	9 (6)	8 (9)	1 (3)	0 (0)	
Multi-race	10 (7)	6 (7)	3 (8)	1 (5)	
Education[a]					0.44
> High school	74 (51)	42 (47)	21 (58)	11 (58)	
≤ High school or equivalent	70 (49)	47 (53)	15 (42)	8 (42)	
Employment[a]					0.47
Unemployed	84 (58)	55 (62)	20 (56)	9 (47)	
Employed full or part-time	60 (42)	34 (38)	16 (44)	10 (53)	
Health insurance					**0.04**
Medicaid	77 (53)	49 (55)	21 (57)	7 (37)	
Medicare	27 (19)	19 (21)	7 (19)	1 (5)	
Private/Commercial	41 (28)	21 (24)	9 (24)	11 (58)	
Cigarette Smoking					
Cigarettes/day, M + SD	12 + 9	13 + 9	9 + 7		**.01**
Smoke within 30 min of waking	72 (58)	54 (61)	18 (50)		0.24
Nicotine E-Cigarette Use					
Number of past 30 days vaped nicotine, M + SD	21 + 12		16 + 12	30 + 0	**<.0001**
Device Type					0.55
Rechargeable with pre-filled cartridges	32 (57)		23 (62)	9 (47)	
Rechargeable with liquid refills	22 (39)		13 (35)	9 (47)	
Disposable (non-rechargeable)	2 (4)		1 (3)	1 (5)	
Buprenorphine (Bup) Treatment					
Last drug screen bup positive	122 (86)	72 (83)	33 (92)	17 (89)	0.39
Last drug screen illicit opioid negative	130 (90)	79 (90)	33 (89)	18 (95)	0.78
Bup dose (mg), M + SD	18 + 7	18 + 7	19 + 6	14 + 8	**0.02**
Years in current bup treatment, M + SD	3 + 1	3 + 1	3 + 1	3 + 1	0.45
Other Substance Use					
Past month injection drug use	8 (6)	7 (8)	1 (3)	0 (0)	0.24
Past month cocaine/crack	13 (9)	9 (10)	4 (11)	0 (0)	0.27
AUDIT-C, M + SD[b]	4 + 3	4 + 3	4 + 3	3 + 2	0.47
Psychological					

(continued on next page)

Table 1 (*continued*)

	All (N = 145)	Past 30-day Nicotine Use Status			P value
		Cigarette Smoking Only (n = 89, 61 %)	Dual Use (n = 37, 26 %)	Nicotine Vaping Only (n = 19, 13 %)	
PHQ-8 Total Score > 10 (vs. < 10)[c]	62 (43)	43 (48)	7 (37)	12 (33)	0.26
GAD-7 Total Score > 10 (vs. < 10)[d]	64 (44)	45 (51)	10 (28)	9 (47)	0.07

Note. Cells represent n (%) unless otherwise indicated. Percentages represent column percentages. P-values represent chi square for categorical outcomes and ANOVA for continuous outcomes.

[a] One participant responded, "don't know"and their data was excluded.

[b] AUDIT-C assesses alcohol use severity in the past 6 months with scores ranging from 0 to 12, with higher scores indicating greater problem severity. Scores of 5 and above represent problematic use.

[c] PHQ-8, Patient Health Questionnaire assessment of depression severity with scores (range 0–3) on 8 items summed to create a total composite score (range 0–24) with a cut score of 10 or greater established to determine major depression.

[d] GAD-7, Generalized Anxiety Disorder scale assessment of anxiety severity with scores on each of the 7 items summed to create a total composite score (range 0–21). A cut score of 10 or greater has been proposed to identify clinical levels of anxiety.

had changed since hearing about the pandemic; 35 % reported smoking more, 44 % reported no change in smoking, and only 21 % reported smoking less. Additional details on tobacco use patterns among cigarette smokers and dual users are available in Supplementary Table 1. Briefly, most dual using patients (78 %) did not shift their preference in products (i.e., amount of use of each product) during the pandemic and 37 % of those who reported interest in quitting smoking also reported attempting to quit during the pandemic.

Unadjusted and adjusted logistic regression analyses assessing characteristics associated with the COVID-19 smoking measures are presented in Table 2. Participants who believed that smoking increased their risk for contracting COVID-19 (vs. other responses) were four-fold more likely to report an increased interest in quitting (adjusted odds ratio [AOR] 4.63, 95 % confidence intervals [CI] 1.73−12.4); there was also a non-significant univariate relationship between perceiving increased COVID-19 risk and making a quit attempt in the univariate analysis for that outcome (OR 3.52, 95 % CI, 0.99−12.6). There were no significant associations between demographic factors and these outcomes. Dual users did not differ significantly from people who smoked cigarettes only, but people who smoked more heavily were less likely to have made a quit attempt than people who smoked less heavily (OR 0.91, 95 % CI, 0.86−0.98). Participants with clinical levels of anxiety symptoms (GAD-7 total scores > 10 vs. < 10) reported an increased interest in quitting smoking (AOR 2.31, 95 % CI 1.04−5.14) and more quit attempts (OR 2.35, 95 % CI 1.02−5.44). Clinical levels of depression symptoms (PHQ-8 total score >10 vs. < 10) were also associated with making more quit attempts (OR 2.83, 95 % CI 1.21−6.63). No statistically significant associations were identified between any covariates and participants' reporting of increased smoking since COVID-19.

3.3. Nicotine vaping measures

Over three quarters of people who vaped nicotine, including both nicotine vapers only and people who also smoked cigarettes, perceived that vaping nicotine increased their risk of contracting COVID-19 or having a more severe case, while 21 % perceived no difference and 2% perceived a lower risk of COVID-19 (Fig. 1, lower panel). Forty-two percent of people who vaped nicotine reported an increased interest in quitting since hearing about the COVID-19 pandemic and 20 % reported having made a quit attempt. However, most people who vaped nicotine (56 %) reported no change in the amount vaped and 27 % increased their vaping, while only 16 % decreased the amount vaped.

We conducted a univariate analysis of the association between vaping outcomes and participant characteristics (Table 3). Patients who perceived that vaping increased their risk for contracting COVID-19 were more likely to report an increased interest in quitting vaping (91 % vs. 63 %, p = .02). No other significant associations were identified between vaping measures and participant demographics, vaping behavior, or psychiatric symptoms.

4. Discussion

In this cross-sectional survey conducted during Massachusetts' COVID-19 surge in the spring of 2020, cigarette smokers and nicotine e-cigarette vapers receiving buprenorphine treatment for OUD reported heterogeneous associations between the COVID-19 pandemic and their risk perceptions, motivation to quit, and tobacco product use. Nearly 80 % of respondents reported that cigarette smoking and nicotine vaping increased their risk of COVID-19. Consistent with our hypothesis, respondents who perceived vulnerability to COVID-19 due to their nicotine or tobacco use reported an increased interest in quitting smoking and vaping, and nearly one-quarter of smokers had made a quit attempt since hearing about COVID-19. However, more than one-third of people who smoked cigarettes and more than one-quarter of people who vaped nicotine reported increasing nicotine or tobacco use, consistent with the hypothesis that the pandemic's multiple stresses and overall changes in lifestyle could lead some people to increase consumption. To our knowledge, this is the first study to examine the impact of the COVID-19 pandemic on the smoking and vaping beliefs and self-reported behaviors of individuals with OUD, a vulnerable population with a very high prevalence of tobacco use.

Our findings generally align with the prior cross-sectional web-based survey of the impact of COVID-19 on smoking and vaping, which was conducted in the general population (Klemperer et al., 2020). Like our survey, the previous one found an association between perceived COVID-19 risk due to smoking and increased motivation to quit, although the absolute level of increased interest in quitting was higher in our survey than in the earlier one (49 % vs. 35 %), consistent with prior work demonstrating that smokers with OUD have high motivation to quit (Nahvi et al., 2006). Both surveys reported that about 20 % of respondents attempted to quit smoking or vaping during the pandemic and that about one-third of smokers reported increased smoking. While promising and potentially suggestive of the pandemic serving as a salient motivator for behavior change in some patients, future research is needed to investigate the success of quit efforts prompted by the pandemic and to understand and identify how to avoid or treat the increased cigarette use and nicotine vaping reported by about one-third of respondents.

In line with our findings, evidence from data published prior to the pandemic suggest that most people with OUD who smoke are motivated to quit and try to quit (See Vlad et al., 2020 for a review; Shah et al., 2017). For example, Nahvi and colleagues (2006) conducted a cross-sectional survey study of patients in methadone treatment and reported about half (48 %) of smokers were contemplating quitting smoking. This population is also well aware of the health risks associated with smoking (Campbell et al., 2017; Clemmey et al., 1997). Data suggest that most patients agree with statements that smoking is dangerous to their health and that smoking may cause them to suffer from cancer or other smoking-related diseases (Clemmey et al., 1997) and that increased risk perceptions of smoking are associated with smoking cessation (Campbell et al., 2017). Unfortunately, most smoking cessation interventions with efficacy in the overall population of smokers appear to be less effective for individuals with OUD (Miller and Sigmon, 2015; Vlad et al., 2020). Further, data suggest that less than 40 % of opioid treatment programs offer smoking cessation to patients and even fewer offer cessation pharmacotherapy (Knudsen and Studts, 2011;

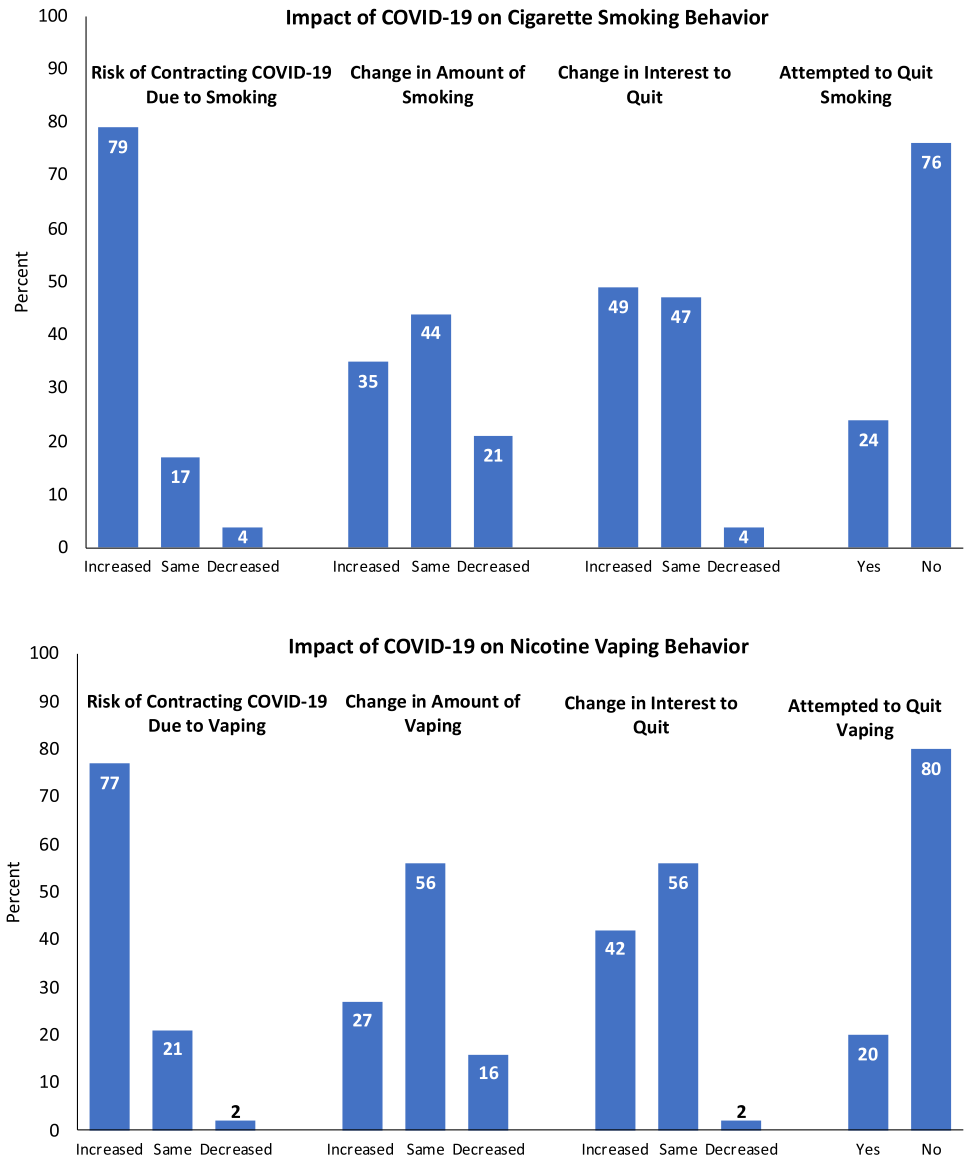

Fig. 1. Bar graphs depicting participant's self-reported opinions of the impact of COVID-19 on cigarette smoking behavior (upper panel) and nicotine vaping behavior (lower panel) assessed at the time of the survey. Bars are labeled with the percentage of participants reporting each response. Note. Bar labels represent percentages.

Richter et al., 2004). Our results suggest that opioid treatment programs should work to support and encourage quit attempts among those motivated to quit due to the pandemic by providing evidence-based treatments or referrals, and motivational or tobacco harm reduction strategies to those who may increase their use of nicotine in response to the pandemic. Additionally, these clinics may consider proactive outreach to offer cessation treatment and support to patients during this challenging time when the pandemic is resulting in less face-to-face contact.

Clinical levels of anxiety were associated with increased quit interest among smokers, and clinical levels of both depression and anxiety were associated with increased likelihood of cigarette quit attempts. Psychiatric symptoms are much more common in patients with OUD vs. the general population (González-Saiz et al., 2011; Strain, 2002). While a large body of work has suggested that increased anxiety and depression results in higher levels of smoking and less success in quitting, studies also suggest that smokers with anxiety and depression do make attempts to quit and that they are more likely to express interest in quitting compared to those without these symptoms (Fluharty et al., 2017; Petroulia et al., 2018). Our results suggest that during a pandemic, anxiety and depression may be associated with increased motivation to change tobacco use behavior, but future research is needed to investigate the relationship with successful quitting.

Limitations of this study include its cross-sectional design, which limits the ability to make causal inferences about observed statistical associations. Another limitation is possible recall bias, because we asked past 30-day vapers and smokers at the time of the survey to report retrospectively on past tobacco use behavior. Retrospective reports may be biased by factors such as the time delay between the recalled behavior and the self-report. Additionally, the impact of smoking (or vaping) status on perceived risk of COVID-19 was assessed by a single question that combined the constructs of both disease susceptibility and severity. Thus, we cannot disentangle which of the more specific perceived risks applied to a respondent if they answered "yes" to this question. Our findings apply to patients with OUD who were stable in office-based buprenorphine treatment at the start of a COVID-19 surge and may not generalize to individuals who smoke cigarettes or vape nicotine and are in other OUD treatment programs (e.g., methadone maintenance) or to less stable samples such as those out of treatment and actively using opioids. The survey response rate may have been higher

Table 2
Factors associated with self-reported cigarette smoking outcomes (N = 126).

	COVID-19 Increased Amount Smoked				COVID-19 Increased Quit Interest				COVID-19 Prompted Quit Attempt		
	Yes (n = 44)	No (n = 82)	OR (95 % CI[a])	AOR[b] (95 % CI[a])	Yes (n = 62)	No (n = 64)	OR (95 % CI[a])	AOR[c] (95 % CI[a])	Yes (n = 30)	No (n = 96)	OR[d] (95 % CI[a])
Demographic											
Female (vs. Male)	52 %	40 %	1.63 (0.78–3.40)	1.81 (0.82–4.00)	52 %	38 %	1.78 (0.87–3.62)	1.36 (0.62–3.00)	57 %	41 %	1.91 (0.83–4.38)
Age	46 + 11	47 + 12	1.00 (0.97–1.03)		48 + 12	45 + 11	1.02 (0.99–1.05)		50 + 11	46 + 11	1.03 (0.99–1.07)
White (vs. Non- White)	82 %	77 %	1.36 (0.54–3.41)	1.18 (0.44–3.15)	81 %	77 %	1.28 (0.54–3.00)	1.30 (0.50–3.36)	67 %	82 %	0.43 (0.17–1.08)
> HS (vs. < HS)[e]	91 %	90 %	1.05 (0.30–3.72)		92 %	89 %	1.38 (0.41–4.59)		93 %	89 %	1.65 (0.34–7.97)
Unemployed (vs. employed)	70 %	55 %	1.90 (0.87–4.15)	1.81 (0.81–4.03)	64 %	56 %	1.38 (0.67–2.83)		70 %	57 %	1.77 (0.73–4.27)
Medicaid (vs. other)	61 %	52 %	1.44 (0.68–3.04)		52 %	59 %	0.73 (0.36–1.48)		57 %	55 %	1.06 (0.46–2.42)
Smoking											
Cigarette smoking only (vs. Dual use)	77 %	67 %	1.67 (0.72–3.87)	1.75 (0.70–4.37)	69 %	72 %	0.89 (0.41–1.91)	1.14 (0.47–2.75)	77 %	69 %	1.49 (0.58–3.86)
Cigarettes/day	14 + 11	11 + 8	1.03 (0.99–1.08)	1.03 (0.99–1.08)	11 + 9	13 + 9	0.97 (0.93–1.01)	0.97 (0.93–1.02)	8 + 6	13 + 9	**0.91 (0.86–0.98)**
Belief that Smoking Increases Risk for COVID-19 (vs. others)[f]	75 %	77 %	0.90 (0.39–2.12)		89 %	64 %	**4.41(1.73 −11.3)**	**4.63 (1.73–12.4)**	90 %	72 %	3.52 (0.99–12.6)
Psychiatric											
GAD-7 Total Score > 10 (vs. < 10)[g]	51 %	40 %	1.55 (0.74–3.27)		52 %	36 %	1.97 (0.96–4.03)	**2.31 (1.04–5.14)**	60 %	39 %	**2.35(1.02 −5.44)**
PHQ-8 Total Score > 10 (vs. < 10)[h]	40 %	46 %	0.76 (0.36–1.60)		49 %	39 %	1.51 (0.74–3.07)		63 %	38 %	**2.83(1.21 −6.63)**

Note. Bolded values represent p values <.05.
[a] CI, confidence interval.
[b] AOR, Adjusted Odds Ratio; Multivariable logistic regression model adjusted for gender, race, employment, nicotine status, and cigarettes per day.
[c] AOR, Adjusted Odds Ratio; Multivariable logistic regression model adjusted for gender, race, nicotine status, cigarettes per day, perceived risk of COVID due to cigarette smoking, and anxiety (GAD-7 > 10 vs. < 10).
[d] Only unadjusted analyses are presented due to insufficient cell sizes for multiple logistic regression analyses.
[e] HS, High School.
[f] Participants were asked, "In your opinion, do you think that being a cigarette smoker affects your risk of getting coronavirus or having a more serious case in any way?" Response options for this question included cigarette smoking definitely increases my risk, does not affect my risk, might decrease my risk, or definitely decreases my risk. The first two response options were combined against the remaining response options (i.e., increases risk vs. others).
[g] GAD-7, Generalized Anxiety Disorder scale assessment of anxiety severity with scores on each of the 7 items summed to create a total composite score (range 0–21). A cut score of 10 or greater has been proposed to identify clinical levels of anxiety.
[h] PHQ-8, Patient Health Questionnaire assessment of depression severity with scores (range 0–3) on 8 items summed to create a total composite score (range 0–24) with a cut score of 10 or greater established to determine major depression.

had we been able to approach patients in-person at their regular office visits as originally planned, as this has been shown to optimize response rates in other vulnerable samples (Oga et al., 2018; Shah et al., 2017). This strategy was precluded by restrictions on research recruitment during the COVID-19 surge at our institution. In fact, most CHC appointments for opioid treatment were conducted via telehealth due to the pandemic. Further, it is likely that those who responded to our survey were more stable than those who did not. Additionally, because we surveyed only current smokers and nicotine vapers, the estimate of the proportion of smokers or nicotine vapers who made a quit attempt after hearing about the pandemic is limited because it does not include individuals whose quit attempts succeeded. Finally, our sample size limited the statistical power for detecting associations between perceived risk of COVID-19 and smoking and vaping study outcomes.

These limitations notwithstanding, the study results suggest that the COVID-19 pandemic might be associated with positive behavior change among some people who use nicotine and tobacco and are stable in treatment for OUD, while also being associated with no change in or increased use of these products among others. Further research is needed to identify how to translate this into successful long-term tobacco abstinence in this group, which has a higher smoking prevalence and lower quit success than the general population, even when using evidence-based tobacco cessation treatments (Guydish et al., 2016; Miller and Sigmon, 2015). More research is needed to investigate changes in tobacco and other substance use pre vs. post pandemic to more directly assess pandemic-driven behavior changes. Additional work should attempt to understand the reasons for increased smoking during the pandemic among a minority of smokers and nicotine vapers with OUD; these questions are being addressed in the VIBE study's ongoing qualitative interviews.

Contributors

Design and conduct of the study: Drs. Rigotti and Streck
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Manuscript Drafting: Drs. Streck, Kalkhoran, Bearnot, Gupta, Regan, Wakeman, Rigotti, and Ms. Kalagher.
All authors have read and approved of the final manuscript.

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Table 3
Factors associated with self-reported nicotine vaping outcomes (N = 55).

	COVID-19 Increased Amount Vaped n (%)			COVID-19 Increased Quit Interest n (%)			COVID-19 Prompted Quit Attempt n (%)		
	Yes (n = 15)	No (n = 40)	OR (CI)	Yes (n = 23)	No (n = 32)	OR (CI)	Yes (n = 11)	No (n = 44)	OR (CI)
Demographic									
Female (vs. Male)	9 (60)	22 (55)	1.23 (0.37–4.10)	14 (61)	17 (53)	1.37 (0.46–4.07)	8 (73)	23 (52)	2.43 (0.57–10.4)
Age, M + SD	43 + 12	41 + 10	1.02 (0.97–1.08)	42 + 11	41 + 11	1.01 (0.96–1.07)	41 + 9	42 + 11	0.99 (0.93–1.06)
White (vs. Non White)	14 (93)	34 (85)	2.47 (0.27–22.4)	22 (96)	26 (81)	5.08 (0.57–45.4)	10 (91)	38 (86)	1.58 (0/ 17–14.7)
> HS (vs. < HS)	13 (93)	36 (90)	1.44 (0.15–14.1)	20 (91)	29 (91)	1.03 (0.16–6.76)	10 (91)	39 (91)	1.03 (0.10–10.2)
Unemployed (vs. employed)	8 (57)	20 (50)	1.33 (0.39–4.55)	11 (50)	17 (53)	0.88 (0.30–2.62)	6 (55)	22 (51)	1.15 (0.30–4.33)
Medicaid (vs. other)	9 (60)	18 (45)	1.83 (0.55–6.13)	10 (43)	17 (53)	0.68 (0.23–1.99)	5 (45)	22 (50)	0.83 (0.22–3.14)
Vaping									
Vaping only (vs. dual use)	7 (47)	12 (30)	2.04 (0.60–6.91)	8 (35)	11 (34)	1.02 (0.33–3.14)	3 (27)	16 (36)	0.66 (0.15–2.83)
Number of days vaped nicotine/past month, M + SD, n	25 + 9	20 + 12	1.04 (0.98–1.11)	21 + 11	21 + 12	1.00 (0.95–1.05)	17 + 13	23 + 11	0.96 (0.90–1.01)
Vaping Increase Risk for COVID-19 (vs. others)	10 (67)	31 (78)	0.58 (0.16–2.14)	21 (91)[a]	20 (63)[a]	6.30 (1.25–31.8)	10 (91)	31 (70)	4.19 (0.49–36.2)
Uses re-chargeable pre-filled device (vs. other)	8 (53)	24 (60)	0.76 (0.23–2.52)	13 (57)	19 (59)	0.89 (0.30–2.63)	7 (64)	25 (57)	1.33 (0.34–5.21)
Psychiatric									
GAD-7 Total score > 10 (vs. < 10)	5 (36)	13 (33)	1.15 (0.32–4.14)	6 (27)	12 (38)	0.63 (0.19–2.03)	3 (27)	15 (35)	0.70 (0.16–3.04)
PHQ-8 Total score > 10 (vs. < 10)	4 (29)	14 (35)	0.74 (0.20–2.81)	8 (36)	10 (31)	1.26 (0.40–3.95)	3 (27)	15 (35)	0.70 (0.16–3.04)

Note. Tabled values represent n (%) unless otherwise indicated. OR, Odds ratio (unadjusted); CI, Confidence interval; HS, High School; GAD-7, Generalized Anxiety Disorder scale assessment of anxiety severity with scores on each of the 7 items summed to create a total composite score (range 0–21). A cut score of 10 or greater has been proposed to identify clinical levels of anxiety; PHQ-8, Patient Health Questionnaire assessment of depression severity with scores (range 0–3) on 8 items summed to create a total composite score (range 0–24) with a cut score of 10 or greater established to identify depression.

[a] p = .02. All other associations in the table are not statistically significant (p > .05).

analysis, and interpretation of the data, preparation of the manuscript, or decision to submit the manuscript for publication.

Declaration of Competing Interest

Dr. Rigotti receives royalties from UpToDate, has consulted for Achieve Life Sciences, and consulted (without pay) for Pfizer. Dr. Kalkhoran receives royalties from UpToDate. Dr. Wakeman receives royalties from UpToDate and has received salary support from OptumLabs, Celero Systems, and Alosa Health. No other authors have conflicts of interest to disclose.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.drugalcdep.2020.108438.

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