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Online survey characterizing vaporizer use among cannabis users

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ABSTRACT

Background: Along with changes in cannabis laws in the United States and other countries, new products for consuming cannabis are emerging, with unclear public health implications. Vaporizing or "vaping" cannabis is gaining popularity, but little is known about its prevalence or consequences.
Methods: This study characterized the prevalence and current patterns of vaping cannabis among a large national sample of cannabis users. An online survey was distributed through Facebook ads targeting individuals with interests related to cannabis use. The sample comprised 2910 cannabis users (age: 18–90, 84% male, 74% Caucasian).
Results: A majority (61%) endorsed lifetime prevalence of ever vaping, 37% reported vaping in the past 30 days, 20% reported vaping more than 100 lifetime days, and 12% endorsed vaping as their preferred method. Compared to those that had never vaped, vaporizer users were younger, more likely to be male, initiated cannabis at an earlier age, and were less likely to be African American. Those that preferred vaping reported it to be healthier, better tasting, produced better effects, and more satisfying. Only 14% reported a reduction in smoking cannabis since initiating vaping, and only 5% mixed cannabis with nicotine in a vaporizer. Many cannabis users report vaping cannabis, but currently only a small subset prefers vaping to smoking and reports frequent vaping.
Conclusion: Increases in availability and marketing of vaping devices, and the changing legal status of cannabis in the United States and other countries may influence patterns of use. Frequent monitoring is needed to assess the impact of changing cannabis laws and regulations.

1. Introduction

The prevalence of using electronic cigarettes (e-cigs) to vaporize nicotine is rapidly growing and generating debate and research on its potential benefit and harm (Arrazola et al., 2015; Gostin and Glasner, 2014; Hajek et al., 2014). Similarly, devices now use similar electronic technologies to vaporize cannabis, and this practice is gaining popularity as an alternative to smoking cannabis products. Vaporizing, or 'vaping' cannabis refers to the process of heating cannabis concentrates, liquid, or plant material to a temperature that releases an aerosolized mixture of water vapor and active cannabinoids, which is then consumed by inhalation. Vaping devices for cannabis vary widely, from large tabletop units to small pen-style devices that are similar to e-cigs, and depending on the device, additional substances such as flavoring agents can be added to enhance the vaping experience (Giroud et al., 2015). Few studies have examined the practice of vaping cannabis, and little is known about its prevalence, patterns, or consequences.

Two small survey studies suggest that cannabis users believe vaping to be less harmful to their health than typical combustible smoking methods (Etter, 2015; Malouff et al., 2014), which is similar to tobacco users perceptions of e-cigs (Zhu et al., 2013). This theoretical benefit relates to reduction in the ingestion of potentially harmful cannabis smoke, which contains tar (phenols and carcinogens such as benzopyrene and benzanthracene), ammonia, hydrogen cyanide, and nitrosamines in comparable amounts to tobacco smoke (Tashkin, 2013), a benefit that may extend to concerns about second-hand cannabis smoke. A laboratory study evaluating contents of cannabis smoke and vapor found that the vaporizer extracted more active cannabinoids with fewer carcinogenic byproducts than smoking at 230 °C, but lower temperatures extracted minimal amounts of cannabinoids, suggesting

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that temperature control is important (Pomahacova et al., 2009). A study directly comparing the impact of smoking vs. vaping cannabis reported fewer respiratory problems associated with vaping (Earleywine and Barnwell, 2007), supporting the contention that vaping affords a harm reduction effect on respiratory disorders caused by cannabis smoking.

Aside from this potential health advantage of vaping over smoking, initial surveys have identified a number of other appealing aspects of vaping (Etter, 2015; Malouff et al., 2014). First, some believe that vaping provides a more efficient way to use cannabis (more positive effect for less cost or effort). Objective evidence for differences in psychoactive effects between vaping and smoking is lacking, however; a laboratory study of three cannabis cigarette concentrations (1.7%, 3.4%, and 6.8% THC) did not show clear differences in ratings of "high" between vaping and smoking, but 14 of 18 participants reported preference for vaping and expired carbon monoxide levels were lower after vaping (Abrams et al., 2007). Survey respondents identified two other positive features of vaping: better taste and the ability to use it more discreetly with little or no smell (Etter, 2015; Malouff et al., 2014).

As with use of e-cigs, public health concerns related to vaping cannabis warrant attention (Budney et al., 2015). First, little is known about the potential negative effects of acute and long-term inhalation of aerosols emitted by vaping devices. While vaping eliminates many of the potentially harmful byproducts of cannabis smoke (Pomahacova et al., 2009), more information is needed to determine the overall safety profile of vaporization. Second, the perceived positive attributes of vaping cannabis mentioned above could result in increased prevalence or frequency of cannabis use. Perceptions that vaping is a safer, better tasting experience that provides a more efficient high and can be used discreetly in locations where smoking cannot occur could contribute to earlier initiation of use, more rapid escalation of use, more frequent use, and therefore more problematic use of cannabis. Last is the contribution of vaping cannabis to an emerging "vaping culture" (Gostin and Glasner, 2014), which includes marketing of vaping devices not just for nicotine or cannabis, but for inhaling non-psychoactive flavors, which could increase the prevalence and decrease age of onset of cannabis (or nicotine) use via vaping devices.

The primary goal of the present online survey was to characterize age of onset, prevalence, and current patterns of vaping among cannabis users. Facebook was utilized to facilitate rapid data collection in a large, national sample of cannabis users and to obtain initial benchmarks for vaping. Previous studies have begun to assess trends in vaporizer use (Etter, 2015; Malouff et al., 2014), however, sample sizes were small and only included individuals that reported vaping cannabis and/or nicotine, so prevalence among cannabis users, and differences between cannabis users that vaped vs. never vaped were not assessed. To address these gaps, this survey assessed: (1) lifetime and current prevalence of vaping, (2) demographic differences between those who vape and those who do not, (3) reasons for vaping, (4) comparisons between smoking and vaping, (5) within-person vaping and smoking patterns, and (6) the relationship between vaping and other substance use (e.g., tobacco use, vaping flavors).

2. Method

2.1. Participants and recruitment

Participants were adult (≥18 years of age) cannabis users from the United States who responded to advertisements on Facebook seeking volunteers to complete an online survey about cannabis use. Advertisements for the survey were shown to a targeted audience of cannabis users through proprietary marketing algorithms that utilized Facebook users' self-reported interests. Examples of the self-reported interests that were used to target cannabis users included organizations with pro-cannabis interests such as NORML or High Times Magazine, legalization movements (e.g., Colorado Amendment 64), and popular media that were automatically suggested by Facebook (e.g., comedians and musicians/bands that were associated with cannabis use interests). Participants were recruited in two phases; phase 1 was collected over a 35 day period in October and November, 2014, and phase 2 over an 8 day period in February, 2015. The advertisements contained a hyperlink that directed potential participants to a survey hosted on Qualtrics with all automatic data collection features disabled to preserve anonymity. Prior to completing the survey, participants were directed to an informed consent page approved by Dartmouth College's Institutional Review Board. Respondents that consented were then directed to the survey, which was designed to take <10 min to complete, and no compensation was provided.

2.2. Survey

The survey comprised 63 and 72 items in phase 1 and 2, respectively. Survey items included: demographics (i.e., age, gender, race, education, income), cannabis use characteristics by route of administration (i.e., age of onset, lifetime prevalence and current patterns of cannabis smoking and vaping), reasons and preferences for vaping cannabis, types of vaporizer devices used, comparisons between smoking and vaping cannabis, and other substance use. Cannabis dependence was assessed using the Severity of Dependence Scale (Gossop et al., 1995) and tobacco dependence was assessed using the Fagerstrom Test of Cigarette Dependence (FTCD: Heatherton et al., 1991). Additional questions assessing demographics, vaping patterns, and other substance use were added to the survey in phase 2 but were not included in the current analysis. Survey results were analyzed using descriptive statistics, and comparisons between individuals that ever vaped vs. never vaped were conducted using t-tests for continuous variables and chi-square tests for categorical variables.

3. Results

3.1. Participant characteristics

Advertisements for the survey were shown to 168,894 people, out of whom 3708 (2.2%) clicked the advertisement link, and of which 2910 (1.7%) were included in the final sample. Respondents were excluded if they: did not consent ($N = 60$), did not report ever using cannabis ($N = 103$), responded incorrectly to a data check question asking them to choose the number 4 from a 5-choice categorical response ($N = 47$), were not from the United States ($N = 13$), or if they failed to respond any of these items ($N = 575$). A total of 2357 of the 2910 respondents (81%) finished the survey. The mean percentage of missing data for each item was 4% (range 0–23%). All available data from every respondent was used in the analyses.

A comparison with 2014 US state census data indicated that the proportional distribution of participants from each state corresponded closely to the population distribution across US states ($r = .94$, $p < .001$). Participant characteristics are presented in Table 1. Respondents were primarily male (84%) and Caucasian (74%), with a mean age of 32.4 (SD 15.5). The sample contained somewhat fewer minorities than the general population (74% white, 8% African-American, and 15% Hispanic), and were less educated (with half having a high school education or less).

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