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## The Relationship of E-Cigarette Use to Tobacco Use Outcomes among Young Adults Who Smoke and Use Alcohol

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### Abstract

**Objectives**—E-cigarette use is increasing among young adults in the U.S. However, longitudinal research studies examining associations between e-cigarette use and combustible cigarette use among young adults are limited. This study assessed the relationship of e-cigarette use to smoking reduction and cessation among young adults.

**Methods**—This is a secondary analysis of a randomized controlled social media-based smoking cessation trial comprising adults ages 18–25 who smoked cigarettes and engaged in heavy episodic drinking (N=179). Over 12 months, participants reported past month e-cigarette use with nicotine or tetrahydrocannabinol (THC), cigarette quantity in the past week, quit attempts, and cessation strategies including nicotine e-cigarettes. Longitudinal regression models estimated associations between e-cigarette use, smoking reduction, and 7-day abstinence.

**Results**—Past-month nicotine e-cigarette use prevalence ranged from 53.1% at baseline to 50.3% at 12 months. Over 70% of participants who reported past month nicotine e-cigarette use also smoked cigarettes (i.e., dual use). Neither past month nicotine nor THC e-cigarette use was associated with smoking reduction or cessation. However, use of nicotine e-cigarettes as a cessation strategy among participants attempting to quit (N=137) was positively associated with abstinence (adjusted odds ratio = 2.47, 95% C.I. = 1.20 – 5.09) and 50% reduction in cigarettes per week from baseline (aOR = 2.36, 95% C.I. = 1.08 – 5.18), relative to other strategies.

**Conclusions**—Nicotine e-cigarettes were significantly associated with improved tobacco use outcomes when used as a cessation strategy, but not when used apart from trying to quit smoking. Dual use may not be an effective path to achieve smoking cessation.

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Conflicts of Interest – none

## Keywords

E-cigarette; Vaping; Smoking; Cessation strategy; Young Adults

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## Introduction

E-cigarette use (vaping) is growing among young adults in the United States. In 2018, 7.6% of adults aged 18–24 years reported using cigarettes on some or all days.<sup>1</sup> Smoking cessation is a commonly reported reason for e-cigarette use.<sup>2</sup> Although some trials have demonstrated that e-cigarettes promote cessation,<sup>3</sup> naturalistic study results are mixed<sup>4</sup> and have not focused on young adults. Understanding the effects of e-cigarettes on smoking patterns for young adults who smoke cigarettes and also drink alcohol heavily is particularly important since both behaviors co-occur in this population, and heavy drinking is associated with fewer quit attempts<sup>5</sup> and lower abstinence rates.<sup>6</sup> Cannabis use may also reduce tobacco abstinence rates among young adult smokers who use both substances.<sup>7</sup>

Social media -based interventions have a growing role in smoking cessation. A recent Facebook-based smoking cessation trial targeting young adults who smoke cigarettes and drink alcohol showed significant improvements in smoking abstinence and reduction in cigarette use among all participants over 12 months.<sup>8,9</sup> We conducted a secondary analysis to explore longitudinal patterns of e-cigarette use and associations between e-cigarettes and tobacco use outcomes.

## Methods

The Smoking Tobacco and Drinking (STAND) study was a randomized controlled Facebook-based smoking cessation trial addressing tobacco and heavy alcohol use among young adults. The University of California San Francisco Institutional Review Board (IRB) approved the study procedures. Eligible participants were aged 18–25, smoked 4+ days/week, and reported past-month heavy episodic drinking (HED) (i.e., 4+ drinks/day for women 5+ drinks/day for men). Trial procedures are reported elsewhere.<sup>8</sup> Briefly, enrolled participants (N=179) were assigned to secret Facebook groups (private and invisible to non-members), where they received daily posts for 90 days and weekly live counseling sessions for 12 weeks. Counseling sessions utilized motivational interviewing techniques and provided cognitive behavioral coping skills for smoking cessation. Intervention participants (N=85) received content addressing both tobacco and alcohol use, and control participants (N=94) received tobacco-only content. E-cigarettes were not recommended as part of the intervention and were explicitly discouraged in several intervention posts which prompted participants to consider the intentions of e-cigarette companies and the lack of evidence for e-cigarettes as an effective smoking cessation tool.

Participants completed online surveys at baseline, 3, 6, and 12 months to assess past month e-cigarette use with nicotine or tetrahydrocannabinol (THC); number of cigarettes smoked in the past week; quit attempts in the year before baseline and since last follow up, and cessation strategies. Participants who reported 1 24-hour quit attempt reported which strategies they tried, including (1) without assistance, (2) with professional assistance, (3)

nicotine replacement therapy (NRT) and (4) e-cigarettes with nicotine (THC e-cigarettes was not a response option). Outcomes included: (1) 7-day smoking abstinence; (2) a reduction in the number of cigarettes per week by 50% or more between baseline and each follow-up and; (3) the number of cigarettes per week. Retention was 84% at 12 months.

Logistic and linear regression models using generalized estimating equations estimated longitudinal, population-level associations between each outcome and (1) past-month nicotine e-cigarettes, (2) past month THC e-cigarettes, and, among participants reporting 1 24-hour quit attempt during follow-up (3) nicotine e-cigarettes as a cessation strategy. Models were adjusted for intervention condition, baseline alcohol consumption using the Alcohol Use Identification Test Consumption (AUDIT-C),<sup>10</sup> and variables related to attrition: age, gender, and baseline number of cigarettes smoked per week.

## Results

Participants were 50.3% female or non-binary and 80.4% non-Hispanic White with a mean age of 22.1 years (standard deviation = 2.2). Past-month nicotine e-cigarette use ranged from 42.1% to 53.1% over the 12-month study (Table 1). Between 32.5% and 50% of participants who used nicotine e-cigarettes also used THC e-cigarettes. Over 70% of participants who reported nicotine e-cigarette use reported smoking cigarettes in the past 7 days. Past month THC e-cigarette use ranged from 27.0% to 32.5%.

Among participants with 1 quit attempt during follow-up (n=137), 32.9% to 41.1% reported using nicotine e-cigarettes to quit. There were no baseline differences in age, gender, race and ethnicity, cigarettes smoked per week, and alcohol consumption between participants who used e-cigarettes to quit those who did not.

Neither past month use of nicotine nor THC e-cigarettes was significantly associated with tobacco use outcomes in the full sample (Table 2). Among participants with a quit attempt, use of nicotine e-cigarettes to quit was associated with higher odds of self-reported abstinence (adjusted odds ratio (aOR) = 2.47, 95% C.I. = 1.20 – 5.09) and 50% reduction in cigarettes smoked per week since baseline (aOR = 2.36, 95% C.I. = 1.08 – 5.18) compared to those not using this strategy. Nicotine e-cigarette use remained significantly associated with both outcomes in the presence of additional cessation strategies (Table 2).

## Discussion

The prevalence of past-month nicotine e-cigarette use in this sample was notably higher than estimates for young adults nationally (>40% vs 7.6%).<sup>1</sup> This difference may be due to our study population of young adults who smoke and drink. Use of both nicotine and THC e-cigarettes was also common, consistent with recent studies.<sup>11</sup>

Dual use of e-cigarettes and combustible cigarettes was frequent and in alignment with previous studies.<sup>12</sup> Dual use could be beneficial if it represents a transition between smoking and either e-cigarette use alone or abstinence from all tobacco products. Yet a recent study indicated that dual use was not associated with greater likelihood of smoking abstinence relative to cigarettes alone.<sup>13</sup> Dual use may lead to heavier use of both products over

time rather than “switching” to or substituting e-cigarettes for cigarettes.<sup>14</sup> Participants who used nicotine e-cigarettes as a cessation strategy were significantly more likely to reduce combustible cigarette smoking and to achieve smoking abstinence compared to those who did not use this strategy. Although any e-cigarette use was discouraged, many participants reported using nicotine e-cigarettes to quit, which may reflect perceptions of their effectiveness.<sup>15</sup> In future studies, social media platforms could be used to examine knowledge and perceptions of e-cigarettes among young adults who intend to use them to quit smoking. Additionally, social media-based interventions could be used to disseminate information about the risks of e-cigarettes to young adults who are considering using them to quit smoking.

Strengths of this study include a 12-month longitudinal design and a focus on young adults, a population that has received comparatively less attention in the e-cigarette literature relative to younger (adolescent) or older adult populations. Limitations include self-reported behaviors and measurement time frames for e-cigarette use (past month), and quit attempts (past 3–6 months) that were broader than tobacco use outcome time frames (past week). Additionally, use of nicotine e-cigarettes as a cessation strategy was not randomized, but rather self-selected. Consequently, the relationship with tobacco use outcomes may be confounded by unmeasured differences between participants who used nicotine e-cigarettes to quit and those who did not, such as nicotine dependence and motivation to quit. Findings may not generalize to the broader population of young adult smokers, nor to those who have not participated in a smoking cessation intervention.

## Conclusion

E-cigarettes with nicotine were significantly associated with improved tobacco use outcomes when used as a cessation strategy among heavy drinking, young adult smokers who attempted to quit smoking. Future studies should assess whether and how using nicotine e-cigarettes as a cessation aid can lead to long-term smoking abstinence among this population.

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**Table 1.**

E-cigarette use and tobacco use outcomes over 12 months (N=179)

Mean ± SD, or % (n)	Baseline (N=179)	3 months (N=148)	6 months (N=114)	12 months (N=151)
<b>E-cigarette Use</b>				
Past 30-day use of e-cigarettes with nicotine	53.1 (95)	52.0 (77)	42.1 (48)	50.3 (76)
Nicotine e-cigarettes only	65.3 (62/95)	67.5 (52/77)	50.0 (24/48)	53.9 (41/76)
Both nicotine and THC e-cigarettes	34.7 (33/95)	32.5 (25/77)	50.0 (24/48)	46.1 (35/76)
Dual use of e-cigarettes with nicotine and combustible cigarettes*	98.9 (94/95)	87.0 (67/77)	75.0 (36/48)	71.1 (54/76)
Past 30-day e-cigarettes with THC	29.1 (52)	27.0 (40)	31.6 (36)	32.5 (49)
THC e-cigarettes only	36.5 (19/52)	37.5 (15/40)	33.3 (12/36)	28.6 (14/49)
Both THC and nicotine e-cigarettes	63.5 (33/52)	62.5 (25/40)	66.7 (24/36)	71.4 (35/49)
Use of nicotine e-cigarettes as a quit method, % (n/N)**	59.3 (70/118)	37.2 (35/94)	32.9 (23/70)	41.1 (42/102)
<b>Tobacco Use Outcomes</b>				
Self-reported abstinence	-	16.2 (24)	24.6 (28)	32.5 (49)
Used nicotine e-cigarettes as a quit method, % (n/N)***	-	31.4 (11/35)	34.8 (8/23)	54.8 (23/42)
Did not use nicotine e-cigarettes as a quit method, % (n/N)***	-	22.0 (13/59)	36.2 (17/47)	38.3 (23/60)
Reduction in cigarettes smoked per week by 50% since baseline (total sample)	-	45.2 (66)	58.0 (68)	61.7 (91)
Used nicotine e-cigarettes as a quit method, % (n/N)***	-	68.6 (24/35)	78.3 (18/23)	82.5 (33/40)
Did not use nicotine e-cigarettes as a quit method, % (n/N)***	-	54.4 (31/57)	66.7 (30/45)	74.6 (44/59)
Cigarettes smoked in past 7 days	73.02 ± 53.7	48.21 ± 50.5	40.25 ± 47.4	40.25 ± 50.4

\* Includes participants who endorsed past month nicotine e-cigarette use and smoking cigarettes in the past 7 days.

\*\* Among participants who reported at least one quit attempt. Baseline N = individuals who made 1 attempt in the prior year. N at 3-, 6-, and 12 months = individuals who made 1 attempt in the prior follow-up period.

\*\*\* N = the number of individuals who either used or did not use nicotine e-cigarettes as a quit method among those who reported a quit attempt.

Generalized estimating equation models testing the associations between e-cigarette use on tobacco use outcomes over 12 months

Table 2.

	Self-Reported 7-day Abstinence (yes/no)		Cigarette quantity: Reduction by 50% <sup>1</sup> (yes/no)		Number of cigarettes in past 7 days <sup>2</sup>	
	aOR	95% CI	aOR	95% CI	$\beta$	95% CI
<b>Among full sample (N=179)</b>						
E-cigarettes with nicotine in past 30 days (Ref: no use)	0.81	0.50 – 1.30	1.09	0.70 – 1.69	-1.84	-8.22 – -4.54
E-cigarettes with THC in past 30 days (Ref: no use) <sup>3</sup>	0.59	0.33 – 1.04	0.72	0.45 – 1.17	0.15	-6.52 – -6.82
<b>Among participants with 1 quit attempt (N=137)</b>						
E-cigarettes with nicotine as a quit method <sup>4</sup> (Ref: no use)	2.47	1.20 – 5.09	2.36	1.08 – 5.18	-2.33	-10.67 – -6.01
E-cigarettes with nicotine as a quit method <sup>4</sup> (Ref: no use), controlling for quitting without professional assistance	2.31	1.13 – 4.76	2.50	1.14 – 5.45	-1.85	-10.17 – -6.46
E-cigarettes with nicotine as a quit method <sup>4</sup> (Ref: no use), controlling for quitting with professional assistance	2.48	1.20 – 5.12	2.36	1.08 – 5.20	-2.41	-10.79 – -6.00
E-cigarettes with nicotine as a quit method <sup>4</sup> (Ref: no use), controlling for quitting with NRT	2.43	1.18 – 5.01	2.32	1.06 – 5.10	-2.57	-10.74 – -5.59
E-cigarettes with nicotine as the sole quit method <sup>4</sup> (Ref: other type of quit method)	3.32	1.27 – 8.64	2.32	0.56 – 9.68	-19.52	-31.30 – -7.73

$\beta$  = effect estimate, aOR = adjusted odds ratio

All models were adjusted for intervention condition (tobacco content vs. tobacco and alcohol content) and variables related to attrition: age, gender, and baseline number of cigarettes smoked per week, and alcohol consumption (AUDIT-C score)

1. A 50% reduction in cigarettes smoked per week from baseline

2. Linear regression modeling was appropriate based on tests of normality.

3. Adjusted for smoking tetrahydrocannabinol (THC)

4. In addition to e-cigarettes, quit strategies included: Without Professional Assistance (e.g., quit “cold turkey,” gradually cut down); With Professional Assistance (e.g., stop smoking class, advice or counseling from health professional, telephone quit line) and; Nicotine Replacement Therapy (NRT) (e.g., patch, gum, lozenge)