E-cigarette Use Is Associated with Non-prescribed Medication Use in Adults: Results from the PATH Survey

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INTRODUCTION

Electronic cigarettes ("e-cigs") are devices designed to simulate smoking cigarettes by heating a liquid that usually contains glycerine, propylene glycol, flavors, and nicotine, a behavior commonly known as "vaping."[1] E-cig use has significantly increased in popularity during the last decade, particularly among adolescents and young adults.[2] Although they have been promoted as a safer alternative to smoking conventional cigarettes, e-cigs are not without harm,[1] and additionally, recent reports suggest that e-cigs could also be used as illicit drug delivery systems.[3] This is highly relevant as e-cig users have reported other high-risk behavior when compared with subjects who do not use them, including alcohol, tobacco, and marijuana use.[4, 5]

The purpose of this study was to examine the association between e-cig use and a participant's report of non-prescription use of controlled prescription medications, including[1] pain killers, sedatives or tranquilizers, and/or[2] the stimulants methylphenidate (Ritalin®) and dextroamphetamine/amphetamine (Adderall®) within a nationally representative sample of adults. Our hypothesis was that regular use of e-cigs would be associated with a higher reporting of non-prescription drug use.

METHODS

Publicly available data from the first three waves of the Population Assessment of Tobacco and Health (PATH) study were used.[6] Wave 1 respondents were eligible to participate in wave 2 and 3 interviews if they continued living in the USA and were not incarcerated.

We included adults ≥ 18 years who completed interviews for waves 1–3 (N = 23,670). Current e-cig use was defined as daily or some-day use of e-cigs in wave 1. We used logistic regression to examine the association between current e-cigarette use in wave 1 and use of diverted prescription drugs including[1] pain killers, sedatives, or tranquilizers and[2] Ritalin/Adderall in the last 30 days or last 12 months in waves 2 or 3, after adjusting for the covariates in Table 1. Replicate weights and balanced repeated replication methods were utilized to account for the complex survey design. All analyses were conducted using R version 3.4.2.

RESULTS

We compared the 2639 current e-cig users to the 21,024 non-users. Weighted demographics and other characteristics are presented in Table 1. After adjusting for potential confounders, the use of e-cigs was associated with significantly higher use of non-prescribed pain killers, sedatives, or tranquilizers in the last 30 days (odds ratio [OR] 1.30, 95% confidence interval [CI] 1.14–1.48) and last 12 months (OR 1.31, 95% CI 1.15–1.49). Additionally, the use of e-cigs was associated with significantly higher use of non-prescribed Ritalin/Adderall in the last 30 days (OR 1.50, 95% CI 1.06–2.12) and last 12 months (OR 1.31, 95% CI 1.01–1.67).

DISCUSSION

We found that e-cig users have significantly higher odds of non-prescription use of pain killers, sedatives or tranquilizers, and the stimulants Ritalin/Adderall. These findings are consistent with previous research examining other risky behaviors among e-cig users, including alcohol, tobacco, and marijuana use.[4, 5] Although these non-prescribed drugs would have been acquired in pill form, research has found that methamphetamines, Ritalin, opioids, and muscle relaxers can also be dissolved in glycerin, and potentially be vaped in e-cigs. Also, some benzodiazapines come in liquid form which can be vaped if diluted.[3] This findings suggest that medications could be dissolved and vaped by e-cig users.

In summary, we found an association between e-cig use and the non-prescription use of controlled medications, which adds to the literature on the relationship between e-cig use and risky behavior. A limitation is the possibility of recall bias in the survey. Despite this limitation, clinicians should be aware of this association and assess whether inappropriate use of prescription medications occurs in their patients who

Table 1 Weighted Demographics and Health History of Adults at Wave 1

	Not current e-cig user (n = 21,024) (%, 95% CI)	Current e-cig user (n = 2639) (%, 95% CI)
Age group		
18 to 24 years old	12.6 (12.5–12.7)	21.2 (19.6–22.8)
25 to 34 years old	17.3 (16.7–17.9)	26.9 (24.9–28.9)
35 to 44 years old	16.6 (16–17.2)	18.5 (16.6–20.4)
45 to 54 years old	18.0 (17.4–18.5)	17.2 (15.6–18.8)
55 to 64 years old	17.0 (16.5–17.6)	11.7 (10.2–13.2)
65 and older	18.4 (18.2–18.6)	4.4 (3.3–5.5)
Gender		
Male	47.6 (47.4–47.7)	53.0 (50.8–55.1)
Race		
White	77.8 (77.4–78.2)	80.8 (79.2–82.4)
Black	12.5 (12.3–12.7)	9.4 (8.2–10.6)
Other	9.7 (9.5–10.0)	9.8 (8.5–11.1)
Hispanic	15.2 (15.1–15.3)	12.4 (10.9–13.9)
Highest grade of education		
Less than high school	11.4 (11.0–11.8)	12.3 (11.0–13.6)
GED	4.8 (4.4–5.1)	9.5 (8.3–10.7)
High school graduate	24.1 (23.9–24.3)	25.7 (23.6–27.8)
Some college (no degree) or associates degree	30.7 (30.5–30.9)	39.0 (36.7–41.3)
Bachelor's degree or higher	29.0 (28.8–29.2)	13.5 (12.3–14.8)
Income		
Less than $10,000	13.4 (12.8–14.0)	19.8 (17.9–21.7)
$10,000 to $24,999	19.9 (19.0–20.8)	26.0 (24.0–28.1)
$25,000 to $49,999	22.7 (21.8–23.6)	25.0 (23.0–27.1)
$50,000 to $99,999	25.9 (24.9–26.9)	20.5 (18.5–22.5)
100,000 or more	18.1 (17.1–19.2)	8.7 (7.4–9.9)
Other exposures		
Current established cigarette user	14.9 (14.4–15.5)	70.0 (68–71.9)
Former established cigarette user	20.5 (19.5–21.5)	14.4 (12.6–16.1)
Current hookah user	3.1 (2.9–3.4)	20.0 (18.0–22.0)
Current cigarillos user	3.5 (3.3–3.7)	20.0 (18.2–21.8)
Current pipe user	0.9 (0.8–1.0)	5.4 (4.3–6.5)
Current any oral tobacco use	3 (2.8–3.3)	8.8 (7.5–10)
Current any cigar use	4.7 (4.4–4.9)	20.4 (18.6–22.3)
Alcohol use last 30 days	50.9 (49.2–52.6)	59.1 (56.9–61.3)
Marijuana use last 30 days	6.6 (6.0–7.1)	20.6 (18.8–22.5)
Crack cocaine use last 30 days	0.4 (0.3–0.5)	1.3 (0.8–1.8)
Methamphetamine use last 30 days	0.2 (0.2–0.3)	1.2 (0.7–1.7)
Heroin, inhalants, solvents, or hallucinogens use last 30 days	0.3 (0.2–0.3)	1.0 (0.6–1.4)
Psychiatric symptoms		
Felt lonely, depressed, and/or hopeless last 30 days	13.1 (12.4–13.8)	23.3 (21.5–25.1)
Felt anxious, nervous, tense, scared, and/or panicked last 30 days	15.5 (14.8–16.2)	29.3 (27.4–31.1)
Used Ritalin or Adderall last 30 days*	0.5 (0.4–0.6)	3.1 (2.3–3.9)
Used Ritalin or Adderall last 30 days[†]	1.0 (0.9–1.2)	4.5 (3.5–5.6)
Used Ritalin or Adderall last 12 months[†]	2.2 (2.0–2.4)	7.6 (6.5–8.8)
Used painkillers, sedatives or tranquilizers last 30 days*	4.7 (4.3–5.1)	10 (8.8–11.3)
Used painkillers, sedatives or tranquilizers last 30 days[†]	9.1 (8.5–9.7)	17.7 (16.3–19.2)
Used painkillers, sedatives or tranquilizers last 12 months[†]	12.5 (11.8–13.2)	23.6 (21.7–25.5)

*Wave 1

[†]Wave 2 or 3

use e-cigs. Clinicians need to inform all patients that they should only take medication prescribed to them, use medications as instructed, and not share with others.

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Compliance with Ethical Standards:

Conflict of Interest: Dr. Mortensen has consulted, and provided expert testimony, for Paratek Pharmaceuticals. All remaining authors declare that they do not have a conflict of interest.

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