Short Communication

E-cigarette- specific symptoms of nicotine dependence among Texas adolescents

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HIGHLIGHTS

- Adolescents report symptoms of nicotine dependence specific to e-cigarettes
- Dependence symptoms associated with lower odds of e-cigarette cessation behaviors.
- Research is needed to identify e-cigarette use behaviors that affect dependence.

ABSTRACT

Introduction: The potential of e-cigarettes to elicit symptoms of nicotine dependence has not been adequately studied, particularly in adolescent populations. The present study examined the prevalence of e-cigarette-specific symptoms of nicotine dependence ("symptoms of e-cigarette dependence") and the associations between these symptoms, e-cigarette usage group, and e-cigarette cessation-related items among Texas adolescents.
Methods: This study involved a cross-sectional analysis of adolescents from Wave 4 of the Texas Adolescent Tobacco and Marketing Surveillance System (TATAMS) (n = 2891/N = 461,069). Chi-Square analyses examined differences in the prevalence of symptoms of dependence by e-cigarette usage group (exclusive versus dual users of e-cigarettes and combustible tobacco products) and demographic characteristics. Weighted multivariable logistic regression analyses examined the associations between symptoms of e-cigarette dependence, e-cigarette usage group, and e-cigarette cessation items.
Results: Exclusive e-cigarette users experienced symptoms of e-cigarette dependence, although the prevalence of most of the symptoms was higher for dual users. Adolescents who reported more symptoms of dependence were less likely to report both wanting to quit e-cigarettes and a past-year quit attempt for e-cigarettes (adjusted odds ratio "AOR" = 0.61 (95% CI = 0.41, 0.92) and AOR = 0.52 (95% CI = 0.30, 0.92), respectively).
Conclusions: This study is the first to demonstrate that adolescent e-cigarette users are experiencing symptoms of dependence specific to e-cigarettes. In addition, symptoms of dependence may be barriers to e-cigarette cessation. Future research is needed to determine if characteristics of e-cigarette use (e.g. frequency and intensity) are associated with dependence.

1. Introduction

Electronic cigarettes (e-cigarettes) are now the most commonly used tobacco product among adolescents (Miech, Johnston, O'Malley, Bachman, & Schulenberg, 2016), and research is needed to explore the addictive potential of these products. While the amount of nicotine delivered to e-cigarette users varies considerably depending on various factors (e.g., model type, manufacturer, user vaping behaviors) (Cameron et al., 2014; U. S. Department of Health and Human Services,

2016), recent research suggests that some types of e-cigarettes are capable of delivering nicotine at levels similar to or greater than those produced by conventional cigarettes.(Ramôa, Hiler, Spindle, et al., 2016; U. S. Department of Health and Human Services, 2016) This is concerning as nicotine is a highly addictive stimulant whose use can result in dependence even at low levels and prior to the initiation of daily use.(Benowitz, 2010; DiFranza, Savageau, Fletcher, et al., 2007; Wheeler, Fletcher, Wellman, & Difranza, 2004) The biological consequences of nicotine dependence may be particularly harmful for

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adolescents given the rapid changes in brain development that occur during this time period.(U. S. Department of Health and Human Services, 2016) Previous research in animal models found that nicotine alters normal brain development (U. S. Department of Health and Human Services, 2016), which may result in the development of mood disorders and a reduction in cognitive function (Dwyer, McQuown, & Leslie, 2009; U. S. Department of Health and Human Services, 2016; Yuan, Cross, Loughlin, & Leslie, 2015).

Importantly, the majority of nicotine dependence research has occurred in the context of conventional cigarette use; less is known about symptoms of nicotine dependence among non-cigarette tobacco users. (Etter & Eissenberg, 2015; Foulds, Veldheer, Yingst, et al., 2014) In addition, while a handful of studies have demonstrated e-cigarette dependence symptoms among adults (Etter & Eissenberg, 2015; Liu, Wasserman, Kong, & Foulds, 2017; Rostron, Schroeder, & Ambrose, 2016), no studies have yet examined e-cigarette-specific symptoms of nicotine dependence among adolescent e-cigarette users. One potential explanation for the lack of research is the relative novelty of e-cigarettes; e-cigarettes were introduced to the U.S. market about a decade ago (U. S. Department of Health and Human Services, 2016). Furthermore, to date, measures for nicotine dependence largely focus on conventional cigarette use and thus, measures specific to e-cigarette use are still in development (Bold, Sussman, O'Malley, et al., 2018). Ultimately, e-cigarette-specific measures of nicotine dependence are important as characteristics (e.g. nicotine concentration, type of device) differ substantially from other tobacco products (Bold et al., 2018; Fagerström & Eissenberg, 2012).

Furthermore, no study has examined the associations between symptoms of dependence and e-cigarette cessation-related behaviors among adolescents. In research specific to conventional cigarette smoking, nicotine dependence was a significant barrier to smoking cessation; adolescents who demonstrated higher levels of nicotine dependence were less likely to quit smoking successfully (Kleinjan et al., 2009). Ultimately, examining potential barriers to e-cigarette cessation is particularly important as the recent Surgeon General's Report on e-cigarette use called for effective strategies to encourage youth to abstain or quit e-cigarette use (U. S. Department of Health and Human Services, 2016). Thus, to develop effective cessation interventions, it is important to understand factors associated with cessation-related behaviors of past 30-day e-cigarette users.

1.1. Study aims

First, this study examines the prevalence of e-cigarette-specific symptoms of nicotine dependence ("symptoms of e-cigarette dependence") and cessation-related items by e-cigarette usage group (exclusive e-cigarette users versus dual product users of e-cigarettes and combustible tobacco products), and demographic characteristics (age, gender, race/ethnicity). Second, this study examines the association between symptoms of e-cigarette dependence, e-cigarette usage group, and e-cigarette cessation-related items (wanting to quit e-cigarettes and past-year quit attempt) among adolescents. No specific hypotheses were tested as this is the first study to examine these associations in e-cigarette. In addition, previous research has found that the associations between symptoms of nicotine dependence and cigarette smoking cessation behaviors differ based on the measurement and conceptualization of each construct (Kleinjan, Engels, et al., 2009; DiFranza, Savageau, Fletcher, et al., 2002; Prokhorov et al., 2001; Kleinjan, van den Eijnden, & Engels, 2009).

2. Methods

2.1. Study design & participants

This study examines cross-sectional data from Wave 4 of the Texas Adolescent Tobacco and Marketing Surveillance System (TATAMS).

TATAMS is a multi-component, rapid response surveillance system focused on the four largest metropolitan areas in Texas (i.e., Austin, Dallas/Fort Worth, Houston, and San Antonio). TATAMS assesses tobacco product use, and exposure to marketing of tobacco products in Texas adolescents every six months over a period of three years. Participants for Wave 4 of TATAMS include a representative sample of 7th, 9th and 11th grade students; data collection for Wave 4 was conducted from April 2016 to June 2016. A total of 79 schools and 2891 adolescents, representative of 461,069 students, participated in Wave 4. All analyses applied sampling weights to generalize the findings back to the population from which it was drawn, to adjust for school-level clustering, and to account for non-response bias. More details about study recruitment and sampling design have been reported elsewhere (Pérez, Harrell, Malkani, et al., 2017).

2.2. Measures

Past 30-day e-cigarette usage groups: Participants were classified as past 30-day users if they reported using a product (e-cigarettes, cigarettes, hookah, large cigars/cigarillos, and little filtered cigars) on at least one day in the past 30 days. Two categories of use were created: 1) exclusive e-cigarette users, and 2) e-cigarette and combustible tobacco product users ("dual users").

E-cigarette-specific symptoms of nicotine dependence: Symptoms of e-cigarette dependence were assessed by six measures; response options were coded as 0 ("No") and 1 ("Yes"). Five items were adapted from the Hooked on Nicotine Checklist(DiFranza et al., 2007): 1) "Have you ever felt like you really needed an electronic cigarette, vape pen, or e-hookah?;" 2) "Do you ever have a strong urge to use an e-cigarette, vape pen or e-hookah?;" "When you have not use an e-cigarette, vape pen, or e-hookah…" 3) "Do you find it hard to concentrate?;" 4) "Do you feel more irritable?;" and 5) "Do you feel nervous, restless or anxious?" The 10-item HONC has demonstrated acceptable reliability (interclass correlation coefficient = 0.88) and convergent construct validity in adolescent samples (Kleinjan et al., 2007; Wheeler et al., 2004). One additional item based on the Fagerstrom Tolerance Questionnaire(Fagerström, 1978) was also assessed: "Do you typically use an e-cigarette, vape pen, or e-hookah within 30 minutes of waking up in the morning?." In addition to each item, a summary score was developed corresponding the total number of symptoms experienced, ranging from 0 to 6. The alpha for the six items was 0.79.

E-cigarette cessation-related variables: Wanting to quit e-cigarettes was assessed by the question: "Do you want to completely stop using electronic cigarettes, vape pens, or e-hookah right now?" Past-year e-cigarette quit attempts was assessed by the question "Have you tried to completely stop using electronic cigarettes, vape pens, or e-hookah within the past 12 months?" These measures were adapted from the Population Assessment of Tobacco and Health (PATH) survey (United States Department of Health and Human Services. National Institutes of Health. National Institute on Drug Abuse, and United States Department of Health and Human Services. Food and Drug Administration. Center for Tobacco Products, 2017). Response options were "yes" and "no."

Covariates: Current age, gender, and race/ethnicity were included as covariates in the regression analyses. Race/ethnicity was dichotomized due to small sample sizes (n = 74 for White/Other, n = 58 for non-White/Other).

2.3. Statistical analysis

First, Chi-Square tests were conducted to examine differences in the prevalence of symptoms of e-cigarette dependence and e-cigarette cessation-related variables by e-cigarette usage group and demographic characteristics (Table 1). Further, mean age was compared for those who reported each symptom/cessation-related item versus those who did not using weighted means. Next, multivariable logistic regression