E-cigarette use among women of reproductive age: Impulsivity, cigarette smoking status, and other risk factors

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A B S T R A C T

Introduction. The study aim was to examine impulsivity and other risk factors for e-cigarette use among women of reproductive age comparing current daily cigarette smokers to never cigarette smokers. Women of reproductive age are of special interest because of the additional risk that tobacco and nicotine use represents should they become pregnant.

Method. Survey data were collected anonymously online using Amazon Mechanical Turk in 2014. Participants were 800 women ages 24–44 years from the US. Half ($n = 400$) reported current, daily smoking and half ($n = 400$) reported smoking <100 cigarettes lifetime. Participants completed questionnaires regarding sociodemographics, tobacco/nicotine use, and impulsivity (i.e., delay discounting & Barratt Impulsiveness Scale). Predictors of smoking and e-cigarette use were examined using logistic regression.

Results. Daily cigarette smoking was associated with greater impulsivity, lower education, past illegal drug use, and White race/ethnicity. E-cigarette use in the overall sample was associated with being a cigarette smoker and greater education. E-cigarette use among current smokers was associated with increased nicotine dependence and quitting smoking; among never smokers it was associated with greater impulsivity and illegal drug use. E-cigarette use was associated with hookah use, and for never smokers only with use of cigars and other nicotine products.

Conclusions. E-cigarette use among women of reproductive age varies by smoking status, with use among current smokers reflecting attempts to quit smoking whereas among non-smokers use may be a marker of a more impulsive repertoire that includes greater use of alternative tobacco products and illegal drugs.

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1. Introduction

Smoking prevalence in the US has declined substantially over the past approximately 50 years, but smoking rates among women have shown a slower decline (Chilcoat, 2009; Higgins and Chilcoat, 2009; Higgins et al., 2009; Kandel et al., 2009). Smoking during pregnancy is the leading preventable cause of poor pregnancy outcomes in the US and other developed countries (Bonnie et al., 2007; Cnattingius, 2004; Pauly and Slotkin, 2008). The adverse consequences of smoking during pregnancy or raising children in a smoking environment have led researchers to target women of reproductive age as an important population to study in understanding risk from use of tobacco and nicotine delivery products (e.g., Ahluwalia et al., 2004; Hand et al., 2015; Vurbic et al., 2015).

Use of e-cigarettes is increasing rapidly (e.g., Lee et al., 2014; Lopez and Eissenberg, 2015). However, knowledge regarding vulnerability to use of these products and their health impacts has not kept pace (Benowitz, 2014; Lopez and Eissenberg, 2015; Pisinger and Døssing, 2014; Prignot et al., 2008). Evidence is beginning to accumulate that e-cigarettes may be less harmful than tobacco cigarettes and at least among adults may be more readily adopted by people trying to quit cigarette smoking (Britton and Bogdanovica, 2014; Goniewicz et al., 2014; Hajek et al., 2014). Recent reports suggest that users of e-cigarettes in the US tend to be cigarette smokers, White, of younger age, and more educated (e.g., King et al., 2015; McMillen et al., 2012; Richardson et al., 2014). We know of no prior studies examining e-cigarette use specifically among women of reproductive age.

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The current study assessed use of e-cigarettes in female current daily cigarette smokers and never smokers to begin to gain a better understanding of risk factors for use and how they may differ as a function of a woman's cigarette smoking status. We also assessed use of other tobacco and nicotine delivery products to see how use of those products may distinguish e-cigarette users from non-users. Impulsivity is an important characteristic to examine as a risk factor for e-cigarette use considering the robust associations between cigarette smoking and impulsivity (including delay discounting) observed in previous studies (e.g., Bickel and Marsch, 2001; Bickel et al., 1999). To our knowledge, neither delay discounting nor any other measure of impulsivity has been examined in relation to use of e-cigarettes. Thus we included delay discounting and the Barratt Impulsiveness Scale-11 (BIS) (Patton et al., 1995) in the present study. The BIS is a widely used measure of trait-level impulsiveness that also has been reported to be related to smoking status (Mitchell, 1999).

The present study was conducted via Amazon Mechanical Turk (AMT), an online crowdsourcing marketplace that brings together individuals offering small jobs for pay with individuals willing to complete web-based tasks for payment. People (called "requestors") who have work to offer post work opportunities called "Human Intelligence Tasks" (HITs). Users (called "workers") can browse available HITs and decide which, if any, to complete. The requestor has access only to the Worker ID number. AMT is being used with increasing frequency and positive results for psychological research (e.g., Buhrmester et al., 2011; Crump et al., 2013; Mason and Suri, 2012; Paolacci and Chandler, 2014; Rand, 2012; Shapiro et al., 2013). Prior studies using AMT have found both comparable disclosure of sensitive information such as drug use and sexual behavior and discounting outcomes for AMT participants compared to previous studies conducted in controlled laboratory settings (e.g., Bickel et al., 2014; Herrmann et al., 2015; Jarmolowicz et al., 2012; Johnson et al., 2015).

2. Method

2.1. Participants

Participants ($N = 800$) were recruited as part of a larger study of educational attainment, impulsivity, and other decision-making biases among cigarette smokers versus never-smokers. For study eligibility, AMT users had to be connected via a US IP address, have had at least 95% of their previous HITs approved, be female, between 24 and 44 years, and a current (past 30 days) daily cigarette smoker or never smoker (<100 cigarettes lifetime). Although the target population was US women of reproductive age, using educational attainment as a risk factor necessitated increasing the conventional minimum age from 15 to 24 years to maximize the likelihood that women had reached their terminal education level. After screening, eligible participants viewed informed consent information and either continued on to the survey to imply consent or exited. Eligible participants who completed the survey received a $2.00 credit to their AMT account. The study was approved by the University of Vermont Institutional Review Board.

2.2. Procedure

Data collection occurred in two waves in August 2014 ($n = 250$) and in December 2014 ($n = 550$). Participants completed the survey at their own pace, and reported sociodemographics, tobacco cigarette smoking characteristics, use of other tobacco and nicotine products, drug use histories, and impulsivity (additional measures of decision-making biases were completed that will be reported separately).

2.2.1. Tobacco cigarette smoking characteristics and use of e-cigarettes and other tobacco and nicotine delivery products

Current smokers answered additional questions assessing smoking history and current use of nicotine replacement therapies (NRT), and

completed the Fagerström Test for Nicotine Dependence (Heatherton et al., 1991); from this, time to first cigarette dichotomized as ≤30 min or >30 min was used as an indicator of nicotine dependence.

All participants reported on their use (every day, some days, or not at all) over the past 30 days and past 12 months for e-cigarettes, cigars, hookah, bidis/cloves, smokeless tobacco, snus, and other tobacco products (see Lee et al., 2014). Use was operationalized as any reported use in the past year, collapsing across some days and every day use.

2.2.2. Drug use history

Drug use questions were adapted from the Addiction Severity Index (McLellan et al., 1992). Participants were considered ever drug users if they reported any lifetime use of illegal substances or misuse of prescription drugs.

2.2.3. Impulsivity measures

All participants completed a Monetary Choice Questionnaire (MCQ) and the Barratt Impulsiveness Scale-11 (BIS). The MCQ is a 27-item measure that assesses delay discounting (Kirby et al., 1999). Each item asks participants to choose between a smaller amount of hypothetical money available now and a larger amount available at some delay (e.g., "Would you prefer $54 today or $55 in 117 days?"). Delays range from 7 to 186 days. Three different magnitudes of delayed rewards are presented: small (ranging from $25–35), medium (ranging from $50–60) and large (ranging from $75–85). Presentation of the items followed a fixed order established by Kirby et al. (1999).

The following equation was used to quantify the relationship between temporal delay and subjective reward value: $V = A/(1 + kD)$, where V is the present value of the delayed reward, A is the undiscounted value of the delayed reward, and D is the delay to receipt of the delayed reward. The parameter k is a free parameter that represents the discount rate (Mazur, 1987; Rachlin et al., 1991). Larger k values indicate greater discounting of future rewards. An overall k for all 27 MCQ items was determined using the estimation procedure described by Kirby et al. (1999).

BIS consists of 30 statements describing common impulsive and non-impulsive characteristics (e.g., "I do things without thinking", "I plan tasks carefully") and has demonstrated reliability and validity (Patton et al., 1995). Participants rated the frequency of each item on a 4-point scale: 1 = *Rarely/Never*, 2 = *Occasionally*, 3 = *Often*, & 4 = *Almost Always/Always*. BIS yields a total score (BIS-Total) and three subscores: BIS-Attentional (intrusive/racing thoughts and ability to focus on tasks), BIS-Motor (acting on the spur of the moment and maintaining a consistent lifestyle), and BIS-Nonplanning (desire to plan/think through things and enjoyment of complex tasks).

2.3. Statistical methods

Frequencies and descriptive statistics of participant sociodemographics, impulsivity, and substance use histories were examined. Log transformed k values were used in statistical analyses due to the skewed distribution of k. Tests of differences were conducted between current smokers and never smokers, and between e-cigarette users and non-users, using Fisher's Exact Test for categorical variables and Wilcoxon Rank Sum Test for continuous variables. Tests of differences in past-month use of e-cigarettes were also conducted between current and never smokers who used e-cigarettes within the past year, as well as within the group of current smokers who used e-cigarettes over the past year, comparing those who smoked more and less than the median number of cigarettes per day ($Mdn = 13$) and those who smoked their first cigarette more and ≤30 min after waking. Fisher's Exact Test was used for testing these differences.

A six-step series of multiple logistic regression analyses were conducted to examine predictors of cigarette smoking and e-cigarette use, using purposeful selection of covariates (Hosmer et al., 2013). First, univariate analysis of each prospective independent variable was