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Prevalence, correlates, comorbidity and treatment of electronic nicotine delivery system use in the United States

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ABSTRACT

Introduction: This study presents nationally representative data on the prevalence, correlates, psychiatric comorbidity and treatment (including pharmacological and nonpharmacological) among electronic nicotine delivery system (ENDS) users.

Methods: Face-to-face interviews in the National Epidemiologic Survey on Alcohol and Related Conditions-III.

Results: Prevalences of 12-month and lifetime ENDS use were 3.8% (SE = 0.14) and 5.4% (SE = 0.17). Odds of ENDS use were greater among men than women, regardless of timeframe. Rates were lower among Blacks, Hispanics and Asians/Pacific Islanders relative to Whites. Odds of 12-month and lifetime ENDS use was also higher among younger (< 65 years) than older (≥65 years) individuals and higher among individuals with high school education relative to these with some college education. Odds of 12-month and lifetime ENDS use was also higher among individuals with incomes < $70,000.00 compared with those with incomes ≥ $70,000.00 and higher among the previously married relative to those who were currently married. Associations between 12-month ENDS use and severe nicotine use disorder were strong, whereas associations with other substance use disorders and borderline and antisocial personality disorders were modest (AORs = 1.3–2.6). Rates of treatment seeking to cut down or quit tobacco or nicotine use (12-month, 25.0% (SE = 1.6); lifetime, 24.4% (SE = 1.4)) were low.

Conclusions: ENDS use is substantially comorbid, especially with nicotine use disorder. Virtually all ENDS users smoked cigarettes. Research is needed to understand their role in smoking cessation, adverse effects on bodily systems and their potential for addiction and comorbidity.

1. Introduction

E-cigarettes or electronic nicotine delivery systems (ENDS) were first patented in China in 2003 and introduced to the U.S. market in 2007 (Hon, 2003). Sales were valued at $20 million in 2009, over $2 billion in 2014, with sales projected to reach $17 billion in 2017 in the U.S. alone (Rom et al., 2014). Awareness of ENDS also rose during this time, from 40.9% in 2010–79.7% in 2013, with current and ever use increasing from 1.3% to 1.9% and from 3.3% to 8.1%, respectively (King et al., 2013; Regan et al., 2015). Despite increases in sales, awareness and use of ENDS, very little is known about their relationships to addiction liability, comorbidity with psychiatric disorders, treatment or quality of life.

Recently, several U.S. epidemiologic surveys have reported the prevalence of ENDS use. The 2014 National Health Interview Survey (NHIS), the only face-to-face U.S. survey to date, reported current and ever ENDS use rates as 3.7% and 12.6% (Delnevo et al., 2015). Five consumer-based web, mail, and random digit dialing surveys conducted in the U.S. also reported rates of ENDS use: the 2012–2013 National Adult Tobacco Survey (current use, 4.2%) (Agaku et al., 2014); the 2012–2013 Health Styles Survey (current use, 1.9%; lifetime use, 8.1%) (King et al., 2013); the 2012 Knowledge Networks Knowledge Panel Survey (current use, 1.4%; lifetime use, 8.2%); the 2010 Consumer Styles Survey (current use, 3.6%; lifetime use 6.5%) (Giovenco et al., 2014); and the 2010 Knowledge Networks Knowledge Panel Survey (current use, 3.4%) (Zhu et al., 2013).

These surveys all contributed valuable information, but leave important questions unanswered about the current epidemiology of ENDS

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use in the U.S. For example, due to their mode of administration and response rates, little is known about the sociodemographic correlates of ENDS use at the national level. Furthermore, to date, no nationally representative sample has addressed the associations between ENDS use and nicotine use disorder and other psychiatric disorders, an important area of inquiry given strong relationships observed between tobacco use, nicotine use disorder and other psychopathology (Breslau, 1995; Grant et al., 2004). To address this gap in our knowledge, we present nationally representative data on the prevalence of ENDS use and its associations with Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition (DSM-5) (American Psychiatric Association, 2013) tobacco use disorder, other substance use disorders and major mood, anxiety, trauma-related and personality disorders in addition to examining treatment among ENDS users. The data were derived from the National Institute on Alcohol Abuse and Alcoholism's 2012–2013 National Epidemiologic Survey on Alcohol and Related Conditions-III (NESARC-III) (Grant et al., 2014).

2. Methods

2.1. Sample

The target population of the 2012–2013 NESARC-III comprised the noninstitutionalized U.S. population, 18 years and older, residing in households and selected group quarters (Grant et al., 2014). Respondents were selected through multistage probability sampling. Primary sampling units were counties/groups of contiguous counties, secondary sampling units (SSUs) comprised groups of Census-defined blocks, and tertiary sampling units were households within sampled SSUs, within which eligible adult respondents were selected. Hispanic, Black, and Asian individuals were assigned higher selection probabilities than non-minority household members. The sample size was 36,309: household response rate for tertiary sampling units was 72%; person-level response rate (i.e., individuals within households) was 84%; and overall response rate was 60.1% (72% × 84%), comparable to other current U.S. national surveys (Centers for Disease Control and Prevention, 2012). As detailed elsewhere (Grant et al., 2014), data were adjusted for nonresponse and then weighted through poststratification to represent the civilian U.S. population based on the 2012 American Community Survey (Bureau of the Census, 2013). These weighting adjustments compensated adequately for nonresponse (Grant et al., 2015a).

Informed consent was electronically recorded and respondents received $90 for their participation. Protocols and informed consent procedures were approved by the Institutional Review Boards of the National Institutes of Health and Westat, Inc.

2.2. Assessment/ENDS use

The diagnostic interview was the NIAAA Alcohol Use Disorder and Associated Disabilities Interview Schedule–5 (AUDADIS-5) (Grant et al., 2011), designed to measure detailed information on the use of cigarettes, ENDS, cigars, pipes, snuff/chewing tobacco, alcohol and drugs and DSM-5 nicotine use disorder (NUD), alcohol use disorder (AUD), specific drug use disorders (DUDs) and selected mood, anxiety, trauma-related, eating, and personality disorders. Although DSM-5 uses the label tobacco use disorder to encompasses disorders arising from the use of any product containing nicotine we will use the term NUD here. Among lifetime users of ENDS (ever used), current users consisted of respondents who used ENDS during the year prior to the interview.

2.3. Nicotine use disorder

Consistent with DSM-5, 12-month NUD diagnoses required > 2 of the 11 criteria in the last 12 months before the interview. Prior-to-the-last-12-month diagnoses required clustering of > 2 criteria in a single year prior to the last 12 months. Past year and prior-to-the-last 12-month diagnoses were aggregated to yield lifetime diagnoses. DSM-5 NUD diagnoses were classified as mild (2–3 criteria), moderate (4–5 criteria) or severe (> 6 criteria).

Reliability of DSM-5 NUD past year and prior-to-the-past-year diagnoses (kappa = 0.87-0.50) and associated dimensional criteria scales (continuous scales of DSM-5 NUD criteria: intraclass correlation coefficient (ICC) = 0.84,0.83) were fair to excellent in a large general population sample (Grant et al., 2015b). Procedural validity was assessed by clinical reappraisal using the semi-structured, clinician-administered Psychiatric Research Interview for Substance and Mental Disorders, DSM-5 version (PRISM-5) (Hasin et al., 2011), in a large general population sample. Concordance between AUDADIS-5 and PRISM-5 diagnoses was fair to good (kappa = 0.54, 0.68), and concordance between their criteria scales was excellent (ICC = 0.80,0.84) (Hasin et al., 2014).

2.4. Other psychiatric disorders

Past year and prior-to-the-past-year AUD and drug-specific DUD diagnoses were assessed similar to those for NUD. DUD diagnoses included sedative/tranquilizer, cannabis, amphetamine, cocaine, non-heroin opioid, heroin, club drugs, hallucinogen, solvent/inhalant and other drug use disorders. These diagnoses were aggregated to yield diagnoses of any 12-month or lifetime DUD. Test-retest reliabilities for past year and prior-to-the-past-year AUD (kappa = 0.62, 0.60) were good and fair for DUD (kappa = 0.40–0.54) diagnoses, and excellent for their criteria scales (ICC = 0.85,0.83 for AUD, 0.45,0.84 for DUDs) (Grant et al., 2014). Concordances between AUDADIS-5 and PRISM-5 diagnoses and dimensional scales for AUD and DUDs were generally fair to good (kappa = 0.39–0.66; ICCs > 0.68) (Hasin et al., 2015a).

DSM-5 mood disorders included major depressive disorder (MDD), persistent depression (dysthymia), bipolar I and bipolar II disorders. Anxiety disorders included DSM-5 panic disorder, agoraphobia, social and specific phobias and generalized anxiety disorder (GAD). Consistent with DSM-5, primary mood and anxiety diagnoses excluded substance- and medical illness-induced disorders. In addition to mood and anxiety disorders, posttraumatic stress disorder (PTSD), anorexia nervosa, bulimia nervosa, binge-eating disorder, and schizotypal, borderline and antisocial personality disorders were assessed. PTSD diagnoses generally followed the DSM-5 definition, but criteria C and D more strictly required ≥ 3 positive, rather than ≥ 2 positive criteria to be met. Details on the psychometric properties of these diagnoses are reported elsewhere (Hasin et al., 2015b).

2.5. Treatment

Respondents were asked a series of questions on where or how they sought treatment or help to quit or cut down on their tobacco or nicotine use: counseling, family services or other social services; support groups, internet chat room; healthcare practitioner prescribed medication such as varenicline or bupropion (the brand names Chantix, Wellbutrin and Zyban were used in the questionnaire); nicotine patches, lozenges or gum; ENDS; acupuncture, acupressure, laser or electrostimulation or meditation; or any other methods.

2.6. Statistical analysis

Weighted percentages were computed for 12-month and lifetime ENDS use for the total sample and by sociodemographic characteristics. Multivariable logistic regression analyses yielded associations between ENDS use and sociodemographic variables controlling for all others. Logistic regressions estimated associations between ENDS use and NUD, and ENDS use with other DSM-5 psychiatric disorders adjusted for: (1) only sociodemographic characteristics; and (2) sociodemographic characteristics and all other substance use and psychiatric disorders.