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Correlates of use of electronic cigarettes versus Nicotine Replacement Therapy for help with smoking cessation

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Abstract

Introduction—Electronic- or e-cigarettes are nicotine-delivery devices commonly used by smokers to quit or reduce smoking. At present, not much is known about the characteristics of smokers who specifically try e-cigarettes to quit smoking compared to the nicotine replacement therapy (NRT) products approved by the U.S. Food and Drug Administration (FDA). Determining the characteristics of smokers who are likely to choose e-cigarettes as cessation aids would help develop strategies to impart valid information about e-cigarettes to such smokers as facts regarding the safety and utility of e-cigarettes emerge.

Methods—This study is based on 834 daily smokers [Mean age = 45.8 (Standard Deviation = 13)] from Hawaii. Demographic, smoking- and cessation-related variables were examined as correlates of ever use of e-cigarette only or any FDA-approved NRT product only or both as cessation aids.

Results—Results indicated that younger smokers, non-White smokers, and smokers reporting higher income, lower nicotine dependence, shorter smoking history, and higher lifetime quit attempts were more likely to have tried e-cigarettes but not NRT products for help with smoking cessation.

Conclusion—Smokers who are attracted to use e-cigarettes but not FDA-approved NRT products may differ from smokers who are likely to have used NRT products but not e-cigarettes in terms of demographic (e.g., age, ethnicity) and smoking- or cessation-related characteristics (e.g., nicotine dependence, quit attempts). Given the lack of knowledge regarding the health effects of e-cigarettes and their efficacy as cessation aids, future research needs to continue characterizing smokers who are likely to use e-cigarettes for smoking cessation.

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INTRODUCTION

Electronic or e-cigarettes are battery-powered devices that deliver nicotine or non-nicotine vapor when a fluid, commonly based on propylene glycol and/or vegetable glycerine, is heated. The popularity of e-cigarettes is increasing rapidly, especially among cigarette smokers. A recent study based on a nationally representative U.S. sample found that compared to 2010, when 3% of all adults and 10% of adult smokers reported having ever used e-cigarettes, in 2011 6% of all adults and 21% of adult smokers reported having ever tried e-cigarettes (King et al., 2013).

However, questions about the safety of e-cigarette use and the efficacy of e-cigarettes as smoking cessation aids are still mostly unanswered (Benowitz & Goniewicz, 2013). A study that tested the efficacy of e-cigarettes as cessation aids found that the use of e-cigarettes, with or without nicotine, resulted in smoking reduction among 22.3% of the participants at 3-month follow-up and 10.3% of the participants at 1-year follow-up (Caponetto et al., 2013). The study also found that e-cigarette use resulted in 10.7% and 8.7% smoking abstinence at 3-month and 1-year follow-ups, respectively. Another randomized trial (Bullen et al., 2013) reported that 7.3% of the smokers assigned to use nicotine e-cigarette showed abstinence at 6-month follow-up compared to 5.8% of the smokers who were assigned to use nicotine replacement patches. Although these studies imply that e-cigarettes may be useful as smoking cessation aids, consensus has not yet been reached as to the efficacy of e-cigarettes as cessation aids, especially relative to different types of Nicotine Replacement Therapy (NRT) products currently approved by the FDA.

E-cigarettes are comparable to NRT products because, similar to NRT products, e-cigarettes may be used to deliver nicotine and purchased over-the-counter. Further, reports suggest that e-cigarettes are competing with conventional NRT products in the market (Ayers, Ribisl, & Brownstein, 2010). At present not much is known regarding how smokers who have tried e-cigarettes only to quit smoking compare, in terms of demographic, smoking- and cessation-related characteristics, to smokers who have tried FDA-approved NRT products but not e-cigarettes, and smokers who have tried both NRT and e-cigarettes. This type of comparison is necessary to identify smokers who are more likely to adopt e-cigarettes as a means of smoking cessation. Increased understanding of smokers who are likely to try e-cigarettes to quit smoking compared to smokers who are likely to use NRT but not e-cigarettes may help policy and intervention development. For example, the knowledge would facilitate future research investigating why certain smokers prefer e-cigarettes as cessation aids and consider e-cigarettes as better alternatives to conventional NRT products. Further, such information could help e-cigarette regulators address the needs of smokers who are likely to choose e-cigarettes to quit smoking, depending on the emerging science, by either regulating e-cigarettes as cessation aids or by preventing such smokers from trying e-cigarettes as cessation aids. Using cross-sectional data collected from a relatively large sample of multiethnic smokers we compared the demographic, smoking-, and cessation-related correlates of having tried e-cigarettes only to quit smoking, of having tried both e-cigarettes and NRT, versus of having tried NRT only.

METHODS

Participants

The participants for the current study were 834 current daily smokers who had ever-used either e-cigarettes or conventional NRT products for help with smoking cessation. The participants represented a subset of 1988 current daily smokers who completed the baseline survey of an ongoing study being conducted to test alternative stage models of smoking cessation.

Procedures

Participants were recruited using advertisements in the local media. Eligible participants: (a) were 18 years or older, (b) were able to read English, (c) had mailing addresses, and (d) smoked at least 100 cigarettes in their lifetime, and (e) were self-identified current smokers. Eligible potential participants were mailed baseline questionnaires. Ninety-three percent of those who received the questionnaire completed and returned the baseline survey. Upon receipt of the completed questionnaires, participants were mailed \$25 gift cards. The study and its informed consent protocol were approved by the University of Hawaii at Manoa Institutional Review Board.

Measures

Sociodemographic variables assessed included participants' age, gender, income, education, and ethnicity. To assess ethnicity, participants were asked to select one ethnicity that they identified most with from a list of ethnicities common in Hawaii and the U.S. Because there were relatively small numbers of Chinese (N=52) and Koreans (N=26) in the sample, these ethnicities were combined with Filipinos (N= 147) and Japanese (N= 205) to form one "Asian" category. Ethnicities other than Asian, Hawaiian/Part Hawaiian, or White/Caucasian were combined into a single "Other" category because of their small individual group sizes.

Ever use of cessation products/methods was assessed with a "yes/no" question, separately for each product or method: "Have you ever used [cessation product/method] when trying to quit smoking?" Products and methods assessed included e-cigarettes, nicotine gum, patch, lozenge, spray, inhaler, Zyban (Bupropion), Chantix (Varenicline), group program/therapy, individual counseling/therapy, tobacco quitline, internet program, and cold turkey. Cigarette use per day was determined based on a single item which asked participants to report the average number of cigarettes they smoked per day in the past 7 days. *Nicotine Dependence* was assessed using the 6-item östrom Test of Nicotine Dependence (FTND) scale (Heatherton, Kozlowski, Frecker, & Fagerström, 1991). *Cessation-related variables* assessed included *motivation to quit* (Herzog & Pokhrel, 2012), *readiness to quit* (Biener & Abrams, 1991), *6-month quitting self-efficacy* (Herzog & Pokhrel, 2012), *lifetime quit attempts* (i.e., number of times having quit for > 24hrs), and *duration of the most recent quit attempt* (6-point scale; "never tried quitting," "1 day or less," ... "1 year or more"; Herzog & Pokhrel, 2012).

Data analysis

Data were analyzed using SAS (Version 9.3). Means or proportions for key study variables were calculated for all 834 participants and across the following categories of smokers: 1) those who had ever used one or more FDA-approved NRT products (i.e., gum, patch, lozenge, inhaler, or nasal spray) but not e-cigarettes, when trying to quit smoking; 2) those who had ever used e-cigarettes but no NRT product; and 3) those who had used e-cigarettes as well as one or more NRT products. Analysis of Variance (ANOVA) was conducted using the PROC GLM procedure to test whether mean age, daily cigarette use, nicotine dependence, years of having been a smoker, motivation and readiness to quit, quitting self-efficacy, lifetime quit attempts and recent quit duration differed across the 3 categories of smokers. Multiple comparisons among means were conducted using Tukey's Studentized Range (HSD) test ($\alpha=0.05$; 2-tailed) which controls the Type I experiment-wise error rate. Logistic regression was used to determine and compare the demographic, smoking-, and cessation-related correlates of e-cigarette-only use, NRT-only use, or use of both NRT and e-cigarettes (NRT/e-cigarettes).

Logistic regression models were run parallel for e-cigarette-only, NRT-only, and NRT/e-cigarettes use. First, we tested all demographic variables in the same model as independent variables, with e-cigarette-only use, NRT-only use, or e-cigarette/NRT use as a dependent variable. Next, we tested each smoking- or cessation-related variable separately as a predictor of e-cigarette-only use, NRT-only use, and both NRT/e-cigarette use, adjusting for age, gender, ethnicity, income, and education.

RESULTS

Table 1 shows the demographic, smoking-, and cessation-related characteristics of participants by their status of having ever used e-cigarette-only, NRT-only, or both. Approximately 15% of the participants reported having ever tried e-cigarettes when attempting to quit smoking; 23%, 29%, 8%, 3%, and 1% reported having ever tried nicotine replacement gum, patch, lozenge, inhaler, and spray when trying to quit smoking, respectively. E-cigarette-only users were significantly younger than NRT-only users and tended to represent higher proportions of Native Hawaiians and Asian-Americans compared to Whites, who predominantly represented NRT-only users. Compared to NRT-only users, e-cigarette-only users reported significantly lower nicotine dependence, shorter smoking history, and higher lifetime quit attempts. Although compared to the other 2 categories, similar proportions of e-cigarette-only users reported having tried quitting cold-turkey and having tried individual counseling, or internet methods for help with cessation, lower proportions of e-cigarette-only users had tried Bupropion, Varenicline, telephone quitline, or group programs.

Table 2 shows the results of the parallel logistic regression analyses for ever-use of e-cigarette-only, e-cigarette and NRT use, and NRT-only use as dependent variables. Younger age, higher income, and Asian-American and Native Hawaiian ethnicity (relative to White) were associated with greater likelihood of having tried e-cigarettes-only for smoking cessation. In addition, lower nicotine dependence, shorter smoking history, and higher lifetime quit attempts were associated with greater likelihood of having tried e-cigarettes but

not NRT for smoking cessation, adjusting for demographic covariates. Older age, lower income and longer smoking history were associated with greater likelihood of having used NRT but not e-cigarettes for smoking cessation. Asian-American ethnicity (relative to White), higher motivation to quit and higher lifetime quit attempts were inversely associated with having tried NRT-only for smoking cessation.

DISCUSSION

This study characterized smokers who are likely to use e-cigarettes but not FDA-approved NRT products for help with smoking cessation. Because e-cigarettes are gaining rapid popularity, especially among smokers and presumably as cessation aids, understanding the type of smokers who are attracted to e-cigarettes relative to conventional NRT is crucial, primarily because the safety and efficacy of e-cigarettes as cessation aids are not firmly established. To this end, the present study contributed important new knowledge. Although previous studies (e.g., Pearson et al., 2012) have shown that younger individuals are more likely to have tried e-cigarettes, this may be the first study to examine age in relation to e-cigarette and/or NRT use for smoking cessation. The findings that younger smokers were more likely to have tried e-cigarettes-only for smoking cessation (compared to NRT) and older smokers were more likely to have tried NRT-only suggest that younger smokers are more willing to consider e-cigarettes as valid cessation aids. However, our finding that older smokers are more likely to have tried NRT-only is not surprising: NRT products have been around for longer and older smokers are more likely to be advised by health professionals to quit smoking and to do so by using an NRT product. Unfortunately, the present data lacked information to determine the temporal sequence of e-cigarette and NRT use among those who had tried both types of products.

The present study suggested interesting differences in demographic correlates between those who had tried e-cigarettes only and those who had tried NRT only for cessation help. While lower levels of use of conventional NRT products by ethnic minorities have been previously documented (Fu et al., 2005; Carpenter et al., 2011), the finding that ethnic minorities such as Asian American and Pacific Islanders (e.g., Native Hawaiians) are more likely to have tried e-cigarettes-only (compared to NRT) for cessation is new. Currently most U.S. studies on e-cigarettes appear to have included predominantly White participants (Pepper & Brewer, 2013). More research is needed to investigate ethnic differences in e-cigarette use for smoking cessation in particular because emerging science on e-cigarettes may have important implications for ethnic disparities in tobacco use.

The current findings regarding the relationships between lower nicotine dependence, shorter smoking history, higher quit attempts and greater likelihood of e-cigarette-only use for smoking cessation warrant attention. It appears that younger smokers who have been smoking for a shorter duration of time but have tried to quit more often and are less dependent on nicotine are specifically interested in e-cigarettes as cessation aids versus conventional NRT products. Future studies are needed to understand why this type of smokers is attracted to e-cigarettes as cessation aids more than to conventional NRT products. The safety and efficacy of e-cigarettes as cessation aids is likely to have most

urgent implications for this type of smokers who may be more amenable to cessation because of lower nicotine dependence.

There are limitations to this study that need to be noted. First, the study is based on a sample that was self-selected, was recruited in one U.S. state, and was a smaller, reduced portion of the original sample. Because of this, there may be concerns about the generalizability of current findings. But it should be noted that the original sample was comparable to adult U.S. smokers (Hughes & Callas, 2010) in terms of SES and smoking-related indicators (Pokhrel, Fagan, Little, Kawamoto, & Herzog, 2013). Second, this was a cross-sectional study; hence, no causal inferences may be made based on the present findings. Third, this study lacked a detailed assessment of cessation aid use behavior. Fourth, smoking status in this study was determined based on self-report, which although a valid means of assessing smoking status (Patrick et al., 1994), may be subject to errors. Fifth, because e-cigarette use is rapidly increasing, the prevalence of e-cigarette use in the current may be lower compared to the current prevalence of e-cigarette use among smokers across nation. However, despite these limitations, the present study is significant for generating novel findings concerning characteristics of smokers who are likely to use e-cigarettes but not FDA-approved NRT for smoking cessation.

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Highlights

- Little is known about smokers who try e-cigarettes (vs. NRT) for smoking cessation
- Smokers who try e-cigarettes specifically for cessation may be less dependent on nicotine
- Younger and ethnic minority smokers may be more likely to choose e-cigarettes vs. NRT

Table 1Participant characteristics by e-cigarette and/or NRT use ($N = 834$).

	Total ($N = 834$)	E-cigarette only ($n=112$)	E-cigarette and NRT ($n=180$)	NRT only ($n=542$)
Mean Age (SD) *	45.8 (13.0)	40.3 (15.1) _a	43.0 (13.1) _{ab}	47.8 (11.9) _c
Gender				
% Male	48.3	46.4	43.9	50.3
% Female	51.7	53.6	56.1	49.7
Ethnicity *				
% White	41.4	24.1	38.9	46.0
% Asian	20.9	27.7	23.3	18.6
% Native Hawaiian	25.1	34.8	26.1	22.5
% Other	12.7	13.4	11.7	12.9
Income				
% Over \$20,000	38.9	24.5	21.5	19.0
% \$20,000 or below	61.1	54.6	55.9	64
Education *				
% College or more	9.3	15.3	21.1	21.6
% Some college	28.7	36.0	42.8	41.6
% High school	41.4	37.8	28.9	26.8
% Below high school	20.6	10.8	7.2	9.7
Cigarette/day	17.5 (9.3)	17.1 (10.0) _a	17.8 (10.3) _a	17.5 (8.8) _a
Nicotine dependence *	5.2 (2.3)	4.5 (2.5) _a	5.3 (2.3) _b	5.2(2.2) _b
Years of smoking *	27.6 (13.3)	21.8 (14.8) _a	24.9 (13.6) _a	29.7(12.5) _b
Motivation to quit *	17.4 (4.5)	17.9 (4.7) _{ab}	18.2 (4.0) _a	17.1(4.6) _b
Readiness to quit	5.8 (2.6)	5.9 (2.5)	6.0 (2.3)	5.7(2.7)
6-month Quitting self-efficacy	2.5 (1.1)	2.4 (1.0)	2.6 (1.0)	2.5(1.1)
Lifetime quit attempts *	10.1 (19.1)	13.4 (24.3) _a	11.0 (20.3) _{ab}	9.0(17.4) _b
Recent quit duration	2.4 (1.4)	2.4 (1.5)	2.5 (1.2)	2.4(1.4)
Ever use of other cessation methods/products				
% Zyban (Bupropion) use *	14.6	5.4	19.0	15.1
% Chantix (Varenicline) use *	13.5	5.5	19.0	13.5
% Group program use *	18.3	3.7	23.3	19.6
% Individual counseling use	71.7	71.0	72.6	71.5
% Tobacco quitline use *	24.5	8.3	30.3	26.0
% Internet program use	71.9	71.0	73.0	71.7
% Tried quitting cold turkey ¹	72.0	71.3	73.2	71.8

Note. SD = Standard Deviation.

* Variable differs statistically significantly across those who had tried e-cigarette-only, conventional NRT-only, and both e-cigarette and NRT. If a subscript is common between a pair of mean values across a row (e.g., a, a; b, b; c, c) then the mean values are not statistically significantly different, if the subscripts are different (e.g., a, b; b, c; a, c) then the mean values are statistically significantly different. Significance of pairwise comparison was tested at $\alpha = 0.05$ by using Tukey's Studentized Range (HSD) Test which controls for the Type I experiment-wise error rate in multiple comparisons.

¹ Cold turkey: Cold turkey in the context of smoking cessation refers to quitting smoking cigarettes abruptly, without the help of smoking cessation aids or programs.

Table 2

Associations of demographic, smoking-, and cessation-related variables with having tried e-cigarettes and/or conventional NRT to quit smoking ($N = 834$).

	Adjusted Odds Ratio (95% CI)		
	E-cigarette only	E-cigarette/NRT use	NRT-only use
Age	0.97 (0.95, 0.98) ***	0.98 (0.97, 0.99) ***	1.04 (1.02, 1.05) ***
Gender			
Male	1	1	1
Female	1.02 (0.67, 1.6)	1.3 (0.92, 1.8)	0.81 (0.60, 1.09)
Ethnicity			
White	1	1	1
Asian	2.27 (1.27, 4.04) **	1.12 (0.72, 1.8)	0.62 (0.42, 0.93) ***
Native Hawaiian	2.18 (1.23, 3.86) **	0.92 (0.59, 1.46)	0.73 (0.49, 1.09)
Other	1.87 (0.93, 3.78)	0.94 (0.53, 1.64)	0.80 (0.49, 1.31)
Annual income			
\$20,000 or below	1	1	1
Over \$20,000	1.64 (1.05, 2.55) *	1.31 (0.91, 1.87)	0.63 (0.46, 0.87) **
Education			
College or more	1	1	1
Some college	1.04 (0.55, 1.96)	1.01 (0.64, 1.61)	0.94 (0.62, 1.44)
High school	1.41 (0.72, 2.74)	0.90 (0.54, 1.51)	0.89 (0.56, 1.43)
Below high school	1.43 (0.61, 3.38)	0.74 (0.35, 1.54)	0.80 (0.49, 1.31)
Cigarette/day	0.99 (0.97, 1.02)	1.01 (0.99, 1.03)	0.99 (0.98, 1.01)
Nicotine dependence	0.86 (0.78, 0.94) **	1.08 (0.99, 1.16)	1.02 (0.95, 1.09)
Years of smoking	0.97 (0.94, 0.99) *	0.99 (0.97, 1.01)	1.02 (1.01, 1.04) *
Motivation to quit	1.04 (0.98, 1.09)	1.05 (1.01, 1.10) **	0.94 (0.91, 0.98) **
Readiness to quit	1.02 (0.94, 1.11)	1.03 (0.97, 1.10)	0.97 (0.91, 1.03)
Quitting self-efficacy ¹	0.91 (0.74, 1.12)	1.10 (0.93, 1.29)	0.98 (0.85, 1.13)
Lifetime quit attempts	1.01 (1.006, 1.02) **	1.01 (0.99, 1.02)	0.98 (0.97, 0.99) **
Recent quit duration	1.08 (0.93, 1.27)	1.04 (0.92, 1.18)	0.93 (0.83, 1.04)

Note.

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

¹ Next 6-month. All demographic variables were tested in the same model adjusting for each other; each smoking- or cessation-related variable was tested separately adjusting for demographic variables.