

Electronic Cigarettes As a Smoking-Cessation Tool

Results from an Online Survey

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Background: Electronic cigarettes (e-cigarettes) are battery-powered devices that deliver nicotine without any combustion or smoke. These devices have generated much publicity among the smoking-cessation community and support from dedicated users; however, little is known about the efficacy of the device as a smoking-cessation tool.

Purpose: This study aimed to examine the effectiveness of e-cigarettes for smoking cessation using a survey of smokers who had tried e-cigarettes.

Methods: Using as a sampling frame a cohort of all first-time purchasers of a particular brand of e-cigarettes during a 2-week period, a cross-sectional, online survey was conducted in 2010 to describe e-cigarette use patterns and their effectiveness as a smoking-cessation tool. There were 222 respondents, with a survey response rate of 4.5%. The primary outcome variable was the point prevalence of smoking abstinence at 6 months after initial e-cigarette purchase.

Results: The primary finding was that the 6-month point prevalence of smoking abstinence among the e-cigarette users in the sample was 31.0% (95% CI=24.8%, 37.2%). A large percentage of respondents reported a reduction in the number of cigarettes they smoked (66.8%) and almost half reported abstinence from smoking for a period of time (48.8%). Those respondents using e-cigarettes more than 20 times per day had a quit rate of 70.0%. Of respondents who were not smoking at 6 months, 34.3% were not using e-cigarettes or any nicotine-containing products at the time.

Conclusions: Findings suggest that e-cigarettes may hold promise as a smoking-cessation method and that they are worthy of further study using more-rigorous research designs.

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Introduction

Electronic cigarettes (e-cigarettes) are battery-powered devices that deliver nicotine without any combustion or smoke. Use and awareness of e-cigarettes has dramatically increased over the past 3 years.¹⁻³ Ayers et al.,³ in this issue of the *American Journal of Preventive Medicine*, report that Internet searchers for e-cigarettes in the U.S. now exceed those for any other smoking alternative, nicotine replacement, or smoking-cessation product. Although e-cigarettes have generated much support from dedicated users, little is known about the efficacy of the device as a smoking-cessation tool.

Most smoking-cessation methods focus on one component of smoking: nicotine addiction. However, even with the assistance of medications that treat nicotine addiction, the success rate for quitting remains low. Based on a Cochrane review of seven studies⁴⁻⁹ that measured smoking cessation using nicotine replacement therapy (NRT), the average 6-month point prevalence of smoking abstinence is only 17.8%, and the 6-month point prevalence of smoking abstinence in the pooled data from these studies is only 11.9%.

Several studies^{10,11} have suggested that physical and behavioral stimuli—such as merely holding a cigarette—can reduce the craving to smoke, even in the absence of nicotine delivery. Given that both nicotine and smoking-related cues appear to influence cigarette craving, e-cigarettes may present a unique opportunity to promote smoking cessation. Two preliminary studies¹²⁻¹⁴ provide evidence that e-cigarette use suppresses the urge to smoke.

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Results from two recent surveys^{15,16} suggest that e-cigarettes may be effective in helping smokers quit. However, both of these surveys relied on convenience samples of e-cigarette users.

This paper reports the results of a survey conducted using a non-convenience sampling frame. Compared with previous studies, which used convenience samples, this survey is based on a sample of all first-time purchasers of a particular brand of e-cigarettes.

Methods

An anonymous Internet-based, cross-sectional survey was conducted among a cohort of first-time purchasers of e-cigarettes from a leading e-cigarette distributor to determine the effectiveness of e-cigarettes for smoking cessation.

Recruitment

A leading e-cigarette distributor (Blu) provided investigators with e-mail addresses of a consecutive sample of first-time Blu e-cigarette purchasers. This sample represented the first 5000 customers who purchased Blu e-cigarettes over a 2-week period beginning July 1, 2009, when Blu commenced its first, continuous operation. Subjects from this customer list were sent a recruitment e-mail. The e-mail invitation was sent to potential subjects in March 2010, that is, 7 months after their initial e-cigarette purchase.

Of the 5000 e-mail addresses to which the survey was sent, 4884 were valid. In total, 222 e-cigarette purchasers responded to the survey, resulting in a response rate of 4.5%. Of the 222 respondents, six were deleted because they did not meet the definition of a "smoker": having smoked 100 or more cigarettes in their lifetime. Therefore, the final sample consisted of 216 respondents, all of whom indicated that they had tried e-cigarettes.

Survey and Data Collection

Those who opted to participate in the study accessed the survey via a secure link in the recruitment e-mail. The current study was approved by the IRB at the Boston University Medical Center.

Data Analysis

The primary hypothesis tested in the present study was the effectiveness of e-cigarettes in smoking cessation, defined as the point prevalence of abstinence from cigarette smoking at 6 months after the first purchase of Blu e-cigarettes. For this estimate, 95% CIs were calculated using standard methods for the estimation of the variance of a proportion.¹⁷

Results

Participant Characteristics and Smoking History

There were more men (71.5%) than women (28.5%) in the study (Table 1). The majority of respondents had smoked for 6 or more years (81.1%), and nearly two

Table 1. Demographic information, smoking characteristics, and cessation/reduction of tobacco use after e-cigarette use

Variable	n (%)
DEMOGRAPHIC INFORMATION	
Gender	
Male	153 (71.5)
Female	61 (28.5)
Age (years)	
18–24	41 (19.1)
25–44	114 (53.0)
45–64	48 (22.3)
≥65	12 (5.6)
SMOKING CHARACTERISTICS	
Smoking history (years smoked)	
≤5	32 (14.7)
6–15	77 (35.5)
16–30	67 (30.9)
>30	41 (18.9)
Number of previous quit attempts	
0	17 (7.9)
1–2	59 (27.4)
3–5	90 (41.9)
>5	49 (22.8)
CESSATION/REDUCTION OF TOBACCO USE AFTER E-CIGARETTE USE	
Reported reducing nicotine use	
Yes	106 (49.3)
No	109 (50.7)
Reduced number of tobacco cigarettes per day after e-cigarette use	
Yes	143 (66.8)
No	71 (33.2)
Quit/abstained for a period of time	
Yes	104 (48.8)
No	109 (51.2)

thirds (64.7%) of participants reported having made three or more previous quit attempts.

Cessation or Reduction of Tobacco After E-Cigarette Use

More than two thirds of respondents (66.8%) reported having reduced the number of tobacco cigarettes they

smoked per day after trying e-cigarettes, and nearly half (49.3%) reduced their nicotine use (Table 1). Nearly half (48.8%) of respondents indicated that they quit smoking for a period of time after trying e-cigarettes.

E-Cigarette Use Patterns and 6-Month Smoking Status

Thirty-one percent (31.0%) of respondents were not smoking at the 6-month point (95% CI=24.8%, 37.2%; Table 2). Of those who were not smoking at 6 months, 56.7% were using e-cigarettes, 9.0% were using tobacco-free nicotine products, and 34.3% were completely nicotine-free.

Among subjects who were not using e-cigarettes at the time of the survey, only 26.8% were nonsmokers (Table 2). However, among current e-cigarette users, 34.5% were nonsmokers. Smoking abstinence rates generally increased with higher frequency of e-cigarette use, with more than two thirds (70.0%) of respondents using e-cigarettes more than 20 times per day being nonsmokers at 6 months.

Table 2. How e-cigarette use patterns relate to 6-month smoking status

Use pattern	% (95% CI) not smoking
Total: smoking status at 6-month point (n=216)	31.0 (24.8, 37.2)
Number of times used per day	
No current e-cigarette use (n=97)	26.8 (17.9, 35.7)
<5 (n=50)	28.0 (15.4, 40.6)
5–10 (n=31)	35.5 (18.4, 52.6)
11–15 (n=16)	31.3 (8.2, 54.3)
16–20 (n=12)	33.3 (6.3, 60.4)
>20 (n=10)	70.0 (41.2, 98.8)
Weekly pattern of e-cigarette use	
No current e-cigarette use (n=97)	26.8 (17.9, 35.7)
Only uses some days (n=71)	21.1 (11.5, 30.8)
Everyday use (n=48)	54.2 (39.9, 68.5)
Nicotine use of those who are not smoking at 6-month point (n=67) (n [%])	
Nicotine-free	23 (34.3)
Using tobacco-free nicotine products	6 (9.0)
Using only e-cigarettes	38 (56.7)

Discussion

The primary finding was a 6-month point prevalence of smoking abstinence among the e-cigarette users in the sample of 31.0%. This compares favorably to the average 6-month point prevalence of smoking abstinence of 17.8% in prior studies and to the 6-month point prevalence of smoking abstinence of 11.9% in the pooled data from these studies.^{4–9}

Of those respondents who were not smoking at the 6-month point, more than one third (34.3%) were also nicotine-free. This suggests that e-cigarettes can help decrease nicotine dependence, rather than maintain or increase nicotine addiction as some opponents have argued.¹

A large percentage of respondents reported a reduction in the number of cigarettes they smoked (66.8%) and almost half reported abstinence from smoking for a period of time (48.8%). These results are notable because smokers who reduce the amount of cigarettes smoked are more likely to quit smoking,¹⁸ and a reduction in the amount of cigarettes smoked can lower the individual's risk of smoking-related illnesses.¹⁹

There are a number of important limitations of this study. First, because of the low survey response rate, the sample is not representative of all smokers who have tried e-cigarettes. Further, because of lack of information on the survey non-respondents, the factors related to nonresponse could not be assessed. It is possible that smokers who had less success with e-cigarettes were also less likely to complete the survey. This would bias the results toward overestimating the 6-month abstinence rate. Second, self-reported abstinence was not verified using biochemical methods. It is possible that respondents over-reported smoking abstinence because of perceived social pressure. Third, only users of one brand of e-cigarettes were surveyed. Thus, these results cannot be generalized to the use of all e-cigarette brands.

Because of these study limitations, these findings must be viewed as suggestive, rather than definitive. Although the findings suggest that e-cigarettes may hold promise as a smoking-cessation method, further studies with more-rigorous research designs are warranted.

The distinct and unique advantage of e-cigarettes is that they allow individuals to utilize one device that can simultaneously address nicotine withdrawal, psychological factors, and behavioral cues that serve as barriers to smoking abstinence. The finding that most individuals who used e-cigarettes at least reduced the number of tobacco cigarettes they smoked suggests that if proven safe, e-cigarettes may be a potentially important tool for harm reduction, especially among smokers who have found currently available pharmaceutical smoking-cessation options to be ineffective. The present study suggests that

this alternative approach to smoking cessation is worthy of further investigation.

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References

1. U.S. Food and Drug Administration. E-cigarettes: questions and answers [Internet]. www.fda.gov/ForConsumers/ConsumerUpdates/ucm225210.htm.
2. American Association of Public Health Physicians [Internet]. New Orleans: Tobacco Control Task Force. FDA petition 2. www.aaphp.org/special/joelstobac/2010/Petition/20100207FDAPetition2.pdf.
3. Ayers JW, Ribisl KM, Brownstein JS. Tracking the rise in popularity of electronic nicotine delivery systems ("electronic cigarettes") using search query surveillance. *Am J Prev Med* 2011;40(4):XXX-XXX.
4. Stead L, Perera R, Bullen C, Mant D, Lancaster T. Nicotine replacement therapy for smoking cessation (review). *The Cochrane Collaboration* 2008;3:1-160.
5. Fiore MC, Kenford SL, Jorenby DE, Wetter DW, Smith SS, Baker TB. Two studies of the clinical effectiveness of the nicotine patch with different counseling treatments. *Chest* 1994;105(2):524-33.
6. Hays JT, Croghan IT, Schroeder DR, et al. Over-the-counter nicotine patch therapy for smoking cessation: results from randomized, double-blind, placebo-controlled and open label trials. *Am J Public Health* 1999;89(11):1701-7.
7. Joseph AM, Norman SM, Ferry LH, et al. The safety of transdermal nicotine as an aid to smoking cessation in patients with cardiac disease. *N Engl J Med* 1996;335(24):1792-8.
8. Lewis SF, Piasecki TM, Fiore MC, Anderson JE, Baker TB. Transdermal nicotine replacement for hospitalized patients: a randomized clinical trial. *Prev Med* 1998;27(2):296-303.
9. Moolchan ET, Robinson ML, Ernst M, et al. Safety and efficacy of the nicotine patch and gum for the treatment of adolescent tobacco addiction. *Pediatrics* 2005;115(4):e407-14.
10. Barrett SP. The effects of nicotine, denicotinized tobacco, and nicotine-containing tobacco on cigarette craving, withdrawal, and self-administration in male and female smokers. *Behav Pharmacol* 2010;21(2):144-52.
11. Dar R, Rosen-Korakin N, Shapira O, Gottlieb Y, Frenk H. The craving to smoke in flight attendants: relations with smoking deprivation, anticipation of smoking, and actual smoking. *J Abnorm Psychol* 2010;119(1):248-53.
12. Bullen C, McRobbie H, Thornley S, Glover M, Lin R, Laugesen M. Effect of an electronic nicotine delivery device (e cigarette) on desire to smoke and withdrawal: randomized cross-over trial. *Tob Control* 2010;19(2):98-103.
13. Eissenberg T. Electronic nicotine delivery devices: ineffective nicotine delivery and craving suppression after acute administration. *Tob Control* 2010;19(1):87-8.
14. Cahn Z, Siegel M. Electronic cigarettes as a harm reduction strategy for tobacco control: a step forward or a repeat past mistakes? *J Public Health Policy* 2011;32:16-31.
15. Heavner K, Dunworth J, Bergen P, Nissen C, Phillips C. Electronic cigarettes (e-cigarettes) as potential tobacco harm reduction products: results of an online survey of e-cigarette users. *Tobacco Harm Reduction*. tobaccoharmreduction.org/wpapers/011.htm.
16. Etter J. Electronic cigarettes: a survey of users. *BMC Public Health* 2010;10:231. www.biomedcentral.com/1471-2458/10/231.
17. Fleiss JL, Levin B, Cho Paik M. *Statistical methods for rates and proportions*. 3rd ed. Hoboken NJ: Wiley, 2003.
18. Hyland A, Levy DT, Rezaishiraz H, et al. Reduction in amount smoked predicts future cessation. *Psychol Addict Behav* 2005;19(2):221-5.
19. Pisinger C, Godtfredsen NS. Is there a health benefit of reduced tobacco consumption? A systematic review. *Nicotine Tob Res* 2007;9(6):631-46.