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Perceived relative harm of electronic cigarettes over time and impact on subsequent use. A survey with 1-year and 2-year follow-ups

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ABSTRACT

Introduction: Media presentations of e-cigarettes may affect perception of the devices which may influence use.
Objectives: To assess in a cohort of past-year smokers (1) if perceived harm of e-cigarettes relative to cigarettes changed over time, (2) predictors of perceived relative harm, (3) if perceived relative harm predicted subsequent e-cigarette use among never-users.
Methods: Longitudinal web-based survey of a general population sample of British smokers and ex-smokers, waves in 2012 ($n = 4553$), 2013 and 2014 (44%, 31% response rate, respectively). Changes over time were assessed using Friedman and McNemar tests, $n = 1204$. Perceived relative harm at wave 3 was regressed onto perceived relative harm at waves 1 and 2, while adjusting for socio-demographics and change in smoking and e-cigarette status, $n = 1204$. Wave 2 e-cigarette use among 1588 wave 1 never-users was regressed onto wave 1 socio-demographics, smoking status and perceived relative harm.
Results: Perceived relative harm changed ($\chi^2 = 20.67$, $p < 0.001$); the proportion perceiving e-cigarettes to be less harmful than cigarettes decreased from 2013 to 2014 ($\chi^2 = 16.55$, $p < 0.001$). Previous perception of e-cigarettes as less harmful, having tried e-cigarettes and having stopped smoking between waves predicted perceiving e-cigarettes as less harmful than cigarettes. Perceiving e-cigarettes to be less harmful than cigarettes predicted subsequent use, adjusting for other characteristics (OR = 1.39; 95% CI: 1.08–1.80, $p = 0.011$).
Conclusion: Among a cohort of smokers and ex-smokers, accurately perceiving e-cigarettes as less harmful than smoking predicted subsequent e-cigarette use in never-users; this perception declined over time. Clear information on the relative harm of cigarettes and e-cigarettes is needed.

1. Introduction

Combustible tobacco cigarettes (referred to as cigarettes in the remainder of this article) kill between half and two thirds of continuing smokers (Banks et al., 2015; Doll et al., 2004). It is primarily the nicotine in cigarettes that produces the addiction to tobacco but most of the health harms of smoking are related to other components of cigarette smoke (Benowitz, 2009). Electronic cigarettes (e-cigarettes) deliver nicotine without burning tobacco. While the long-term health effects of e-cigarettes are as yet unknown and may differ across brands, types and usage (Britton and Bogdanovica, 2014; Cheng, 2014; Goniewicz et al., 2014; Kosmider et al., 2014), a group of experts with expertise in nicotine and tobacco research from different disciplines estimated that e-cigarettes are likely to be at least 95% less harmful than cigarettes (Nutt et al., 2014). Whilst the exact figure is still to be determined, most experts agree that continued smoking of cigarettes will be more harmful to an individual's health than using e-cigarettes (Farsalinos and Polosa, 2014; Grana et al., 2014). The potential harms and benefits and appropriate regulation of e-cigarettes are being publically discussed extensively among experts (Letter from 56 Specialists in Nicotine Science and Public Health Policy, 2014; Letter from 129 Signatories, 2014; McNeill et al., 2014). These discussions are not limited to the scientific community; many media reports cover e-cigarettes, and although no reliable data are available, reports may often focus on rising prevalence of use, explosions or

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poisoning linked to them (for example Meikle, 2014; BBC, 2014, 2015). Media reports, increased use (McMillen et al., 2014; Richardson et al., 2014a) and advertising (Bauld et al., 2014; McCarthy, 2014; Richardson et al., 2014a) may affect perceptions of the relative harm of e-cigarettes, particularly in the absence of equally intense discussion of the enormous health harms of cigarettes.

Perceived harm or perceived risk influence behaviour and in the field of smoking, associations between harm perception and use have for example been reported for nicotine replacement therapy and smokeless tobacco (O'Connor et al., 2007; Shiffman et al., 2008). However, this association has not consistently been found; one study of adult smokers in England reported no association between perceived harm of long-term nicotine replacement therapy and reported use (Black et al., 2012).

Cross-sectional studies have found associations between lower perceived harm of e-cigarettes and e-cigarette use (Adkison et al., 2013; Amrock et al., 2015; Pokhrel et al., 2015; Richardson et al., 2014b). However, no studies have documented whether perceptions of e-cigarette harm prospectively predict e-cigarette use. Because previous use may affect harm perception, it is important to use longitudinal data to assess whether harm perceptions influence use among those who have never previously used e-cigarettes. Additionally, because of the public debate and insofar as perceptions are associated with use, it is important to track perceptions of e-cigarettes over time and to assess socio-demographic and smoking predictors of those perceptions.

This study had three specific aims. First, to assess whether the perceived harm of e-cigarettes relative to cigarettes changed over a two-year period (2012 to 2014) in a cohort of smokers and ex-smokers. Second, to assess predictors of perception of e-cigarettes as less harmful than cigarettes; and third, to assess whether perceived relative harm in 2012 predicted subsequent e-cigarette use in 2013 among respondents who had never previously used an e-cigarette while adjusting for demographics and smoking status.

2. Methods

2.1. Design and sample

We used data from a longitudinal web-based survey of a national general population sample of smokers and ex-smokers (past year at baseline) in Great Britain. Members of an online panel managed by Ipsos MORI were invited to participate in a survey about smoking. Those who accepted (n = 23,785) were screened and past-year smokers (n = 6165) were eligible for the survey. Quotas were imposed to ensure broad representativeness by sex, age, and region. Wave 1 (November/December 2012) was completed by 5000 respondents, of whom 4553 were aware of e-cigarettes. Of those aware of e-cigarettes at wave 1, n = 2011 respondents (44.2%) completed wave 2 in December 2013 and n = 1407 (30.9%) wave 3 in December 2014. Wave 1 sample characteristics were broadly similar to those of representative samples from a household survey (Brown et al., 2014; Fidler et al., 2011). Wave 1 characteristics including perceived relative harm have been described previously (Brown et al., 2014) and data from waves 1 and 2 have been used to assess associations of e-cigarette use with changes in smoking behaviour (Brose et al., 2015; Hitchman et al., 2015). Overall, 1217 respondents were aware of e-cigarettes throughout and rated their perceived relative harm at all three waves.

To address aims 1 and 2, thirteen respondents who were unsure at any wave about their smoking status or whether they had tried e-cigarettes were excluded, leaving 1204 respondents for analysis. To address aim 3, 416 wave 1 users and seven who were unsure about their smoking or whether they had tried e-cigarettes were excluded, leaving data from 1588 respondents who were not using e-cigarettes at wave 1 and were followed up at wave 2. Secondary analysis included 364 respondents who had never used e-cigarettes at wave 2 and were followed up at wave 3.

2.2. Measures

Demographics included age (continuous, for main analyses grouped as 18 to 24; 25 to 39; 40 to 54; 55 and over), gender (male; female), education (collapsed into: no higher education; some higher education; don't know/prefer not to say) and annual household income (collapsed into: ≤£30,000; >£30,000; don't know/prefer not to say).

At each wave, participants were asked if they had ever tried an electronic cigarette (yes; no; don't know). This was used to determine e-cigarette trial status (tried prior to wave 1; tried between wave 1 and 3; never tried). Perceived relative harm was rated at each wave using the question: "Do you think electronic cigarettes are more harmful than regular cigarettes, less harmful, or are they equally harmful to health? (a) more harmful than regular cigarettes; (b) equally harmful; (c) less harmful than regular cigarettes; (d) don't know". For analysis, the response options were dichotomised into less harmful (c) and all other, inaccurate, responses (a, b and d).

Current e-cigarette use among those who had tried an e-cigarette was determined using the question: "How often, if at all, do you currently use an electronic cigarette? (a) daily; (b) less than daily, but at least once a week; (c) less than weekly, but at least once a month; (d) less than monthly; (e) not at all; (f) don't know". For analysis, responses were collapsed into any current use (a–d) and non-use (e); (f) was excluded. Smoking status was determined using the question: "Which of the following best applies to you? (a) I smoke cigarettes (including hand-rolled) every-day; (b) I smoke cigarettes (including hand-rolled) but not every day; (c) I do not smoke cigarettes at all but I do smoke tobacco of some kind (e.g. pipe or cigar); (d) I have stopped smoking completely in the last year; (e) I stopped smoking more than a year ago (at waves 2 and 3 only); (f) Don't know/couldn't say". For analysis, responses were collapsed into current smoker (a–c) or ex-smoker (d and e); (f) was excluded. Based on responses across the three waves, change in smoking status across the waves was categorised as: smoker throughout; ex-smoker throughout; relapsed to smoking; stopped smoking. For n = 33 (2.7%) with more than one change in smoking status over the three waves, change from wave 2 to 3 was used to predict perceived relative harm at wave 3 (aim 2).

2.3. Analysis

Characteristics of those successfully followed up and those lost to follow-up were compared using chi-square statistics and a t-test for age.

To address aim 1, proportions of responses about perceived relative harm across the three waves were analysed descriptively. A Friedman test was used to assess change across all three waves, followed by McNemar tests for comparison between two waves. In a sensitivity analysis, the analyses were repeated with the exclusion of those responding 'don't know' to the question about perceived relative harm.

To address aim 2, bivariate and multivariable logistic regressions were used to assess predictors of perceived relative harm at wave 3. Predictors included in the regressions models were perceived relative harm at waves 1 and 2, gender, age (grouped), education and income at wave 1, change in smoking across the waves and e-cigarette trial status.

And to address aim 3, bivariate and multivariable logistic regressions were used to assess if perceived relative harm among non-e-cigarette users at wave 1 predicted use of e-cigarettes at wave 2; multivariable regression adjusted for wave 1 gender, age (grouped), education, income and smoking status. Analyses were repeated to assess if perceived relative harm among non-e-cigarette users at wave 2 predicted use of e-cigarettes at wave 3; the sample available for these analysis was much smaller (n = 364).

3. Results

3.1. Attrition and sample characteristics

Compared with respondents who were lost to follow-up between wave 1 and wave 2, respondents who were followed up at

Table 1
Wave 1 characteristics of those followed up at wave 2 and those lost to follow-up.

	Followed up	Lost to follow-up	Comparison
Age, mean, standard deviation	46.4, 15.5		t = 13.3, p < 0.001
Female (%)	41.8	51.7	χ^2 = 48.9, p < 0.001
Some higher education (%)	35.4	36.9	χ^2 = 11.6, p = 0.003
Annual income >£30,000 (%)	37.9	41.1	χ^2 = 4.9, p = 0.027
Tried e-cigarette (%)	35.2	41.0	χ^2 = 15.9, p < 0.001
Perceived e-cigarettes as less harmful (%)	66.8	70.7	χ^2 = 7.8, p = 0.006
Current smoker (%)	87.1	86.6	χ^2 = 0.3, p = 0.60