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Comparison of the characteristics of long-term users of electronic cigarettes versus nicotine replacement therapy: A cross-sectional survey of English ex-smokers and current smokers

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ABSTRACT

Background: Electronic cigarettes (ECs) and nicotine replacement therapy (NRT) are non-combustible nicotine delivery devices being widely used as a partial or a complete long-term substitute for smoking. Little is known about the characteristics of long-term users, their smoking behaviour, attachment to smoking, experience of nicotine withdrawal symptoms, or their views on these devices. This study aimed to provide preliminary evidence on this and compare users of the different products.

Methods: UK participants were recruited from four naturally occurring groups of long-term (≥6 months) users of either EC or NRT who had stopped or continued to smoke ($N = 36$ per group, total $N = 144$). Participants completed a questionnaire assessing socio-demographic and smoking characteristics, nicotine withdrawal symptoms, smoker identity and attitudes towards the products they were using.

Results: Adjusting for relevant confounders, EC use was associated with a stronger smoker identity (Wald $X^2(1) = 3.9$, $p = 0.048$) and greater product endorsement (Wald $X^2(1) = 4.6$, $p = 0.024$) than NRT use, irrespective of smoking status. Among ex-smokers, EC users reported less severe mood and physical symptoms (Wald $X^2(1) = 6.1$, $p = 0.014$) and cravings (Wald $X^2(1) = 8.5$, $p = 0.003$), higher perceived helpfulness of the product (Wald $X^2(1) = 4.8$, $p = 0.028$) and lower intentions to stop using the product (Wald $X^2(1) = 17.6$, $p < 0.001$) than NRT users.

Conclusions: Compared with people who use NRT for at least 6 months, those who use EC over that time period appear to have a stronger smoker identity and like their products more. Among long-term users who have stopped smoking, ECs are perceived as more helpful than NRT, appear more effective in controlling withdrawal symptoms and continued use may be more likely.

1. Introduction

Despite the huge burden of tobacco smoking on health (Doll et al., 2004; WHO, 2012), smokers struggle to quit successfully and global smoking prevalence remains stubbornly high (Eriksen et al., 2012). Stopping smoking is largely difficult because of the highly addictive properties of nicotine (Watkins et al., 2000). Nicotine withdrawal produces both physical symptoms (e.g., tremors) and mood symptoms (e.g., elevated anxiety), and causes the majority of smokers making an unassisted quit attempt to return to smoking within two weeks (Hughes et al., 2004). Thus, nicotine withdrawal may be a useful target to support long-term transitions to smoking reduction or complete smoking cessation. This is the rationale for the provision of medicinal nicotine in the form of nicotine replacement therapy (NRT), which has been shown in randomised trials to increase quit rates by 50 to 70% (Stead et al., 2012). However, beyond smoking cessation, for smokers who are unwilling or unable to quit, NRT use for harm reduction may be a valuable strategy in reducing the burden of tobacco use, and in the UK, guidelines recommend this approach for these smokers (NICE, 2013). As the combustion of cigarettes is recognised as the primary cause of cigarette toxicity, harm reduction in this context is defined as the use of non-combustible forms of nicotine delivery to partially or fully replace combustible forms such as cigarettes

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in the long run (Le Houezec et al., 2011). Research suggests that a substantial minority of smokers use NRT for long-term harm reduction, e.g. for temporary abstinence or to cut-down on cigarettes, and that this may be increasing (Beard et al., 2011; Hammond et al., 2008; Levy et al., 2007; Silla et al., 2014).

In addition to traditional NRT, electronic cigarette (EC) is another non-combustible nicotine delivery device which has gained a wide popularity in recent years (Brown et al., 2014b; King et al., 2013; Vardavas et al., 2014) and potentially may be particularly suited for harm reduction, given high levels of dual use in the population (McMillen et al., 2014) and continued long-term single and dual use in clinical trials (Shahab and Goniewicz, 2014). EC usually consists of a battery, heating element, and a tank or a cartridge containing a nicotine solution ('e-liquid'). The battery is typically activated either manually or by inhalation through the device, and produces an aerosol that can be inhaled by the user. Although some toxic chemicals have been detected in EC aerosol (Goniewicz et al., 2013; Schober et al., 2014; Vardavas et al., 2012), it does not contain tar, or most of the other chemical compounds detected in cigarette smoke, as the process does not involve combustion, resulting in levels of toxicants at least an order of magnitude lower than that in cigarette smoke (Goniewicz et al., 2014; Kosmider et al., 2014). Thus EC can arguably be considered a much safer alternative to smoking cigarettes (Hajek et al., 2014). ECs have also been demonstrated to increase cessation rates in clinical trials (McRobbie et al., 2014) and some population studies (Biener and Hargraves, 2015; Brown et al., 2014a), but not all observational studies have detected an effect (Grana et al., 2014), and more research is needed to confirm EC effectiveness, using an appropriate methodology to distinguish between the impact of EC use on cessation when used as part of a quit attempt vs. when it is used for any general purpose (Hajek et al., 2014).

Although some concerns remain in the population regarding the safety of prolonged use of non-combustible nicotine delivery devices (Black et al., 2012; Dockrell et al., 2013), the evidence indicates that long-term NRT use is safe in terms of levels of nicotine delivered (Shahab et al., 2014) and associated toxicity (Benowitz and Gourlay, 1997; Hubbard et al., 2005) and growing data on EC would suggest the same (Hajek et al., 2014). This, combined with the known toxicity of combustible nicotine use, further supports the idea of harm reduction, shifting smokers towards non-combustible nicotine delivery devices and away from smoked tobacco. However, relatively little is known about the processes which underpin a smoker's transition to sole use of non-combustible nicotine delivery devices and whether long-term use of such products aids cessation or maintains smoking in the long run.

One universal mechanism worth investigating in the context of understanding this transition is "smoker identity", the self-concept that being a smoker is an essential constituent of one's identity (Shadel and Mermelstein, 1996; Shadel et al., 1996). It has been posited that identity influences behaviour by creating strong wants or needs, such as wanting to be a non-smoker, which compete with external impulses, such as the desire to smoke, and may therefore reinforce or undermine shifts in behaviour (West and Brown, 2013). Studies have observed a weakening in smoker identity during cessation as smokers distanced themselves from an unwanted smoker identity (Johnson et al., 2003; Vangeli and West, 2012), and liking being a smoker has been identified as an important barrier to smoking cessation (Tombor et al., 2013; van den Putte et al., 2009).

Another important factor in the transition from smoker to non-smoker is the physiological impact of cessation. The role of mood and physical symptoms in relapse is well-documented (West et al., 1989), and even after long periods of abstinence the presence of withdrawal symptoms has been shown to predict return to smoking (Piasecki et al., 2003). In line with existing theory (West and Brown, 2013), it is therefore important that such symptoms are minimised to ensure the motivation not to smoke remains stronger than the motivation to smoke. For this reason, effective harm reduction should treat negative mood and physical symptoms.

Lastly, attitudes towards the product, e.g., in terms of satisfaction or intention to stop its use, are likely to inform its suitability for long-term harm reduction purposes, on the one hand, and transition towards complete cessation of all nicotine products, on the other. Ideally, all factors that are likely to influence the product–contingent transition from smoking to non-smoking would be assessed prospectively. However, given the length of time needed to evaluate the use of non-combustible nicotine products for harm reduction appropriately, this study used a pragmatic approach, purposively selecting participants who had been using products for at least six months.

In order to evaluate the transitions from smoking to non-smoking, both smokers and ex-smokers using non-combustible nicotine delivery devices were selected. In addition, comparisons were made between EC and NRT users to determine the relative associations with the modality of nicotine delivery. Given the relative lack of data on EC, NRT was deemed a useful comparator as it has well-established effectiveness. Specifically, the present study assesses the associations between smoking status and product type among long-term users of EC or NRT with (1) smoker identity, (2) withdrawal symptoms, and (3) attitudes towards non-combustible nicotine delivery devices.

2. Methods

2.1. Study design and procedure

This cross-sectional study forms part of a larger, international study assessing the impact of long-term use of non-combustible nicotine delivery devices on health (currently being prepared for publication). The present study, which focuses on psychological measures collected only in the UK sub-sample, also involved the collection of biological samples (not reported here) as well as administration of a questionnaire at a single laboratory appointment, lasting approximately 30 min. Smokers and ex-smokers using either EC or NRT on a long-term basis of at least six months were purposively recruited, resulting in four groups of participants: current and ex-smokers using NRT and current and ex-smokers using EC. Participants were screened into these four naturally occurring groups to allow for comparisons between EC and NRT use, and between smoking status. Participants were reimbursed for time and travel. The study received ethical approval from the University College London (UCL) Ethics Committee (Project ID 0483/002).

2.2. Participants

Participants were told that this study was about the effects of long-term use of non-combustible nicotine delivery devices and recruited in the greater London, UK area during January–July, 2014 using various recruiting methods to access a diverse sample. These included adverts in newspapers, Facebook, online electronic cigarette forums, posters in independent pharmacies, emails to students and staff at UCL, the use of an online smokers panel as well as marketing companies.

Participants were screened for eligibility via phone or online questionnaires. Inclusion criteria were based on long-term product use in order to control for a noted learning curve in effective EC use (e.g., Bullen et al., 2013). Ex-smokers had to have quit any tobacco products (including waterpipe, cigars, smokeless products) for six months, use their non-combustible nicotine delivery device weekly for the past six months, and not use other non-combustible nicotine delivery devices regularly (i.e., ex-smoker NRT users could not use EC regularly and vice versa). Smokers had to smoke an average of one cigarette per day and meet the same non-combustible nicotine delivery device use criteria as ex-smokers. Current smoking status was verified using a breathalyser to assess expired air carbon-monoxide (CO); readings above 10 ppm indicated current smoking. Due to the collection of biological samples (not reported here), participants were excluded if they were younger than 18 years old, had a history of heart or lung disease, were pregnant, or had bleeding gums, illness, or infection within 24 h of their scheduled appointment.

Thirty-six participants were recruited into each of the four study groups which provided sufficient power to detect a medium-sized effect on outcome measures (Cohen's $d = 0.40$, see Kraemer and Kupfer, 2006). Data for all participants ($N = 144$) are provided in Table 1.