THE UK ELECTRONIC CIGARETTE RESEARCH FORUM

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Electronic Cigarette Research Briefing – February 2021

This research briefing is part of a series of monthly updates aiming to provide an overview of new studies on electronic cigarettes. The briefings are intended for researchers, policy makers, health professionals and others who may not have time to keep up to date with new findings and would like to access a summary that goes beyond the study abstract. The text below provides a critical overview of each of the selected studies then puts the study findings in the context of the wider literature and research gaps.

The studies selected and further reading list do not cover every e-cigarette-related study published each month. Instead, they include high profile studies most relevant to key themes identified by the UK Electronic Cigarette Research Forum; including efficacy and safety, smoking cessation, population level impact and marketing. For an explanation of the search strategy used, please see the end of this briefing.

You can find our previous research briefings at www.cruk.org/UKECRF.

If you would prefer not to receive this briefing in future, just let us know.

Announcements:

- These updates are moving to bi-monthly. The next edition will be in April.
- **We're running a short survey to find out more about our readers and see how we can improve this research briefing.** Please fill out it out here; it should take you less than five minutes to complete.

Let's talk e-cigarettes – University of Oxford Podcasts

Jamie Hartmann-Boyce and Nicola Lindson discuss emerging evidence in e-cigarette research and interview Dr Rachna Begh in the third episode of the podcast series 'Let's talk e-cigarettes'. This podcast is a companion to the electronic cigarettes Cochrane living systematic review and shares the evidence from the monthly searches. In this episode Dr Rachna Begh discusses the findings from her ongoing UK Management of Smoking in Primary Care, MaSC, study. This randomised controlled study explores the feasibility, acceptability effectiveness of general practitioner and nurse promotion of e-cigarettes versus standard care for smoking reduction and abstinence in people who smoke and who have smoking-related chronic diseases who are unwilling to stop smoking.
Subscribe with iTunes or Spotify to listen to regular updates or find all episodes on the University of Oxford Podcasts site.
This podcast series is funded by CRUK.

1. Do the associations between the use of electronic cigarettes and smoking reduction or cessation attempt persist after several years of use? Longitudinal analyses in smokers of the CONSTANCES cohort

- **Study Aims**

  This longitudinal French study aimed to assess the association of duration of e-cigarette (EC) use and smoking reduction and cessation attempts among current smokers (n=5,409). Data were collected between 2015 - 2017, with a follow-up of one year. Results were adjusted for sociodemographic characteristics, smoking history, previous cessation attempts and respiratory and cardiovascular health.

- **Key Findings**

  Compared with participants who had never used e-cigarettes, participants who were former users had an increased likelihood of smoking more cigarettes at follow up (ps<0.001), irrespective of the time elapsed since discontinuing use of e-cigarettes.

  All current e-cigarettes users, regardless of length of time of use, and including those who started using them again after a period of discontinuation, had an increased likelihood of reducing the number of cigarettes smoked per day compared with those who had never used e-cigarettes (ps<0.001).

  Compared with participants who had never used electronic cigarettes, former e-cigarette users (> one year) were less likely to report a cessation attempt (OR=0.81, 95% CI = 0.69-0.97, p=0.019). There was no difference in likelihood of making a cessation attempt between never e-cigarette users and former users (< one year) (p=0.133).

  All current e-cigarette users, regardless of length of time of use, and including those who started using them again after a period of discontinuation, had an increased likelihood of making a cessation attempt than those who had never used e-cigarettes (ORs=2-3.4, ps<0.001).

- **Limitations**

  This was an observational study and motives for e-cigarette use were not recorded. Therefore, a causal association between e-cigarette use and smoking cessation cannot be established.

  The cohort is not representative of the general population. Therefore, despite efforts to adjust for sociodemographic variables, the findings may not be relevant to the wider population.

  The data on e-cigarette and tobacco use were self-reported at baseline and one-year follow-up. Therefore, any changes in use between these two points, including cessation attempts are not captured.

  The follow up period was one year. As smokers often need several quit attempts for long-term cessation, this may have affected the accuracy of estimates.

A “smoking cessation attempt” was defined as smoking no cigarettes at follow-up. Therefore, those who tried to stop smoking but were not successful would be excluded in this definition.

Airagnes G, Lemogne C, Le Faou AL, Matta J, Romanello L, Wiernik E, Melchior M, Goldberg M, Limosin F, Zins M. (2021). Do the associations between the use of electronic cigarettes and smoking reduction or cessation attempt persist after several years of use? Longitudinal analyses in smokers of the CONSTANCES cohort. doi: 10.1016/j.addbeh.2021.106843.

2. The time course of compensatory puffing with an electronic cigarette: Secondary analysis of real-world puffing data with high and low nicotine concentration under fixed and adjustable power settings

- **Study Aims**

  This is a secondary analysis of a 2018 UK study covered in a previous update. 19 exclusive e-cigarette users used four different combinations of high/low nicotine e-liquid and fixed/adjustable e-cigarette power conditions freely for a week. The initial analysis found average puff number and duration were higher in the low versus high nicotine conditions. This secondary analysis investigated whether compensatory puffing behaviour varied with day of use and device power condition.

- **Key Findings**

  There was no significant main effect of day on Puffing Compensation Score (PCS) (difference in total puffing time in the high nicotine condition subtracted from the low nicotine condition) ($p=0.18$).

  There was a main effect of device power condition ($p=0.04$) and a significant day x setting interaction ($p=0.04$) on PCS.

  For the adjustable power condition, there were no significant differences in PCS at days 2, 3, 4 or 5 compared with day 1 ($ps>0.05$). For the fixed power condition, there was no significant difference in PCS at day 2 compared with day 1, however PCS was significantly greater at days 3, 4 and 5 compared with day 1 ($ps<0.05$).

  For the adjustable power condition, mean puff number was significantly lower at day 2 compared with day 1. There were no significant differences in puff number at days 3, 4 or 5 compared with day 1. For the fixed power condition, there were no significant differences in mean puff number at days 2, 3, 4 or 5 compared with day 1.

  For both adjustable and fixed power conditions, there were no significant differences in mean puff duration at days 2, 3, 4 or 5 compared with day 1.

- **Limitations**

  This study only included a relatively small sample of experienced and exclusive e-cigarette users. This sample may not be representative of all e-cigarette users.

The study examined compensatory behaviour for each condition over a week period. However, this behaviour may continue past this time point.

Participants in this study had to switch between the four conditions consecutively. This may not represent transitions in real life, nor be applicable to more gradual transitions or longer-term use.

The fixed condition effects were always presented first, therefore compensatory behaviour may be explained in part by order effects.

Sex differences in compensatory behaviour were not explored in the analysis however prior research has indicated an effect.

Cox S, Goniewicz ML, Kosmider L, McRobbie H, Kimber C, Dawkins L. (2021). The time course of compensatory puffing with an electronic cigarette: Secondary analysis of real-world puffing data with high and low nicotine concentration under fixed and adjustable power settings. *Nicotine Tobacco Res*. doi: 10.1093/ntr/ntab013.

3. User pathways of e-cigarette use to support long term tobacco smoking relapse prevention: a qualitative analysis

- **Study Aims**

  This qualitative UK study explored patterns of long-term e-cigarette use in adult (18+) participants (n=37) who had used an e-cigarette to try to stop smoking. Participants were interviewed in 2016-2017 and followed up in 2018. They were classified into three long term vaping trajectories; 'maintainers' (exclusive e-cigarette users), 'abstainers' (abstinent from both e-cigarettes and tobacco), "relapsers" (dual users or exclusive smokers). Attitudes, beliefs and behaviours towards e-cigarette use, abstinence and relapse were explored.

- **Key Findings**

  There were 28 exclusive e-cigarette users at baseline and 22 maintained this pattern at follow up. One dual user at baseline had switched to exclusive e-cigarette use at follow up. This person reported experiencing an increase in motivation and buying a better device.

  Most maintainers had no intention to stop using e-cigarettes. They were comfortable with continuing to use nicotine and were concerned about relapsing to smoking. However, many believed that cessation may occur naturally over time. 22% of maintainers reported a brief tobacco lapse. Reasons for not lapsing included being satisfied by e-cigarettes and disgusted by tobacco.

  Six participants were abstinent from both e-cigarettes and tobacco. Three had maintained this pattern from baseline and three had transitioned from exclusive e-cigarette use. Most abstainers viewed e-cigarettes exclusively as a smoking cessation tool and had always intended to give up nicotine completely. However, one described stopping vaping as a gradual, unintentional process.

Most abstainers commented that they would not vape again to avoid relapse, with all but one getting rid of their devices. There was a sense in most participants that vaping again would signify failure.

At follow up, one exclusive smoker and two dual users at baseline retained these patterns. Three participants who were exclusive vapers and two who were dual users at baseline were exclusive smokers at follow up. In most cases, participants experienced more than one trigger causing relapse. Many of these were similar to those encountered by the maintainers.

Unlike the maintainers and like some of the abstainers, most of the relapsers expressed discomfort with vaping and a desire to give up after smoking cessation. Some felt that frequent vaping compromised their quit attempt by continuing nicotine addiction.

- **Limitations**

  The sample were predominantly younger, white and had higher socioeconomic status meaning the results may not be generalisable to the wider population.

  The sample were recruited from social media adverts. Therefore, it is likely that it is skewed towards those more motivated to stop.

  Participants were classified into vaping trajectory groups based on their status at follow up which was approximately one year from baseline. Therefore, the analysis could not explore longer term trajectories in use

  The study did not interview participants who had attempted to stop smoking by other methods, for example nicotine replacement therapy. Therefore trajectories, attitudes and beliefs could not be compared.

Notley C, Ward E, Dawkins L, Holland R. (2021). User pathways of e-cigarette use to support long term tobacco smoking relapse prevention: a qualitative analysis. *Addiction*. 2021 Mar;116(3):596-605. doi: 10.1111/add.15226.

Overview

This month we've included three articles from authors in France, the UK and a multi-country research team.

Our first paper is a longitudinal study examining whether duration of e-cigarette use is associated with smoking cessation or reduction. The researchers recruited just over 5,400 smokers in France from 2015 to 2016 as part of a larger cohort study that had been running since 2012. In the current paper, data from the one year follow up of these smokers was analysed. The participants were asked about e-cigarette use and also various questions about their smoking behaviour and socio-demographic characteristics. The main outcomes of interest at one year follow up were any changes in number of cigarettes smoked per day and quit attempts.

The researchers developed two models to examine the relationship between e-cigarette use and smoking reduction and quit attempts, the first adjusting for age, gender and baseline number of cigarettes per day and the second adjusting for all relevant covariables. In the second 'fully adjusted' model they found that all categories of current e-cigarette use at follow up (new user for less than one year; return to use for less than one year; regular use for one to two years; regular use for more than two years) was associated with both a reduction in cigarette consumption, and increased likelihood of a quit attempt when compared to smokers in the study who had never vaped. However, participants who were no longer vaping at follow up but had done in the past had a decreased likelihood of making a quit attempt and an increase in the number of cigarettes per day at follow up. The authors concluded that e-cigarette use was associated with smoking reduction and making a quit attempt in their study and called for further research with longer term follow up.

This month's second paper goes back to earlier research conducted by the same team. In the original study, the authors had found that the use of a lower nicotine concentration (6mg/ml) resulted in compensatory vaping behaviour. The 19 experienced vapers in the study took more puffs, longer puffs and left a shorter gap between puffs. In the current paper, the team examined the data collected in that study to look at what happened over the full five days the participants used different nicotine concentrations and power settings. They were interested in determining if there were differences in daily patterns of compensation rather than just the weekly average as reported in the original paper.

This new analysis found that in the condition where vapers were using the lower nicotine concentration in a device with fixed power settings that could not be adjusted, increased number of puffs and lengths of puffs was maintained in each of the five days. In contrast when vapers had an adjustable device with low nicotine e-liquid, puffing behaviour was more variable with no clear evidence of compensation. This is relevant because compensation can result in consuming more e-liquid and potentially higher exposure to toxicants from e-cigarette aerosol. The authors concluded that if experienced vapers switch to lower strength e-liquids, devices with adjustable power settings may be preferable to reduce cravings - which other research has shown can play a role in relapse to smoking.

This month's final paper is also a longitudinal analysis like the first article, but uses qualitative methods. The researchers recruited 40 e-cigarette users from the UK via social media matched by gender and age to a representative sample of smokers who had recently quit. They were followed up one year later when 38 of them could be re-contacted, and all but one (n=37) agreed to take part in a further interview. The researchers were interested in exploring 'what is the continued experience of e-cigarette use over time in the context of either tobacco smoking abstinence or relapse?'

After analysing transcripts from the interviews, the researchers described three broad 'pathways' of use over the year. The first was maintenance ('maintainer') to describe those (the largest group in the study) who continued to vape and were not smoking. The second was abstinence ('abstainer') to describe those who by follow up were neither vaping nor smoking, and the third was relapse ('relapser') to describe dual users or those who had return to exclusive smoking. The researchers drew on a theory of behaviour change maintenance to explore the accounts of participants. The relapsers and abstainers shared some similar views, in that they felt e-cigarettes should only be used temporarily, felt uncomfortable with long term nicotine use and had concerns about e-cigarette safety. Many of the maintainers had developed a vaping identity, regarded vaping as much less harmful than smoking and reported support from others to continue vaping. Relapsers were on average younger and had lower motivation to quit. The researchers point to the need for more research and prioritising information and support for this group.

Other studies from February you might find of interest:

Patterns of use

Association between bullying victimization and e-cigarette use among German students.
The Era of E-Cigarettes: A Cross-Sectional Study of Vaping Preferences, Reasons for Use and Withdrawal Symptoms Among Current E-Cigarette Users in the United Arab Emirates.
Electronic Cigarette Use and Its Relationship with Smoking and Alcohol and Illicit Drug Consumption among Romanian University Students.
Developing a targeted e-cigarette health communication campaign for college students.
Shared environmental influences on electronic cigarette use among adolescent and young adult females.
Indicators of dependence and efforts to quit vaping and smoking among youth in Canada, England and the USA.
The time course of compensatory puffing with an electronic cigarette: Secondary analysis of real-world puffing data with high and low nicotine concentration under fixed and adjustable power settings.
Geospatial spread of e-cigarette vape shops in South Africa and the relationship with tobacco product use among adults.
Perceptions, symptoms, and practices of electronic cigarette users: Descriptive analysis and validation of Arabic short form vaping consequences questionnaire.
Association of device type, flavours and vaping behaviour with tobacco product transitions among adult electronic cigarette users in the USA.
Use of E-cigarettes and Other Tobacco Products and Progression to Daily Cigarette Smoking.
Incarceration exposure and electronic cigarette use during pregnancy: Findings from the pregnancy risk assessment monitoring system, 2016-2018.

Perception

Study on E-Cigarettes and Pregnancy (STEP) - Results of a Mixed Methods Study on Risk Perception of E-Cigarette Use During Pregnancy.

Primary Care Physician Perspectives on Recommending E-cigarettes to Smokers: a Best-Worst Discrete Choice Experiment.

Perception of adults toward electronic cigarettes: a cross-sectional study from Jordan.

Do health halos and conspicuous consumption influence the appeal and risk perceptions of e-cigarettes among young Cambodian men?

Associations Between Peer Use, Costs and Benefits, Self-Efficacy, and Adolescent E-cigarette Use.

The effect of e-cigarettes on smoking cessation and cigarette smoking initiation: An evidence-based rapid review and meta-analysis.

Youth and young adult risk perceptions and behaviours in response to an outbreak of e-cigarette/vaping-associated lung injury (EVALI) in the USA.

Cessation

Effectiveness of Non-Nicotinic E-Cigarettes to Reduce Cue- and Abstinence-Induced Cigarette Craving in Non-Treatment Seeking Daily Dependent Smokers.

Electronic cigarettes' withdrawal severity symptoms among users during intermittent fasting: a cross-sectional study.

Do the associations between the use of electronic cigarettes and smoking reduction or cessation attempt persist after several years of use? Longitudinal analyses in smokers of the CONSTANCES cohort.

Interventions for Tobacco Cessation in Adults, Including Pregnant Persons: Updated Evidence Report and Systematic Review for the US Preventive Services Task Force.

Associations between electronic cigarette use and quitting behaviours among South African adult smokers.

Pilot Study of Electronic Nicotine Delivery Systems (ENDS) Cessation Methods.

Real-world vaping experiences and smoking cessation among cigarette smoking adults.

User pathways of e-cigarette use to support long term tobacco smoking relapse prevention: a qualitative analysis.

Youth

The relationship between asthma diagnosis and E-Cigarette use among youth and young adults: the mediation effects of anxiety, depression, and impulsivity and the moderation effects of substance use.

Sex Difference in the Association between Electronic Cigarette Use and Subsequent Cigarette Smoking among U.S. Adolescents: Findings from the PATH Study Waves 1-4.

Comparison of e-cigarette use prevalence and frequency by smoking status among youth in the United States, 2014-2019.

Youth Observation of E-Cigarette Use in or Around School, 2019.

Young Canadian e-Cigarette Users and the COVID-19 Pandemic: Examining Vaping Behaviors by Pandemic Onset and Gender.

Harms and harm reduction

Angiotensin-II type 1 receptor mediates pulmonary hypertension and right ventricular remodeling induced by inhaled nicotine.

A review of constituents identified in e-cigarette liquids and aerosols.

Review of data on chemical content in an aerosol resulting from heating a tobacco or a solution used in e-cigarettes and in the smoke generated from the reference cigarettes.

Vaporization characteristics and aerosol optical properties of electronic cigarettes.

Electronic Cigarette Solvents, Pulmonary Irritation and Endothelial Dysfunction:Role of Acetaldehyde and Formaldehyde.

Biomarkers of Toxicant Exposure and Inflammation Among Women of Reproductive Age Who Use Electronic or Conventional Cigarettes.

Reduction of bronchial response to mannitol after partial switch from conventional tobacco to electronic cigarette consumption.

Enamel staining with e-cigarettes, tobacco heating products and modern oral nicotine products compared with cigarettes and snus: An in vitro study.

Headspace analysis of E-cigarette fluids using comprehensive two dimensional GCGC-TOF-MS reveals the presence of volatile and toxic compounds.

Systematic review of biomarker findings from clinical studies of electronic cigarettes and heated tobacco products.

Determination of polycyclic aromatic hydrocarbons (PAHs) in smoking cessation aids by using high-performance liquid chromatography.

E-cig vapor condensate alters proteome and lipid profiles of membrane rafts: impact on inflammatory responses in A549 cells.

Electronic cigarette aerosols alter the expression of cisplatin transporters and increase drug resistance in oral cancer cells.

E-cigarette use and respiratory disorders: an integrative review of converging evidence from epidemiological and laboratory studies.

Metabolome-wide association study of flavorant vanillin exposure in bronchial epithelial cells reveals disease-related perturbations in metabolism.

Misc

Potential factors affecting the free base nicotine in electronic cigarette aerosol.

Potential revenue from taxing e-cigarettes and comparison of annual costs of daily e-cigarette use versus daily cigarette smoking among South African adults.

A review of nicotine-containing electronic cigarettes-Trends in use, effects, contents, labelling accuracy and detection methods.

Electronic cigarette refill liquids: Nicotine content, presence of child-resistant packaging, and in-shop compounding.

Cleaning up the science: the need for an ontology of consensus scientific terms in e-cigarette research.

Search strategy

The Pubmed database is searched in the middle of each month, for the previous month using the following search terms: e-cigarette*[title/abstract] OR electronic cigarette*[title/abstract] OR ecig[title/abstract] OR (nicotine AND (vaporizer OR vaping OR vapourizer OR vaporiser OR vapouriser))

Based on the titles and abstracts new studies on e-cigarettes that may be relevant to health, the UK and the UKECRF key questions are identified. Only peer-reviewed primary studies and systematic reviews are included – commentaries will not be included. Please note studies funded by the tobacco industry will be excluded.

This briefing is produced by Alice Davies from Cancer Research UK with assistance from Professor Linda Bauld at the University of Edinburgh and the UK Centre for Tobacco and Alcohol Studies, primarily for the benefit of attendees of the CRUK & PHE UK E-Cigarette Research Forum. If you wish to circulate to external parties, do not make any alterations to the contents and provide a full acknowledgement. Kindly note Cancer Research UK cannot be responsible for the contents once externally circulated.