The UK Electronic Cigarette Research Forum

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Electronic Cigarette Research Briefing – November 2024

This research briefing is part of a series of quarterly updates aiming to provide an overview of new studies on electronic cigarettes (e-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 do not cover every e-cigarette-related study published each quarter. 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.

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

Jamie Hartmann-Boyce and Nicola Lindson discuss emerging evidence in e-cigarette research. In the latest episode, Jamie Hartmann-Boyce and Nicola Lindson interview Benjamin Toll, Medical University of South Carolina. This podcast is a companion to the Cochrane living systematic review of e-cigarettes for smoking cessation and shares the evidence from the monthly searches. 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 Cancer Research UK (CRUK).

Cochrane Living Systematic Review of E-cigarettes for Smoking Cessation update

The latest update to the CRUK-funded Cochrane Living Systematic Review of E-cigarettes for Smoking Cessation was published in January 2024 and includes 10 new studies. Visit the website (https://www.cebm.ox.ac.uk/research/electronic-cigarettes-for-smoking-cessation-cochrane-living-systematic-review-1) for full information on the review, including briefing documents, and new studies found since the update. A further update is currently underway.

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.

Summary

This quarter, we cover a range of methods (a lab study, a mixed-methods exploration embedded in a randomized controlled trial, and three studies using data from representative surveys), participants (youth, adults, and young adults, including people who do and do not smoke), and research questions. It is encouraging to see such a broad range of approaches to research in this space.

Firstly, **Simovic *et al*** conducted a cross-sectional study comparing young adults aged 21-27 who had regularly vaped for at least two years (n=26) to matched controls who had never vaped (n=16) and found reduced cardiorespiratory fitness in the group who vaped. This study cannot establish causality, and was relatively small, but does pave the way for further research. Investigating these questions in people without histories of smoking is likely to provide the most useful data on vaping versus non-vaping, but these results should not be extrapolated to adults vaping to quit smoking.

Ward *et al* present a mixed-methods embedded analysis from the COSTED trial, which tested an opportunistic smoking cessation intervention using e-cigarettes in emergency departments in England and Scotland. They provide useful detail on patterns of vaping, smoking, and dual use in their cohort. The analysis found that 13% of respondents stopped smoking within the first month of the trial; of these, 58% reported vaping in the past seven days at six months. Almost 20% of participants were classed as 'delayed quitters' – including those who gradually reduced smoking with a period of dual smoking and vaping leading to ultimate smoking cessation, and those who delayed trying an e-cigarette but, once they did, stopped smoking soon after; in this group, 65% reported vaping in the past seven days at six months. A quarter of respondents didn't quit but did reduce their smoking by at least 50%; approximately half of these reported vaping in the past seven days at six-month follow-up. Among the remaining 40% who hadn't reduced smoking at all, only 45% had vaped in the last seven days at six months. These data suggest important variations in dual use trajectories and show six month vaping levels were highest in those who had reduced or quit smoking.

The final three studies are derived from large, regularly repeated, representative surveys: two from International Tobacco Control (ITC) surveys, and one from the Smoking Toolkit Study (STS). **Koops *et al*** examined, via longitudinal ITC surveys, whether perceived vaping addiction predicts subsequent vaping cessation. In the 574 adults who completed both surveys, perceived level of addiction was negatively associated with having made an attempt to quit vaping, but this relationship was no longer statistically significant in the fully adjusted model. Among only those who had made a quit attempt, people who perceived themselves to be not at all addicted were more likely to have achieved quit success than those who perceived themselves as somewhat addicted. Also using ITC data, **Taylor *et al*** evaluated awareness and use of short-fill e-liquids by 16-19-year-olds in England (n=4,224). Short-fill e-liquids are large bottles of e-liquid that contain no nicotine when purchased, but that intentionally aren't filled to the top, so users can add their own nicotine 'shots' and/or flavours. Nearly a quarter (23%) of respondents were aware of short-fills, and of those who had vaped in the past 30 days, 22.1% had used a short-fill. Reasons cited for using short-fills included convenience, price, customisation, to get a nicotine concentration above the legal limit and to use them as a nicotine-free e-liquid. This data was collected in 2021; 2023 and 2024 ASH YouGov surveys don't ask about short-fills, but in 2022 the survey found 26% of current vapers who used tank and/or nicotine devices reported using short-fills (described as 'shake and vape' products).

Finally, **Jackson *et al*** used cross-sectional data from the STS in Great Britain to investigate patterns and perceptions of vaping among adults living in social housing. Vaping prevalence was approximately 30% higher in people living in social housing than people in other housing types. Among people who smoked, those living in social housing were less likely to perceive e-cigarettes as less harmful than

smoking and more likely to perceive them as more harmful. Vaping for smoking cessation in people living in social housing is an ongoing and active area of research in the UK. The insights gleaned from these large, regularly conducted surveys are a strong reminder of the importance of this survey infrastructure for monitoring experiences, trends and outcomes related to tobacco use, which can in turn shape both research and policy and clinical guidelines.

Simovic *et al:* Young users of electronic cigarettes exhibit reduced cardiorespiratory fitness

Study aims

This US laboratory-based cross-sectional study compared measurements of cardiovascular fitness between young adults aged 21-27 who had vaped regularly for at least two years (n = 26) and demographically matched controls who had never vaped (n = 16). In the e-cigarette group all participants except one reported never smoking tobacco. In the non-vaping group, all participants reported never smoking tobacco or vaping. Participants also reported other health behaviours including use of other substances, diet, exercise and sleep. The primary outcome measure was cardiorespiratory fitness, measured by peak oxygen consumption during an exercise test. Other aspects of cardiovascular fitness, including haemodynamics and blood oxygen content were also measured.

Key findings

- Participants who used e-cigarettes had significantly lower oxygen consumption during exercise than those who did not vape, when measured per kilogram of body weight, fat-free mass and lean mass (all $p<0.005$). Oxygen consumption was not associated with circulating cotinine level or length of time vaping.

- The only haemodynamic measurement that differed significantly between the groups was systemic vascular resistance index, an indication of the force exerted on the blood by the vascular system, which was lower in the regular vaping group($p=0.046$).

- Two measures of oxygen extraction and utilisation differed significantly between the regular vaping group and the non-vaping group: mixed venous oxygen saturation ($p = 0.006$) and peripheral oxygen extraction ratio ($p = 0.005$).

- Participants who vaped regularly had a significantly higher physiological age based on peak oxygen consumption (average 13 years older than their biological age, $p = 0.033$) than those who did not vape (average 2 years older).

Limitations

- As a cross-sectional study, it is unable to establish causality.

- Participants in the regular vaping group may have used different devices and e-liquids and varied in their vaping patterns and histories.

- The study was carried out in the US, so the results may not generalise to the UK, where the regulatory and demographic landscapes are different.

- Sample sizes were small, so the study may be underpowered. Recruitment methods are not described, so any risk of sampling bias is unclear, and health behaviours were self-reported, introducing risk of bias.

- Although the vaping and non-vaping groups did not differ on any of the reported health behaviours, there may be additional confounding factors not identified or adjusted for.

Simovic T, Matheson C, Cobb K, Heefner A, Thode C, Colon M, Tunon E, Billingsley H, Salmons H, Ahmed SI, Carbone S, Garten R, Breland A, Cobb CO, Nana-Sinkam P, Rodriguez-Miguelez P. Young users of electronic cigarettes exhibit reduced cardiorespiratory fitness. J Appl Physiol (1985). 2024 Sep 1;137(3):569-580. doi: 10.1152/japplphysiol.00292.2024. Epub 2024 Jul 11. PMID: 38990977; PMCID: PMC11424176.

Ward *et al:* How do people quit smoking using e-cigarettes? A mixed-methods exploration of participant smoking pathways following receiving an opportunistic e-cigarette-based smoking cessation intervention

Study aims

This UK mixed methods study used data and interviews with participants in the 'COSTED' trial, who were offered a free e-cigarette as part of an opportunistic smoking cessation intervention in five emergency departments ('EDs') in England and one in Scotland. Data from participants who had responded to follow-up at six months (n=366) were analysed to investigate smoking pathways following the intervention, and 24 participants were interviewed about their experiences of the intervention and perspectives on smoking and vaping.

Key findings

- 13.4% of respondents were classed as 'rapid quitters,' who reported stopping smoking within the first month after recruitment into the trial. At six-month follow-up, 58.1% of rapid quitters reported vaping in the past seven days and 21.9% reported vaping monthly or less or not at all, during the previous six months.

- Themes that emerged from qualitative interviews with rapid quitters included finding the e-cigarette satisfying and easy to use and using distraction and tobacco avoidance strategies. 25.6% had accessed stop smoking support and 27.3% reported using nicotine replacement therapy ('NRT').

- 19.1% of respondents were classed as 'delayed quitters,' who reported stopping smoking more than a month into the trial. Within this group, two trajectories were identified: those who stopped gradually, with a period of dual use; and those who delayed trying the e-cigarette and stopped soon after.

- Delayed quitters also reported finding the e-cigarette satisfying and using distraction and tobacco avoidance strategies. 21.3% of delayed quitters reported vaping monthly or less or not at all. 8.3% had accessed stop smoking support and 16.1% had used NRT.

- 24.9% of respondents were classed as 'tobacco reducers,' who had reduced the number of cigarettes smoked per day by at least 50%. 53.4% of tobacco reducers reported vaping in the preceding seven days and respondents in this group reported a median of one quit attempt

in the preceding six months. Two trajectories were identified: respondents who had initially stopped smoking then relapsed; and those who had gradually reduced their cigarette consumption but had been unable to stop completely. 19.3% had vaped monthly or less or not at all.

- Themes that emerged in interviews with tobacco reducers group included dissatisfaction with vaping, smoking to cope with mental health issues and living with someone who smoked as a barrier to cessation. 24.1% had accessed stop smoking support and 22.7% had used NRT.

- 42.6% of respondents were classed as 'tobacco non-reducers,' who had not reduced their cigarettes per day by at least 50%. 35.5% of tobacco non-reducers vaped monthly or less or not at all. 45% had vaped in the preceding seven days, the lowest proportion among the groups. Three trajectories were identified: stopping vaping shortly after starting; relapse to smoking following cessation and continuing to smoke and using vaping as a substitute in situations where smoking was not permitted.

- Themes that emerged in tobacco non-reducers included wanting to stop smoking in the future and low motivation to stop, with stress being the main reason given for continuing to smoke. Participants in this group reported a median of two quit attempts. 11.4% had accessed stop smoking services, and 22.4% had used NRT.

Limitations

- The sample size was small, limiting analysis.

- Due to attrition, the follow-up sample differed in some characteristics from the sample recruited to the trial.

- Detailed information on trajectories such as intervals between receiving and starting to use the e-cigarette, vaping frequency during the day was not collected.

- Participants were not purposively sampled by group, leading to uneven numbers from each group being interviewed.

Ward E, Belderson P, Clark A, Stirling S, Clark L, Pope I, Notley C. How do people quit smoking using e-cigarettes? A mixed-methods exploration of participant smoking pathways following receiving an opportunistic e-cigarette-based smoking cessation intervention. Addiction. 2024 Sep 10. doi: 10.1111/add.16633. Epub ahead of print. PMID: 39252616.

Koops *et al:* Does perceived vaping addiction predict subsequent vaping cessation behaviour among adults who use nicotine vaping products regularly?

Study aims

This study used data from the International Tobacco Control (ITC) Four Country Smoking and Vaping survey to investigate any association between perceived level of addiction to vaping and making an attempt to quit vaping and quit success rates. At baseline in the 2018 survey, adults (18+) who reported vaping daily or weekly for at least four months and current nondaily smoking or having quit smoking in the previous two years (n = 1,407) were asked whether they considered themselves addicted to vaping. At a follow-up survey in 2020, they were asked whether they had attempted to

quit vaping since their previous survey. Participants who reported making a vaping quit attempt were classed as successful if they were no longer vaping and otherwise as failure. Responses to both the baseline and follow-up survey were provided by 574 participants. Potential confounders collected at baseline and adjusted for included sociodemographic variables (including gender, age group, country, ethnicity, educational attainment, and annual household income), smoking status and vaping frequency and any interaction with country was explored.

Key findings

- In the unadjusted model, respondents who reported at baseline being somewhat or very addicted or not knowing whether they were addicted to vaping were significantly less likely to report having made a quit attempt at follow-up. In the fully adjusted model, the associations for being somewhat or very addicted became nonsignificant.

- In the fully adjusted model, compared with participants who perceived themselves to be not at all addicted to vaping, those who responded 'Don't know' were significantly less likely to make a quit attempt (aOR=0.35, 95 % CI=0.16–0.79, p = 0.012). There was no significant interaction with country.

- In all models, among participants who reported making a quit attempt between the baseline and follow-up surveys, compared with participants who perceived themselves to be not at all addicted to vaping, those who perceived themselves to be somewhat addicted were significantly less likely to be successful (aR 0.13, 95% CI 0.04–0.40, p < 0.001). There was no significant interaction with country.

- In post-hoc sensitivity analysis, no significant interaction was found for smoking status or vaping frequency with making a quit attempt or quit success.

Limitations

- The response rate was 40.8%, leaving a small sample of respondents which may be underpowered to detect associations.

- Only participants who reported making a quit attempt were included in the analysis for success and failure, so the results would not capture any quits occurring outside a quit attempt.

Koops A, Yong HH, Borland R, McNeill A, Hyland A, Lohner V, Mons U. Does perceived vaping addiction predict subsequent vaping cessation behaviour among adults who use nicotine vaping products regularly? Addict Behav. 2024 Sep 19;160:108172. doi: 10.1016/j.addbeh.2024.108172. Epub ahead of print. PMID: 39341187.

Taylor *et al:* Awareness and use of short-fill e-liquids by youth in England in 2021: findings from the ITC Youth Tobacco and Vaping Survey

Study aims

This cross-sectional study used data from Wave 5 (August 2021) of the International Tobacco Control Youth Survey. It examined awareness and use of 'short-fill' e-liquids (e-liquids without nicotine that nicotine or flavours can be added to) and reasons for using them among young people in England aged

16-19 (n = 4,224). It investigated any association between smoking and vaping status, nicotine concentration and awareness and use, adjusted for age, sex, ethnicity, smoking and vaping.

Key findings

- 23% of all respondents reported being aware of short-fills. Respondents who had vaped in the past 30 days were significantly more likely to be aware than those who had never vaped (aOR 2.14, 95% CI 1.67 to 2.74, p <0.001). Participants who currently (aOR 3.13, 95% CI 2.26 to 4.33, p <0.001) or had ever (aOR 1.30, 95% CI 1.05 to 1.61, p= 0.015) smoked were more likely than those who had never smoked to be aware.

- 22.1% of respondents who had vaped in the past 30 days had also used a short-fill in the past 30 days. Respondents who had vaped in the past 30 days and currently (aOR 13.7, 95% CI 4.56 to 40.93, p<0.001) or had ever (aOR 4.58, 95% CI1.60 to 13.14, p=0.005) smoked were significantly more likely to have used a short-fill in the past 30 days than those who had never smoked.

- Participants who vaped nicotine-containing e-liquids below (i.e. 1-19mg/ml) (aOR 1.68, 95% CI 1.06 to 2.69, p= 0.029) and above (i.e. 21mg/ml or more) (aOR 2.22, 95% CI 1.23 to 3.99, p=0.008) the legal limit were significantly more likely than those who used non-nicotine e-liquids to be aware of short-fills. Among participants who had vaped in the past 30 days, those who used nicotine-containing e-liquids were significantly more likely than those who used nicotine-free e-liquids to have used a short-fill in the past 30 days.

- Among respondents who had used a short-fill in the past 30-days, the most frequently selected reason for use was the convenience of a bigger bottle (45.0%), followed by short-fills being less expensive (37.6%), to customise flavour or propylene glycol/vegetable glycerin content (34.5%), to get a nicotine concentration over 20mg/mL (27.6%), and ability to use short-fills as a nicotine-free e-liquid (25.4%)

Limitations

- Some subsample sizes were small (e.g. 747 respondents had vaped and 150 had used a short-fill in the past 30 days), leading to wide confidence intervals.

- The data were collected in August 2021, near the beginning of the increase in popularity of disposable devices, and so are unlikely to reflect current usage patterns among young people.

- All participants were in England, so results may not generalise to the wider UK population.

- Data were self-reported, introducing risk of bias.

Taylor E, East K, Reid JL, Hammond D. Awareness and use of short-fill e-liquids by youth in England in 2021: findings from the ITC Youth Tobacco and Vaping Survey. Tob Control. 2024 Sep 25;33(5):684-687. doi: 10.1136/tc-2022-057871. PMID: 37130791; PMCID: PMC10620100.

Jackson *et al:* Patterns and perceptions of vaping among adults living in social housing: a representative survey in Great Britain, 2023

Study aims

This cross-sectional study used data from the 2023 Smoking Toolkit Study to investigate any association between living in social housing and vaping prevalence, current vaping behaviours, vaping as a cessation aid and harm perceptions of vaping among adults (16+) in Great Britain (n = 23,245). Potential confounders adjusted for were age, gender, occupational social grade, country, and smoking status.

Key findings

- Vaping prevalence was significantly higher among respondents living in social housing than in other housing types (aOR 1.33, 95% CI 1.14–1.54).

- In subgroup analysis, the difference between vaping prevalence among those living in social housing and other housing types was significant among respondents aged 35+, men, all occupational social grades, respondents in England and those who had never and formerly smoked.

- Among respondents who currently vaped, there were no significant differences between those living in social housing and those living in other types of housing in prevalence of daily vaping, device type used, nicotine concentration and source of purchase.

- Among participants who had smoked in the past year, there were no differences between those living in social housing and those in other types of housing in the proportion reporting having used an e-cigarette in their most recent quit attempt.

- Among respondents who smoked, those living in social housing were significantly less likely to perceive e-cigarettes as less harmful than smoking (aOR 0.69, 95% CI 0.54–0.88) and more likely to perceive them as more harmful (aOR 1.61, 95% CI 1.30–1.99). In subgroup analysis, among those who exclusively smoked respondents living in social housing were more likely to perceive vaping as more harmful than smoking (aOR 1.77, 95% CI 1.39–2.24) and those who dual used were significantly more likely to say they didn't know (aOR 1.87, 1.13–3.11).

Limitations

- Data on smoking and vaping are based on self-report and not biochemically verified, introducing risk of bias.

- Respondents were located in Great Britain, so the results may not generalise to Northern Ireland.

- Respondents were asked about their main device type and usual source of purchase, so responses may not reflect use of secondary devices or other sources of purchase.

- Only respondents who currently smoked were asked about harm perceptions of vaping, so the results are unable to capture harm perceptions among people who formerly/never smoked or currently/formerly/never vaped.

Jackson SE, Brown J, Lewer D, Cox S. Patterns and perceptions of vaping among adults living in social housing: a representative survey in Great Britain, 2023. BMC Public Health. 2024 Sep 20;24(1):2572. doi: 10.1186/s12889-024-20043-5. PMID: 39304840; PMCID: PMC11414268.

Search strategy

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

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 are not included. Please note studies funded by the tobacco industry are also excluded.

This briefing is produced by Julia Cotterill from Cancer Research UK with assistance from Associate Professor Jamie Hartmann-Boyce at the University of Oxford, primarily for the benefit of attendees of the CRUK 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.