# THE UK ELECTRONIC CIGARETTE RESEARCH FORUM

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## Briefing: July and August 2015

This research briefing is the fourth in 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 briefing also aims to provide a critical overview of individual studies and put them in the context of what we already know from previous research.

The studies selected in these briefings do not form an exhaustive list of every e-cigarette-related study published each month. Instead they include those most relevant to key themes identified by the newly formed UK Electronic Cigarette Research Forum. This includes mechanisms and safety, cessation, population level impact, marketing and unintended consequences. For an explanation of the search strategy used, please see the end of this briefing.

The text below provides an overview of the aims, key findings and limitations of each of the highlighted studies. The briefing concludes with a section that puts the study findings in the context of the wider literature and what we know about existing research gaps.

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

**This month we'd also like to highlight a detailed independent review of e-cigarette evidence commissioned by Public Health England, available at: https://www.gov.uk/government/publications/e-cigarettes-an-evidence-update**

1. **Electronic cigarette use in young people in Great Britain 2013–2014**

- **Study aims**
  This representative online YouGov survey explored e-cigarette and cigarette use, perceived harm and intentions in young people in Great Britain (aged 11-18). Cross-sectional surveys were conducted in 2013 (n=2,062) and 2014 (n=1,952). Findings were adjusted for demographic variables.

- **Key findings**
  Awareness and use of e-cigarettes increased from 2013 to 2014 - ever use from 4.6% to 8.2% and monthly (regular) use from 0.9% to 1.7%. Regular use (more than monthly) in never smokers was extremely rare (0.2% in 2014).

  The proportion of young people who perceived e-cigarettes to be less harmful to users than cigarettes fell from 73.4% in 2013 to 66.9% in 2014 and the proportion who believed they caused similar levels of harm increased from 11.8% to 18.2%.

- **Limitations**
  These cross-sectional surveys were not designed to track how individual behaviours changed over time. The definition of an e-cigarette given only incorporated devices which looked like a cigarette so may have missed users of second (or third) generation devices or perhaps coloured cig-a-likes.

  When comparing harm to cigarettes there wasn't an option in the questions to rate e-cigarettes as less harmful but not safe, which could be useful.

Eastwood B, Dockrell MJ, Arnott D, Britton J, Cheeseman H, Jarvis MJ, McNeill A. 2015. Electronic cigarette use in young people in Great Britain 2013–2014. Public Health. DOI: 10.1016/j.puhe.2015.07.009

2. **E-Cigarette Uptake Amongst UK Youth: Experimentation, but Little or No Regular Use in Nonsmokers**

- **Study aims**
  This UK research letter pulled together evidence from four UK studies to provide a comprehensive picture of e-cigarette use in young people in the UK in 2013-2014 (age 11-18) – the UK Youth Tobacco Policy Survey, United Kingdom (n = 1205), ASH/YouGov UK survey (n = 1731), Health Behaviour in School Children in Wales (n = 9055) and Scottish Schools Adolescent Lifestyle and Substance Use Survey (n = 33 685).

- **Key findings**
  Ever use was between 8 and 12% and ever use in non-smokers was between 2 and 5%. Regular use, at least monthly, was rare – less than 2% overall and no regular use was found in never smokers except in a very small group in the Welsh study. Results were consistent across the UK.

- **Limitations**
  The surveys did not ask what types of e-cigarettes were used or whether they contained nicotine.

  These surveys provide a snapshot between 2013 and 2014. These results may change in future.

Bauld L, MacKintosh AM, Ford A, McNeill A. 2015. E-Cigarette Uptake Amongst UK Youth: Experimentation, but Little or No Regular Use in Nonsmokers. Nicotine Tob Res. doi:10.1093/ntr/ntv132.

3. **E-cigarette use and willingness to smoke: a sample of adolescent non-smokers**

- **Study aims**
  This study in Hawaii, USA explored indicators predictive of future smoking behaviour in high school students (mean age 14.7 years) who had used an e-cigarette but never smoked, compared to non-smokers who had never used an e-cigarette. 2,309 adolescents (response rate of 76%) from 6 schools filled in a questionnaire about smoking and e-cigarette use, demographic and psychosocial indicators (such as parental relationship, peer affiliations, academic and social competence and attitudes towards smokers and sensation seeking). 31% of respondents had used an e-cigarette and 16% had smoked. 18% were vapers but not smokers (n=418).

- **Key findings**
  Mean scores for willingness to smoke were significantly higher among those who had used an e-cigarette than those who hadn't, but scores were still very low (0.55 compared to 0.21, on a scale of 0 – 9). Willingness rating increased slightly with frequency of e-cigarette use, but there were quite small numbers who used e-cigarettes weekly/daily.

  As well as the direct association, e-cigarette use was also associated with peer smoker affiliations, positive smoking expectancies and prototypes of smokers which were in turn linked to willingness to smoke.

- **Limitations**

The cross-sectional nature of this study means it's not possible to know the direction of these associations. The study didn't explore attitudes towards quitting so it's not clear whether e-cigarettes could also have positive effects for normalising quitting. Furthermore we can't say whether this small an increase in willingness could translate into any difference in behaviour.

It's also not clear how representative this sample is or how applicable these findings may be to the UK.

Wills TA, Sargent JD, Knight R, Pagano I, Gibbons FX. 2015. E-cigarette use and willingness to smoke: a sample of adolescent non-smokers. Tob Control. doi: 10.1136/tobaccocontrol-2015-052349.

4. **Psychosocial Factors Associated With Adolescent Electronic Cigarette and Cigarette Use**

- **Study aims**
  This US study explored the association of e-cigarette and cigarette use with demographic and psychosocial factors, such as home environment and friends' attitudes towards e-cigarettes. A written questionnaire was administered to 2,084 11th and 12th grade students (average age 17 years) from schools in Southern California in spring 2014 (the Southern California Children's Health Study).

- **Key findings**
  24% of respondents had tried e-cigarettes and 9.6% had used them in the last 30 days – they were then classified as current users, even if they had only used them once. Boys were twice as likely as girls to report past 20-day e-cigarette use but no associations were identified with other demographic variables. E-cigarette use was higher than cigarette use (18.7%).

  44.2% of ever e-cigarette users had never smoked a cigarette and a third of "current" e-cigarette users were also smokers. Current smoking was strongly associated with smoking status.

  E-cigarette use was strongly associated with psychosocial factors, including number of friends who used e-cigarettes/cigarettes and friends' reaction to e-cigarette/cigarette use, e-cigarette/cigarette users at home and the belief that e-cigarettes aren't bad for your health. These factors were also all associated with current cigarette use.

- **Limitations**
  The cross-sectional nature of this study means it's not possible to know the direction of these associations.

  Timing or frequency of e-cigarette use was not explored in detail and "current use" did not differentiate between ongoing daily use and ever use within the last month. In addition, "e-cigarettes" were grouped together and could include non-nicotine-containing devices. So it's difficult to know whether the respondents in this survey were continued e-cigarette users.

  It is not clear what the response rate was to this survey and how representative this sample is of the area or how applicable these findings may be to the UK.

  Perceptions of harm were not measured by comparing cigarettes and e-cigarettes, only a broad question about perceived harm to health was asked.

Barrington-Trimis JL, Berhane K, Unger JB, Cruz TB, Huh J, Leventhal AM, Urman R, Wang K, Howland S, Gilreath TD, Chou CP, Pentz MA, McConnell R. 2015. Psychosocial Factors Associated With Adolescent Electronic Cigarette and Cigarette Use. Pediatrics. 136(2):308-17. doi: 10.1542/peds.2015-0639.

5. **Association of Electronic Cigarette Use With Initiation of Combustible Tobacco Product Smoking in Early Adolescence**

- **Study aims**
  This longitudinal study in Los Angeles, USA explored whether 14 year old school students' smoking and e-cigarette use influenced future behaviour (6 and 12 month follow-up). 2,530 students were asked about use of various tobacco products and e-cigarette use, socio-demographic variables, environmental (family and peer influences) and other interpersonal factors (such as mental health and personality traits). E-cigarette and tobacco responses were classified as never or ever use.

- **Key findings**
  At baseline there were more ever smokers (n=768) than e-cigarette users (n=617) and e-cigarette and tobacco product use was inter-related. At both follow-ups, in never smokers, those that had used an e-cigarette (n=222) were more likely than those who hadn't to have tried tobacco products. Adjusted models weakened this associated but the odds ratio was still 2.73 (95% CI 2.00-3.73).

- **Limitations**
  Baseline tobacco use was associated with future e-cigarette use as well, however overall smoking prevalence trends for this age and area are not discussed so it's not clear whether e-cigarettes are having an overall positive or negative effect, or none. It may be that other factors were common between trying e-cigarettes or tobacco that the authors did not adjust for – causation cannot be assumed from this association.

  This survey only asked about ever/never use rather than frequency of use for both e-cigarette and tobacco use so we cannot know whether the students continued to become regular smokers or vapers.

  The study was conducted in schools in just one area and at a time when they were transitioning between middle and high school, a period linked to experimentation which may not be representative of behaviour in the age group.

Leventhal AM, Strong DR, Kirkpatrick MG, Unger JB, Sussman S, Riggs NR, Stone MD, Khoddam R, Samet JM, Audrain-McGovern J. 2015. Association of Electronic Cigarette Use With Initiation of Combustible Tobacco Product Smoking in Early Adolescence. JAMA. 18;314(7):700-707. doi: 10.1001/jama.2015.8950.

6. **Nicotine absorption from electronic cigarette use: comparison between experienced consumers (vapers) and naïve users (smokers)**

- **Study aims**
  This Greek study aimed to test whether puff topography and nicotine delivery from a next-generation ('tank') e-cigarette was different between healthy experienced vapers (n=24) and smokers who hadn't used an e-cigarette before (n=23). Both groups were asked to take 10 puffs in 5 minutes then use the device ad lib for an hour. Blood samples were taken and puff topology recorded.

- **Key findings**
  Although both groups took a similar number of puffs of the e-cigarette, vapers took significantly longer puffs and achieved higher average plasma nicotine levels at all time-points (43-54% lower) other than baseline.

  Assuming smoking raises plasma nicotine levels to 15 ng/mL within 5 minutes, it took approximated 30 minutes for the average vaper to reach this level and naïve users on average did not reach this level within 65 minutes. However there was large variation between users; at 5 minutes vapers' nicotine levels ranged from 1.5 ng/mL to 21.8 ng/mL and from 1.3 ng/mL to 15.2 ng/mL in smokers.

- **Limitations**
  Only a very small number of users were included in the study. Puff duration and frequency were measured but not puff volume.

A specific device was used for consistency – results may differ for different types of devices and e-liquids and users may be able to achieve higher levels with their usual device. Higher levels may also have been achieved in the first 5 minutes if users were allowed to vape ad lib.

Farsalinos KE, Spyrou A, Stefopoulos C, Tsimopoulou K, Kourkoveli P, Tsiapras D, Kyrzopoulos S, Poulas K, Voudris V. 2015. Nicotine absorption from electronic cigarette use: comparison between experienced consumers (vapers) and naïve users (smokers). Sci Rep. 5:11269. doi: 10.1038/srep11269.

7. **Has growth in electronic cigarette use by smokers been responsible for the decline in use of licensed nicotine products? Findings from repeated cross-sectional surveys**

- **Study aims**
  This English study investigated whether the rise in e-cigarette use was likely to be responsible for the decline in use of licensed nicotine-replacement therapy (NRT) by exploring temporal usage trends through 14,500 smokers in the Smoking Toolkit study.

- **Key findings**
  The rapid increase in e-cigarette use in England occurred between 2011 and the third quarter of 2013, since then use appears to have reached a plateau. Conversely there was no change in NRT use over the same period and a continual slow decline afterwards.

- **Limitations**
  This study only included smokers so e-cigarette or NRT use by non-smokers or ex-smokers is not captured. It can't tell us why NRT use has decreased – just that it is unlikely to be due to e-cigarettes based on the temporal trends.

Beard E, Brown J, McNeill A, Michie S, West R. 2015. Has growth in electronic cigarette use by smokers been responsible for the decline in use of licensed nicotine products? Findings from repeated cross-sectional surveys. Thorax. doi: 10.1136/thoraxjnl-2015-206801.

**Overview**

During July and August 2015 a significant number of peer-reviewed journal publications on young people and e-cigarettes were published and these are the primary focus of this bulletin, alongside two other studies that examined how e-cigarettes are used (puffing behaviour) and the relationship between prevalence and the use of Nicotine Replacement Therapy.

The first two papers report on prevalence of use by young people in the UK. The first paper outlines results from a repeat cross-sectional survey conducted by YouGov for ASH amongst 11-18 year olds in Great Britain. This showed rising levels of ever use between years, as has been found in surveys in other countries. Regular use was at very low levels but also rose slightly, to 1.7%, and was entirely concentrated amongst smokers. The 2014 version of this survey and three others conducted in the same 12 month period (one UK wide, one Scotland and one in Wales) had strikingly similar findings and these are summarised in the second article included here. Ever use was 12% in three out of the four surveys with regular use (more than once a month) much lower (from 0.4% in Scotland to 2% in the UK survey) and no regular use was identified in young people who didn't also smoke tobacco, with the exception of 54 young people in the survey in Wales which included a sample of around 9,000. An important characteristic of these surveys is that they include questions on frequency of use which many earlier studies and some current ones, including those from the USA, do not. Although we have research that allows us to estimate what proportion of young people experiment with cigarettes might go on to become established smokers, we don't have these data for e-cigarettes so measures of regular use are particularly important.

The other three youth studies included here are all from the USA – one from Hawaii and two from California. The study in Hawaii compared possible indicators of future tobacco smoking behaviour in young people who had never smoked but had a) ever tried an e-cigarette or b) never tried one. 'Willingness to smoke' scores were low amongst all participants but there was a significant difference between the group who had tried an

e-cigarette and those who hadn't, with those who had tried an e-cigarette showing more willingness to smoke. The first of two Californian studies found that older teens who had tried an e-cigarette had similar psychosocial characteristics (use amongst friends and family, for example) to smokers, suggesting that some predictors of tobacco use can be applied to young people who experiment with an e-cigarette.

The second Californian study (#5 above) is distinctive as it is the first study of e-cigarette use in young people to have a longitudinal design, including (in this case) follow up at 6 and 12 months. Study participants were 14 years old at baseline and recruited from schools in Los Angeles. The study focused on never smokers. It found that the group of 222 young people who had tried e-cigarettes at least once were more likely to then go on to have tried tobacco at least once in the past month when asked at both follow up points. The authors are careful to point out the limitations of the study and that it does not show that experimentation with e-cigarettes causes smoking uptake, but further studies are needed that employ this type of longitudinal design.

Overall, what is perhaps most interesting about the American studies is that they suggest young people who try e-cigarettes may be the same 'types' of young people who are more vulnerable to becoming smokers. Whether their experimentation with e-cigarettes results in health gain (for example, they become regular users of a less harmful product instead of smokers, or try e-cigarettes but don't progress to either regular e-cigarette use or smoking), or loss, remains to be seen.

The sixth study summarised above is useful as it addresses a common query asked about vaping which is why vapers appear to puff on an e-cigarette for longer periods (even 'continuously' by some observers) than we see people smoking. Although the study has a number of important limitations, including that it was conducted with a very small sample, it suggests that it takes much longer (30 minutes in experienced vapers and 65 minutes in naïve users, compared with 5 minutes for smokers, with variations) for blood nicotine levels to reach a level that may deal with cravings for nicotine.

Finally, another common question for policy makers and others is whether the rise in e-cigarette use explains the observed declines in the UK of use of Nicotine Replacement Therapy. Analysis from the CRUK funded smoking toolkit study suggests the two trends did not run in parallel and thus other (or additional) factors account for the decline, and these are a subject for further research.

**Other studies from the last month that you may find of interest:**

- Deficiencies in public understanding about tobacco harm reduction: results from a United States national survey.
- Characteristics of emerging adulthood and e-cigarette use: Findings from a pilot study.
- Vapor Store Owner Beliefs and Messages to Customers.
- Young adult e-cigarette users' reasons for liking and not liking e-cigarettes: A qualitative study.
- How to define e-cigarette prevalence? Finding clues in the use frequency distribution
- Potential harmful health effects of inhaling nicotine-free shisha-pen vapor: a chemical risk assessment of the main components propylene glycol and glycerol.
- Different physiological and behavioural effects of e-cigarette vapour and cigarette smoke in mice.
- Gender differences in satisfaction ratings for nicotine electronic cigarettes by first-time users.
- Adolescents' Perceptions of Risks and Benefits of Conventional Cigarettes, E-cigarettes, and Marijuana: A Qualitative Analysis.
- Free-base and protonated nicotine in electronic cigarette liquids and aerosols
- Associations between perceptions of e-cigarette advertising and interest in product trial amongst US adult smokers and non-smokers: results from an internet-based pilot survey.
- E-cigarettes and expectancies: why do some users keep smoking?
- A Randomized Trial of the Effect of E-cigarette TV Advertisements on Intentions to Use E-cigarettes.
- E-cigarette use in the past and quitting behavior in the future: a population-based study

- Unexpected nicotine in Do-it-Yourself electronic cigarette flavourings
- Highly Reactive Free Radicals in Electronic Cigarette Aerosols.
- The influence of menthol, e-cigarettes and other tobacco products on young adults' self-reported changes in past year smoking.
- Acute Exposure to Electronic and Combustible Cigarette Aerosols: Effects in an Animal Model and In Human Alveolar Cells.
- Acute inhalation of vaporized nicotine increases arterial pressure in young non-smokers: a pilot study.
- Tobacco-Specific Nitrosamines in Electronic Cigarettes: Comparison between Liquid and Aerosol Levels.

**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 e-cig[title/abstract] OR (nicotine AND (vaporizer 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 published 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 Nicola Smith from Cancer Research UK with assistance from Professor Linda Bauld and Kathryn Angus at the University of Stirling and the UK Centre for Tobacco and Alcohol Studies, primarily for the benefit of members 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.***